Energy Angles

Purpose

This activity will help us answer our Unit Central Question:

- Why are some places on Earth hotter than others at different times of the year?

Team Task

Investigate the scientific question:

- What causes the average temperatures on Earth near the equator to be higher than the average temperatures on Earth far from the equator?

During the investigation, describe what happens to light when it shines on graph paper at different angles. Be prepared to share your ideas.

Materials

1 tray	1 pair of scissors
2 pieces of graph paper	tape
1 flashlight	1 pencil
1 ruler	your science notebooks

Directions

Part 1

1. Tape one piece of graph paper to the tray.
2. Decide who will hold the flashlight and who will hold the tray.
3. To investigate what happens to light that shines at different angles onto a surface, do these things:
    a. Hold the flashlight so the light is about one foot from the tray that is held by your partner. (Use your ruler to check the distance.)
    b. Point the flashlight horizontally and directly toward the graph paper. Hold the tray straight up and down, directly in front of and perpendicular to the flashlight.

c. Turn on the flashlight. Observe the shape and size of the light image and describe it to your partner.

d. Trace around the pattern of light. (The person holding the tray should trace the pattern without moving the position of the tray. Take your time!)

e. Cut out the pattern shape image and label it “straight on.” (Write the label on the back of the cutout image.)

f. Next, tape a new piece of graph paper to the tray.

g. Then, tip the tray **down** so the light shines on the graph paper at an angle or a slant. Remember to hold the flashlight horizontally about one foot from the tray at all times. (Use your ruler to check the distance.)

h. Observe the shape and size of the light image and describe it to your partner.

i. Trace the new pattern of the light. (Remember to take your time to be as accurate as possible.)

j. Cut out this pattern shape image and label it “at an angle.” (Write the label on the back of the cutout image.)

k. Now, tip the tray at different angles and observe what happens to the light. (You do not need to record these images. Just notice what happens to the light when you have less of a slant—less of an angle—and more of a slant—a greater angle.)

4. Talk about these questions with your partner.

   a. How does the image of the light on the paper change when you tip the tray?

   b. Do you observe any difference in the brightness of the light coming from the flashlight? Describe your observations.

   c. Do you observe any difference in the brightness of light hitting the surface of the paper? Describe your observations.

Part 2

1. Set the images side by side and compare them.
    a. Which image is bigger: “straight on” or “at an angle”?
    b. Which one is smaller: “straight on” or “at an angle”?
2. Now, count the number of squares on each of the images.
    a. On each image, write the number of squares that the light covered. (Do not count any partial squares, only whole squares.)
    b. Which image covers the most squares?
3. Put away all your supplies except for the two images of the light patterns on graph paper.
4. Let your teacher know that you are ready to post the images you cut from the graph paper.
5. Begin your Analogy Map to help you connect the Energy Angles activity to the real world. How is the model we used like the real world, and how is it different?

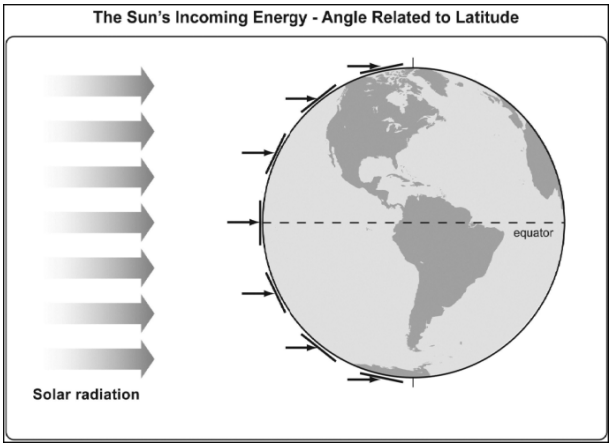
Analogy Map

Part of the model		Part of the real world	They are alike because	They are different because
	... is/are like …			

_____ WAIT FOR INSTRUCTIONS TO GO ON TO PART 3 _____

Part 3

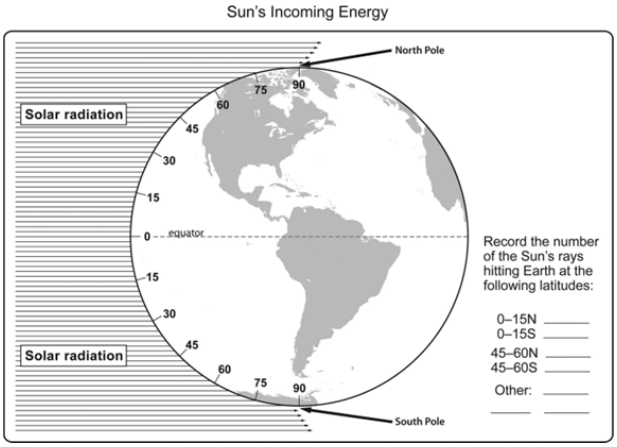
1. With your partner, review the Sun's Incoming Energy—Angle Related to Latitude diagram. Use your Analogy Map to make connections between this diagram and your flashlight-tray model. On the diagram below, label the model parts.



2. With your partner, review the *Sun's Incoming Energy* handout. The numbers along the edge of the diagram of Earth represent lines of latitude. The lines of latitude between the equator and the North Pole are north latitudes, and the lines of latitude between the equator and the South Pole are south latitudes.

    a. How many light rays hit Earth's surface at the latitudes closest to the equator? Write the number in the space on your handout.

    b. Count the number of light rays hitting Earth's surface at the other latitudes and record the latitude and number on the space on your handout.

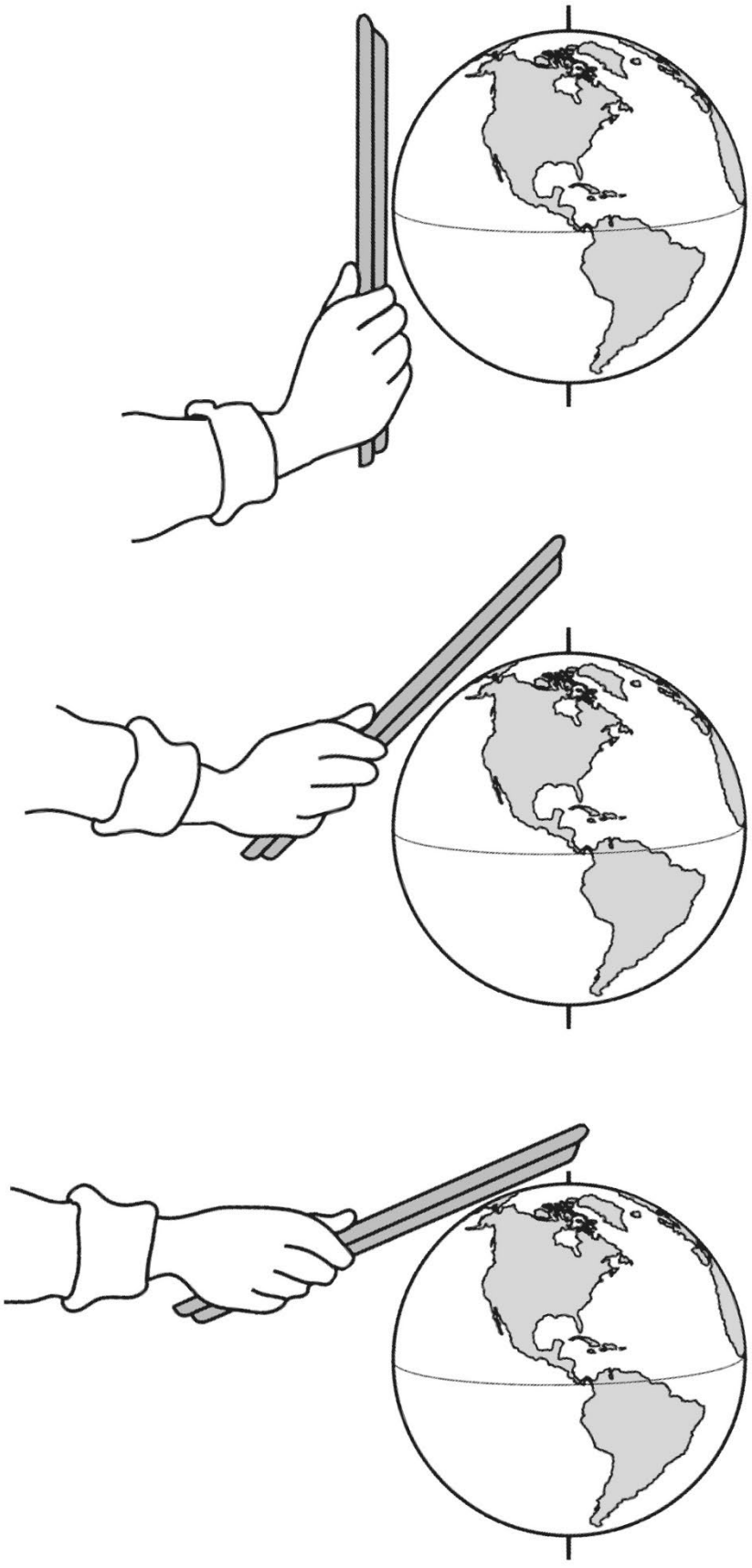


3. What pattern do you notice in the numbers you have recorded? Where on Earth is the Sun's light energy more concentrated? What is your evidence? Where on Earth is the Sun's energy more spread out? What is your evidence?

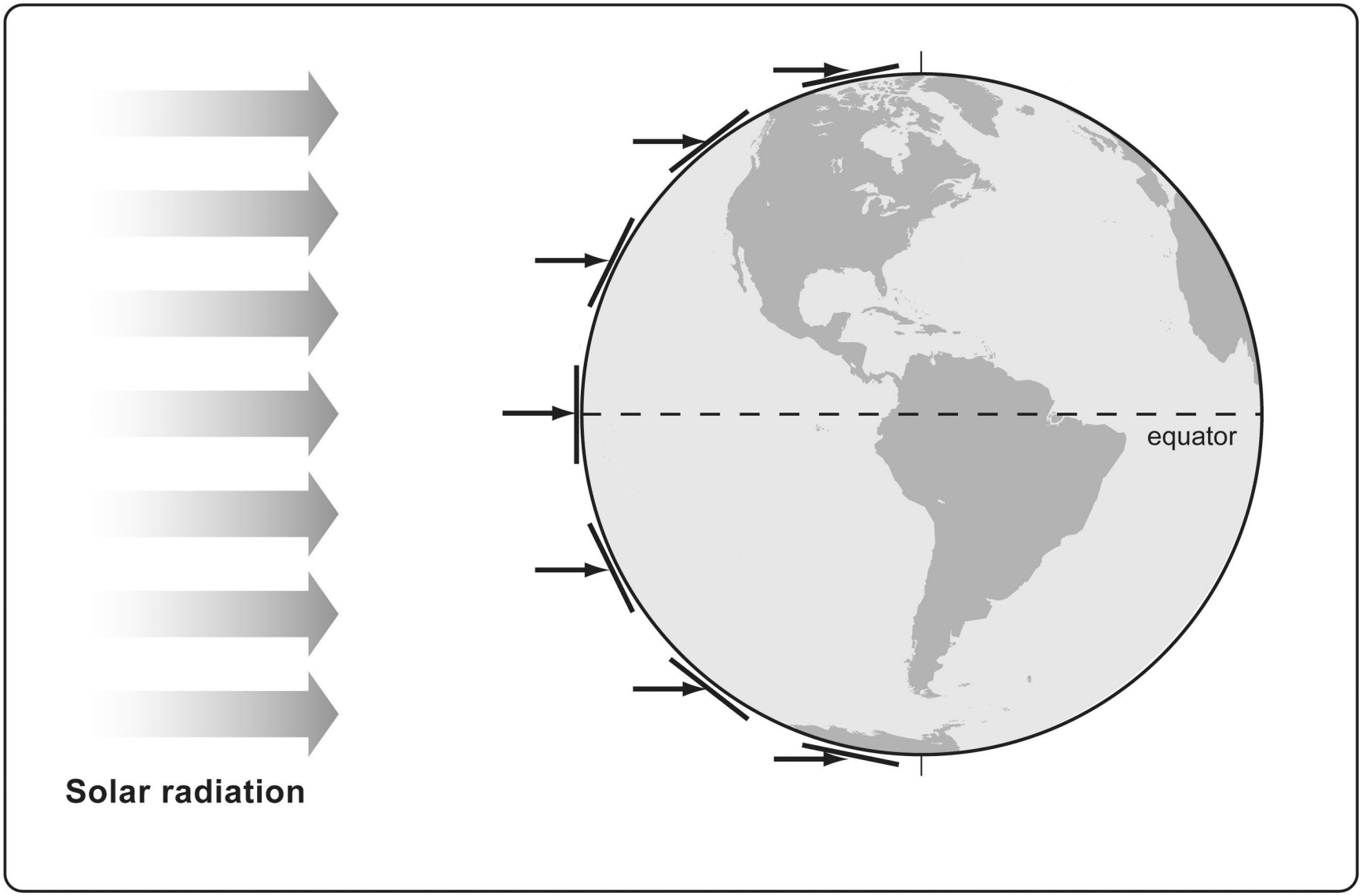
4. Think about this question: How does the number of the Sun's rays hitting Earth's surface connect to the activity you did with the flashlight? Use what you learned from these activities to answer the Lesson Focus Question: What causes the average temperatures on Earth near the equator to be higher than the average temperatures on Earth far from the equator?

Activity adapted from BSCS. (1999). *Investigating Weather Systems*. Dubuque, IA: Kendall/Hunt Publishing.

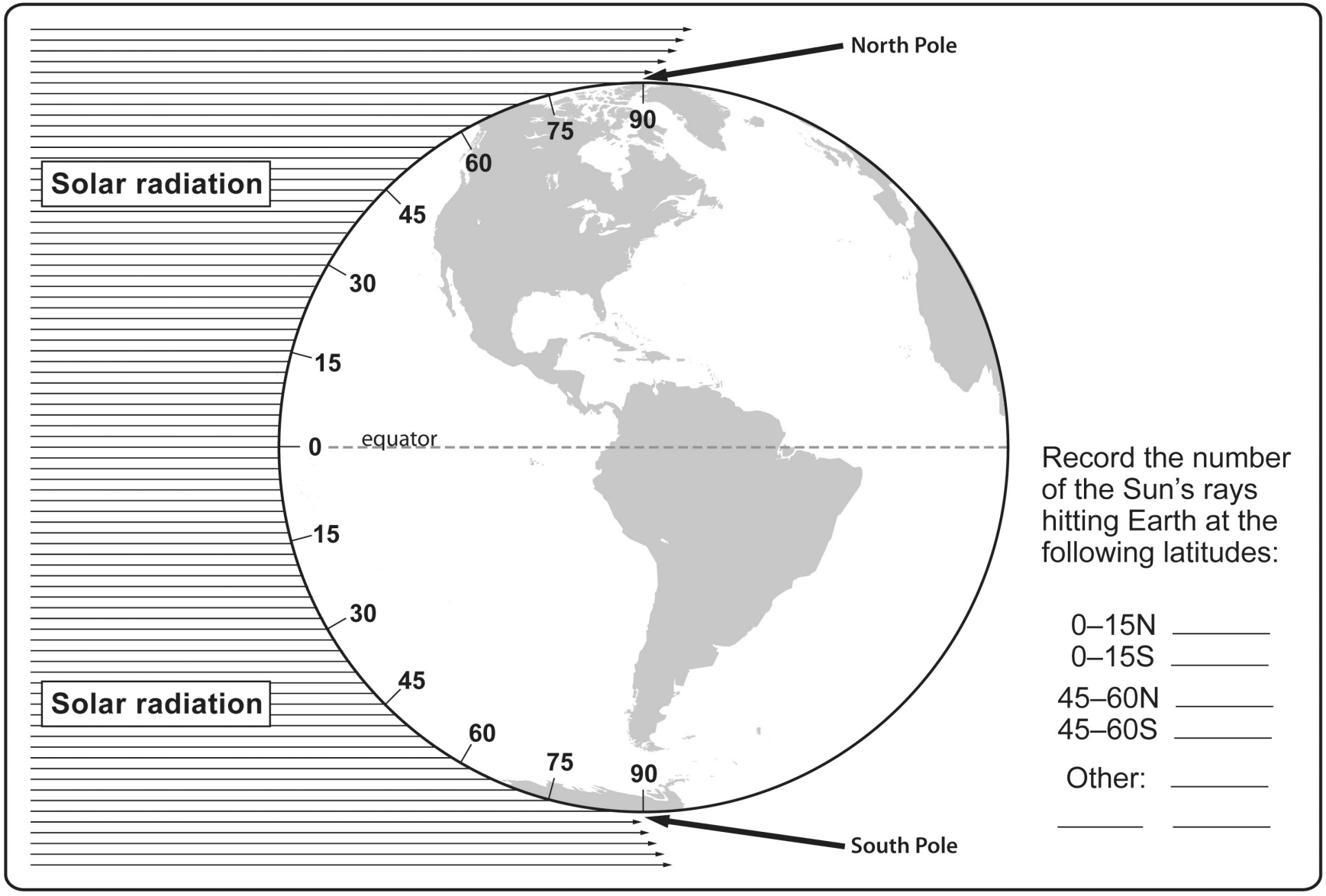
Tray and Globe Example



The Sun's Incoming Energy - Angle Related to Latitude



Sun's Incoming Energy



Record the number of the Sun's rays hitting Earth at the following latitudes:

0–15N _____
0–15S _____
45–60N _____
45–60S _____
Other: _____
_____ _____

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