WHAT CAUSES THE SEASONS?

Overview

In this activity, students use a model to investigate how the Earth's position determines the seasons.

Objectives

On successful completion of this lesson, students will be able to:

- use scientific models to make observations about the Earth's tilt and orbit; and
- explain how the Earth's position relates to seasonal changes.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[3] SA1.1 The student develops an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.

[3] SA2.1 The student will demonstrate an understanding of the attitudes and approaches to scientific inquiry by answering, "how do you know?" questions with reasonable answers.

[3] SD3.1 The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by using recorded weather patterns (e.g., temperature, cloud cover, or precipitation) to make reasonable predictions).

Alaska Cultural Standards

[A] Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community. Students who meet this cultural standard are able to:

[A.4] practice their traditional responsibilities to the surrounding environment.

[E] Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E.4] determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems.

Bering Strait School District Scope & Sequence

2nd grade sequence #11: Seasons

3rd grade sequence #11: Seasons

Materials

- TEACHER OVERHEAD "Fall Boating"
- TEACHER OVERHEAD "Bundled for Weather"
- TEACHER OVERHEAD "Seasons Change"
- Foam ball—approximately 3" in diameter (one per student or group)
- Sharpened pencil (one per student or group)
- Black marker
- Lamp or other light source (one per student or group)

Additional Resources

HSP II: Ch.8, Lesson 4

HSP III: Ch. 10, Lesson 1

Activity Preparation

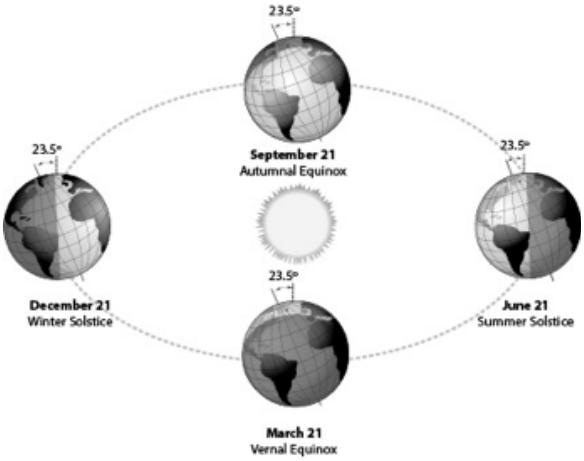
1. Determine whether students will work individually, or in paired groups. For each student or group, prepare a foam ball and pencil according to the steps below:
   a. Using the black marker, divide each ball into two hemispheres, by drawing a line around the center of the ball.
   b. Poke a pencil through the center of each foam ball. The pencil should be perpendicular to the line you drew.

2. Do a practice run of the experiment so that you will be ready to assist students.
3. If possible, invite a Native speaker to your class to help your students learn Native language terms for the vocabulary words.
4. Read the Whole Picture section for more background on this topic.

Whole Picture

Most places on Earth experience seasonal changes. Some people think that it is hotter in the summer because the earth is closer to our sun, the star at the center of our solar system. This is not the case. Earth is actually closer to the sun in the winter, but because the earth is tilted on its axis, the imaginary line around which the globe rotates, the sun's rays hit Earth at more of an angle, so temperatures are less intense.

Seasons, distinguishable by the amount of daylight and the temperature, are caused by three factors: the degree Earth's axis is tilted, Earth's rotation on its own axis, and its revolution, or orbit, around the sun.



Night and Day

Earth's axis is tilted at approximately 23.5°, an angle that remains constant as Earth rotates on its axis and completes its orbit around the sun. Every 24 hours, Earth rotates counterclockwise on its axis, creating day and night. When a point on Earth faces the sun, it is day; when it faces away from the sun, it is night. For most of the planet, the sun appears to rise in the east and set in the west. Closer to the poles, however, the sun only appears to rise in the ease and set in the west during spring and fall. In the Arctic and sub-Arctic, for example, the sun appears to rise in the north and set in the north during summer, while it appears to rise and set in the south during winter. This is because of Earth's tilt. If not for the tilt, the sun would appear to rise and set in the same places year round.

Seasons

Like the other planets in our solar system, Earth orbits the sun. One orbit takes approximately 365 days, or 1 year. During this orbit, the seasons slowly change.

Summer solstice, occurring approximately June 21st every year, marks the beginning of summer for the Northern Hemisphere. At this date, the North Pole, marking the northern tip of Earth's axis, is tipped toward the sun. As a result, the Northern Hemisphere receives a greater amount of solar energy, and therefore experiences warmer temperatures and increased daylight. At the same time, on the opposite side of the earth, the South Pole points away from the sun. This results in the Southern Hemisphere experiencing reduced daylight and a reduction in solar energy, which leads to cooler temperatures. Thus, when

it is summer in the Northern Hemisphere, it is winter in the Southern Hemisphere.

The autumnal equinox, approximately September 22nd each year, marks the point at which neither the North nor South Poles point toward or away from the sun. This is the beginning of fall, or autumn, in the Northern Hemisphere (and the beginning of spring in the Southern Hemisphere). The entire planet experiences 12 hours of daylight and 12 hours of darkness.

As Earth continues its revolution around the sun, the North Pole will point away from the sun, and the South Pole will point toward the sun. On December 21st each year, the winter solstice arrives for the Northern Hemisphere — the darkest day of the year. After this date, the days will get longer again, as Earth moves toward spring. The sun's rays also hit the Northern Hemisphere at an angle, creating lower thermal energy, and thereby cooler temperatures. Meanwhile, in the Southern Hemisphere, the opposite is happening; winter in the Northern Hemisphere means summer in the Southern Hemisphere.

The vernal equinox, the beginning of spring, occurs in the Northern Hemisphere around March 21st. Like fall, neither the North nor South Poles point toward or away from the sun. All parts of Earth experience 12 hours of daylight and 12 hours of darkness. In the Northern Hemisphere, the days will continue to get longer as the summer solstice approaches and the cycle begins anew.

Regional Differences

Seasons vary from region to region on the globe, especially at the poles. Above the Arctic Circle, for example, the sun does not set at all between mid-April and mid-August. Long days provide ample time to gather resources that will be used during winter. Many people travel to fish camps and stay up late to process their harvests. During the winter season, there are more hours of darkness than of daylight, and temperatures are colder. Above the Arctic Circle, the sun sets in mid-November and does not show itself again until mid-February. Winter has traditionally been a time to come together as a community, to share stories, and participate in traditional inside activities, using materials gathered during the longer summer months.

Even though the South Pole experiences a summer of constant daylight, the days never get very warm, because the sun's rays hit at an angle, which results in a lower thermal energy. At the equator, the imaginary line encircling the globe half way between the

North and South Poles, the temperature and number of daylight hours stay relatively constant throughout the year. This is because the angle at which the sun's rays hit that location of the globe change very little throughout the year.

Vocabulary

season	a time of the year that has a certain kind of weather. Four seasons are spring, summer, fall, and winter.
axis	an imaginary line that runs through the center of Earth from the North to South Poles
rotation	the spinning of Earth on its axis
orbit	the movement of Earth one time around the sun

Activity Procedure

1. Individually, display the TEACHER OVERHEADS "Fall Boating" and "Bundled for Weather." For each, ask students the following questions:
   a. What season do you think it is in this picture?
   b. How do you know?
2. Explain that in the Northern Hemisphere, winter occurs when Earth's axis points away from the sun. The first day of winter and the shortest day of the year is December 21.
3. Ask students "What causes seasons?" (allow students to guess; list their ideas on the board). Explain that students will conduct an experiment to learn about what causes seasons.
4. Tell students that the foam ball and pencil represents Earth and its axis. The lamp represents the sun. You may wish to do this activity with the overhead classroom lights turned off; this will allow students to better see the shadows on the ball.
5. Show students how to tilt the ball at approximately a 45˚ angle. They should keep this same orientation throughout the activity.
6. Instruct students to turn on their lamp, and hold the foam ball near the lamp. They should practice moving the ball around the lamp, while maintaining the angle. Assist any students who are having difficulty.

Teacher's Note

If students have a difficult time maintaining the angle and direction of the pencil's tilt, instruct them to use the black marker to make a dot somewhere in the "Northern Hemisphere" on the ball. This will help them visualize a particular area of the globe.

7. Instruct students to move the ball so that the pencil tip tilts away from the lamp. Ask the following question:
   a. Where on the ball does the light shine most brightly?
8. Instruct students to move the ball to the other side of the lamp. They should not change the pencil's direction or tilt (the tip of the pencil should now be pointing toward the lamp). Ask the following questions:
   a. Where does the light shine most brightly now?
9. Ask students to communicate their observations and draw conclusions:
   a. Where does the light always shine most brightly on the ball?
   b. When you move the ball around the lamp, what differences do you see in how the light changes on the ball?
   c. Critical Thinking: How is this model like the Earth and the Sun?
   d. Critical Thinking: What season would it be for the side of the ball tilted away from the light?
10. Display the TEACHER OVERHEAD "Seasons Change." Ask students the following questions:
   a. What is in the center of the picture?
   b. What is moving around the sun?
   c. Critical Thinking: What do the arrows show?
   d. What do the pictures show?
   e. What is different about Earth during each season?

Answers

TEACHER OVERHEAD "Fall Boating"

It looks like fall, because the leaves on the bushes are starting to turn color and the lighting is low, but intense.

TEACHER OVERHEAD "Bundled for Weather"

It looks like winter, because there is snow on the ground, and it is windy — you can see the wind blowing the snow. Also, the long shadows show that the sun is low in the sky, which happens during winter.

Activity Questions

(Student answers may vary slightly, but their answers should be similar to those below.)

7a. The light shines most brightly on the bottom (the Southern Hemisphere) of the ball. The light hitting the top of the ball (the Northern Hemisphere) hits at an angle.

8a. The light shines more brightly and directly on the top (the Northern Hemisphere) of the ball. The light hitting the bottom of the ball (the Southern Hemisphere) hits at an angle.

9a. The light always shines the most brightly on the part of the ball tilted directly toward the light.

9b. When I move the ball around the lamp, the light changes from shining on the bottom of the ball to shining on the top of the ball. As the ball moves around the lamp, the light shines differently on the same part of the ball. The light becomes less direct on the parts of the ball that are tilted away from the lamp.

9c. The ball is tilted and orbits around the lamp just like Earth is tilted and orbits around the sun.

9d. It would be winter for the part of the ball tilted away from the light. It would be summer for the part of the ball tilted toward the light.

TEACHER OVERHEAD "Seasons Change"

a. The sun is in the center of the picture.

b. Earth is moving around the sun.

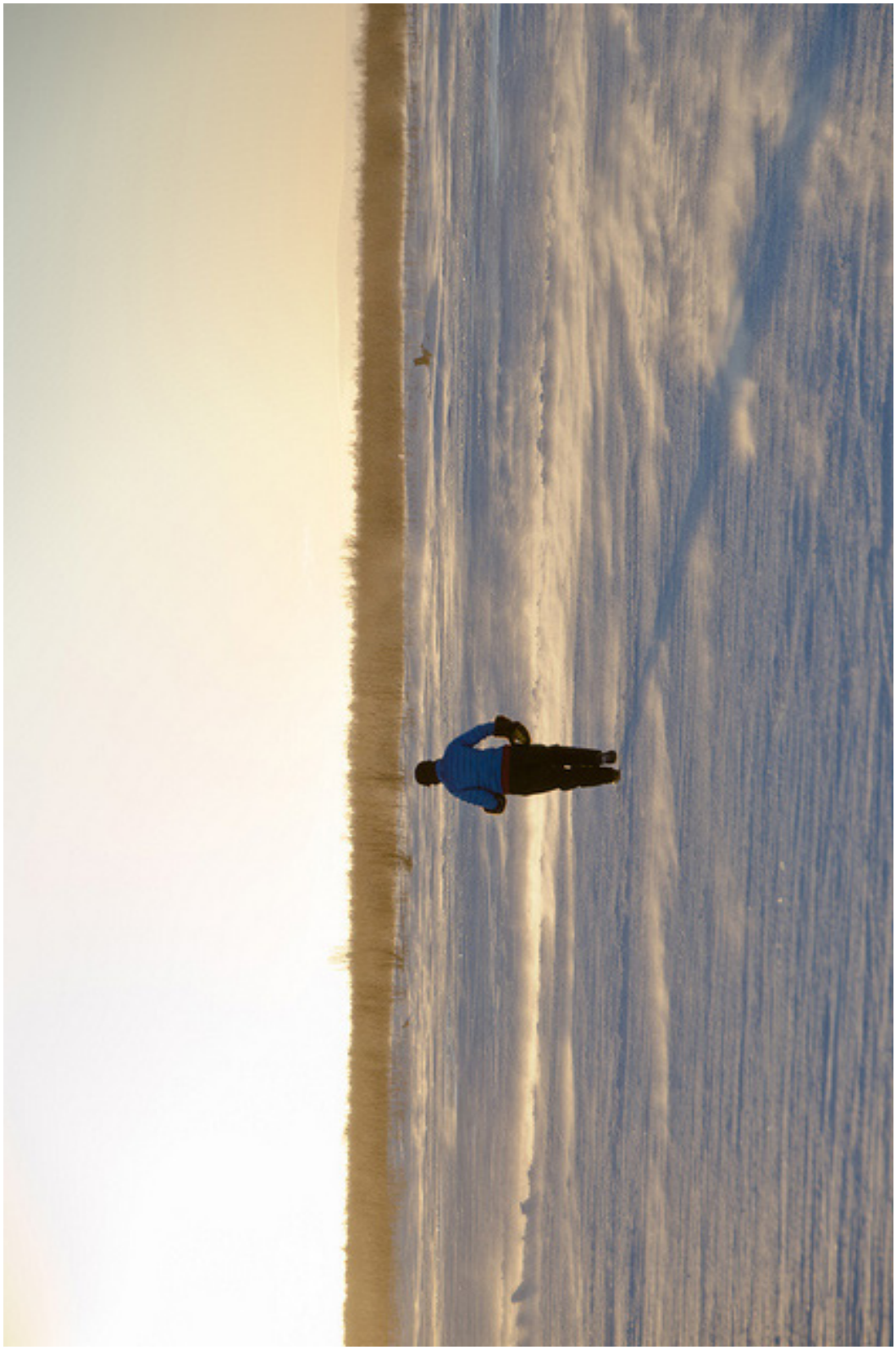
c. The arrows show Earth's path (or orbit) around the sun.

d. The pictures show the pattern of the seasons when Earth is at a particular place around the sun.

e. Earth is in a different place in its orbit during each season. The part of Earth that is tilted toward the sun is different for each season.

Teacher Overhead "Fall Boating" By Andy Pokrzywinski

Teacher Overhead "Bundled for Weather" By Andy Pokrzywinski



Teacher Overhead "Seasons Change"