Sun and Shade

Student Objectives
The student:
- will explain the effect of solar thermal energy
- will 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 the 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 every two minutes.

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.

Key Words and Definitions

- **solar thermal** – energy from the sun used to heat something
- **trial** – the action of testing, as in an experiment

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.)

Related Reading

- ***Catch the Wind, Harness the Sun: 22 Super-Charged Projects for Kids*** by Michael Caduto (Storey Publishing, 2011)
  Twenty-two projects plus stories, background information, cartoons and photos covering solar thermal, photovoltaics, solar cooking, climate change, energy production and energy conservations–plus wind energy!
- ***Energy From the Sun (Rookie Read-About Science)*** by Allan Fowler (Children's Press, 1998)
  This book defines energy and examines how energy from the sun provides us with heat, light, plants, food and other things necessary for life on Earth. This book is particularly suited for the young reader and remedial readers.
- ***The Kid's Solar Energy Book*** by Tilly Spetgang (Imagine, 2009)
  Cleverly intertwined with the science of solar thermal and photovoltaics are economics lessons about the cost advantages of energy efficient buildings and the production and price of solar cells. Illustrated with cartoon figures and set in a classroom, this book is appealing to students.

Internet Sites

http://www.weatherwizkids.com/weather-temperature.htm
Weather Wiz Kids site, Temperature page includes calculators for figuring wind chill, heat indexes as well as temperature conversions.

Sun and Shade

Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6	.7	.8
Grade 3										
The Practice of Science	**Big Idea 1**	**SC.3.N.1**	**X**	**X**	**X**			**X**		
Earth Structures	**Big Idea 6**	**SC.3.E.6**	**X**							
Grade 4										
The Practice of Science	**Big Idea 1**	**SC.4.N.1**	**X**	**X**		**X**	**X**	**X**		
Grade 5										
The Practice of Science	**Big Idea 1**	**SC.5.N.1**	**X**							
Forms of Energy	**Big Idea 10**	**SC.5.P.10**	**X**							

Third Grade Benchmarks
Science–Big Idea 1: The Practice of Science

- SC.3.N.1.1 - Raise questions about the natural world, investigate them individually and in teams through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
- SC.3.N.1.2 - Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.
- SC.3.N.1.3 - Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
- SC.3.N.1.6 - Infer based on observation.

Science–Big Idea 6: Earth Structures

- SC.3.E.6.1 - Demonstrate that radiant energy from the Sun can heat objects and when the Sun is not present, heat may be lost.

Fourth Grade Benchmarks
Science–Big Idea 1: The Role of Theories, Laws, Hypotheses, and Models

- SC.4.N.1.1 - Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information, conduct both individual and team investigations through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
- SC.4.N.1.2 - Compare the observations made by different groups using multiple tools and seek reasons to explain the differences across groups.
- SC.4.N.1.4 - Attempt reasonable answers to scientific questions and cite evidence in

support.

- SC.4.N.1.5 - Compare the methods and results of investigations done by other classmates.
- SC.4.N.1.6 - Keep records that describe observations made, carefully distinguishing actual observations from ideas and inferences about the observations.

Fifth Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.5.N.1.1 - Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

Science–Big Idea 10: Forms of Energy

- SC.5.P.10.1 - Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical.

National Next Generation Science Standards

Fourth Grade

Science–Energy

- 4-PS3-2 - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents,

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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					

Tape thermometer here

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? _____

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.

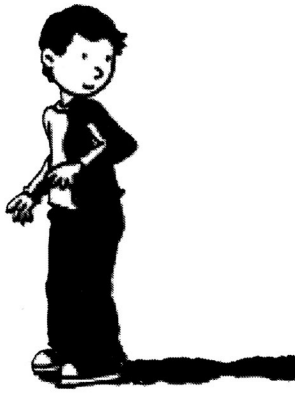
2. What do you think the temperature is? (Check later to see how close you are!)

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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