Solar Radiation and Warming Temperatures

Driving Question: What impacts our local climate?
Synopsis: In this activity, students will explore how seasons influence their local climate.
Rationale: This activity seeks to teach students how solar radiation impacts individual regions, including their local area. Using this knowledge, they will have a greater understanding of how to determine the amount of heat or warming that occurs in an area.
Materials: Large Globe
Flashlight
Source: Quoted and adapted from Seasons by Stanford STAR lab http://www-star.stanford.edu/projects/mod-x/ad-globe.html

Procedure

EXPLORE

Task – Seasonal Changes in Radiation (from Seasons by Stanford STAR lab http://www-star.stanford.edu/projects/mod-x/ad-globe.html)

1. Tell students that today they will be learning how seasons work and how it impacts their climate and weather.
2. Ask the students: "How many seasons are there? What are they called? When do they begin and end? What are the signs that the season is going to begin or end (i.e flowers bloom)? What controls the seasons?"
3. Explain while many things happen during a season, what causes all weather change is the sun.
4. Tell students the flashlight represents the sun. Explain how Earth moves around the sun.
5. Turn off the lights in the classroom.
6. Have one person hold a globe with the rotation axis tilted like the rotation axis of the Earth. The amount of this tilt is 23.5 degrees.
7. Have a second person illuminate the globe with a flashlight.
8. Making sure not to change the orientation of the globe with respect to the rest of the classroom, have the first person carry the globe slowly in a circle around the flashlight. As the globe is carried around the circle, the person with the flashlight should continue to illuminate the globe directly. If viewed from above, the globe should be carried counter-clockwise around the circle because that is the direction which all the planets orbit the Sun.
9. Observe how the tilt of the axis changes with respect to the flashlight over the course of an "orbit." At one point during the orbit, the North Pole should be tilted toward the "Sun" and at one point during the orbit the South Pole should be tilted toward the "Sun." Observe that the Sun never shines directly on the Poles, however.
10. Have the first person make one more orbit around the Sun, but this time have that person spin the globe around its rotation axis while orbiting the Sun. Make sure not to change the orientation of the rotation axis while the globe is spinning. Also, remember that Earth makes many (365) rotations for every revolution around the Sun. Observe that the seasons do not change because the globe is spinning, but

that the length of the day (amount of daylight) in each hemisphere does change over the course of an orbit around the Sun.

11. Ask the students to raise their hands if they think that based on what they saw in the demonstration the extreme heat of summer and the icy cold of winter have something to do with how close Earth is to the Sun.
12. Explain that the Earth's orbit is almost *circular* around the Sun, so there is very little difference in the distance from Earth to the Sun throughout the year.
13. Ask the students if it's not the distance from the Sun, what are the reasons for the seasons?
14. Explain that one big part of the answer is that Earth is *tilted* on an axis. To explain an axis, use the globe and tell them to picture an imaginary stick going through the north and south poles of Earth. Earth rotates about this axis every 24 hours. However, this axis isn't straight up and down as Earth goes through its orbit about the Sun. Instead, it is tilted approximately 23 degrees and is always pointing in the same direction, as Earth goes through its orbit around the Sun. It is this tilt that changes how the sunlight hits Earth at a given location.
15. Demonstrate with the flashlight and globe that when it is summer in North America, the top part of the axis (the north pole) points in the direction of the Sun, and the Sun's rays shine *directly* on North America; while in South America, the axis is tipped *away* from the Sun and the Sun's rays hit Earth on a *slant.*
16. Ask the students the following questions:
    a) Which point in the orbit corresponds to the summer in the Northern Hemisphere (upper half of the globe)? Why does the Sun shine 24 hours a day at the high Northern latitudes (near the Arctic) during the Northern summer?
    b) Which point in the orbit corresponds to the winter in the Northern Hemisphere (upper half of the globe)? Where is there 24 hours of sunlight when the Northern Hemisphere is having winter? What season is it there?
    c) Why is it winter in one hemisphere while it is summer in the other?
    d) Why is the weather hottest is summer time and coldest in winter time?
    e) Why is it so warm in the tropics (around the middle of the globe)? Is there a place that it is always cold?