SOLAR ENERGY

JILL WILLIAMS

SOLAR COLLECTION

Time Frame:	Standards:
45-60 minutes	8-9.PS(ES).1.2.1 Use observations and data as evidence on which to base scientific explanations 8-9.PS(ES).1.6.3 Use appropriate technology and mathematics to make investigations. 8-9.PS.2.3.2 Classify energy as potential and/or kinetic and as energy contained in a field 7.S.1.2.2 Use observations to make defendable inferences 7.S.1.6.2 Use appropriate tools and techniques to gather and display data 7.S.1.6.3 Evaluate data in order to form conclusions 7.S.1.6.4 Use evidence and critical thinking to accept or reject a hypothesis

Objectives:

To learn that radiant energy can be collected and converted into heat and stored.

Background Information:

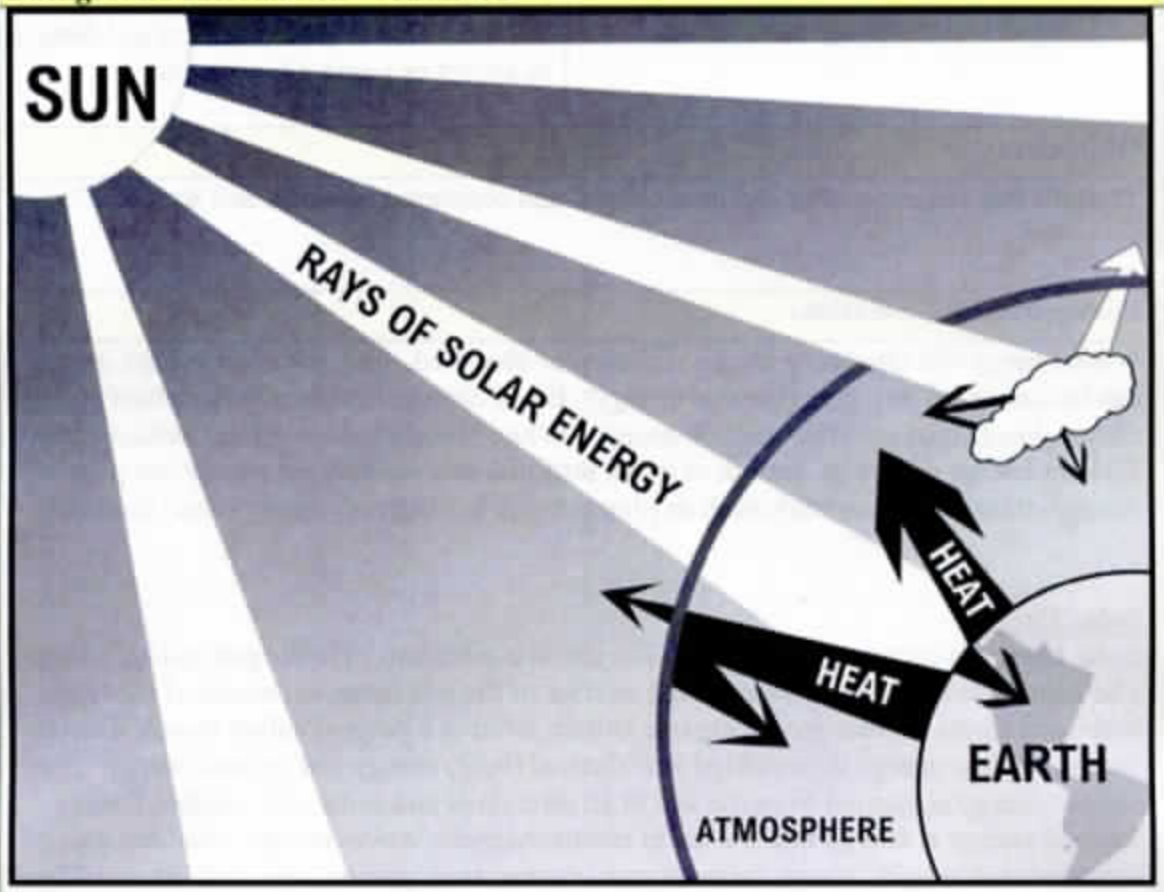
When energy hits objects, it can be reflected or absorbed. The absorbed radiant energy can be converted into heat (thermal energy). Black objects tend to absorb radiant energy. Shiny objects tend to reflect radiant energy. White objects tend to reflect radiant energy. Radiant energy can be by the sun or by an artificial source. Radiant energy can pass through transparent materials such as plastic wrap, but thermal energy (heat) does not.

Solar Energy

Solar energy is energy from the sun. The sun is a giant ball of hydrogen and helium gas. The enormous heat and pressure in the interior of the sun cause the nuclei of the two hydrogen atoms to fuse, producing one helium atom in a process called fusion. During fusion, nuclear energy is converted into thermal (heat) energy and radiant energy. The radiant energy is emitted from the sun in all directions and some of it reaches Earth. Radiant energy is energy that travels in electromagnetic waves or rays. Radiant energy includes visible light, x-rays, infrared rays, microwaves, gamma rays, and others. These rays have different amounts of energy depending upon their wavelength. The shorter the wavelength, the more energy they contain.

With the students review the greenhouse effect of solar radiation in the atmosphere. Only a small portion of the energy radiated by the sun into space strikes the earth, one part in two billion. Yet this amount of energy is enormous. Every day enough energy strikes the United States to supply the nation's energy needs for one and a half years. About 15 percent of the radiant energy that reaches the earth is reflected back into space. Another 30 percent is used to evaporate water, which is lifted into the atmosphere and produces rainfall. Radiant energy is also absorbed by plants, the land and the oceans. You can use the picture below to help explain the greenhouse effect.

Background Information: Continued



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Materials:

- 20 plastic containers (clear) (large **clear** plastic cups can be used)
- 20 thermometers
- 5 beakers
- Plastic wrap
- Black and white construction paper
- Rubber bands
- Scissors
- Cold water
- Compasses (For making circles of the black and white paper.)
- Classroom set of Lab directions or individual sheet of lab directions
- Timers (optional)

Procedure:

Preparation: Create 5 centers in your classroom. Each center needs 4 plastic containers, 4 thermometers, a beaker, 2 rubber bands, enough plastic wrap to cover 2 plastic containers, 1 quarter sheet of white construction paper, 1 quarter sheet of black construction paper and one compass. You also need to determine the diameter of the bottom of your plastic container so you can tell the students to cut a circle of _?_ cm in diameter for the bottom of their cups.

1. Place the students into 5 groups. Assign each group a center. Explain the procedure and have the students complete the activity (outlined below).
2. Cut two circles each of white and black construction paper _?_ cm in diameter. Place the circles in the bottoms of four plastic containers and cover with 40 ml of cold water. Record the temperature of the water in Celsius.
3. Cover one black and one white container with plastic wrap held in place with rubber bands.
4. Place the containers in a sunny place so that the sun is directly over the containers. This can be outside or in a place in your room. Predict what will happen. Record the temperature of the water after five minutes.
5. Calculate and record the change in temperature after the five minutes
6. Record the temperature of the water after ten minutes. Calculate and record the change in temperature after ten minutes.
7. Record the temperature of the water after 15 minutes. Calculate and record the change in temperature after 15 minutes.
8. Have the students draw their conclusions from their data. Discuss their conclusions. Lead a discussion on how this can help them or others. Could we store solar radiation? Why should we collect and store solar radiation?

Extension of the Activity

1. Have the students research ways that solar radiation collection is being used. From their research, have them design a way that they could possibly use solar collection in their home, school or town. They could then create a model from their design.
2. Have the students research ways that solar radiation collection is being used. From their research, have them write a paper on how solar radiation collection could be used in their town or school. You could have them write the paper in the form of a proposal to the town council or school board to adapt their use of solar radiation collection for some use to the town or school.
3. Have the students graph the information from their data table. What conclusions can they draw from their data? Is it easier to see and understand the information in a data table or a graph?

Assessment:

Assess how well the students work together in their groups.
Assess if the students completed the lab as outlined by the lab sheet. Did the students copy down or create their data tables correctly? Are their conclusions logical when compared with what they recorded on their data table?

Additional Content:

These are examples of lab sheets to hand out to students.

SOLAR COLLECTION

Solar collectors absorb radiant energy, convert it into heat and hold the heat.

PURPOSE: To explore solar collection.
Hypothesis: Read through the procedures. Predict what you think will occur.
PROCEDURE:
Step 1: Cut two circles each of white and black construction paper ? cm in diameter. Place the circles in the bottoms of four plastic containers and cover with 40 ml of cold water. Record the temperature of the water in Celsius.
Step 2: Cover one black and one white container with plastic wrap held in place with rubber bands.
Step 3: Place the containers in a sunny place so that the sun is directly over the containers. Predict what will happen.
Step 4: Record the temperature of the water after five minutes. Calculate and record the change in temperature after the five minutes.
Step 5: Record the temperature of the water after ten minutes. Calculate and record the change in temperature after ten minutes.
Step 6: Record the temperature of the water after 15 minutes. Calculate and record the change in temperature after 15 minutes.

RECORD THE DATA

	WHITE NO COVER	BLACK NO COVER	WHITE WITH COVER	BLACK WITH COVER
ORIGINAL TEMPERATURE - C				
AFTER 5 MINUTES TEMPERATURE – C				
AFTER 10 MINUTES TEMPERATURE – C				
AFTER 15 MINUTES TEMPERATURE – C				
CHANGE IN TEMP – 5 MIN				
CHANGE IN TEMP – 10 MIN				
CHANGE IN TEMP – 15 MIN				

CONCLUSION: Look at your data. What have you learned about collecting and storing solar radiation? How can you use this information?

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PROCEDURE:

Step 1: Cut two circles each of white and black construction paper ? cm in diameter. Place the circles in the bottoms of four plastic containers and cover with 40 ml of cold water. Create a data table and use it to record the data from your lab. Record the temperature of the water in Celsius.

Step 2: Cover one black and one white container with plastic wrap held in place with rubber bands.

Step 3: Place the containers in a sunny place so that the sun is directly over the containers. Predict what will happen.

Step 4: Record the temperature of the water after five minutes. Calculate and record the change in temperature after the five minutes.

Step 5: Record the temperature of the water after ten minutes. Calculate and record the change in temperature after ten minutes.

Step 6: Record the temperature of the water after 15 minutes. Calculate and record the change in temperature after 15 minutes.

CONCLUSION: Look at your data. What have you learned about collecting and storing solar radiation? How can you use this information?

References:

Adapted from The NEED Project's 2008 Exploring Solar Energy Activity 4
http://www.need.org/
Adapted by Jill Williams as part of the INL Educational Science writing team.