Reasons for the Seasons

Reviewing Content

There are two main reasons for the seasons. The first is that Earth is tilted on its axis. This tilt causes sunlight to strike different parts of Earth in different ways. Sunlight hits Earth’s surface most directly near the equator. Near the poles, the sunlight strikes at a very shallow angle. The second reason for the seasons is Earth’s orbit around the sun. As Earth moves around the sun, the north end of its imaginary axis is tilted away from the sun for part of the year and toward the sun for part of the year. As a result, most places on Earth have four distinct seasons: winter, spring, summer, and autumn.

Reviewing Inquiry Focus

Models are often used in science to visualize processes or events that cannot be directly observed. Scientists use such models to make inferences about these processes or events. An inference is a possible explanation that is based on fact or observation. Because we currently cannot actually observe Earth’s orbit around the sun from elsewhere, scientists have made models to study this movement. In this Lab Investigation, you will make a model that will allow you to see how the sun shines on Earth as Earth makes its orbit around the sun. You will be able to make conclusions based on your observations about the seasons that most of Earth experiences.

1. In this investigation, how will you model Earth and the tilt on its axis?

2. How will you model the sun in this investigation?

3. What types of inferences will you be able to make about seasons on different parts of Earth?
Reasons for the Seasons

Problem

How does the tilt of Earth’s axis affect the light received by Earth as it revolves around the sun?

Materials

books
flashlight
grid transparency
pencil
protractor
toothpick
foam ball marked with poles and equator
marker
metric ruler

Design an Experiment

1. You have probably noticed that during winter, the sun is much lower in the sky and average temperatures are considerably lower than during summer. What is the connection between the angle at which sunlight strikes Earth’s surface and the temperature on Earth’s surface? Imagine that you have to explain this connection to someone who is convinced that winter in the Northern Hemisphere is colder only because the days are shorter and there’s less sunlight in general.

2. Your teacher will provide you with a flashlight and a special transparency with a grid on it. The grid on the transparency will help you visualize what happens to sunlight when it shines on a surface at an angle. You will also be given a foam ball and pencil to make a model of Earth on its axis. The toothpick can be used as an object to cast shadows on the Earth model. You will use the protractor to tilt the Northern Hemisphere both 23.5º away from the sun and 23.5º toward the sun to model sunlight during the different seasons.

3. Gather your materials and design an experiment to determine how the tilt of Earth’s axis affects the way sunlight strikes different parts of the Northern Hemisphere during summer and winter. Consider the following questions as you design your experiment:

   a. When the North Pole is tilted away from the sun, what season is it in the Northern Hemisphere? What season is it when the North Pole is tilted toward the sun?

   b. Using the flashlight, how can the projected pattern of the gridlines on Earth demonstrate what happens when light hits a curved surface at an angle?

   c. How do shadows cast by objects on Earth’s surface help demonstrate the connection between the tilt of the axis, seasons, and higher temperatures on Earth’s surface?
REASONS FOR THE SEASONS continued

4. 🚨⚠️ Use the notepad below to describe your procedure and record your observations. Be sure to include sketches that show how the modified flashlight projects the gridlines onto the Earth model when the model’s axis is tilted away from the source of light and when it is tilted toward it. Have your teacher review your procedure before you begin. CAUTION: Do not shine the flashlight into your eyes or anyone else’s.

Procedure

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Analyze and Conclude

1 **Make Models** Use your model to show that when the North Pole is not tilted toward or away from the sun, sunlight hits both hemispheres equally. How does the distribution of the sun’s rays near the equator differ from the distribution of the rays near the poles? How does this relate to the temperature in these areas? How did your model capture this difference?

2 **Interpret Data** When both hemispheres are receiving the same amount of sunlight, what seasons is Earth experiencing? What is the term that describes this event?

3 **Draw Conclusions** When the Northern Hemisphere is tilted away from the sun, describe what happens to sunlight that strikes the high latitudes in the Northern Hemisphere, and explain how this relates to the arctic climate during winter.

4 **Infer** The lengths of shadows can give some clue about what season it is and how far the object is from the equator. Where on Earth would shadow lengths change the least from season to season? Explain.