

LESSON
13

Why is it hotter at the equator than other places on Earth?

**STEP 1: Observe patterns in average annual temperatures.**

Look closely at the World Average Temperatures slide.

1. Where are temperatures cooler?
2. Where are they warmer?
3. What patterns do you notice?

Draw and write your answers to the questions above on the map below.



Record your ideas about why it's hotter at the equator than other places on Earth.



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STEP 2: Observe energy angles.

Work in groups of three to investigate what happens to light when it shines on graph paper at different angles. Be prepared to share your ideas.

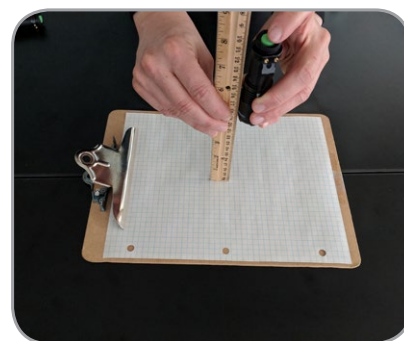
Materials: A clipboard or flat surface, flashlight, ruler, one sheet of graph paper, pencil

What does the flashlight represent in this investigation?

What does the clipboard represent in this investigation?

INSTRUCTIONS:

1. Decide who will hold the flashlight and ruler, who will hold the clipboard, and who will record.
2. Put a piece of graph paper on your clipboard and lay it flat on the table.
3. To investigate what happens to light that shines at different angles onto a surface, follow these steps:
 - a. Turn on the flashlight and hold it directly above the clipboard.
 - b. Adjust the distance between the flashlight and the clipboard so that the light shines entirely on the graph paper, with lots of space around the edges. Use your ruler to measure the distance.
Note: This distance will vary depending on how bright your flashlight is, but try about 4-5 cm and move closer or further away as needed.
 - c. The recorder will trace the edges of the light pattern onto the graph paper. Be sure that the flashlight is pointed straight down when you take this measurement!
 - d. Label this image "straight on."
 - e. Next, tip the clipboard so that the light shines on graph paper at an angle, as shown in the picture at the right. Remember to hold the flashlight the same distance from the clipboard as you did when taking the "straight on" measurement (Use your ruler!). Again, be sure that the flashlight is pointing straight down towards the table like it was when you made the "straight on" measurement.
 - f. The recorder should trace the new pattern of light on the graph paper.
 - g. Label the new image "tilted."
 - h. Now, tip the clipboard 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) versus more of a slant (a greater angle).



STRAIGHT ON



TILTED



DISCUSS WITH YOUR GROUP:

- Describe how the pattern of light changes when the clipboard changes from flat to angled.
- Do you observe any difference in the brightness of the light?
- Think about the amount of light energy from the flashlight that reaches any particular square on the graph paper. How does this change when you change the angle of the clipboard?

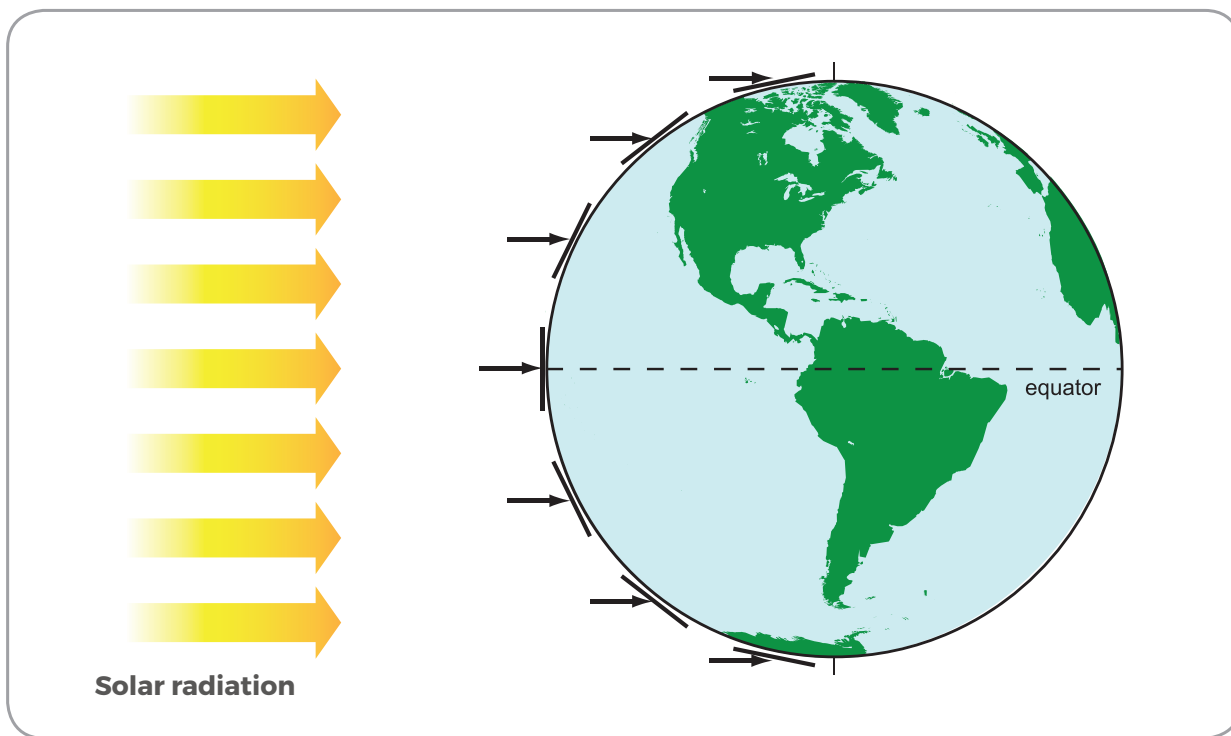


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STEP 3: Think about the Sun's incoming energy.

Use the image below to think about where solar radiation (sunlight) is more direct and where it is more spread out on Earth's surface. Then answer the questions below.

THE SUN'S INCOMING ENERGY - ANGLE RELATED TO LATITUDE



1. Which area receives more concentrated sunlight? What is your evidence?
2. Which area receives less concentrated sunlight? What is your evidence?
3. How does the concentration of sunlight affect temperatures? Which areas are hotter? Which areas are colder?



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STEP 4: Analyze temperature and latitude.

Your teacher will provide you with graphs of daily maximum temperature. Students at schools in Finland, Vermont (US), Arizona (US), Saudi Arabia, and Sri Lanka collected these data. Work with your group to match the graphs with the location where you think that data was collected. Use the clues below to help you decide how graphs and locations match:

CLUE 1: Seasonal differences are stronger at higher latitude (further from the equator). At or near the equator there is usually no seasonal difference in temperature.

CLUE 2: Temperatures are warmer at low latitude (close to the equator) than at high latitude (far from the equator).

	GRAPH (letter)	LOWEST MAXIMUM TEMPERATURE	HIGHEST MAXIMUM TEMPERATURE	DIFFERENCE IN TEMPERATURE (highest minus lowest)
Finland				
This is why I think Finland matches this graph:				
Vermont, US				
This is why I think Vermont matches this graph:				
Arizona, US				
This is why I think Arizona matches this graph:				
Saudi Arabia				
This is why I think Saudi Arabia matches this graph:				
Sri Lanka				
This is why I think Sri Lanka matches this graph:				