Activity: Two Reasons for the Seasons

(Adapted from Meteorology, NSTA Publications)

Lesson Summary

Slanted light does not heat objects as quickly as direct light. Due to the differential heating of the Earth's surface, it is always warmer at the equator than at the poles. Because the earth is a sphere, the sun's light hits the equator almost directly and in a gradient of slant from the equator to either pole.

Ohio Standards Correlations

Standard: Earth and Space Sciences

Grades 3-5 Benchmark A: Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.

Indicator(s)

Grade Five

1. Describe how night and day are caused by Earth's rotation.
2. Explain that Earth is one of several planets to orbit the sun, and that the moon orbits the Earth.
3. Describe the characteristics of Earth and its orbit about the sun (e.g., three-fourths of Earth's surface is covered by a layer of water [some of it frozen], the entire planet surrounded by a thin blanket of air, elliptical orbit, tilted axis and spherical planet.

Standard: Scientific Ways of Knowing

Grades 3-5 Benchmark A: Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained.

Indicator(s)

Grade Five

1. Summarize how conclusions and ideas change as new knowledge is gained.

Grades 3-5 Benchmark B: Describe different types of investigations and use results and data from investigations to provide the evidence to support explanations and conclusions.

Indicator(s)

Grade Five

1. Develop descriptions, explanations and models using evidence to defend/support findings.

Time
2 hours (Can be broken into four thirty-minute sessions)

Materials
Demonstration: large globe which needs to be on the correct tilt, a strong flashlight, black electrical tape to mark the equator on the globe
Student activity 1(per student group): 3 identical Celsius thermometers (glass or metal backed), reflector lamp with clamp and 60 watt bulb, black construction paper, staplers, blocks to use as props, meter stick, scissors, Data Table, Graph paper, stopwatches
Student activity 2 (per student group): three sheets of white cardstock, strong flashlight, centimeter grid paper, protractor, pencils

Background
The reasons for the seasons on earth are one of the most often misconceived concepts. Seasons are influenced by the surface temperature on earth. The surface temperature is determined by two main factors: the length of day and the angle at which the sun's rays hit the surface of the earth. Daylight hours are less in winter and longer in summer. The angle of the sun's rays hitting the earth determines the length of daylight at any given time.

Teacher Tips
The amount of radiant energy absorbed on Earth depends on the number of daylight hours and the incoming angle of solar rays.

Procedures

Getting Started
Pose the question: How does the position of the sun in relationship to the earth influence seasonal change on our planet?

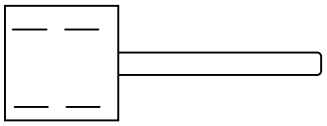
Set up the following demonstration:
1. Set the globe where the entire class can make observations.
2. Identify the equator and circle the globe with the black electrical tape to make it stand out for students.
3. Make sure the globe is tilted to represent the angle of the Earth's axis.
4. Ask for one student volunteer to represent the Sun by holding the flashlight in a fixed location that shines on the globe (Earth).
5. As you spin the globe, the surface area lit by the flashlight will change as it hits the globe at various angles. Have students make observations of how much surface area is lit when the light is focused on the

equator (90°), at a center point of the northern hemisphere (45°), and at the North Pole (0°/180°).

6. This demonstration shows how radiant energy from the sun is diffused as it strikes the earth at different angles thus causing a difference in thermal energy created at the surface. The student activities that follow show both how the surface area changes at each angle as well as how the temperature changes when radiant energy strikes at various angles.
7. Assign students **a Type 1 writing** with the following question.
   Which thermometer do you predict will show the greatest temperature change and why?
8. Further conversation to address the length of daylight at various locations on the Earth due to the positions of the earth and sun at different seasons allow for high temperatures (i.e., Alaska, Iceland, etc. during the summer season) may be necessary.

Doing Science – Activity 1

1. Make 5 cm (approx.2") square pockets to cover the bulb of each thermometer. Cut 5 cm x 10 cm strips of paper, fold and staple leaving one end open. Slip in thermometer. Make 3 covers.



2. Prop thermometers at three angles; 45°, 90°(vertical), and 180° (flat). Make sure the thermometer can be read without touching it during the experiment.
3. Securely attach lamp using clamp so it is **centered 40cm above** the three thermometers.
4. Record the temperature of all three thermometers in the "0" minute column on the data sheet before turning on the lamp.
5. Turn on the lamp and record the temperature for each thermometer every minute for 15 minutes. Be very careful to not move the thermometers when reading the temperatures.
6. When you are finished collecting your data, use the graph paper to create a graph of *temperature versus time* for each thermometer. Plot all three results on the same graph using different colors to show the results from each thermometer. Remember to provide a key for the graph.

Wrapping Up

Questions:

1. What parts of the world/globe are represented by each thermometer?

Type 2:

Using what you have learned from this experiment, why do you think snowfalls of similar amounts melt faster in the spring than in the winter?

Doing Science- Activity 2

1. Provide each student group with white cardstock, flashlight, protractor, cm grid paper, and pencils.
2. Have students hold a piece of cardstock at 45°, 90°(vertical), and 180° (flat). While the paper is at the exact angle, shine the flashlight at the paper from a standard distance of 12". Have a team member draw a line around the perimeter of the light ring on the cardstock.
3. Cut out each of the light surface areas, lay each one on top of the cm grid paper, trace and compute the surface area illuminated.
4. Compare the amount of surface area created by the flashlight at each angle and use the data to make inferences about the relationship between the angle of the sun, the length of daylight and the thermal energy created by the sun's radiant energy.

Wrapping Up

Type 2:

Using what you have learned from this experiment, why do you think snowfalls of similar amounts melt faster in the spring than in the winter?

Name _____

Data Table

Time (min.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Change in Temperature
Thermometer A																	
Thermometer B																	
Thermometer C																	

Type 2 Name _____

Prompt: Using what you have learned from this experiment, why do you think snowfalls of similar amounts melt faster in the spring than in the winter?

X

X

X

X

X

X

X

Centimeter Grid Paper

Notes