PRELIMINARY ACTIVITY FOR

Seasons and Angle of Insolation

Have you ever wondered why temperatures are cooler in the winter and warmer in the summer? This happens because the Earth's axis is tilted. The Earth remains tilted as it revolves around the sun. Because of this tilt, different locations on the Earth receive 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 *angle of insolation* is the angle at which the sun's rays strike a particular location on Earth. When the north end of the Earth's axis points toward the sun, the Northern Hemisphere experiences summer. At the same time, the south end of the axis points away from the sun and the Southern Hemisphere experiences winter.

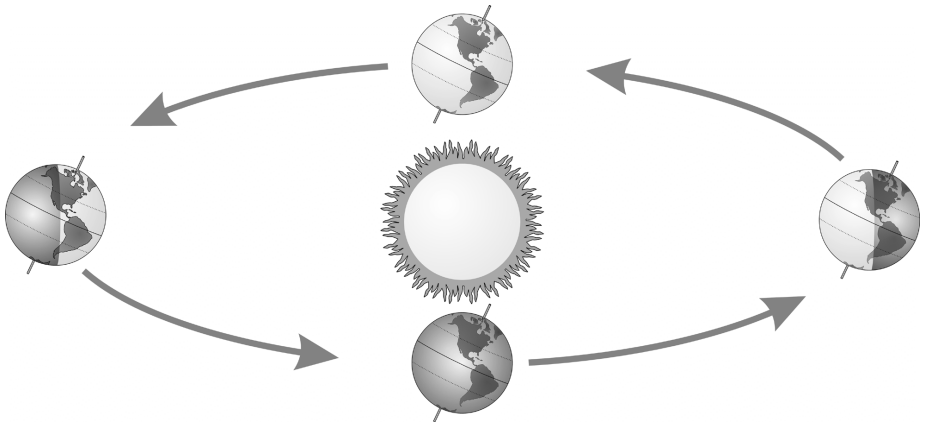

Figure 1

In this experiment you will investigate the relationship between angle of insolation and temperature change due to energy absorption from a simulated sun—a light bulb.

In the Preliminary Activity, you will learn how to position equipment for data collection, learn how to measure angle of insolation, and gain experience using a Temperature Probe.

After completing the Preliminary Activity, you will first use reference sources to find out more about seasons of the year and angle of insolation before you choose and investigate a researchable question. Some topics to consider in your reference search are:

- Seasons
- Solar energy
- Active solar heating
- Passive solar heating
- Solar thermal electric generation

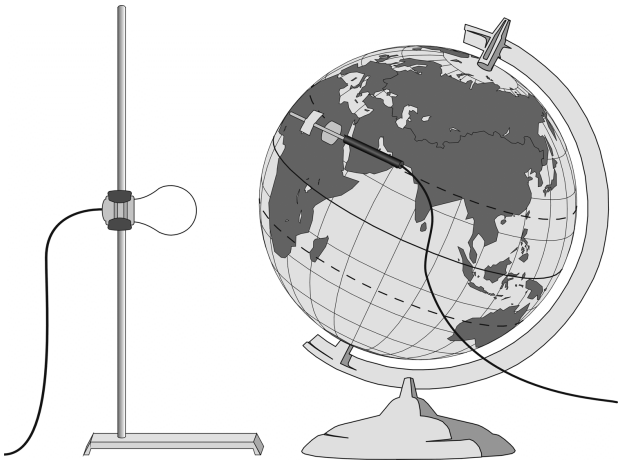

Figure 2

PROCEDURE

1. Set up the light bulb (simulated sun).
   a. Fasten the lamp to a ring stand as shown in Figure 2.
   b. Stand the ring stand and lamp to the left side of your work area.
   c. Position the globe with the North Pole tilted away from the lamp as shown in Figure 2. Position the bulb at approximately 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 it in contact with the surface of the globe as shown in Figure 3.

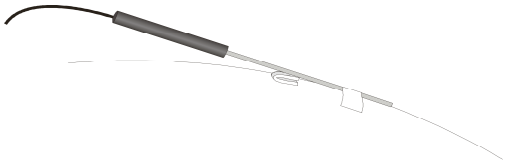

Figure 3

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. Tape the globe in this position so that it does not rotate.
   b. Measure the vertical distance from the Tropic of Capricorn to the table. Position the bulb so that its center is the same height from the table.
   c. Obtain a piece of string 20 cm long.
   d. Use the string to position your location on the globe 20 cm from the center of the end of the bulb.
   e. Do not turn on the lamp until directed in Step 7.

4. Measure the angle of insolation.
   a. Tape the 20 cm string from your location on the globe to the center of the end of the bulb.
   b. Tape another piece of string from the Tropic of Capricorn to the center of the end of the bulb. This string should be taut and parallel to the table. Use only as much of the string as needed.
   c. Use a protractor to measure the angle between the strings.
   d. Record the angle.
   e. Remove the tape and string from the bulb and globe.
5. Connect the Temperature Probe to the interface.
6. Open the data-collection program and set up the program to collect data for 5 minutes.
7. Collect winter data.
   a. Note and record the displayed temperature.
   b. 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.

   Caution: Do not touch the bulb. It will be very hot.

QUESTIONS

1. What was the initial temperature in the Preliminary Activity? The final temperature?

2. Calculate the temperature change.

3. What is the angle of insolation at your location on the first day of winter?

4. How would the setup be changed to model summer data collection at your location?

5. List at least one researchable question for this experiment.