**Activity:** Sun Angle and Radiant Energy

**Subject:** Direct Versus Indirect Suns Rays, Earth Science

**Time Required:** 30-40 minutes

**Groups Size:** 2-3 students in each group

**What you will investigate:**

In this lab, you will investigate and measure how sunlight is distributed on the earth’s surface in different seasons, illustrating that the seasonal temperature variation has nothing to do with the distance from the earth to the sun, and everything to do with how much direct sunlight a region gets. You will be able to observe how direct sunrays deliver considerably more energy to the earth’s surface than indirect rays.

**Safety Precautions:**

* Do not look directly into bright overhead projector light.
* Take precautions not to get burned on hot overhead projector surfaces.

**Objectives:**

* Model Earth’s position with respect to the sun during summer and winter in the northern hemisphere.
* Calculate the area of the grid square projected onto the globe.
* Compare and associate the area of the grid square with the amount of energy received by the earth’s surface.

**Learning Goals:**

* Understand that seasons are not caused by the earth’s orbit taking it closer to the sun
* Understand that seasons are not caused because the earth tilting toward the sun means that one hemisphere is “closer” to the sun than the other
* Understand that a region that gets more direct sunlight is hotter than a region which gets sunlight at an angle, and this is the reason for the seasons, as well as the reason the equator is hot and the poles are cold

**Materials:** Each station will need the following:

Globe of the Earth (preferably one on which marks can be made and erased)

Dry erase marker, wax pencil or crayon

Overhead projector

Transparency with grid squares (1 cm or ½ cm size works well)

A darkened room is helpful

**Procedure:**

1. Gather all materials needed and read through procedure steps before you begin to perform this activity.
2. Place the globe about 1-1.5 meters from the projector. NOTE: It will be helpful to place projector on a chair and globe up on a table, as the different height levels will allow for better focus of the grid squares onto the globe.
3. Place grid transparency onto projector and turn on the projector, focusing the grid squares onto the globe.
4. Position the globe so that the northern hemisphere is tilted away from the projector in the Winter Solstice position (Dec. 21st, 2012 at 4:12pm MST).
5. Focus the projector so the grid lines appear clearly on the front of the globe. In this position the smallest grid squares should appear directly over the Tropic of Capricorn (southern hemisphere). This location is the sun’s most direct rays striking the earth’s surface.
6. Using a non-permanent dry erase marker or crayon, trace around the smallest square at the Tropic of Capricorn and another square directly North of the first square over Nebraska. Over Nebraska the light, representing the sun’s rays, are not as direct and are striking the earth’s surface at an angle.
7. Calculate the areas of these two different “squares” and record on the data table under “Nebraska Winter Solstice”
8. Next, position the globe so that the northern hemisphere is tilted toward the projector in the Summer Solstice position (June. 20th, 2012 at 5:09 pm MST).
9. Focus the projector so the grid lines appear clearly on the front of the globe. In this position the smallest grid squares should appear directly over the Tropic of Cancer (northern hemisphere). This location is the sun’s most direct rays striking the earth’s surface.
10. Using a non-permanent dry erase marker or crayon, trace around the smallest square over Nebraska and another square directly South of the first square over the Tropic of Capricorn.
11. Calculate the areas of these two different “squares” and record on the data table under “Nebraska Summer Solstice”.

**DATA TABLE: Area of grid square on globe**

|  |  |  |
| --- | --- | --- |
|  | Nebraska | Tropic of Capricorn |
| Winter Solstice | cm2 | cm2 |
| Summer Solstice | cm2 | cm2 |

**Conclude and Apply:**

1. How do the areas of the squares over Nebraska compare between summer and winter solstices? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How do the areas of the squares over the tropic of Capricorn compare between summer and winter solstices? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Describe which size of square on the globe represent more direct light and which size of square on the globe represents indirect light. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. The projector light represents the sun shining on Earth. If the projector shines onto a flat surface, such as a wall, how would the size of the grid squares compare with one another? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. After forming a hypothesis, test the hypothesis by shining the projector on a wall at a distance equal to that of the globe from the projector. NOTE. Do not adjust the focus on the projector, merely move the projector closer to, or farther from the wall to get clear lines on the wall.
6. The grid squares of equal size on the transparency represent a certain amount of energy. When the grid transparency shines on a flat surface each square receives an equal amount of radiant energy spread over an equal area. When the grid transparency shines on a curved surface, such as a globe the same amount of energy for each grid square is spread over a different area depending on the part of the globe the square falls. How are direct and indirect sunrays related to summer and winter seasons on Earth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_