

# Hot Equator, Cold Poles

Why is Ecuador so hot and Antarctica so cold?

## Description

Use thermometers and a lamp to investigate why some places on Earth's surface are much hotter than others.

Age Level: 10 and up



## Materials

- three thermometers
- incandescent lightbulb and lamp, 40 W preferred
- clay
- paper and pencil
- watch or timer
- ruler
- masking tape
- calculator

The thermometers need to read from roughly  $15^{\circ}\text{C}$  to  $45^{\circ}\text{C}$  and be the long, slender glass or plastic type shown in the image above. If you have only one thermometer, you can still do the experiment.



## Time

Preparation: 5 minutes

Activity: 25 minutes

Cleanup: 5 minutes

## Safety

Since you will be using an incandescent bulb that can get very hot, be careful not to touch the bulb or get it near objects that could be damaged by the hot bulb.

## Step 1

Place the lamp on a table, with the bulb oriented down. The bottom of the bulb should be about 20 cm from the table. Do not turn on the lamp yet.

### Tip

A 40 W lightbulb works great. If you use a brighter bulb, you may need to increase the distance from the bulb to the table, so the bulb doesn't melt or damage anything.



## Step 2

Form a piece of clay about the size and shape of your finger, and stick it along the edge of your table.



## Step 3

Create three masking tape labels—A, B, and C—one for each thermometer. Stick the three thermometers into the clay, so the middle of each thermometer is at the edge of the table. Thermometer A should be vertical, B at an angle of about 45 degrees, and C lying flat on the table.

### Tip

Make sure the middle of each thermometer is lined up at the edge of the table.



## Step 4

Make a data table on a sheet of paper, or use the one on the right, to record your data in the format shown here. Predict which thermometer will heat up the most by the time the lamp is on for 10 minutes. Take the initial temperature reading for each thermometer and record the values in your data table.

### Tip

In your data table, circle the thermometer that you think will heat up the most after 10 minutes.

Thermometer	Original Temp	Final Temp	Change in Temp
A Vertical			
B Angled			
C Flat			

## Step 5

Turn on the lamp. After the lamp shines on the thermometers for 10 minutes, record the final temperature of each thermometer.

### Tip

If you are using a very bright lightbulb, be sure that the thermometers and table under the lightbulb do not get too hot!



## Step 6

Find the change in temperature for each thermometer. Which thermometer heated up the most? Which one heated up the least?



## Step 7

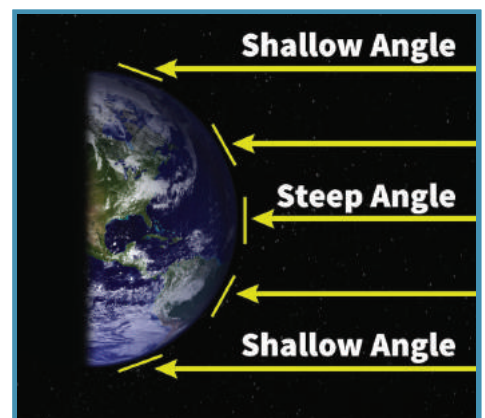
The three thermometers represent places on Earth's surface where sunlight hits at different angles. What regions on Earth do the flat, angled, and vertical thermometers represent?



## What's Going on?

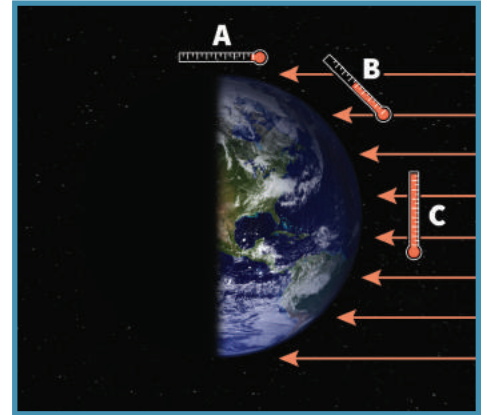
Places near Earth's equator (like Ecuador and Singapore) are warm, while places near the poles (like Antarctica and Greenland) are cold. Why is this true?

At the equator, the Sun's light hits Earth nearly straight on (at a steep angle). If you were at the equator at noon, the Sun would be close to directly overhead. The sunlight would be very intense and cause a lot of heating. If you were in Antarctica at noon, the Sun would never be directly overhead. Instead it would always be low in the sky, near the horizon. The sunlight would be striking Earth at a low angle, not causing much heating.



## Hottest thermometer?

The thermometer that got the hottest after 10 minutes should have been thermometer C, which was lying flat on the table. That's because the entire thermometer was receiving light from the lamp, which heated it up the most. (Think of the area along Earth's equator, where sunlight hits nearly directly.) The smallest change in temperature should have been thermometer A, which was propped up vertically. Only the top of that thermometer had light shining on it, so it didn't heat up much at all. (Think of the area near Earth's poles, where not much sunlight falls on Earth's surface.)



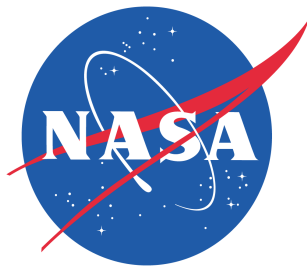
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## Credits



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