

**Physical Science: Solar Energy**  
**Joey Bland, Beverley McQueary, Ronna Mills**  
**Grade: 4-5**

**Overview:**

Students will develop an understanding of how solar energy and electricity produce light and heat.

**Major Focus**

**Academic Expectations:**

- 2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.
- 2.3 Students identify and analyze systems and the ways their components work together or affect each other.
- 2.4 Students use the concept of scale and scientific models to explain the organization and functioning of living and nonliving things and predict other characteristics that might be observed.
- 2.5 Students understand that under certain conditions nature tends to remain the same or move toward a balance.
- 2.6 Students understand how living and nonliving things change over time and the factors that influence the changes.

**Core Content:**

SC-E-1.3.1 Light travels in a straight line until it strikes an object. Light can be reflected by a shiny object, refracted by a lens, or absorbed by an object.

SC-E-1.3.2 Heat can be produced in many ways such as burning or rubbing. One way heat can move from one object to another is by conduction. Some materials absorb and conduct heat better than others. For example, metal objects conduct heat better than wooden objects.

SC-E-1.3.3 Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete conducting path through which an electrical current can pass.

SC-E-2.2.1 The Sun provides the light and heat necessary to maintain the temperature of Earth. The Sun's light and heat are necessary to sustain life on Earth.

SC-E-2.2.2 Objects in the sky have properties, locations, and real or apparent movements that can be observed and described.

SC-E-2.3.3 Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes slowly over seasons. The moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

**Program of Studies:**

S-4-ESS-4 Students will understand that the Sun provides the light and heat necessary to maintain the temperature of the Earth.

S-4-ESS-5 Students will understand that common objects in the sky have properties, locations, and movements that can be observed and described.

S-4-ESS-6 Students will understand that objects in the sky have patterns of movement.

S-4-PS-7 Students will understand that electrical currents move through electrical circuits. Electricity in circuits can produce light, heat, sound, and magnetic effects.

S-4-PS-8 Students will understand that heat can be produced in many ways and can move from one object to another by conduction.

S-4-PS-9 Students will understand that light travels in a straight line until it strikes an object. Light can be reflected, refracted, or absorbed by objects.

**National Standards:**

NSS4\_2.8 Light travels in a straight line until it strikes an object. Light can be reflected by a mirror, refracted by a lens, or absorbed by the object.

NSS4\_2.9 Heat can be produced in many ways, such as burning, rubbing, or mixing one substance with another. Heat can move from one object to another by conduction.

NSS4\_2.10 Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete loop through which an electrical current can pass.

NSS4\_4.4 The sun, moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.

NSS4\_4.5 The sun provides the light and heat necessary to maintain the temperature of the Earth.

NSS4\_4.8 Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

**Organizer:**

Solar energy and electricity produce light and heat.

**Essential Questions:**

- How are light and heat produced by electricity?
- Can solar energy be collected and stored?
- How do different color materials create various temperatures?
- How does the position of the light source create various temperature changes?
- What are the properties of light?

**Culminating Performance:**

Students will conduct a photo/picture journal and include pictures taken during solar energy activities to a PowerPoint slide presentation. The photo journal will be included to show student understanding of how solar energy and electricity produce light and heat. Photo's should include: Graphs of charted temperatures containing data collected from data loggers, white and black plastic bottles with balloons, solar houses, and students standing in several areas holding mirrors, inside and outside, to make light beams. Students will also include rationales with their picture journals to illustrate comprehension.

## Solar Energy Photo/Picture Journal Rubric

Name \_\_\_\_\_

Date \_\_\_\_\_

<b>Scoring Criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
Student included pictures taken during each activity.				
Student included graphs of charted temperatures collected from data loggers.				
Student included written rationales to illustrate comprehension				
Student effectively participated in fieldwork and large group discussions.				
Student inferred that solar energy and electricity produced light and heat.				

### Scoring Key

- 4 points** correct, complete, detailed
- 3 points** partially correct, complete, detailed
- 2 points** partially correct, partially complete, and lacks some detail
- 1 point** incorrect or incomplete, needs assistance

**Enabling Knowledge:**

- Light travels in a straight line until it strikes an object. Light can be reflected by a shiny object, refracted by a lens, or absorbed by an object.
- Heat can be produced in many ways such as burning or rubbing. Heat can move from one object to another by conduction. Some materials absorb and conduct heat better than others. For example, metal objects conduct heat better than wooden objects.
- Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete conducting path through which an electrical current can pass.
- The Sun provides the light and heat necessary to maintain the temperature of Earth. The Sun's light and heat are necessary to sustain life on Earth.
- Objects in the sky have properties, locations, and real or apparent movements that can be observed and described.
- Changes in movement of objects in the sky have patterns that can be observed and described. The Sun appears to move across the sky in the same way every day, but the Sun's apparent path changes slowly over seasons. The moon moves across the sky on a daily basis much like the Sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

**Enabling Skills and Processes:**

- identifying similarities and differences
- summarizing and note-taking
- cooperative learning
- generating and testing hypothesis
- technology (Powerpoint, Excel, digital camera, Microsoft Word)
- data loggers and Boxcar software
- language skills (use of descriptive and figurative language, word usage, spelling, writing, reading)
- organizing information
- speaking skills (appropriate forms, conventions, and styles to communicate information)

## **Activity 1: Solar Energy**

### **Essential question:**

How are light and heat produced by electricity?

**Core Content** – SC-E-1.3.3

### **Materials:**

- Heat Lamp Kit (Light bulb, clamp, metal reflector)
- Data Loggers

### **Objective:**

Students will be able to understand how the light bulb will produce light and heat.

### **Procedure:**

1. Hook up the heat lamp and have data loggers launched.
2. Identify the source of light.
3. Identify the source of heat by placing hand near heat source.

### **Activity:**

1. Position heat lamp to shine directly over temperature probe of data logger.
2. Wait 5 minutes then download results from data logger.
3. Use chart paper to graph results of both light and temperature.
4. Discuss how the bulb produced a constant light source.
5. Discuss how the bulb produced an increase in temperature.

### **Assessment:**

Assessment will be made based on class discussion of graphs.

## **Activity2: Solar Energy Collection and Storage**

**Essential Question:** Can solar energy be collected and stored?

**Core Content:** SC-E-1.3.1, SC-E-1.3.2

### **Materials:**

- 1 plastic bottle painted white
- 1 plastic bottle painted black
- two small balloons

### **Objective:**

Students will demonstrate that energy from the sun can be collected and stored in many ways.

### **Procedure:**

The experiment is conducted with two plastic bottles. One of the bottles is painted black and the other is painted white. Place the open end of one small balloon on the mouth of the white bottle and place the other balloon on the mouth of the black bottle. Make sure the balloon forms an air tight seal. Next, place both bottles in bright sunlight. The black bottle will absorb the sun's energy more efficiently. The white bottle reflects away most of the sun's energy. As the bottle absorbs energy, the air temperature inside the bottle increases and thus expands, causing the balloon to inflate.

### **Activity:**

Within a few minutes, the students will notice the balloon on the black bottle will start to expand. The balloon on the white bottle will remain limp. Have students touch the bottles to see if temperature changes are noticeable. Ask students the following questions: Why do you think the balloon on the black bottle expanded? Does heat make air expand? Does a black object get warmer in the sunlight than a white object? What would be a good color to paint your car if you wanted to stay cool in the summer?

### **Assessment:**

Teacher observation and large-group discussion.

### **Activity 3: Solar Houses**

#### **Essential Question:**

How do different color materials create various temperatures?  
How does the position of the light source create various temperature changes?

**Core Content:** SC-E-1.3.2  
SC-E-2.2.1  
SC-E-2.2.2  
SC-E-2.3.3

#### **Materials:**

- Direct sunlight
- Solar House
- White and black construction paper
- Data Loggers

#### **Objective:**

Students will understand that dark materials will absorb heat and conduct heat better than light colored materials.

Students will identify the sun provides the necessary heat to maintain the temperature of the earth so life is sustained.

Students will understand the sun's movement can be observed.

Students will learn that the change in movement of the sun will result in temperature change.

#### **Procedure:**

1. Position solar houses in direct sunlight.
2. Launch data loggers.
3. Place white colored construction paper on the floor of one house, and place dark colored construction paper on the floor of the other house.
4. Position data logger probe on the floor of each solar house.
5. After compiling data for 5 minutes, reposition solar house away from direct sunlight. (This will show movement of the sun).

**Activity:**

1. Take class outside and find the best place for obtaining direct sunlight.
2. Position houses in the direct sunlight with white and black paper on the floor of the solar houses.
3. Position data loggers on floor of solar houses.
4. Wait 5 minutes and download results.
5. Re-launch data loggers.
6. Return outside and reposition solar houses out of direct sunlight.
7. Position data loggers on the floor of the solar houses.
8. Wait 5 minutes and download results.
9. Return to classroom and analyze temperature differences.
10. Graph temperatures differences between the houses containing the white and black construction paper. Discuss how dark colored materials absorb heat quicker than light colored materials.
11. Design the following graph: House out of direct sunlight with white paper, house in direct sunlight with white paper, house out of direct sunlight with black paper, house in direct sunlight with black paper.
12. Compare temperature changes when the direct sunlight was removed. Discuss how this relates to the actual movement of the sun.

**Assessment:**

Each student will complete an Open Response Question: Draw a picture of the sun's position in the morning, midday, and late afternoon. Explain how the position of the sun affects a change in temperature.

## Activity 4: Properties of Light

**Essential Question:** What are the properties of light?

**Core Content:** SC-E-1.3.1

**Materials:**

- several mirrors
- light source (sun)

**Objective:**

Students will comprehend that light travels in a straight line until it strikes an object and a shiny object can reflect it.

**Procedure:**

One student will take a mirror outside so that he/she can use the sunlight as a light source. Another student will stay inside the school auditorium in a way so that both can see each other. Turn off the light in the auditorium. The student outside will hold their mirror up to make a light beam that will connect with the student's mirror in the auditorium. The student inside will hold the mirror up so that their mirror will use the light beam from outside to make another light beam which can be directed at the auditorium wall, or another mirror.

**Activity:**

Have students take turns reflecting the beams into and around the auditorium. Attempt to see how many times and shapes one beam can be reflected around the auditorium. Ask students the following questions: How does light travel? What happens when light hits a shiny material?

**Assessment:**

Teacher observation, large-group discussion, open-response questioning