

# Energy from the Sun

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**Strand** Interrelationships in Earth/Space Systems

**Topic** Investigating the sun as a source of energy and light

**Primary SOL** 1.6 The student will investigate and understand the basic relationships between the sun and Earth. Key concepts include

- a) the sun is the source of energy and light that warms the land, air, and water.

**Related SOL** 1.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

- b) observations are made from multiple positions to achieve a variety of perspectives and are repeated to ensure accuracy;
- d) simple tools are used to enhance observations;
- e) length, mass, volume, and temperature are measured using nonstandard units;
- f) inferences are made and conclusions are drawn about familiar objects and events;
- g) a question is developed from one or more observations;
- h) predictions are made based on patterns of observations;
- i) observations and data are recorded, analyzed, and communicated orally and with simple graphs, pictures, written statements, and numbers;
- j) simple investigations and experiments are conducted to answer questions.

## Background Information

The sun's radiant energy is absorbed by land, air, and water and turned into thermal energy. Specific heat is the amount of heat needed to raise the temperature of 1 gram of a substance 1 degree Celsius. Water, land, and air have different specific heat and thus take different amounts of energy to change their temperatures. Water has a high specific heat—about four times than that of air. The specific heat of the materials used in this experiment is as follows: water 4.183 kJ/kgK; air (at 20°C) 1.005 kJ/kgK; dry soil 0.80 kJ/kgK. Therefore, when this experiment is conducted, results should show that soil will have the highest temperature, then air, and then water.

## Materials

- Three trays
- Nine 1-liter clear beakers or containers
- Potting soil
- Water
- Nine student thermometers
- Large yellow ball
- Three clocks (analog or digital)
- Energy from the Sun handout (attached)

## Vocabulary

*light, solar energy, sphere, temperature*

## Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Prior to the lesson, place three 1-liter beakers on each of three trays. In one beaker on each tray, place 1/4 liter of water. In another beaker on each tray, put in soil to the same level as the water is in its beaker. Leave the third beaker on each tray empty. Place a student thermometer in each beaker, making sure it goes all the way to the bottom of the beakers with the soil.

### Introduction

1. Introduce the lesson with this high energy activity (best done outside). Have students form a circle around you. Hold a large yellow ball up high, and ask students what shape they see when looking at the ball. Call on a student on all four sides of the ball to see if all answer “circle.” Then, explain to students that because the ball is not a flat shape, we call this solid a *sphere*, not a circle.
2. Tell the class that we will play a game with the sphere: you will start by tossing the ball into the air, and they must try to keep it in the air *without leaving their places in the circle*. When the game becomes quite frantic, remind students that they may not leave their places in the circle, so they must try to keep the ball in the center of the circle.
3. After several minutes of play, stop the play and stand in the center of circle. Ask students, “After keeping the ball in the air, do you find you’re a little out of breath? That is because you’re using energy to keep the ball up.”
4. Ask students to think of something else they see all the time that is yellow and looks like a circle but is actually a sphere. Accept all answers, and if necessary, prompt them to answer “the sun.” Ask students to tell how the yellow ball is like a model of the sun.
5. Have students sit around the model “sun,” and ask them what they already know about the sun. Display reasonable answers, which will begin to create a K-W-L chart. If students do not mention it, lead them to mention the heating role of the sun. Explain that we will do an experiment to show how the sun affects objects we encounter every day.

### Procedure

Several hours prior to the experiment, place the three prepared trays of beakers in three observation areas, as follows:

- Area 1—Sunny area outdoors
- Area 2—Shady area outdoors
- Area 3—In the classroom away from direct sunlight

Label each beaker according to its area number and its contents in order to assist students in recording their observations. Also, place a clock in each area for students to use to record the observation times. Note that this experiment is best performed on a sunny day and has a more dramatic effect if set up several hours ahead of the observation time.

1. Distribute copies of the attached Energy from the Sun handout. Explain the three observations areas, and remind students that the purpose of this experiment is to show how the sun affects similar items sitting in the three different areas.

2. Have students predict the answer to the question, “How will the sun affect the water, soil, and air in our three observation areas?” Have students make a few predictions, based on what they already know.
3. Allow students to visit each area in three groups to make observations. (Note: If classroom assistance is available, the three groups may work in the three areas simultaneously and then rotate. Otherwise, have the whole class visit each area and then work in small groups to complete the activity.) At each location, encourage students to work together to read the clock and record the time of the observations and to read the thermometers and record the temperatures in the three beakers.
4. Gather students, and discuss initial findings from the first observations. During discussion, let enough time elapse so that temperatures outside may change.
5. Have students do a second round of observations and again record their findings. (This will complete the observations, so all materials can be brought back into the classroom.)
6. After completing the final observations, return to the classroom, and compare all findings. Discuss differences between the locations at the same time, and have students brainstorm how these differences affected the temperatures. Have students explain the effect of the sun on the beakers in the sunny location versus those in the shade and/or inside. Discuss why the sun has this effect. (The sun is the source of energy and light that warms the land, air, and water on Earth.) Ask, “Do you think the empty beaker contained anything? If so, what? In the sunny area beakers, which one had the highest temperature? Which one had the lowest? Why do you think this is so?”
7. Tell students that this experiment illustrates the sun’s effect on Earth’s water, soil, and air. Discuss whether the findings support students’ original predications. “Did the sun have an effect on all three contents in each location? Was there a difference between the first and second observations? If so, what may account for that difference?”
8. Continue with the assessment questions at the bottom of the handout.

### **Assessment**

- **Questions**
  - What effect did the sun have on the soil?
  - What effect did the sun have on the air?
  - What effect did the sun have on the water?
  - Why do you think the effect was not exactly the same on all three? Use your measurements to support your answers.
  - Were there differences between the first and second observations? if so, what may account for these differences?
- **Journal/Writing Prompts**
  - Tell what you think would happen if the same experiment were performed on a cloudy day. Would the results be the same? Explain your thinking.

### **Extensions and Connections (for all students)**

- Connect this lesson to Science SOL 2.3c (changes in phases of matter with the addition or removal of energy). Students may not need to know the vocabulary, but they can be exposed to the process.

- Connect this lesson to Science SOL 1.7a and c (changes in temperature...affect plants and animals; changes in temperature...can be observed and recorded over time). Review also Science SOL K.10 (change occurs over time; changes can be observed and measured).
- Extend this lesson to plant and animal observations. (Science SOL 1.4a, 1.5a)
- Have students pretend they live in soil like worms, and have them tell about a day in their life when it is hot or cold.
- Ask students, “Would it be better to set a pot with a seed planted in the soil in a sunny window or in a cold shady part of the room?” Have students defend their answers by telling how the seed would feel in each location and explaining which area would help the seed to sprout first.

### **Strategies for Differentiation**

- Have students suggest ways the results of this experiment may change if it is done in different seasons. “Would winter results be different than hot summer day results?” Tell students why this is possible, using visuals.
- Demonstrate how the sun can heat foods we eat by using marshmallows and chocolate to make “Sunshine S’mores.” Break graham crackers into halves, and put a marshmallow on one half and a small chocolate bar on the other. Place on small paper plates, cover with plastic wrap, place outdoors in the sun or in a sunny window sill, and allow time for both substances to melt in the sun. Have students make observations and write brief descriptions at three times during the day. Then, uncover and mash the two halves together to make a science-review treat.

# Energy from the Sun

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## OBSERVATIONS 1

Location	Time	Temperature of Air	Temperature of Water	Temperature of Soil
Area 1: Sunny area outdoors	____:____	____°	____°	____°
Area 2: Shady area outdoors	____:____	____°	____°	____°
Area 3: Shady area in classroom	____:____	____°	____°	____°

## OBSERVATIONS 2

Location	Time	Temperature of Air	Temperature of Water	Temperature of Soil
Area 1: Sunny area outdoors	____:____	____°	____°	____°
Area 2: Shady area outdoors	____:____	____°	____°	____°
Area 3: Shady area in classroom	____:____	____°	____°	____°

What do you notice about the temperature in all three areas?

What effect did the sunshine have? Explain.