Solar radiation versus latitude: Teacher Guide

Level: Beginning

Subject: Geography

Duration: 40 minutes

Type: hands-on classroom activity

Learning goals:

- Define; Solar radiation, Latitudes and Equator.
- To find out the amount of solar radiation received near the poles as compared to the equator.
- To find out how latitudes affect the amount of solar radiation received at a point.

Materials:

- Globe
- Torch
- Tape Measure or Ruler
- Pencil
- Flat platform
- Stand

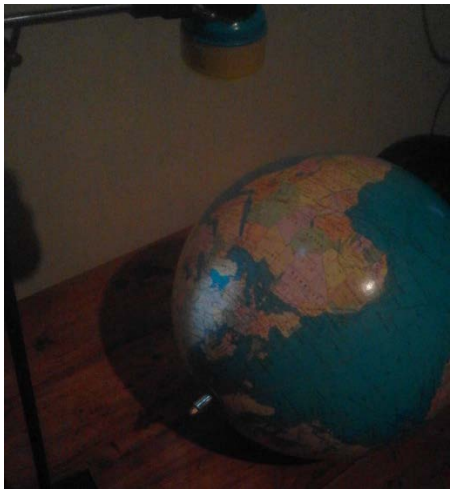
Methods:

Detailed step-by-step directions with pictures are also included in this power points for further instructions:

- Place the globe on a flat platform, preferably a table. Be sure to locate the position of the equator and the Polar Regions.
- With the help of the stand, light the torch and direct the beam of light so that it is at right angle to any point of equator.

- Notice that the light on the globe is circle. Measure the width of the beam of light and write it down (this is the same as the diameter of the circle of light).


- Now, direct the beam of light to any point near the North Pole. Notice that the shape of the light area is now an ellipsoid instead of a circle. Measure the width of light in both directions (the short direction and the long direction)




Calculations:

We measure the width of the beam of light near both the equator and the poles. To calculate the amount of light received per area, we divide the amount of light from the torch by the area the beam covers on the surface of the globe. Since it is hard to get the amount of light produced by the torch, it is preferred to use 100% as the amount produced by the torch. The area of the light can be calculated using the formula for either a circle (at the equator) or an ellipse (at the poles). The formula for the area of a circle is $A=\pi*(D/2)^2=3.14*(D/2)^2$ where D is the length/diameter of the beam of light. For an ellipse, the area is found using the formula $A=\pi*(D_1*D_2)$ where D_1 is the length of the beam of light in the long direction and D_2 is the length of light in the short direction.

Amount of light per area = amount of light produced by the torch / (area light on the surface of the globe). Assume that the amount of light produced by the torch is 100%.

$$L=T/A$$

- L is the amount of light per unit area
- T is light produced by the torch (100%)
- A is the width of the beam of light produced by the torch

Results:

At the Equator, the diameter of light measured was _____ cm. The shape of the light was a (circle one: circle or ellipse) so to find the area of the light on the globe we used the formula $A=\pi*(D/2)^2$. Using the formula to calculate the light per unit area available, we found that the equator received _____ % of the light coming from the flashlight per unit area.

At the Poles, the length of light measured was _____ cm in the long direction and _____ cm in the short direction. The shape of the light was an (circle one: circle or ellipse) so to find the area of the light on the globe we used the formula $A=\pi*(D_1*D_2)/4$. Using the formula to calculate the light per unit area available, we found that the equator received _____ % of the light coming from the flashlight per unit area.

In this exercise, we found out that the equator receives about _____ times more sunlight per unit area than the poles.

[Answer from the example photos in this lesson plan: At the Equator, the diameter of light measured was 8 cm. The shape of the light was a circle so to find the area of the light on the globe we used the formula $A=\pi*(D/2)^2$. Using the formula to calculate the light per unit area available, we found that per unit area that the equator received 2% of the light coming from the flashlight.

At the Poles, the length of light measured was 8 cm in the long direction and 4 cm in the short direction. The shape of the light was an ellipse so to find the area of the light on the globe we used the formula $A=\pi*(D_1/2*D_2/2)$. Using the formula to calculate the light per unit area available, we found that per unit area the equator received 1% of the light coming from the flashlight.

In this exercise, we found out that the equator receives about 2 times more sunlight per unit area than the poles.]

Solar Radiation vs. Latitude: Student Worksheet

Define solar radiation:

_____

_____

What are the units for solar radiation?

_____

_____

Describe latitude:

_____

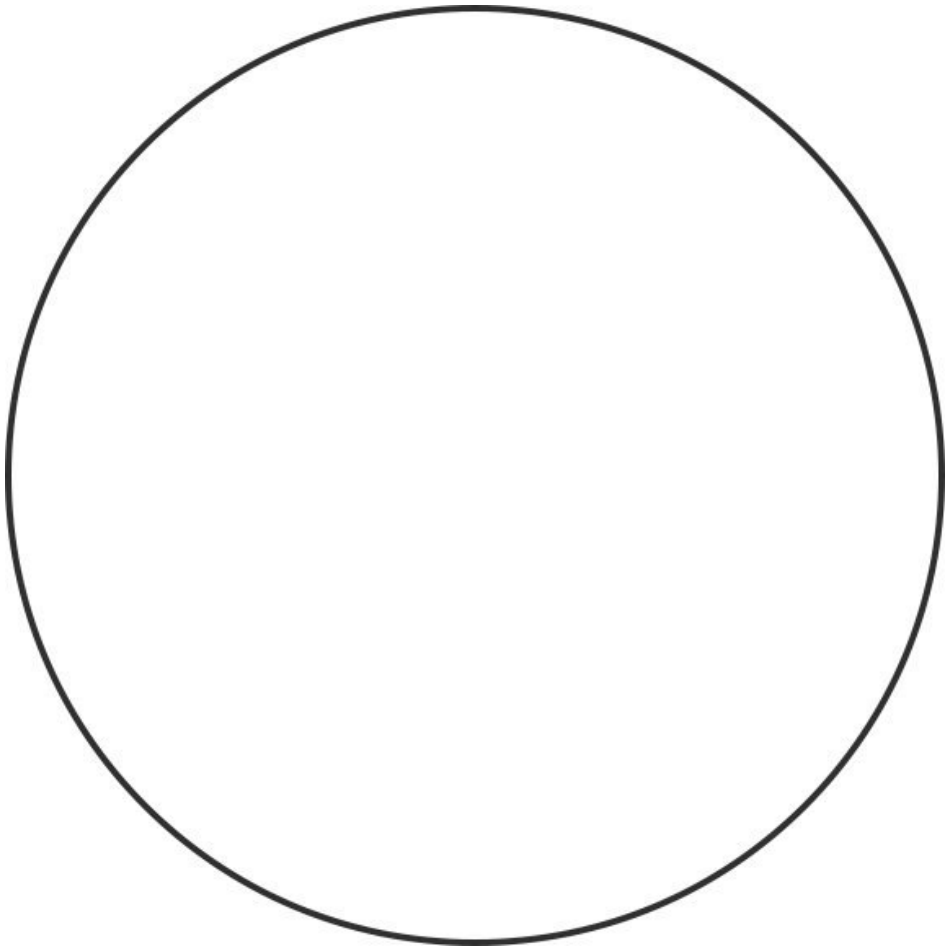
_____

What latitude is the equator?

_____

With the help of a pencil and a ruler, draw and label the following on the globe provided below.

- Equator
- Tropic of cancer
- Tropic of Capricorn
- North Pole
- South Pole



Calculations:

Calculate the amount of light received at both the equator and the poles per unit area covered by the light as follows;

$$L=T/A$$

Where,

L is the amount of light per unit length

T is the light produced by the torch (100%)

A is the width of the beam of light produced by the torch

Results:

At the Equator, the diameter of light measured was _____ cm. The shape of the light was a (circle one: circle or ellipse) so to find the area of the light on the globe we used the formula $A=\pi*(D/2)^2$. Using the formula to calculate the light per unit area available, we found that the equator received _____ % of the light coming from the flashlight per unit area.

At the Poles, the length of light measured was _____ cm in the long direction and _____ cm in the short direction. The shape of the light was an (circle one: circle or ellipse) so to find the area of the light on the globe we used the formula $A=\pi*(D_1*D_2)/4$. Using the formula to calculate the light per unit area available, we found that the equator received _____ % of the light coming from the flashlight per unit area.

In this exercise, we found out that the equator receives about _____ times more sunlight per unit area than the poles.

Based on the results in the table above, which part of the globe receives a high amount of solar radiation?

_____

_____

Does knowing the amount of solar radiation that a latitude receives help us understand the climate in different regions? Why is it cold and snowy at the poles but hot at the equator?

_____

_____

_____

_____

_____