In this unit, students will learn about light and heat energy from the sun. They will use their senses to observe that temperatures are cooler in shaded areas than in the full sun, and will understand that shade is created by both natural and human-made structures. Students will use developmentally appropriate science inquiry and engineering design practices, and will record their findings through drawings, verbal and/or written responses.
### Unit Title: Sunlight and Shadows

**Date Developed/Last Revised:** 7/8/2013  
**Unit Author(s):** B. Jennings with Aiea Gr. K Teachers: A. Audiss, R. Zeprun  
**Grade Level:** K  
**Time Frame:** 3 – 4 weeks  
**Primary Content Area:** Science

### UNIT DESCRIPTION:

Students will observe and record their findings about light and heat from the sun. They will understand that shadows are made when an object is between the sun and another surface, and they will observe that temperatures are cooler in shaded areas than in the full sun. Students will understand that shade is created by both natural and human-made structures that reduce both heat and light from the sun. Students will engage in at least one engineering design project: 1) build a structure that reduces heat by shading an object, and/or 2) design and construct a visor to protect their eyes from bright sunlight.

### Big Ideas (Student Insights that Will Be Developed Over the Course of the Unit):

- The sun produces heat and light.
- A shadow is made when an object is between the sun and another surface.
- Shading an object from the sun can keep it cooler.
- People have invented many devices to shade buildings, people, cars and other objects.

### Essential Questions (Questions that Will Prompt Students to Connect to the Big Ideas):

- Where do shadows come from?
- How do different materials feel in the sun compared to when they are in the shade?
- How do our bodies feel in the sun compared to when we are in the shade?
- How can we change the amount of heat and light we feel from the sun?
<table>
<thead>
<tr>
<th>Benchmark/Standard/Learning Goals</th>
<th>Details</th>
</tr>
</thead>
</table>
| **Science** | - SC.K.1.1 Use the senses to make observations  
- SC.K.1.2 Ask questions about the world around them  
- SC.K.8.2 Identify different types of celestial objects seen in the day and night sky |
| **Technology** | - CCSS.ELA-Literacy.W.K.6: With guidance and support from adults, explore a variety of digital tools to produce and publish writing, including in collaboration with peers. |
| **Engineering** | - CTE Standard 1: TECHNOLOGICAL DESIGN: Design, modify, and apply technology to effectively and efficiently solve problems |
| **Mathematics** | - CCSS.Math.Content.K.MD.A.2: Directly compare two objects with a measureable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference. For example, *directly compare the heights of two children and describe one child as taller/shorter.*  
- CCSS.Math.Content.K.G.A.1: Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.  
- CCSS.Math.Content.K.G.A.2: Correctly name shapes regardless of their orientations or overall size.  
| **English Language Arts and Literacy** | - CCSS.ELA-Literacy.RL.K.1: With prompting and support, ask and answer questions about key details in a text.  
- CCSS.ELA-Literacy.RL.K.2: With prompting and support, retell familiar stories, including key details.  
- CCSS.ELA-Literacy.RL.K.3: With prompting and support, identify characters, settings, and major events in a story.  
- CCSS.ELA-Literacy.W.K.1: Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book (e.g., My favorite book is . . .). |
| • CCSS.ELA-Literacy.W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. |
| • CCSS.ELA-Literacy.W.K.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. |
| • CCSS.ELA-Literacy.SL.K.1: Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups. |
| • CCSS.ELA-Literacy.SL.K.3: Ask and answer questions in order to seek help, get information, or clarify something that is not understood. |
| • CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. |
| • SS.K.7.1 Identify location and physical characteristics represented on maps and globes (e.g., land, water, roads, cities) |
| • SS.K.7.2 Use terms to describe relative location (i.e. above/below, near/far, left/right, and cardinal directions) |
| • SS.K.8.1 Explain people’s basic needs and how they fulfill them |

**STEM Competencies**

**Indicator 3.3:** Generates new and creative ideas and approaches to developing solutions
- raises questions about the world and seeks information through careful observations, investigations, and experiments.  
- uses creativity to generate new and innovative solutions.

**Indicator 5: Effective Communicator**
- uses drawings, models, tables, graphs, symbols, and/or language (both oral and written) to gather and organize their information and support their ideas.
<table>
<thead>
<tr>
<th>Lesson Title/Description</th>
<th>Learning Goals (What Students Will Know &amp; Be Able to Do)</th>
<th>Assessments</th>
<th>Time Frame (1 period = 50-60 min)</th>
</tr>
</thead>
</table>
| **1** Me and My Shadow                                                       | Students can show and explain that a shadow is made when any object blocks light from the sun.                                                                                                                                                                                                                                                                                         | - Teacher observation  
- Student Journal: Drawing with caption: Self and shadow, showing the appropriate position of the sun. | 1-2 class periods                 |
| On a sunny day, students will observe their shadows and notice the positions of their shadows as they move in different directions. Learning is extended in the classroom through opportunities for exploration with light and shadows. |                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                       |                                  |
| **2** Bear Shadow (Literature)                                               | Students can explain how Bear’s actions showed his lack of understanding about his own shadow.                                                                                                                                                                                                                                                                                       | - Teacher observation  
- Student Journal: Drawing with caption: Favorite event from the story. | 1-2 class periods                 |
| Students will listen to the story *Bear Shadow* by Frank Asch as the teacher reads it aloud. They will respond to prompting questions that extend their understanding of shadows, and record a favorite part of the story in their journals. |                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                       |                                  |
| **3** Bear Shadow Mapping Activity                                            | Students can reference a model map as they tell about characters, events and/or locations in the *Bear Shadow* story.                                                                                                                                                                                                                                                                 | - Teacher observation  
- Student Journal: Drawing with caption: Bear Shadow map. | 1-2 class periods                 |
| Using recyclable materials, students will build and tell about a model map of the locations featured in the *Bear Shadow* story. Building the map in an outdoor location will enable students to observe shadows made by the features on the map. |                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                       |                                  |
|   | Shadows are Cool!  
On a sunny day, students will observe and compare felt temperatures in the sun versus in the shade. They will determine whether they can feel a temperature difference when samples of various materials are placed in the sun and in the shade. | Students can show and explain that shaded areas are cooler than areas that are exposed to full sun. | - Teacher observation  
- Student Journal:  
Drawing with caption: Preference for playing in the sun or in the shade. | 1-2 class periods |
|---|---|---|---|---|
|   | Shadows Here, Shadows There – Shadows, Shadows Everywhere!  
Students will observe shade-making structures and devices commonly found in the environment, and will categorize them as being natural or human-made. | Students can show and explain that people build structures and personal items to create shade to provide protection from excess light and heat from the sun. | - Teacher observation  
- Student Journal:  
Drawing with caption: One way student uses shade to protect self from the sun. | 1-2 class periods |
|   | Staying Cool Lunchbox Design Challenge (EDP)  
In small groups, students will learn and practice the Engineering Design Process (EDP). They will design a structure that reduces heat from the sun by shading a “lunchbox” provided by the teacher. | Students will be able to design, create, and use a structure to collect data about how it affects heat from the sun. They will communicate their findings through drawing, speaking, and/or writing. | - Teacher observation  
- Student Journal:  
Drawing with caption: Picture and explanation of group’s shade structure. | 3- 4 class periods |
|   | Visor Design Challenge (EDP) (Optional):  
Students will apply the EDP to design a visor that they will wear on a class field trip. | Students will be able to design, create, and use a structure to collect data about how it affects light from the sun. They will communicate their findings through drawing, speaking, and/or writing. | - Teacher observation  
- Student Journal:  
Drawing with caption: Visor with an opinion (happy or not happy with design) and a reason. | 2-3 class periods |
SUPPLEMENTARY INSTRUCTIONAL MATERIALS:
- Student Journal- Sunlight and Shadows Unit (Sample)
- Lunchbox Design Challenge – Student Handout (Group)
- Visor Design Challenge – Student Handout (Individual)

RESOURCES AND BACKGROUND INFORMATION FOR THE TEACHER:
- Keeping Cool With Shadows (NASA):
  http://www.nasa.gov/audience/forstudents/k-4/stories/F_Keeping_Cool_With_Shadows.html
  - Cooler in the Shadows, Activities 1, 2, 3  http://www.messenger-education.org/teachers/Cooler_intro.php  (Link to Complete Lesson)
- Cover images:  www.pixabay.com
Unit Title: Sunlight and Shadows
Lesson Title: Me and My Shadow
Date Last Revised: 7.8.13
Unit Author(s): B. Jennings, A. Audiss, R. Zeprun

Lesson #: 1
Grade Level: K
Primary Content Area: Science
Time Frame: 1-2 class periods

DESCRIPTION
Students will make observations about their shadows when standing outside on a sunny day. They will notice the direction of the shadow in relationship to the sun and will observe how a shadow changes shape throughout the course of a day in response to the position of the sun in the sky. They will draw and write or dictate to describe their observations.

PLANNING (Steps 1, 2, & 3)

1. Standards/Benchmarks and Process Skills Assessed in this Lesson:
   - SC.K.1.1 Use the senses to make observations
   - SC.K.8.2 Identify different types of celestial objects seen in the day and night sky
   - CCSS.Math.Content.K.MD.A.2: Directly compare two objects with a measureable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.
   - CCSS.ELA-Literacy.W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
   - CCSS.ELA-Literacy.W.K.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
   - CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
   - SS.K.7.2 Use terms to describe relative location (i.e. above/below, near/far, left/right, and cardinal directions)

2A. Criteria- What Students Should Know and Be Able to Do:
Students can-
   - Begin to explain that a shadow is made when an object blocks the light from the sun.
   - Use directional words (in front, behind, beside, etc.) to describe the position of shadows during field experiences.

2B. Assessment Tools/Evidence:
Formative:
   - Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (SC.K.1.1, K.MD.A.2, SS.K.7.2)
   - Student Journals: Drawings with dictated, recorded, or written caption (SC.K.1.1., SC.K.8.2, W.K.2, W.K.8, L.K.1)
   - Rubric to assess student journal entries
### 3. Learning Experiences (Lesson Plan)

**Materials/Needs:**
- A sunny day
- Yarn, ribbon, or long paper strips with which to measure shadows
- Classroom center materials: Light source (small lamp or flashlight), 1 small box to represent a building, and 2 – 3 additional objects such a toy figure, car, etc. It might be useful to place all these items inside a larger box placed on its side to shade out the ambient light in the classroom. (Image source: [http://pixabay.com/](http://pixabay.com/))

**Handouts/Other Resources:**
- See sample Student Journal for this unit.

**Procedure:**

1. On a sunny day, take students to the playground or other outdoor area and explain that they will be using the science process of “observation” to learn some things about the sun. Emphasize that children must NEVER look directly at the sun because this could permanently damage their eyes.

2. Ask students to observe their shadows on the ground. First, have the students stand with their backs to the sun and notice that the shadow is in front of them, then have them turn to face the sun and ask where the shadow is now. Ask why it is not in front of them anymore. Continue to have children turn in different directions and observe where the shadow is as you continue to prompt their thinking about what is making the shadow. Encourage students to use directional words (in front, behind, beside, etc.) to describe the positions of their shadows.

3. Once students understand that the shadow is cast because their bodies are blocking light from the sun, have them observe other shadows cast by trees, buildings, and other objects.

4. Shadow measurements – using one child as an example, take at least 3 shadow measurements at different times of day, e.g. morning, noon, and afternoon. Ask the student to stand on a hard surface so that his or her shadow can be measured. Use chalk to draw around the child’s feet and around the perimeter of the shadow. Place the measurement device (for example, the paper strip) at the top of the child’s feet, extending to the longest point on the shadow, and cut a piece to represent the measurement taken at that point in time. Repeat the process at least twice more so that you have three or more strips that represent the length of the shadow at different times of day. For each measurement, the same child should stand in exactly the same spot, as shown by the chalk markings from the first measurement. Have children observe the change in shape, length, and location of the shadow with each measurement that is taken. Post the paper strips (or other device) side by side in the classroom, so that children can see the change in the shadow over the course of the day. After each measurement prompt students’ thinking by asking questions such as:
  - What do you notice about the shadow?
  - Why does it change?
• Where was the sun when we took the first measurement? The second? The third?
• When was the shadow longest?
• When was it shortest?
• How is the appearance of the shadow related to the position of the sun?

After taking one or two measurements, as you get ready to take the next measurement, ask students to predict whether they think it will be longer, shorter, or the same as the last measurement.

5. At the end of the day, ask students to draw “the sun, yourself, and your shadow” in their science journals (Entry #1) to show what they learned from their observations. Have students explain their drawings in writing or record dictated statements to give details about their pictures.

Option: Make a recording of each student explaining his or her picture using VoiceThread, Fotobabble, or other program. Upload to classroom website for access by all students. (W.K.6)

Reinforce concepts with additional learning experiences over the next several days:
Create a learning center that allows students to manipulate objects to create shadows. You will need a light source such as a small lamp or flashlight, and 2-3 small objects such as toy figures, cars, or small boxes to represent buildings.

EXTEND: When you are outside with students at different times of day, help them observe how the location and length of their shadows change, based on the position of the sun in the sky. At the end of these experiences, students should begin to be able to explain that a shadow is made when an object blocks the light from the sun.

TEACHING & ASSESSMENT (Steps 4, 5, 6, & 7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:
### RUBRIC: Student Journal Entry 1

<table>
<thead>
<tr>
<th>Science Content</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC.K.1.1 SC.K.8.2</td>
<td>One or more specified objects are missing and/or drawing is completely unrelated to the lesson.</td>
<td>Illustration is somewhat unclear, however all three specified objects can be discerned.</td>
<td>Clearly illustrates all three objects: sun, self, shadow. Shows shadow connected to the figure.</td>
<td>Clearly illustrates at least three objects: sun, self, shadow. Shows shadow connected to the figure and extending in the opposite direction from the sun.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Writing/Speaking Skills</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>W.K.2 W.K.8 L.K.1</td>
<td>Unable to tell about the picture.</td>
<td>Tells about the picture in words or phrases.</td>
<td>Uses complete sentences to explain the picture.</td>
<td>Uses complete sentences to explain the picture with details.</td>
</tr>
</tbody>
</table>
**Unit Title:** Sunlight and Shadows  
**Lesson Title:** Bear Shadow  
**Date Last Revised:** 7.8.13  
**Unit Author(s):** B. Jennings, A. Audiss, R. Zeprun  
**Lesson #:** 2  
**Grade Level:** K  
**Primary Content Area:** Science  
**Time Frame:** 1-2 class periods

### DESCRIPTION

In this literature-based lesson, students respond to the read-aloud story *Bear Shadow* by Frank Asch. The teacher helps students relate their own observations about shadows to the events described in the story, and directs them to record their favorite part of the story in their journals.

### PLANNING (Steps 1, 2, & 3)

1. **Standards/Benchmarks and Process Skills Assessed in this Lesson:**
   - SC.K.8.2  Identify different types of celestial objects seen in the day and night sky
   - CCSS.ELA-Literacy. RL.K.1: With prompting and support, ask and answer questions about key details in a text.
   - CCSS.ELA-Literacy. RL.K.2: With prompting and support, retell familiar stories, including key details.
   - CCSS.ELA-Literacy. RL.K.3: With prompting and support, identify characters, settings, and major events in a story.
   - CCSS.ELA-Literacy.W.K.1: Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book (e.g., My favorite book is . . ).
   - CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
   - SS.K.7.2 Use terms to describe relative location (i.e. above/below, near/far, left/right, and cardinal directions).

2A. **Criteria- What Students Should Know and Be Able to Do:**

Students can-
- State a preference for one event from the story *Bear Shadow*.
- Make progress in explaining that a shadow is made when an object blocks the light from the sun.
- Use directional words (in front, behind, beside, etc.) to describe events in the story *Bear Shadow*.

2B. **Assessment Tools/Evidence:**

**Formative:**
- Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (RL.K.1, SS.K.7.2)
- Student Journals: Drawings with dictated, recorded, or written caption (RL.K.2, RL.K.3, SC.K.8.2, W.K.1, L.K.1)
• Rubric to assess student journal entries

### 3. Learning Experiences (Lesson Plan)

**Materials:**
- Book: *Bear Shadow* by Frank Asch (borrow from school or local library, or purchase a copy for your classroom)

**Handouts/Other Resources:**
- See sample Student Journal for this unit

**Procedure:**
1. Introduce students to the read aloud story *Bear Shadow* by Frank Asch. Ask them to guess what the story will be about and where it will take place by looking at the cover of the book. Ask students to find the shadow in the picture and guess where the sun should be to make this shadow.

2. Read the story, then prompt discussion by asking the following questions (increase participation by having every student discuss each question with a partner instead of calling on only one child to respond):
   - What have we learned about shadows that makes this story funny?
   - Why did Bear’s shadow disappear when he hid behind a tree?
   - Why did the shadow disappear when Bear buried it?
   - What makes a shadow fall one direction at one time, and another direction at a different time of day?
   - Is your shadow always the same size and shape as you?
   - Has your shadow ever disappeared? When?

   Students may or may not be able to answer all questions, depending on how much time you have previously spent in shadow activities. If there are questions that students cannot answer, write them on a chart paper and explain that the class will be trying to discover the answer to these questions as you continue to learn more about sunlight and shadows during this unit.

3. Invite students to tell about their favorite part of the story, either by sharing out to the group or sharing with a partner. Explain that they need to tell why they liked this part of the story, and then provide your own example to model what is expected.

4. After students have verbally explained their favorite parts of the story, direct them to draw their favorite part of *Bear Shadow* in their Journals (Entry #2) and tell (dictate or write) why they liked it. Alternatively, use a program such as Voice Thread or Fotobabble. Record –or photo and
record voice over - as each child holds up the book to show his or her favorite part and tell why they liked it. Post recordings on a class website, or assemble student drawings in a class book so students can read and enjoy one another’s work. (W.K.6)

5. At the end of this unit, students should make progress in explaining that a shadow is made when an object blocks the light from the sun.

### TEACHING & ASSESSMENT (Steps 4, 5, 6, & 7)

**Completed by teacher after instruction has taken place**

4. **Teaching and Collecting of Evidence of Student Learning:**
   
   Teacher Notes:

5. **Analysis of Student Products/Performances - Formative:**
   
   Teacher Notes:

6. **Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):**
   
   Teacher Notes:

7. **Teacher Reflection: Replanning, Reteaching, Next Steps:**
   
   Teacher Notes:

### RUBRIC: Student Journal Entry 2

<table>
<thead>
<tr>
<th>Reading And Science Content</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>RL.K.2, RL.K.3, SC.K.8.2</td>
<td>Illustration does not depict any particular event in the story.</td>
<td>Illustrates a character or setting in the story without reference to a specific event.</td>
<td>Clearly illustrates a favorite part of the story (shows an opinion). Relates presence of shadow to the sun.</td>
<td>Clearly illustrates a favorite part of the story (shows an opinion), including many details. Conveys that shadow is caused by the sun.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Writing/Speaking Skills</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>W.K.1, L.K.1</td>
<td>Unable to tell about picture.</td>
<td>Tells about the picture in words or phrases and/or does not clearly express an opinion.</td>
<td>Uses complete sentences to tell about the picture and give an opinion. May or may not tell why.</td>
<td>Uses complete sentences to explain why they liked a particular part of the story including details.</td>
</tr>
</tbody>
</table>
**Unit Title:** Sunlight and Shadows  
**Lesson Title:** Bear Shadow Mapping Activity  
**Date Last Revised:** 7.8.13  
**Unit Author(s):** B. Jennings, A. Audiss, R. Zeprun

<table>
<thead>
<tr>
<th>Lesson #: 3</th>
<th>Grade Level: K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Content Area: Science</td>
<td>Time Frame: 1-2 class periods</td>
</tr>
</tbody>
</table>

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**DESCRIPTION**

Using recyclable materials, the class will build and tell about a 3-D model map of the locations featured in the *Bear Shadow* story. Building the map in an outdoor location will enable students to observe shadows made by the features on the map. Students will then create individual 2D maps using geometric shapes to represent and retell about featured objects and locations.

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**PLANNING (Steps 1, 2, & 3)**

1. **Standards/Benchmarks and Process Skills Assessed in this Lesson:**
   - SC.K.1.1  Use the senses to make observations
   - CCSS.Math.Content.K.G.A.1:  Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.
   - CCSS.Math.Content.K.G.A.2:  Correctly name shapes regardless of their orientations or overall size.
   - CCSS.Math.Content.K.G.A.3   Identify shapes as two-dimensional (“flat”) or three-dimensional (“solid”).
   - CCSS.ELA-Literacy. RL.K.3: With prompting and support, identify characters, settings, and major events in a story.
   - CCSS.ELA-Literacy.W.K.2:   Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
   - CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
   - SS.K.7.1   Identify location and physical characteristics represented on maps and globes (e.g., land, water, roads, cities)
   - SS.K.7.2   Use terms to describe relative location (i.e. above/below, near/far, left/right, and cardinal directions)

2A. **Criteria- What Students Should Know and Be Able to Do:**

Students can-
   - Show progress in explaining that a shadow is made when an object blocks the light from the sun.
   - Use directional words (in front, behind, beside, etc.) to describe events in the story *Bear Shadow*.
   - With support identify characters, settings, and/or major events in the *Bear Shadow* story.
   - Use a combination of drawing, dictating, and writing to compose a text that describes or
explains key information from the *Bear Shadow* story.

### 2B. Assessment Tools/Evidence:

**Formative:**
- Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (SC.K.1.1, RL.K.3, K.G.A.1, K.G.A.2, K.G.A.3, SS.K.7.2)
- Student Journals: Drawings with dictated, recorded, or written caption (SC.K.8.2, K.G.A.2, RL.K.3, W.K.2, L.K.1)
- Rubric to assess student journal entries

### 3. Learning Experiences (Lesson Plan)

**Materials:**
- Book: *Bear Shadow* by Frank Asch
- Objects or recyclable materials to represent items for a 3-D map of the *Bear Shadow* story: house, tree, pond, brook, cliff, hole (class map)
- Paper shapes for 2-D map-making (student map)
- Rubric to assess student journal entry

**Handouts/Other Resources:**
- See sample Student Journal for this unit

**Procedure:**
1. Determine whether the map building activity will be done by the whole class, by groups, or by individuals. Determine whether you will provide the objects for the 3-D map, or if you want students to construct them. If students will construct the items, provide a suitable selection of materials based on the number of students who will build the map.

2. Review the read aloud story *Bear Shadow* by Frank Asch and ask students to recall key events in the story. Explain that students will be asked to build a map that shows the locations of main events in the story using the materials provided.

3. Decide what structures will be built and by whom (for example, you might have different groups for making the house, tree, pond, hole, brook and cliff).

4. In a sunny location, review the story and have students place the structures in an array that makes sense for the sequence of events in the story. Encourage students to retell the story in their own words and observe the shadows that are created by the 3D structures on the map. If the map can be left in the same location for an entire school day, students can also observe and
measure how the shadows change during the course of the day. In this case, items should be glued or taped to the map.

5. In the classroom, explain that students will create similar maps of their own, but this time they will use 2-D shapes to represent the structures in the story so that their maps can be easily carried. Provide a 9 X 12 sheet of construction paper for the base and cut-out shapes or a page of printed shapes for children to cut and use as follows:
- Tree: Triangle
- House: Square
- Pond: Oval
- Hole: Circle
- Cliff: Trapezoid
- Brook: Long, skinny rectangle

6. Students can glue or tape shapes to create maps of the story, then respond to journal prompt #3, which asks them to describe three events from the *Bear Shadow* story. They should try to remember what came first, next, and last, and sequence the events they choose accordingly.

At the end of this lesson, students should show progress in explaining that a shadow is made when an object blocks the light from the sun.

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**TEACHING & ASSESSMENT (Steps 4, 5, 6, & 7)**

Completed by teacher after instruction has taken place

4. **Teaching and Collecting of Evidence of Student Learning:**
   Teacher Notes:

5. **Analysis of Student Products/Performances - Formative:**
   Teacher Notes:

6. **Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):**
   Teacher Notes:

7. **Teacher Reflection: Replanning, Reteaching, Next Steps:**
   Teacher Notes:
<table>
<thead>
<tr>
<th>RUBRIC: Student Journal Entry</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading/ Writing/ Speaking Skills</strong></td>
<td>Unable to tell about any events in the story.</td>
<td>Can tell about 1 - 2 events in the story using words or phrases.</td>
<td>Uses complete sentences to clearly describe three events in the story in sequence with no more than 1 error.</td>
<td>Uses complete sentences to clearly and accurately describe three events in the story in sequence.</td>
</tr>
<tr>
<td>RL.K.3 W.K.2 L.K.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Math Content</strong></td>
<td>Accurately identifies no more than 1 shape by name.</td>
<td>Accurately identifies 2 shapes by name.</td>
<td>Accurately identifies at least 3 shapes by name, i.e.: triangle, square, circle.</td>
<td>Accurately identifies more than 3 shapes by name.</td>
</tr>
<tr>
<td>K.G.A.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Science Content</strong></td>
<td>Does not refer to Bear's shadow when retelling the story.</td>
<td>States that Bear is unable to catch his shadow.</td>
<td>Explains that Bear's shadow is caused by the sun.</td>
<td>Explains that Bear's shadow is caused by his body blocking light from the sun.</td>
</tr>
<tr>
<td>SC.K.8.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bear Shadow 2D Map Instructions

1. Cut out each shape carefully.
2. Arrange the shapes on your map to help you tell someone the Bear Shadow story.
3. Tape or glue the shapes in place.
4. Color your map.
5. Tell the story to someone else.
   - Tree: Triangle
   - House: Square
   - Pond: Oval
   - Hole: Small circle
   - Cliff: Trapezoid
   - Brook: Long, skinny rectangle
**Unit Title:** Sunlight and Shadows  
**Lesson Title:** Shadows Are Cool!  
**Date Last Revised:** 7.8.13  
**Unit Author(s):** B. Jennings, A. Audiss, R. Zeprun  
**Lesson #:** 4  
**Grade Level:** K  
**Primary Content Area:** Science  
**Time Frame:** 1-2 class periods

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### DESCRIPTION

On a sunny day, students will observe and compare felt temperatures in the sun versus in the shade. They will determine whether they can feel a temperature difference when samples of various materials are placed in the sun and in the shade, and will express a preference for playing in the sun or the shade in a journal entry.

### PLANNING (Steps 1, 2, & 3)

#### 1. Standards/Benchmarks and Process Skills Assessed in this Lesson:

- SC.K.1.1 Use the senses to make observations
- CCSS.ELA-Literacy.W.K.1: Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book (e.g., My favorite book is . . ).
- CCSS.ELA-Literacy.W.K.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- SS.K.7.2 Use terms to describe relative location (i.e. above/below, near/far, left/right, and cardinal directions)

#### 2A. Criteria- What Students Should Know and Be Able to Do:

Students can-

- Explain that a shadow is made when an object blocks the light from the sun.
- Explain that objects are cooler in the shade than in the sun.
- Use directional words (in front, behind, beside, etc.) to describe the position of shadows during field experiences.

#### 2B. Assessment Tools/Evidence:

**Formative:**

- Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (SC.K.1.1, SS.K.7.2)
- Student Journals: Drawings with dictated, recorded, or written caption (SC.K.8.2, W.K.1, L.K.1)
- Rubric to assess student journal entries
3. Learning Experiences (Lesson Plan)

Materials:
- A sunny day
- Recyclable materials (2 pieces each) including several or all of the following: styrofoam trays, aluminum pie tins, cardboard, plastic lids, ceramic tiles, construction paper-white, construction paper – black, wood pieces, fabric pieces, etc.

Handouts/Other Resources:
- See sample Student Journal for this unit.

Procedure:
1. On a sunny day, bring a bag of prepared sample materials for students to test in the sun and shade, and take students to the playground or other outdoor area. Explain that they will be using the science process of “observation” to learn more things about the sun. Remind children that they must NEVER look directly at the sun because this could permanently damage their eyes.

2. Begin with the group standing in full sun, and ask students if they would prefer to stand in the shade for the lesson. (Assuming that students say “yes”), ask why they would rather be in the shade. Students may say it is cooler or not as bright (more comfortable for their eyes). As you move the group to a shaded area, tell children they have just pointed out 2 very important things that we get from the sun – light and heat. Facilitate a discussion about how living things need light and heat to survive, but sometimes we need to control the amount of light and heat that we can feel. Too much light or heat may be uncomfortable or even dangerous (for example, sunburn).

3. Remind children that when they learned about shadows they were observing light from the sun, and today you want them to make observations about heat from the sun.

**OBSERVATION 1: Comparing Different Surfaces:** Point out and have students notice temperature differences when they stand in different locations, i.e. in the sun, in the shade, on the sidewalk, on the grass.

**OBSERVATION 2: Same Type of Surface, Sun vs. Shade:** Have students make simple observations by feeling and comparing different surfaces with their hands or bare feet, such as the side of a building in full sun vs. shade; sidewalk in sun vs. shade. Caution students about touching any metal objects, as they can become very hot in the sun.

4. Debrief: After students have made several observations, have them share their findings. Facilitate a discussion to help students realize that different surfaces absorb heat differently, but in most cases the same surface will feel warmer in the sun than it does in the shade.
5. **INVESTIGATE:** Have students work in pairs or small groups. Each group will select a particular material to test, using 2 pieces of the same material. Pre-select a location that will enable students to place one of their 2 pieces in direct sunlight, and one piece in the shade. You may need to be prepared with weights so that the materials won’t be blown out of place by wind. Have students place their materials in the selected location, wait for a minimum of 10 minutes, then compare the temperatures of the two pieces using their hands. Ask them to share their observations.

6. While waiting, you may be able sit with the class in a shady area and hold a discussion about light and heat from the sun, practice a poem, read a shadow-themed story, or make more observations about shadows in your surroundings.

7. **Debrief:** After students have tested their materials, have them share their findings. Facilitate a discussion to help students realize that different surfaces absorb heat differently, but in most cases the same surface will feel warmer in the sun than it does in the shade. Pose the Journal Activity (#4) prompt, and have students tell a partner whether they prefer to play in the sun or in the shade on a sunny day, and to give at least 1 reason why. Answering the prompt verbally with a partner will help prepare them for drawing and writing in their journals.

8. Direct students to respond to the prompt for Journal Entry #4. They are asked to tell if they prefer to play in the **sun** or in the **shade** on a sunny day, and to tell why. Write the key words on the board so that students can choose and write the appropriate response word (underlined above) in the provided blank space in the prompt.

At the end of this lesson, students should begin to explain that surfaces are cooler in the shade than in the direct sun. They should also be able to express an opinion about whether they prefer to play in the sun or in the shade and tell why.

<table>
<thead>
<tr>
<th><strong>TEACHING &amp; ASSESSMENT (Steps 4, 5, 6, &amp; 7)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed by teacher after instruction has taken place</td>
</tr>
</tbody>
</table>

| 4. **Teaching and Collecting of Evidence of Student Learning:** |
| Teacher Notes: |

| 5. **Analysis of Student Products/Performances - Formative:** |
| Teacher Notes: |

| 6. **Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):** |
| Teacher Notes: |

<p>| 7. <strong>Teacher Reflection: Replanning, Reteaching, Next Steps:</strong> |
| Teacher Notes: |</p>
<table>
<thead>
<tr>
<th>RUBRIC: Student Journal Entry 4</th>
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<tbody>
<tr>
<td><strong>Science/ Writing Content</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SC.K.8.2 W.K.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response is unrelated to prompt.</td>
<td></td>
<td></td>
<td></td>
<td>Clearly expresses a preference for playing either in the sun or in the shade and supports preference with 1 or more reasons related to temperature.</td>
</tr>
<tr>
<td><strong>Writing/Speaking Skills</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.K.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unable to express ideas.</td>
<td></td>
<td></td>
<td></td>
<td>Uses complete sentences to explain thinking and reasoning.</td>
</tr>
<tr>
<td>Uses words or phrases to express ideas.</td>
<td></td>
<td></td>
<td>Uses complete sentences to express ideas.</td>
<td></td>
</tr>
</tbody>
</table>
**Unit Title:** Sunlight and Shadows  
**Lesson Title:** Shadows Here, Shadows There – Shadows, Shadows Everywhere!  
**Date Last Revised:** 7.8.13  
**Unit Author(s):** B. Jennings, A. Audiss, R. Zeprun

| Lesson #: 5  
| Grade Level: K  
| Primary Content Area: Science  
| Time Frame: 1 - 2 class periods |

### DESCRIPTION
Students will observe shade-making structures and devices commonly found in the environment, and will categorize them as being natural or human-made.

### PLANNING (Steps 1, 2, & 3)

#### 1. Standards/Benchmarks and Process Skills Assessed in this Lesson:
- SC.K.1.1 Use the senses to make observations
- SC.K.8.2 Identify different types of celestial objects seen in the day and night sky
- CCSS.ELA-Literacy.W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
- CCSS.ELA-Literacy.W.K.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- SS.K.7.2 Use terms to describe relative location (i.e. above/below, near/far, left/right, and cardinal directions)

#### 2A. Criteria- What Students Should Know and Be Able to Do:
Students can-
- Explain that a shadow is made when an object blocks the light from the sun.
- Explain that people build structures and use personal items to create shade that will protect them from excess light and heat from the sun.

#### 2B. Assessment Tools/Evidence:
**Formative:**
- Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (SC.K.1.1, SS.K.7.2)
- Student Journals: Drawings with dictated, recorded, or written caption (SC.K.8.2, W.K.2, W.K.8, L.K.1)
- Rubric to assess student journal entries
3. Learning Experiences (Lesson Plan)

Materials:
- A sunny day and a place to observe structures and people OR
- Pictures of structures such as awnings, canopies, tents, and other shelters that provide shade.
- Pictures of people using umbrellas, sunglasses, different kinds of hats to protect themselves from the sun.

Handouts/Other Resources:
- See sample Student Journal for this unit.

Procedure:
1. Campus walk: On a sunny day, take students on a campus walk to observe objects and structures that create shade. Ask students to determine whether each object is natural (i.e. trees), or human-made (i.e. eaves from a building).

2. Campus walk or pictorial material: Have students observe how individual people create shade to protect parts of their bodies from excess sunlight (umbrellas, sunglasses, ball caps, etc.).

3. Direct students to draw in their Journals (Prompt #5) one way they use shade to protect themselves from the sun, and add a caption with the help of an adult. Consider mounting these pictures in a class book or bulletin board, and classifying pictures according to whether the shade item pictured is natural or human-made.

Optional: Instead of or in addition to making drawings, let students take turns taking photos of shade structures with a digital camera. Download photos for bulletin board or class book, accompanied by student captions. (W.K.6)

EXTEND: Describe how sun block lotion is a product that acts like an invisible shade to block sunlight from damaging our skin (sunburn).

At the end of this lesson, students should be able to describe one or more ways they use structures or objects to shade themselves from excess heat or light from the sun.

Homework Activity (Optional):
- Have students interview family members and/or make observations at home about structures or personal items that family members use to create shade.
### TEACHING & ASSESSMENT (Steps 4, 5, 6, & 7)
Completed by teacher after instruction has taken place

<table>
<thead>
<tr>
<th>4. Teaching and Collecting of Evidence of Student Learning:</th>
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<td>6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):</td>
<td>Teacher Notes:</td>
</tr>
<tr>
<td>7. Teacher Reflection: Replanning, Reteaching, Next Steps:</td>
<td>Teacher Notes:</td>
</tr>
</tbody>
</table>

### RUBRIC: Student Journal Entry 5

<table>
<thead>
<tr>
<th>Science Content</th>
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<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC.K.8.2</td>
<td>Illustration and/or explanation is unrelated to prompt.</td>
<td>Illustration and/or explanation is somewhat unclear regarding sun protection.</td>
<td>Illustrates and explains a way to protect oneself from too much sun, such as standing in shade, wearing a hat, sunglasses, umbrella, long-sleeved clothing, etc.</td>
<td>Clearly illustrates and explains a way to protect oneself from too much sun, such as standing in shade, wearing a hat, sunglasses, umbrella, long-sleeved clothing, etc.</td>
</tr>
<tr>
<td>W.K.2</td>
<td>+w.K.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing/ Speaking Skills</td>
<td>Unable to express ideas.</td>
<td>Tells about ideas in words or phrases.</td>
<td>Uses complete sentences to state ideas.</td>
<td>Uses complete sentences to explain the illustration.</td>
</tr>
<tr>
<td>L.K.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Unit Title:** Sunlight and Shadows  
**Lesson Title:** Staying Cool Lunchbox Design Challenge (EDP)  
**Date Last Revised:** 7.8.13  
**Unit Author(s):** B. Jennings, A. Audiss, R. Zeprun  
**Lesson #:** 6  
**Grade Level:** K  
**Primary Content Area:** Science  
**Time Frame:** 3 - 4 class periods

### DESCRIPTION
In small groups, students learn and practice the Engineering Design Process (EDP). They apply what they have learned about sunlight and shadows to design and test a structure that will reduce heat from the sun by shading a “lunchbox” provided by the teacher.

### PLANNING (Steps 1, 2, & 3)

#### 1. Standards/Benchmarks and Process Skills Assessed in this Lesson:
- SC.K.1.1  Use the senses to make observations
- SC.K.1.2  Ask questions about the world around them
- SC.K.8.2  Identify different types of celestial objects seen in the day and night sky
- CCSS.ELA-Literacy.W.K.1: Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book (e.g., My favorite book is . . ).
- CCSS.ELA-Literacy.W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
- CCSS.ELA-Literacy.W.K.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- CCSS.ELA-Literacy.SL.K.1: Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
- CCSS.ELA-Literacy.SL.K.3: Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking
- CTE Standard 1: TECHNOLOGICAL DESIGN: Design, modify, and apply technology to effectively and efficiently solve problems

#### 2A. Criteria- What Students Should Know and Be Able to Do:
Students can-
- Explain that objects placed in the shade stay cooler than those in the sun.
- Describe, in very general terms, the process they used to design, construct and test their shade structures, including results.
- Express an opinion about how well their designs worked.
### 2B. Assessment Tools/Evidence:

**Formative:**
- Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (SC.K.1.1, SC.K.1.2, SL.K.1, SL.K.3, W.K.8)
- Student Journals: Drawings with dictated, recorded, or written caption (CTE Standard 1, SC.K.8.2, W.K.1, W.K.2, W.K.8, L.K.1)
- Rubric to assess student journal entries

### 3. Learning Experiences (Lesson Plan)

#### Teacher Preparation:
- Provide a standard-sized container for each group to serve as the "lunchbox" for purposes of the investigation. The “lunchboxes” you provide could simply be small (2” x 2") plastic, cardboard or paper containers such as a paper condiments cup, or a box-like shape folded from a piece of paper. It needs to be large enough to hold the selected treat items for each group.

#### Materials: (Building)
- Provided at a supply table: Recyclable materials that children can use to design and create shade structures. Available materials should include dark and light paper and see-through materials such as clear plastic or cellophane, as well as any or all of the following: cardboard (flat), cardboard tubes, fabric, aluminum foil, plastic containers, Styrofoam trays and/or cups, fabric.
- For each group: Tools including scissors, tape, glue

#### Materials: (Testing Designs)
- A sunny day
- A food treat that will be kept cooler as the object of the lesson (for example, Hershey Kiss, M & Ms, mini-marshmallows, etc.)
- A “test” item for the first design (for example, 1 Kiss, M & M, or mini marshmallow)

#### Handouts/Other Resources:
- See sample Lunchbox Design Challenge handout.
- See sample Student Journal for this unit.

#### Procedural Recommendations:
1. Because students will need time to plan, build and test, redesign, and re-test, conduct this lesson over a 2 day period as described below.
2. Assign a specific role to each member of the group, and take time to help children understand their assigned responsibilities. These roles might rotate to different children from Day 1 to Day 2:
   A. Facilitator/Recorder –Makes sure everyone contributes, writes/draws on Lunchbox Design Challenge handout
B. Supply Manager – obtains materials from the supply table

C. Builder - takes the lead in building the structure, but gives others opportunities to participate

3. Structure the time provided for each step so that students continue to move forward. For example,
   - Brainstorming – 10 min
   - Determine design and obtain materials – 10 min
   - Build structure – 30 min

4. When it is time for students to get their supplies, you will need to monitor the supply table. Students are not free to take anything they see. They may only have the materials that are shown on their group’s design plan.

5. The Lunchbox Design Challenge handout should be completed by the group as they do the engineering task. Following each part completed by the group, individuals need to record the information on their own individual handouts.

Procedure: Day 1 – EDP Steps 1-4

1. Share the following scenario:

   Today is a special day to celebrate engineers. What is an engineer? It is someone who thinks up ideas and creates something new and helpful. In honor of this celebration, I have a special treat for each of you. The only problem is that this treat might melt if it gets too much heat from the sun. Your challenge is to design something that will prevent the treat from melting so that you will be able to enjoy it! To celebrate engineers, you will be an engineer- how "cool" is that?

2. Explain to students that they will be learning the Engineering Design Process (EDP) used by real scientists to solve a challenge. In this Design Challenge, they will apply what they have learned about sunlight and shade to design a shade structure that will effectively keep a lunchbox cool so that the items inside it will not melt in the sun. The students will work in partners or small groups that you have assigned, and will build their structures out of the materials you have provided.

3. Write the steps in the EDP on the board or on a chart and briefly review each step in the process in “kid-friendly” language. Note the standards addressed in each section to guide teacher observation of students' abilities:

   1) **Ask:** Understand the problem, state the conditions and limitations, and obtain information from prior knowledge. (SC.K.1.2, SL.K.3)
      a. “Students – what is the challenge you will be asked to solve today? What materials will you be able to use? What have we learned about how to keep things cooler in the sun?”
      b. "What questions do you have about your task?"
2) **Imagine:** Brainstorm ideas. (SL.K.1, W.K.8)
   a. “Everyone in your group should try to think of a way to build your structure. You will draw different ideas on your Lunchbox Design Challenge handout. You will need to pay attention to everyone’s ideas before you decide what design to build.”

3) **Plan:** Choose a testable idea, draw a useable prototype, and use obtainable, affordable, and safe materials. (SL.K.1, CTE Standard 1)
   a. “Once you decide what your structure will look like, you will draw a picture of it on your Lunchbox Design Challenge handout. Your drawing must show exactly what materials you need because you will use this drawing to order your materials at the supply table.”

4) **Create:** Follow the plan and make it work. (SL.K.1, CTE Standard 1)
   a. “Follow your plan and build the shade structure to match your drawing.”

5) **Experiment:** Collect, record, and analyze data accurately. (K.1.1)
   a. “You will test your structure in the sun to see how well it keeps the (item) cool.”

6) **Improve:** Review data and repeat the process to optimize.
   a. “After you test your structure, you will have an opportunity to change it or to build a new structure that you think will work better to keep the (item) cool.”

4. Have students sit in groups that you have assigned, and pass out the Lunchbox Design Challenge handout to each student. Explain the role assigned to each student in the group.

5. Show students the "lunchbox" and treats that you are going to provide for them. Then show them the variety of materials that you have provided on your supply table, so that they will know what they can use for their designs. Explain any design parameters related to the size of their structures. For example, the structure must be big enough to provide shade to the “lunchbox” that you will provide.

6. Begin the EDP process:
   **Teacher to Whole Class: Step 1: Ask –**
   “Raise your hand if you can tell the class what the design challenge is.”
   “Who can explain what materials we will be using and how you will get them?”
   “Who can tell us what Step 2 is in the EDP?”
   “You will have ____ minutes for Step 2: Brainstorming. Be sure that everyone in your group has a chance to tell their idea, and draw at least 3 different ideas on your Lunchbox Design Challenge handout.” “You may begin.”

7. After a reasonable amount of time while circulating to assist, the teacher stops the group to transition them to the next step. Remind them what happens in Step 3, and what the “rules” are for getting their supplies. Teacher will need to monitor the supply table, then continue to circulate and assist as needed so that students can successfully complete Steps 3 and 4. When you see a group that has done a good job on the Lunchbox Design Challenge handout, stop the class and show them the handout as an example of what they need to do.
The objective for Day 1 is for each group to complete the structure that they will test.

**Procedure: Day 2 – EDP Steps 5 & 6**

1. In class, explain that they will be testing how well their shade structure design keeps a “lunchbox” cool, and that in each lunchbox you have put a few of the selected treats for their group to share. It is important that each group receives an identical box. The object is for the students to design a shade structure that will keep the lunchbox cool so that the selected treats won’t get too soft and gooey.

2. Explain that students will have 2 chances to come up with a design, so before they get the lunchbox, they will test the first design with just 1 treat (such as an M & M or mini marshmallow) on a small Styrofoam plate. Show students the test object that you will provide to them and explain that you will place a similar object directly in the sun to serve as the “control” object. Explain that the control object will show us what would happen to the object if it had no shade at all, so that students will know if the structures they have built make a difference or not.  
   *(Note: Although proper science terminology is used, i.e. “control”, students are not expected to learn and use this language at this level).*

3. Take students to the sunny area that you have selected for them to test their shade structure designs. Provide each group with the same test object to put under their shade structures and place the control object in the same area directly in the sun.

4. Move the group into a shady area for a discussion about their designs while the test is being conducted for 10 – 15 minutes. Ask students what they think will happen to the test object if it gets hot (melt, squishy, gooey?) and how they decided what design they would make. You could also explain that engineers solve problems like this in the real world. They must think about how to package food so that it won’t be damaged when carried to and from the store, and how even the hard candy shell on an M & M was designed to prevent the chocolate from getting on your hands when you eat them.

5. When the test time is up, have students collect their structures and test objects and return to class to assess their designs. Plastic knives or spoons can be provided so they can see how squishable their test objects are compared to the control object. Have each group share their results with the rest of the class and tell what happened to their test objects.

6. Have students repeat EDP steps 3 – 5 with an improved design, and provide each group with the “lunchbox” containing the objects you have selected (for example – 3 M & Ms or mini-marshmallows per student) for the final test. Students will re-design, test, and report their results to the group.

7. Chart students’ comments/questions about factors that they think might have influenced the success of their designs, so that they can use this as a reference when writing in their journals.
8. Direct students to write about their shade structures in their Journals (Entry #6). They are asked to tell if the structure worked or did not work and to explain why (for example – it kept the object cooler, or did not keep the object cooler). Write the key words on the board so that students can choose and write the appropriate response words (underlined above) in the provided blank space in the prompt.

**TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)**

<table>
<thead>
<tr>
<th>Completed by teacher after instruction has taken place</th>
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<tbody>
<tr>
<td><strong>4. Teaching and Collecting of Evidence of Student Learning:</strong></td>
</tr>
<tr>
<td>Teacher Notes:</td>
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<tr>
<td><strong>7. Teacher Reflection: Replanning, Reteaching, Next Steps:</strong></td>
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<td>Teacher Notes:</td>
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**RUBRIC: Student Journal Entry 6**

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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Science/ Writing Content</strong></td>
<td>Illustration does not depict a solution to the lunchbox challenge.</td>
<td>Illustrates a solution to the lunchbox challenge.</td>
<td>Clearly illustrates a solution to the lunchbox challenge.</td>
<td>Clearly illustrates a solution to the lunchbox challenge.</td>
</tr>
<tr>
<td>SC.K.8.2 W.K.1</td>
<td>Explanation is missing or unrelated to challenge.</td>
<td>Explanation is incomplete and or unclear.</td>
<td>Explains whether or not the solution was effective.</td>
<td>Explains whether or not the solution was effective and why.</td>
</tr>
<tr>
<td><strong>Writing/Speaking Skills</strong></td>
<td>Unable to express opinion.</td>
<td>Expresses opinion in words or phrases.</td>
<td>Uses complete sentences to state opinion.</td>
<td>Uses complete sentences to explain opinion and reasons.</td>
</tr>
<tr>
<td>L.K.1</td>
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### Lunchbox Design Challenge

Your teacher will give your group a box of treats to share. However, your group must design a way to shade the lunchbox so the treats will stay cool when they are placed in a sunny area. Think of as many ideas as you can.

<table>
<thead>
<tr>
<th>Imagine: Draw Different Design Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<tr>
<td>![Lunchbox Design A]</td>
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</table>

| C | D |
| ![Lunchbox Design C] | ![Lunchbox Design D] |
Plan 1: Draw the Design You Will Build

<table>
<thead>
<tr>
<th>Lunch Box</th>
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Test Your Design

Tell how well it worked.
### Plan 2: Draw the Design You Will Build

#### Test Your Design

Tell how well it worked.

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</table>
Unit Title: Sunlight and Shadows
Lesson Title: Visor Design Challenge (EDP)
Date Last Revised: 7.8.13
Unit Author(s): B. Jennings, A. Audiss, R. Zeprun
Lesson #: 7 (Optional)
Grade Level: K
Primary Content Area: Science
Time Frame: 2-3 class periods

DESCRIPTION
It is unusual to conduct more than one design challenge per unit; however this lesson is provided as another option to the EDP described in Lesson 6. In small groups, students learn and practice the Engineering Design Process (EDP). They apply what they have learned about sunlight and shadows to design and test a visor that will provide eye protection from bright sunlight when worn outdoors.

PLANNING (Steps 1, 2, & 3)
1. Standards/Benchmarks and Process Skills Assessed in this Lesson:
   - SC.K.1.1 Use the senses to make observations
   - SC.K.1.2 Ask questions about the world around them
   - SC.K.8.2 Identify different types of celestial objects seen in the day and night sky
   - CCSS.ELA-Literacy.W.K.1: Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book (e.g., My favorite book is . . ).
   - CCSS.ELA-Literacy.W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
   - CCSS.ELA-Literacy.W.K.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
   - CCSS.ELA-Literacy.SL.K.1: Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
   - CCSS.ELA-Literacy.SL.K.3: Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
   - CCSS.ELA-Literacy.L.K.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
   - CTE Standard 1: TECHNOLOGICAL DESIGN: Design, modify, and apply technology to effectively and efficiently solve problems

2A. Criteria- What Students Should Know and Be Able to Do:
Students can-
   - Explain that people make devices that shade their bodies to protect against excess sunlight that can harm their eyes or skin.
   - Describe, in very general terms, the process they used to design, construct and test their shade structures.
   - Express and support an opinion about their visor designs.
2B. Assessment Tools/Evidence:

Formative:
- Teacher observation/anecdotal records of students’ responses during class discussions and field experiences (SC.K.1.1, SC.K.1.2, SL.K.1, SL.K.3, W.K.8)
- Student Journals: Drawings with dictated, recorded, or written caption (CTE Standard 1, SC.K.8.2, W.K.1, W.K.2, W.K.8, L.K.1)
- Rubric to assess student journal entries

3. Learning Experiences (Lesson Plan)

Materials:
- For each student: A tagboard “headband” that will be used as the base of the visor
- For each table: Tools including scissors, tape, glue, markers
- At the supply table: Recyclable materials that children can use to design and create visors. Available materials should include dark and light paper and see-through materials such as clear plastic or cellophane, as well as any or all of the following: cardboard (flat), cardboard tubes, fabric, aluminum foil, plastic containers, Styrofoam trays and/or cups, fabric
- A sunny day

Handouts/Other Resources:
- See sample Visor Design Challenge handout.
- See sample Student Journal for this unit.

Procedural Recommendations:
1. Because students will need time to plan, build and test, redesign, and re-test, conduct this lesson over a 2-day period as described below.
2. Structure the time provided for each step so that students continue to move forward. For example,
   - Brainstorming – 10 min
   - Determine design and obtain materials – 10 min
   - Build structure – 30 min
3. When it is time for students to get their supplies, you will need to monitor the supply table. Students are not free to take anything they see. They may only have the materials that are shown on their design plan.
4. The Visor Design Challenge handout should be completed by the group as they do the engineering task. Following each part completed by the group, individuals need to record the information on their own individual handouts.
Procedure: Day 1 – EDP Steps 1-4

1. In class, explain to students that they will be using the Engineering Design Process (EDP) to make a device that will shade their eyes when they go on an outdoor field trip. Ask the class to name some devices that people use to shade their eyes and chart their responses (umbrella, sunglasses, hats, visors, etc.). Explain that in this Design Challenge, they will design and create a visor that will effectively shade their eyes. Since each student will need his or her own visor, they will do this individually rather than as a group, however they are encouraged to share and explain their ideas to others at their tables as they work.

2. Write the steps in the EDP on the board or on a chart and briefly review each step in the process in “kid-friendly” language. Note the standards addressed in each section to guide teacher observation of students' abilities:

   1) **Ask:** Understand the problem, state the conditions and limitations, and obtain information from prior knowledge. (SC.K.1.2, SL.K.3)
      a. “Students – what is the challenge you will be asked to solve today? What materials will you be able to use?”

   2) **Imagine:** Brainstorm ideas. (SL.K.1, W.K.8)
      “Think of at least three different ways you might design your visor, and draw each idea on your Visor Design Challenge handout. Think about what shape might work best to shade your eyes. Think about how you would like to decorate your visor. Share your ideas with others at your table, and decide which design you will use.”

   3) **Plan:** Choose a testable idea, draw a useable prototype, and use obtainable, affordable, and safe materials. (SL.K.1, CTE Standard 1)
      a. “Once you decide what your visor will look like, you will draw a picture of it on your Visor Design Challenge handout. Your drawing must show exactly what materials you need because you will use this drawing to order your materials at the supply table.”

   4) **Create:** Follow the plan and make it work. (SL.K.1, CTE Standard 1)
      a. “Follow your plan and build the visor to match your drawing.”

   5) **Experiment:** Collect, record, and analyze data accurately. (K.1.1)
      a. “You will test your visor in the sun to see how well it shades your eyes.”

   6) **Improve:** Review data and repeat the process to optimize.
      a. “After you test your structure, you will have an opportunity to make changes to it and test it again.”

3. Have students sit in groups that you have assigned, and provide each student with a copy of the Visor Design Challenge student handout.

4. Show students the variety of materials that you have provided on your supply table, so that they will know what they can use for their designs. Explain any design parameters related to the size of their visors.
5. Begin the EDP process:

   **Teacher to Whole Class: Step 1: Ask –**
   
   “Raise your hand if you can tell the class what the design challenge is.”
   “Who can explain what materials we will be using and how you will get them?”
   “Who can tell us what Step 2 is in the EDP?”
   “You will have ____ minutes for Step 2: Imagine. Be sure that everyone in your group has a chance to tell their idea, and draw at least 3 different ideas on your Visor Design Challenge handout.” “You may begin.”

6. As students begin their work, teacher will need to circulate with a stapler to fit each child’s headband. After a reasonable amount of time while circulating to assist, the teacher will stop the group to transition students to the next step. Remind them what happens in Step 3, and what the “rules” are for getting their supplies. Teacher will need to monitor the supply table, then continue to circulate and assist as needed so that students can successfully complete Steps 3 and 4. When you see a group that has done a good job on the Visor Design Challenge handout, stop the class and show them the handout as an example of what they need to do.

   The objective for Day 1 is for each group to complete one visor that they will test the next day.

**Procedure: Day 2 – EDP Steps 5 & 6**

1. In class, remind students that they will have an opportunity to test and redesign their visors.

2. Take students to the sunny area that you have selected for them to test their visor designs. Encourage students to walk in different directions and test the effectiveness of their visors from all angles. They will also need to determine if the visor is sturdy enough to last through the day of their field trip.

3. Return to class and have students share the results of their test with others at their tables. Students should tell how effective their design is in terms of how well it shades their eyes, and how sturdy it is. They should also tell how they would like to improve it. Point out to students that people who design visors sold in stores need to think about these same questions.

4. After sharing with their groups, have students repeat EDP steps 3 – 5 to make an improved design.

5. Chart students’ comments and questions about factors that they think might have influenced the success of their designs. Students can use this chart as a reference when writing in their journals.

6. Direct students to write about their visors in their Journals (Entry #7). They are asked to tell if they were **happy** or **not happy** with their finished visor and explain why. Write the key words (underlined above) on the board so that students can choose and write the appropriate response words in the provided blank space in the prompt.
## TEACHING & ASSESSMENT (Steps 4, 5, 6, & 7)
Completed by the teacher after instruction has taken place

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## RUBRIC: Student Journal Entry 7

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<tr>
<th>Science/ Writing Content</th>
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<tbody>
<tr>
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<td>Illustrates a solution to the visor design challenge. Opinion/ explanation is incomplete and or unclear.</td>
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<td></td>
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<th>Writing/ Speaking Skills</th>
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## Visor Design Challenge

You will be going on an outdoor field trip with your class. The weather is expected to be hot and sunny. Your teacher will give you a headband, and you must design a visor that will shade your eyes to protect them from the sun. Good luck!

### Imagine: Draw Different Design Ideas

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<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
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</tbody>
</table>

- [A] [Diagram of visor design A]
- [B] [Diagram of visor design B]
- [C] [Diagram of visor design C]
- [D] [Diagram of visor design D]
<table>
<thead>
<tr>
<th>Plan 1: Draw the Design You Will Make</th>
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<table>
<thead>
<tr>
<th>Test Your Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tell how well it worked.</td>
</tr>
</tbody>
</table>
### Plan 2: Draw the Design You Will Make

![Design Diagram]

### Test Your Design

Tell how well it worked.

\[\]  
\[\]  
\[\]  
\[\]
My Journal

Sunlight and Shadows
1. What is a shadow? Show what you know.
   - Draw the sun.
   - Draw yourself.
   - Draw your shadow.

Tell about your picture:
2. Draw a picture to show your favorite part of *Bear Shadow*.

Tell about your picture.

My favorite part of *Bear Shadow* was

because…
3. Make a map to show all the places Bear went with his shadow.

Tell about your picture.
4. On a sunny day, would you rather play in the sun or in the shade? Draw a picture to show what you would like to do.

Tell about your picture.

I would like to play in the ______________ because…
5. Show one way you use shade to protect yourself from the sun.

Tell about your picture:
6. Design Challenge: Keeping a Lunchbox Cool

Did your shade structure keep the lunchbox cool? Draw a picture to show how it worked.

Tell about your picture:

The shade structure ___________________ because…
7. Design Challenge: Visor

Were you happy with your visor design? Draw a picture to show how well it worked.

<table>
<thead>
<tr>
<th>Tell about your picture:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was __________________ with my visor</td>
</tr>
<tr>
<td>because…</td>
</tr>
</tbody>
</table>