Sun and Shade

Student Objective
The student:
- will be able to explain the effect of solar thermal energy
- will be able to predict the effect of solar energy on temperature in sunny and shady areas.

Key Words:
solar thermal
trial

Time:
1 class period

Materials:
- thermometers (2 per group)
- tape
- Data Sheets
- Science Journal

Background Information

On a hot summer day, a patch of shade is a welcome sight! Shade not only cools the person standing in it, but also the soil and the air temperature above the ground which helps to stabilize the entire area. A city street lined with trees has sidewalks that are much cooler than a city street without trees, and because of this, people are more likely to show signs of heat stress in a city where there are few trees and shade.

When a temperature is reported on the news it is an official reading taken at a weather observing station. At these stations, thermometers are shielded from sunshine inside specially constructed shelters that allow air in but not direct sunlight. This is necessary if you want to measure the temperature of air. A thermometer in sunlight absorbs infrared radiation which is a component of sunlight. Infrared radiation is "heat" radiation. It is what makes you feel warmer when you stand in sunlight compared to standing in the shade. In addition, the thermometer absorbs some visible light a portion of which is converted to heat by the thermometer material. The thermometer is "feeling" the same effect that you do when standing in sunlight compared to standing in shade. On a sunny day that could be about 30 degrees higher than the actual air temperature.

Procedure
1. Divide students into working groups of 3 - 4 students per group.
2. Explain procedure to the class
   - tape one thermometer to each Record Sheet
   - place one sheet in the sun and record the temperature at two minute intervals
   - place second sheet in the shade and record the temperature at two minute intervals

3. Have the students write in their Science Journal what they think will happen.
4. Pass out materials.
5. Help groups as needed during experiment. Call out the two minute intervals for the groups to record the temperatures.
6. Students should complete their Science Journal. For younger students, provide an example of a two-line graph on the board.

Further Research

1. Would the results be similar for a day with a significantly colder temperature?
2. Would the results be similar for a day with a strong breeze? a partly cloudy day?
3. How do solar thermal devices such as solar water heaters perform on cold days? windy days? partly cloudy days?
4. Pass out the Solar Scavenger Stroll and have the students 'find' the answers outside. (This activity, written by Mackie Rhodes, was originally published in the May/June 2004 issue of Instructor)
5. Participate in the Sun Times Global Temperature Project (web address for registration below). Join schools from around the world as they determine how their geographic location affects their average daily temperature and hours of sunlight.

Related Reading

- ***Solar Power (True Books)*** by Christine Petersen (Children's Press, 2004)
  This book provides readers with a lucid picture of the sun and wind as natural forces before introducing some of the technology (windmills, turbines, solar panels) used to harness energy on a large scale. The captioned photos are well chosen, and the science and the explanations of the technology are eminently clear. Peterson ends the book with a forecast of the future that informs kids about the advantages and disadvantages of such renewable resources and speculates on their use in years to come

Internet Sites

http://www.k12science.org/curriculum/tempproj3/en/

Stevens Institute of Technology. The Sun Times Global Sun Temperature Project

EnergyWhiz

Submit your class Sun and Shade data with the date you collected the data, location of your school and a picture of your class to the EnergyWhiz website at **http://energywhiz.com/** .

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			.1	.2	.3	.4	.5	.6
Energy	**Standard 1**	**SC.B.1.2-**		**X**	**X**	**X**	**X**	**X**
	Standard 2	**SC.B.2.2-**						
Earth and Space	**Standard 1**	**SC.E.1.2-**			**X**			
	Standard 2	**SC.E.2.2-**						
Nature of Science	**Standard 1**	**SC.H.1.2-**		**X**	**X**			
	Standard 2	**SC.H.2.2-**	**X**					
	Standard 3	**SC.H.3.2-**		**X**				

Benchmark SC.B.1.2.2 - The student recognizes various forms of energy.
Grade Level Expectations
The student:
Third
- knows different forms of energy.

Benchmark SC.B.1.2.3 - The student knows that most things that emit light also emit heat.
Grade Level Expectations
The student:
Third
- knows that the Sun provides energy for the Earth in the form of heat and light

Fourth
- knows that most objects that emit light also emit heat.

Benchmark SC.B.1.2.4 - The student knows the many ways in which energy can be transformed from one type to another.
Grade Level Expectations
The student
Fourth
- knows ways that energy can be transformed (for example light to heat).

Benchmark SC.B.1.2.5 -The student knows that various forms of energy can be measured in ways that make it possible to determine the amount of energy that is transformed.
Grade Level Expectations
The student:

Third

- uses a variety of tools to measure the gain or loss of energy

Fourth

- extends and refines use of a variety of tools to measure the gain or loss of energy

Fifth

- extends and refines use of a variety of tools to measure the gain or loss of energy.

Benchmark SC.B.1.2.6 - The student knows ways that heat can move from one object to another.

Grade Level Expectations

The student

Fifth

- understands that convection, radiation, and conduction are methods of heat transfer.

Benchmark SC.E.1.2.3 - The student knows that the Sun is a star and that its energy can be captured or concentrated to generate heat and light for work on Earth.

Grade Level Expectations

The student

Fourth

- knows how the energy of the Sun can be captured as a source of heat and light on Earth.

Benchmark SC.H.1.2.2 - The student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results.

Grade Level Expectations

The student:

Third

- plans and investigates an experiment that identifies variables, collects and organizes data, interprets data in tables, charts and graphs, analyzes information, and presents and supports findings
- uses various kinds of instruments to collect and analyze information.

Benchmark SC.H.1.2.3 - The student knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions.

Grade Level Expectations

The student:

Fourth

- works collaboratively to collect, share, and record information for a scientific investigation.

Benchmark SC.H.2.2.1 - The student knows that natural events are often predictable and logical.

Grade Level Expectations

The student

Third

- makes predictions and inferences based on observations
- uses charts and graphs to understand patterns of change.

Benchmark SC.H.3.2.2 - The student knows that data are collected and interpreted in order to explain an event or concept.

Grade Level Expectations

The student

Third

- knows that data are collected and interpreted in order to explain an event or concept
- understands that scientific information can be presented in several ways

Fourth

- constructs and analyzes graphs, tables, maps, and charts to organize, examine, and evaluate information

Fifth

- selects appropriate graphical representations.

Sun and Shade

solar thermal - energy from the sun used to heat something

trial - the action of testing, as in an experiment

Sun and Shade

Sun

Time	2 min	4 min	6 min	8 min	10 min
Temperature					

Shade

Time	2 min	4 min	6 min	8 min	10 min
Temperature					

Tape thermometer here

Sun

Time	2 min	4 min	6 min	8 min	10 min
Temperature					

Tape thermometer here

Shade

Time	2 min	4 min	6 min	8 min	10 min
Temperature					

Sun and Shade

1. Hypothesis: I think this will happen during the experiment:

_____

_____

_____

_____

Complete the questions below after your data is collected:

2. Did the temperature change in the sun trial? _____

   If the temperature changed, how did it change? _____

_____

3. Did the temperature change in the shade trial? _____

   If the temperature changed, how did it change? _____

_____

4. Were the results of the sun trial and the shade trial the same? _____

5. If the sun and shade temperatures did not change in the same way, write below what happened.

_____

_____

_____

6. In your shade trial, what was the highest temperature? _____

7. At what time did you record this high temperature? _____

8. In your sun trial, what was the highest temperature? _____

9. At what time did you record this high temperature? _____

10. What is the difference between the highest Sun temperature and the highest shade temperature you observed? (Hint: Subtract the shade temperature from the Sun temperature) _____

11. Graph your results below or on a separate sheet of graph paper. Put the time intervals on the x-axis and the temperature on the y-axis. Plot both sun and shade data on the same graph using a different color for each. Be sure to label both axis and provide a key for the two different lines.

12. Where did the energy come from that caused the temperature to rise?

_____

13. Was your hypothesis correct? _____

14. If your hypothesis was not correct, how would you restate it? _____

_____

_____

_____

Solar Scavenger Stroll

Take this page outdoors on a sunny day. Write your answers on the blank lines.

1. Find two things that need sunlight to live.

2. What do you think the temperature is? (Check later to see how close you are!)

3. Find a surface that reflects sunlight.

4. Find something that collects the Sun's heat.

5. Find something that stays cool even though it is sunny out.

6. Find two things that cast shadows from the Sun.

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