

Name: _____

Date: _____

The Angle of Sunlight and Seasons on Earth

Purpose

This activity will help us collect evidence to answer our focus question: *Why is it warmer in the summer than in the winter?*

The Task

As Earth orbits the Sun, describe what happens to the **angle of sunlight** hitting Earth at different times of the year. Focus your attention on the effect of **Earth's orbit** and **axis tilt**. Be prepared to share your ideas.

Materials

Your small group will need the following:

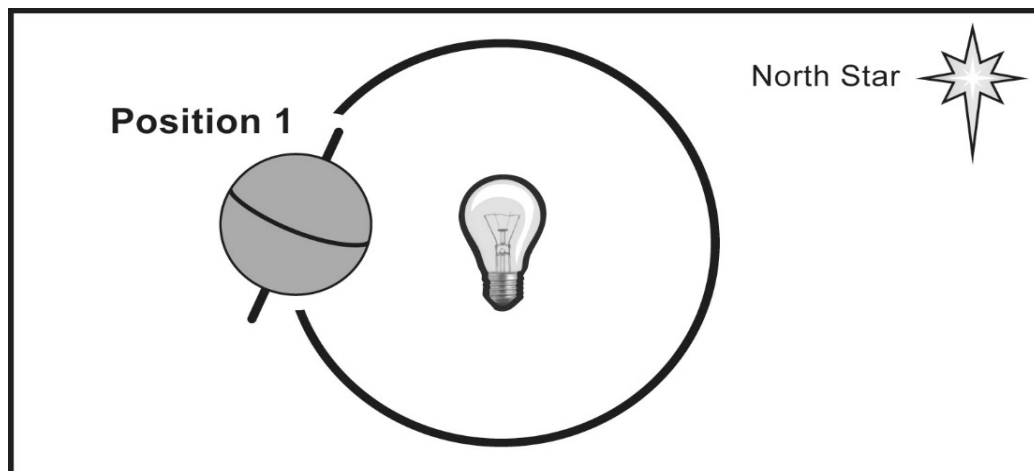
- 1 light setup (lightbulb, socket, plug)
- 1 Hula Hoop (representing Earth's orbit)
- 1 Styrofoam ball on a stick (representing Earth on its axis)
- 1 rubber band (representing Earth's equator)
- 1 pushpin (to show where we are on the globe)
- 1 stand (to keep Earth's axis tilted at 23.5°)

Each of you will need these materials:

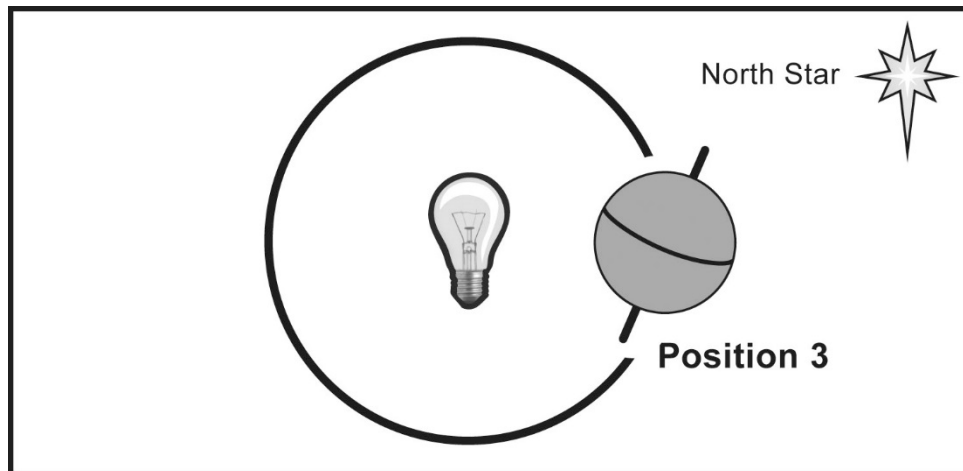
- Handout 2.1: Angles of Light Energy (from lesson 2a)
- Handout 2.3: The Sun's Incoming Energy (from lesson 2b)
- Handout 4.2: Sun's Incoming Energy with Tilt—Position 1
- Handout 4.3: Sun's Incoming Energy with Tilt—Position 3
- Handout 4.4: Data Table—Number of Sun's Incoming Rays by Season at Different Latitudes
- Your science notebook

Directions

1. Place your Styrofoam ball (Earth) in position 1 of its orbit around the Sun so that the North Pole points **toward** the Sun and the North Star with a 23.5° tilt.



- a. Place handout 4.2 (The Sun's Incoming Energy with Tilt—Position 1) on the table next to your model of Earth. Notice that just like your model, Earth in the diagram is tilted at 23.5° so that the North Pole points **toward** the Sun and the North Star.
 - b. Count the number of lines of solar radiation hitting Earth's surface at the following latitudes and record the numbers on your data table (handout 4.4):
 - Latitude $60-75^\circ$ N
 - Latitude $30-45^\circ$ N
 - Latitude $0-15^\circ$ N
 - Latitude $0-15^\circ$ S
 - Latitude $30-45^\circ$ S
 - Latitude $60-75^\circ$ S
2. Now place your model of Earth in position 3 of its orbit. The North Pole is still pointing toward the North Star, but now it's also pointing at a 23.5° angle **away** from the Sun, and the South Pole is pointing **toward** the Sun.



- a. Place handout 4.3 (The Sun's Incoming Energy with Tilt—Position 3) on the table next to your model of Earth. Notice that just like your model, Earth in the diagram is tilted at 23.5° so that the North Pole points **away** from the Sun but still points **toward** the North Star. (Where is the South Pole pointing?)
- b. Count the number of lines of solar radiation hitting Earth's surface at the following latitudes and record the numbers on your data table (handout 4.4):
 - Latitude $60-75^\circ$ N
 - Latitude $30-45^\circ$ N
 - Latitude $0-15^\circ$ N
 - Latitude $0-15^\circ$ S
 - Latitude $30-45^\circ$ S
 - Latitude $60-75^\circ$ S

Discussion Questions

1. Where is the Sun's light energy (solar radiation) hitting Earth's surface straight on when Earth is in position 1 of its orbit? (**Think:** Is it at the equator?)
 - a. Which hemisphere experiences summer in position 1?
 - b. Which hemisphere experiences winter in position 1?
 - c. Use your data to explain why it's summer in one hemisphere and not the other.
2. Where is the Sun's light energy hitting Earth's surface straight on when Earth is in position 3 of its orbit?
 - a. Which hemisphere experiences summer in position 3?
 - b. Which hemisphere experiences winter in position 3?
 - c. Use your data to explain why it's summer in one hemisphere and not the other.
3. Compare the data on your data table (handout 4.4) with the data you collected in lesson 2b (handout 2.3, The Sun's Incoming Energy). Do the data from these sources show the same intensity of solar radiation at the same latitudes? If not, where do you observe differences between the data?
4. What do you think is the reason for the differences in your data? (Think about the differences between the diagram from handout 2.3 in lesson 2b and the diagrams from handouts 4.2 and 4.3 for this lesson.)
5. Use the data from handout 4.4 (Data Table: Number of Sun's Incoming Rays by Season at Different Latitudes) to answer today's focus question: *Why is it warmer in the summer than in the winter?*