



# How Angle Spreads Sunlight

Elementary Grades

## **Lesson Summary**

Students use a tilted surface and a flat surface to compare the temperature when exposed to sunlight. Students discover how a tilted surface “spreads” sunlight, causing the temperature to be lower.

## **Prior Knowledge & Skills**

Begun lesson:

- Measuring the Earth’s Tilt

Ability to:

- Use a thermometer
- Make and record observations

## **AAAS Science Benchmarks**

### **The Nature of Science**

*The Scientific World view*

*Scientific Inquiry* ★

### **The Nature of Technology** ★

*Technology and Science*

### **The Physical Setting** ★

*The Universe*

*The Earth*

*Energy Transformation*

*Motion*

## **NSES Science Standards**

### **Science as Inquiry**

*Abilities to do Scientific Inquiry* ★

*Understanding about Scientific Inquiry*

### **Physical Science** ★

*Position and Motion of Objects*

*Light, Heat, Electricity, and Magnetism*

### **Earth and Space Science** ★

*Objects in the Sky*

*Changes in the Earth and Sky*

### **Science and Technology** ★

*Understanding about Science and Technology*

## **NCTM Mathematics Standards**

**See Appendix**

**Teaching Time:** One 45-minute period

## **Materials per Student**

- Two pieces of cardboard or plywood rectangle
- Bricks or blocks (something to prop up board)
- Black construction paper
- Masking tape
- Two Thermometers

## **Advanced Planning**

**Preparation Time:** 15 minutes

1. Review instructions
2. Gather necessary supplies
3. Choose sunny location

*Editor’s Recommendation*

# How Angle Spreads Sunlight

**Be sure to remind students that looking at the Sun can cause permanent eye damage -- never look at the Sun directly!**

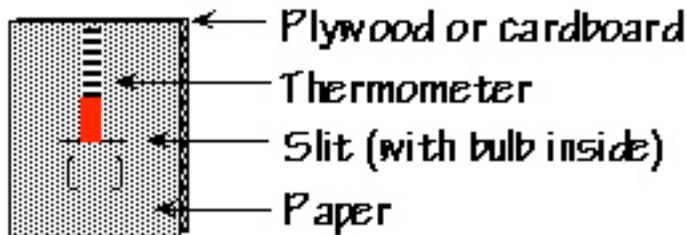
Since the angle of the sunlight influences the amount of energy it creates, it is important for students to observe this effect to understand why the winter on the Earth is colder than the summer. This activity shows how light falling upon a tilted surface is less intense than if it were falling directly, demonstrating this "spreading out" of light by measuring how quickly and by how much the sunlight can warm two sheets of paper: one tilted, one not.

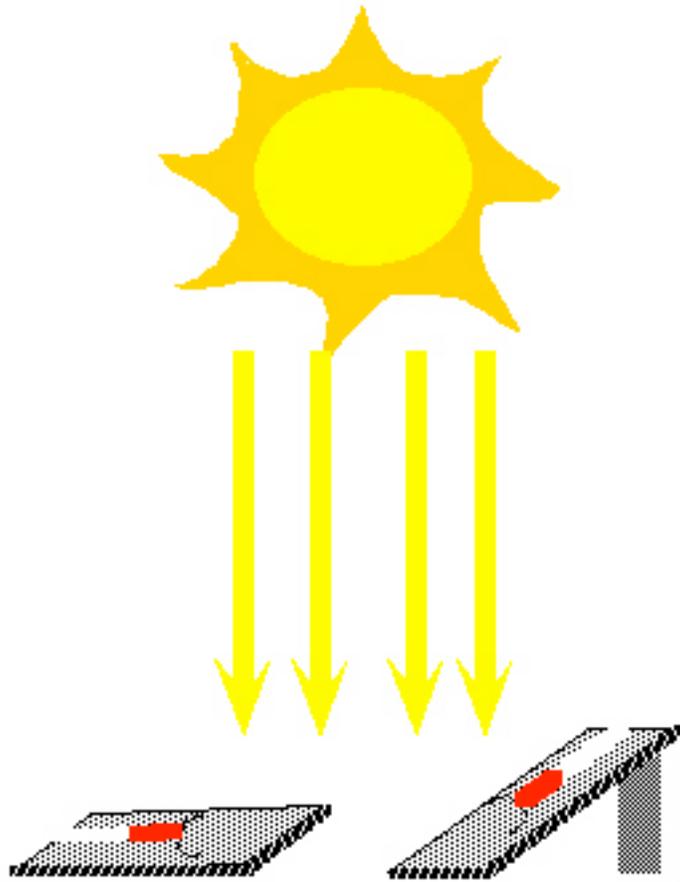
**Materials:** Two sheets of black construction paper; two pieces of cardboard or plywood; bricks or blocks to prop up board; masking tape; two thermometers.

1. Cut an inch-wide slit in the middle of each piece of black construction paper. Tape one of these sheets of black construction paper to each of the cardboard or plywood boards. Place a thermometer into each slit such that the bulb is between

the board and the paper, and the scale can be read without removing the thermometer. Tape the thermometers in place. Leave the assembled thermometers (we'll call them "contraptions"! ) in the shade long enough so that they read the same outside temperature.

2. Bring the contraptions out into the Sun. Tilt one up so that it faces the Sun and the Sun's rays fall nearly perpendicular to the board. The other one should lie flat on the ground, or even tilted slightly backwards from the Sun if the Sun is especially high in the sky.





Paper is  
perpendicular  
to light rays

Paper is not  
perpendicular  
to light rays

3. Periodically (every minute or so) record the temperature on each thermometer until the temperatures level off and stop climbing. Beware the effects of clouds and wind, as well as the shadows of over-anxious students! Let the thermometers sit for a few minutes. Record their final temperatures.

## DISCUSSION

- Which paper's temperature rose more quickly?
- What was the angle of the Sun when the temperature was the highest for each thermometer? Can the students make a relation between the angle of the sunlight and the affect on the Earth from seeing the affect on the tilted paper?
- How high is the Sun at noon in the summer versus how high the Sun is at noon in the winter?
- Try to make a connection between the tilt of the Earth in the summertime and the summer temperatures as well as the tilt of the Earth in the wintertime and the winter temperatures. What if the Earth was not tilted? Would there be any seasons?