

What Causes the Seasons?

Because the axis of the earth is tilted, the earth receives different amounts of solar radiation at different times of the year. The amount of solar radiation received by the earth or another planet is called *insolation*. The tilt of the axis produces the seasons. In this experiment, a simulated sun—a light bulb—will shine on a Temperature Probe attached to a globe. You will study how the tilt of the globe influences warming caused by the lighted bulb.

OBJECTIVES

In this experiment, you will

- monitor simulated warming of your city by the sun in the winter
- monitor simulated warming of your city by the sun in the summer
- interpret your results

MATERIALS

Power Macintosh or Windows PC
Vernier computer interface
Logger Pro
Temperature Probe
ring stand and utility clamp

globe of the earth
masking tape
metric ruler
lamp with 100-watt bulb
20-cm length of string

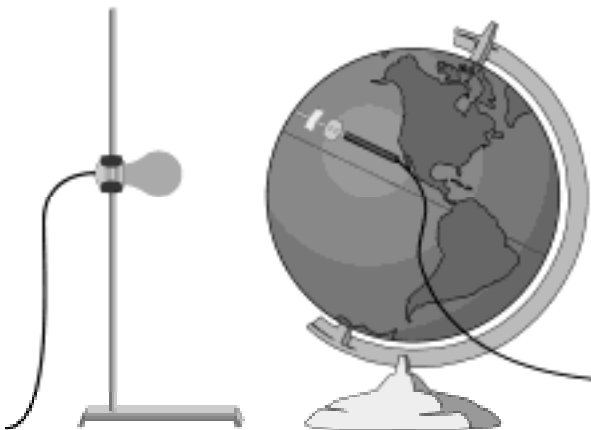






Figure 1



Figure 2

PROCEDURE

1. Ready the light bulb (simulated sun).
 - a. Fasten the lamp to a ring stand as shown in Figure 1.
 - b. Stand the ring stand and lamp in the center of your work area.
 - c. Position the globe with the North Pole tilted away from the lamp as shown in Figure 1.
 - d. Position the bulb at the same height as the Tropic of Capricorn. Note: The sun is directly over the Tropic of Capricorn on December 21, the first day of winter.

2. Attach the Temperature Probe to the globe.
 - a. Find your city or location on the globe.
 - b. Tape the Temperature Probe to the globe with the tip of the probe at your location. Tape the probe parallel to the equator. Place the tape about 1 cm from the tip of the probe.
 - c. Fold a piece of paper and wedge it under the Temperature Probe to keep the tip of the Temperature Probe in contact with the surface of the globe as shown in Figure 2.
3. Position the globe for winter (in the Northern Hemisphere) data collection.
 - a. Turn the globe to position the North Pole (still tilting away from the lamp), your location, and the bulb in a straight line.
 - b. Cut a piece of string 20-cm long.
 - c. Use the string to position your location on the globe 20 cm from the bulb.
 - d. Do not turn on the lamp until directed in Step 5.
4. Prepare the computer for data collection by opening the Experiment 10 folder of *Middle School Science with Computers*. Then open the experiment file that matches the probe you are using.
5. Collect winter data.
 - a. Note and record the temperature displayed in the Meter window.
 - b. Click  to begin data collection.
 - c. After the first temperature reading has been taken, turn on the lamp.
 - d. When data collection stops after 5 minutes, turn the lamp off.
 - e. Choose Store Latest Run on the Data menu.
6. Position the globe for summer data collection.
 - a. Move the globe to the opposite side of the lamp.
 - b. Position the globe with the North Pole tilted toward the lamp. Note: This represents the position of the Northern Hemisphere on June 21, the first day of summer.
 - c. Turn the globe to position the North Pole, your location, and the bulb in a straight line.
 - d. Use the string to position your location on the globe 20 cm from the bulb.
 - e. Do not turn on the lamp until directed in Step 7.
7. Collect summer data.
 - a. Let the globe and probe cool to the temperature that you recorded in Step 5.
 - b. Click  to begin data collection.
 - c. After the first temperature reading has been taken, turn on the lamp.
 - d. When data collection stops after 5 minutes, turn the lamp off.
 - e. Click the Statistics button, , then click  to display Statistics boxes for both runs. Record the minimum and maximum temperature for each run.
8. Print copies of the graph as directed by your teacher.

DATA

Beginning temperature			°C
	Winter	Summer	
Maximum temperature			°C
Minimum temperature			°C
Temperature change			°C

PROCESSING THE DATA

1. In the space provided in the Data table, subtract to find the temperature change for each season.
2. How does the temperature change for summer compare to the temperature change for winter?
3. During which season is the sunlight more direct? Explain.
4. What would happen to the temperature changes if the earth were more tilted than 23.5 degrees?
5. As you move the globe from its winter position to its summer position, the part of the globe closest to the bulb changes. Describe how it changes.
6. What other factors affect the weather in a region?

EXTENSION

1. Repeat the experiment for other locations in the Northern and Southern Hemispheres.