

Sun and Shade

Student Objectives

The student:

- will explain the affect of solar thermal energy on temperature
- given locations in the sun and in the shade will predict which location is warmer.

Key Words:

solar thermal
trial

Time:

½ hour

Materials:

- primary thermometers (2 per group)
- tape
- Science Discovery Sheets

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.

Procedure

(Note: For kindergarten students large outdoor thermometers can be used. Place a sticker on each one with a sun or a shade graphic so the students will know which goes where)

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 minutes, four minutes and six minutes
 - place second sheet in the shade and record the temperature also at two minutes, four minutes and six minutes.
3. Lead the students in a discussion about what they think will happen.
4. Pass out materials.
5. Help groups as needed during experiment. Call out the time intervals for the groups to record the temperatures.
6. Back in the classroom, lead a discussion of the results the groups obtained from their experiment.
 - Was the hypothesis of the class supported?

- If not, what is their conclusion after doing the experiment?
 - Did all the groups have exactly the same data? Discuss with the class the factors that could have caused the differences in the data (i.e. more or less Sun or wind in their chosen locations). Lead the students to understand that even though the data points gathered might be slightly different, they support or refute the hypothesis equally.
7. For older students, create a simple two line graph with a set of data. Have the groups make a similar graph using their data.

Key Words & Definitions

- **solar thermal** – energy from the sun used to heat something
- **trial** – the action of testing, as in an experiment. A trial refers to one set of data collected within an experiment.

Further Activities

1. Compare the results of this experiment during a different season (winter vs. spring/fall). Is the difference between the sun and shade conditions the same, or greater during one season or the other?
2. Compare the air temperature of sun and shade areas by hanging the thermometers in the air in these locations. How does the difference in air temperature compare with the difference in ground temperature? How does wind affect the temperature differences? Do the experiment on a windy day and on a still day and compare the temperature differences between sun and shade.
3. Conduct an experiment on how sunlight fades colored paper. Tape objects like leaves or shape cutouts on pieces of colored construction paper. Place the sheets of colored paper (dark colors work best) in areas that will be in the sun or in the shade. Leave the papers for several days before checking the results.
4. Another very visual experiment of solar thermal energy can be done with ice cubes. Attach screen to the top of mason jars. Divide class into groups of “sun” and “shade”. Put an ice cube on the top of each jar. The sun groups place their jars in the sun and the shade groups place theirs in the shade. The groups call out when their ice cube is completely melted. For older students, time measurements should be taken and graphed.
5. Make melted crayon suncatchers:



Cut sun flares from cardstock (yellow or orange) and cut a circle out of their center. Cut two circles of waxed paper slightly larger than the opening in the cardstock sun. Grate crayons of various warm colors. Sprinkle some of the crayon shavings on one of the pieces of waxed paper (it only takes a little bit—too much will ooze out the sides of the paper). Place the second piece of waxed paper on the top (you may want to secure it with clear tape in a couple of places around the edge). Place the waxed paper on a flat concrete surface in the sun to melt the crayons. After the crayons are melted, glue the waxed paper piece in the center of the sun flares and hang in a window.

Related Reading

- ***Sun*** by Steve M. Tomecek (National Geographic Society, 2001)
This book follows two kids and a purple cat as they learn about sunspots and solar flares, see how the Sun creates night and day and the seasons, and learn how the Sun warms the Earth. Also included is the Earth's place in the solar system, scientists studying the Sun through special telescopes, and the bounty of life on Earth nurtured by the heat-giving rays of our star.

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Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6
Grade K								
The Practice of Science	Big Idea 1	SC.K.N.1	X	X	X		X	
Properties of Matter	Big Idea 8	SC.K.P.8	X					
Grade 1								
The Practice of Science	Big Idea 1	SC.1.N.1	X		X			
Earth in Space and Time	Big Idea 5	SC.1.E.5				X		
Properties of Matter	Big Idea 8	SC.1.P.8	X					
Grade 2								
The Practice of Science	Big Idea 1	SC.2.N.1	X	X				
Earth Systems and Patterns	Big Idea 7	SC.2.E.7		X				
Properties of Matter	Big Idea 8	SC.2.P.8	X					
Language Arts Standards	Kindergarten: LAFS.K.W.3.8, LAFS.K.SL.1.1, LAFS.K.SL.1.3 First Grade: LAFS.1.W.3.8, LAFS.1.SL.1.1 Second Grade: LAFS.2.W.3.8, LAFS.2.SL.1.1							
Mathematics Standards	Kindergarten: MAFS.K.MD.1.2, MAFS.K.MD.3.4							

Kindergarten Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.K.N.1.1 - Collaborate with a partner to collect information.
- SC.K.N.1.2 - Make observations of the natural world and know that they are descriptors collected using the five senses.
- SC.K.N.1.3 - Keep records as appropriate -- such as pictorial records -- of investigations conducted.
- SC.K.N.1.5 - Recognize that learning can come from careful observation.

Science--Big Idea 8: Properties of Matter

- SC.K.P.8.1 - Sort objects by observable properties, such as size, shape, color, temperature (hot or cold), weight and texture.

Language Arts--Writing Standards

- LAFS.K.W.3.8 - With guidance and support from adults, recall information from

experiences or gather information from provided sources to answer a question.

Language Arts–Standards for Speaking and Listening

- LAFS.K.SL.1.1 - Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
- LAFS.K.SL.1.3 - Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

Mathematics–Measurement and Data

- MAFS.K.MD.1.2 - Directly compare two objects with a measurable attribute in common, to see which object has ‘more of’ / ‘less of’ the attribute, and describe the difference.

Mathematics–Represent and Interpret Data

- MAFS.K.MD.3.4 - Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

First Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.1.N.1.1 - Raise questions about the natural world, investigate them in teams through free exploration, and generate appropriate explanations based on those explorations.
- SC.1.N.1.3 - Keep records as appropriate - such as pictorial and written records of investigations conducted.

Science–Big Idea 5: Earth in Space and Time

- SC.1.E.5.4 - Identify the beneficial and harmful properties of the Sun.

Science–Big Idea 8: Properties of Matter

- SC.1.P.8.1 - Sort objects by observable properties, such as size, shape, color, temperature (hot or cold), weight, texture, and whether objects sink or float.

Language Arts–Writing Standards

- LAFS.1.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Standards for Speaking and Listening

- LAFS.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.

Second Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.2.N.1.1 - Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.
- SC.2.N.1.2 - Compare the observations made by different groups using the same tools.
- SC.2.N.1.4 - Explain how particular scientific investigations should yield similar conclusions when repeated.

Science–Big Idea 7: Earth Systems and Patterns

- SC.2.E.7.2 - Investigate by observing and measuring, that the Sun's energy directly and indirectly warms the water, land, and air.

Science–Big Idea 8: Properties of Matter

- SC.2.P.8.1 - Observe and measure objects in terms of their properties, including size, shape, color, temperature, weight texture, sinking or floating in water, and attraction or repulsion of magnets.

Language Arts–Writing

- LAFS.2.W.3.8 - Recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Standards for Speaking and Listening

- LAFS.2.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

National Next Generation Science Standards**Kindergarten Standards****Science–Energy**

- K-PS3-1 - Make observations to determine the effect of sunlight on Earth’s surface.

Note: Related Common Core Mathematics and Language Arts Standards are listed in the Florida section above.

First Grade

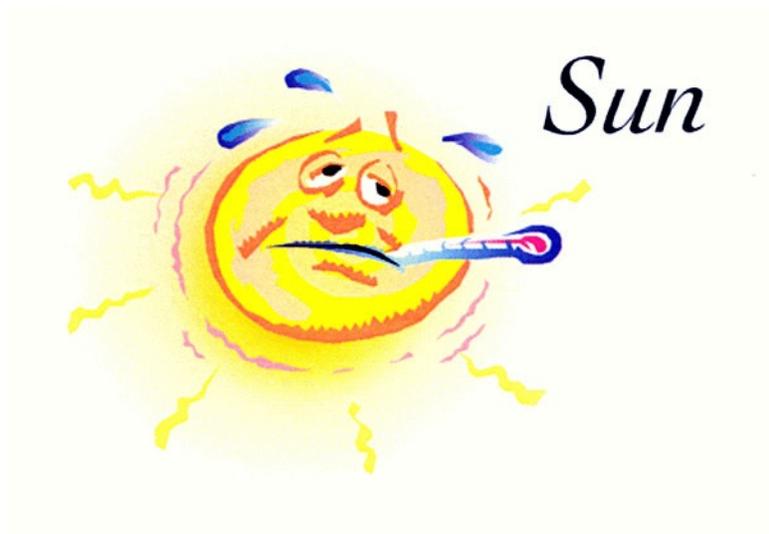
Note: Related Common Core Language Arts Standards are listed in the Florida section above.

Second Grade

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

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Place
Thermometer
Here



Place
Thermometer
Here



Shade