

HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?

UNIT 3: Seasons
Lesson 6 — Grades 4 -5
INSTRUCTIONS



Overview

In this lesson, students learn how Earth's position in relation to the sun affect the seasons.

Objectives

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

- identify the equator and Northern and Southern Hemispheres on a globe;
- demonstrate the Earth's tilt, rotation, and orbit; and
- explain why different parts of the Earth experience the seasons at different times of the year.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

- [4, 5] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [4, 5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations: observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate.
- [4, 5] SA 2.1 The student will demonstrate an understanding of the attitudes and approaches to scientific inquiry by supporting their ideas with observations and peer review.
- [4, 5] 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 recognizing changes to length of daylight over time and its relationships to seasons.
- [5] SD4.2 The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by recognizing that the Earth is in a regular and predictable motion and this motion explains the length of a day and year.

Alaska Cultural Standards

- [E] Culturally knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them.

Bering Strait School District Scope & Sequence

4th Grade Sequence #10: Earth in the Solar System

5th Grade Sequence #11: Earth in the Solar System



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



Materials

For Demonstration

- Globe
- Flashlight
- Circle stickers (two — 1 each of different colors)
- Masking tape
- Sticky notes

For Student Activity

- Four-inch Styrofoam balls (one per group)
- Rubber bands (must fit snugly over Styrofoam ball; one per group)
- Pencils (one per group)
- Flashlights (one per group)
- Student Worksheet "The Four Seasons"
- Student Worksheet "Seasons Vocabulary"

Multimedia

REACH Multimedia 4-6: "Earth's Seasons"

Available at: www.k12reach.org

Additional Resources

Harcourt School Publishers Science IV: Ch. 10, Lesson 1

Harcourt School Publishers Science V: Ch. 13, Lesson 1

Activity Preparation

1. Prepare a piece of chart paper or an area of the board for a class vote:
 - a. Title the chart, "The Reason for Seasons."
 - b. Divide the area into four sections, with the following labels:
 - i. "How close Earth is to the sun"
 - ii. "The moon's influence on tide"
 - iii. "Earth's tilt as it orbits the sun"
 - iv. "The sun moves East to West"
 - c. Cover the chart with a blank piece of chart paper until later.
2. With masking tape on the classroom floor, tape off a large circle representing Earth's orbit. When doing the class demonstration, the student who is the "sun" will stand at the center of this circle, while the "Earth" walks the orbital path.
3. Prepare Styrofoam balls and globe:
 - a. Staying as close to the center as possible, push a pencil through each ball. The pencil represents the North and South Poles.
 - b. Put a rubber band around the middle to represent the equator.



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



- c. On the globe, place one sticker on Alaska and one on the equator.

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. On the Earth's elliptical orbit, the Northern Hemisphere 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 east 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,



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



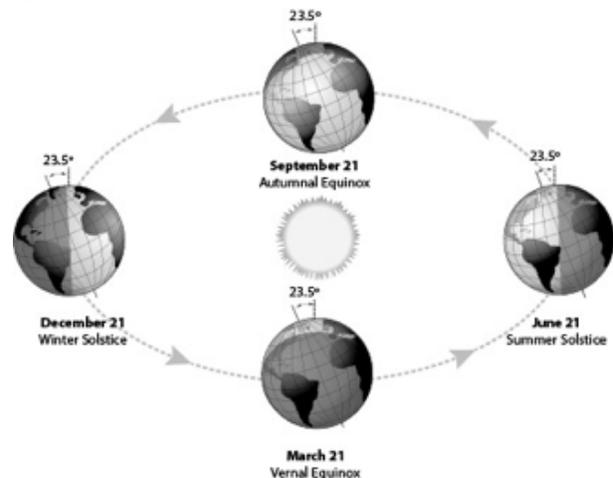
and the South Pole will point toward the sun. On December 21st each year, the winter solstice arrives for the Northern Hemisphere — the darkest day of the year. After this date, the days will get longer again, as Earth moves toward spring. The sun's rays also hit the Northern Hemisphere at an angle, 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.



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



Vocabulary

sun	The star at the center of our solar system, around which all the planets revolve; it supplies the heat and light that sustain life on Earth
rotate	The motion of an object around its own axis
axis	An imaginary line around which an object rotates; on a rotating sphere, such as Earth, the two ends of the axis are called the poles.
revolve	The motion of an object around a point, especially around another object or a center of mass
orbit	The path one body takes in space as it revolves around another
equator	An imaginary line around Earth equally distant from the North and South Poles; this line divides Earth into the Northern and Southern Hemispheres
Northern Hemisphere	The half of the globe that is above the equator
Southern Hemisphere	The half of the globe that is below the equator

Activity Procedure

1. Give each student a sticky note; ask them to write their initials. Uncover the chart you prepared earlier and instruct students to think about what causes seasons.
 - a. Read all the choices, but emphasize that only one answer is correct.
 - b. Ask students to quickly place their sticky note in the section they believe is correct. (Don't talk about which one is correct until later in the activity.)
2. For the demonstration, ask for two student volunteers: one to hold the globe (Earth) and one to hold the flashlight (representing the sun).
 - a. Instruct the student with the flashlight to aim the light directly at the globe and remain fixed on it even when the globe moves.
3. Introduce the concept that Earth is tilted on its axis at an angle of approximately 23.5° .
 - a. Instruct the student with the globe to tilt it, approximating the natural tilt of Earth.
4. Direct the student with Earth to begin rotating, or spinning, it on its axis.
5. Bring students' attention to the colored stickers on the globe. Point out the Northern Hemisphere, the Southern Hemisphere, and the equator, which marks the division.
 - a. Direct students to observe the stickers in relation to the sun.
 - b. Ask questions as the Earth rotates:
 - i. When is the sun more directly on Alaska?
 - ii. When is the sun more directly on the equator?
 - iii. When is it daytime in Alaska?
 - iv. When is it nighttime in Alaska?
 - v. Is this the only movement of Earth? (Answer: No. It also revolves around the sun.)



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



6. Ask for two different volunteers. Explain that Earth, like all the planets in our solar system, revolves around the sun (the sun is in one spot, Earth moves around it).
 - a. As it moves around the sun, it remains tilted on its axis and it continues to rotate. One revolution around the sun is called an orbit.
7. Ask Earth to walk around the sun, following the taped orbital path. The sun is to remain fixed on the globe. The student with Earth should ensure that it continues to rotate on its axis as they revolve around the sun.
8. Have Earth periodically stop, observe the tilt, and ask such questions as:
 - a. When is it winter in the Northern Hemisphere?
(Answer: when the sun is pointed more directly at the Southern Hemisphere)
 - b. When is it winter in the Southern Hemisphere?
(Answer: when the sun is pointed more directly at the Northern Hemisphere)
 - c. When is it summer in the Northern Hemisphere?
(Answer: when the sun is pointed more directly at the Northern Hemisphere)
 - d. When is it summer in the Southern Hemisphere?
(Answer: when the sun is pointed more directly at the Southern Hemisphere)
 - e. How do you know it is winter? Summer?
 - f. When is it fall or spring?
(Answer: when the sun is pointed equidistantly between the Northern and Southern Hemispheres)
 - g. What is happening at the equator? Further north? South? How does this contribute to changes in season at those locations? (Answer: Will vary depending on when you have students stop. Regardless of the time of year, very little change occurs at the equator.)
9. Divide students into groups and hand out one Styrofoam ball and one flashlight to each group. Remind them that the tilt of Earth is a constant, and the sun is always pointed at Earth (because it remains stationary while Earth moves around it).
10. Instruct groups to simulate:
 - a. The tilt of Earth on its axis
 - b. Earth rotating on its axis
 - c. Earth in orbit around the sun
 - d. Day and night
 - e. Summer in the Northern and Southern Hemispheres
 - f. Winter in the Northern and Southern Hemispheres
11. Pass out Student Worksheet: The Four Seasons, and direct students to complete it. Allow them to use the Styrofoam models as they consider questions.
12. When students have completed their worksheets, direct their attention back to the sticky notes on the board. Ask if anyone would like to change their answer, and if so,



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



allow them to do so. Discuss the correct answer based on the activity. (Answer: Due to Earth's tilt, the Northern and Southern Hemispheres are pointed toward or away from the sun at different points in the year. When the Northern Hemisphere is tilted toward the sun, that region of the globe experiences summer, while the regions in the Southern Hemisphere experience winter.)

13. Hand out the Student Worksheet: Seasons Vocabulary, and ask students to complete it according to the directions. Depending on your class size, you may want to add a rule that each student may only sign each sheet once.
 - a. Allow 5–10 minutes for students to complete the activity, then regroup to discuss. As students work on the activity, circulate through the room and correct students as needed.
 - b. As a whole class, go over each question to be sure correct information was discussed among all students.
 - c. For subjective questions, such as “someone who has experienced winter in another state,” ask for raised hands. (Students can share if there is time.) For objective questions, refer to the Answers section for correct answers.

Extension Activity

- For homework, have students talk to cultural knowledge bearers to learn about local seasons. Students may learn what harvestable plants and animals can be found during each season, what environmental indicators suggest the arrival of a particular animal species (e.g., when the cotton flies, the salmon will come), or what changes locals have noted in the seasonal timing of certain plants and animals. Students should share their findings with the class on a specified day.

Answers

Student Worksheet: The Four Seasons

1. A. Northern Hemisphere
2. B. Winter
3. B. False
4. A. summer, B. night, C. winter, D. axis, E. day, F. orbital path
5. Answers will vary, but should indicate that there would be no seasonal changes – climate would remain constant.
6. Answers will vary, but should indicate that there would not be day and night as we know it. There would, instead, be a 365-day period in the cycle of day and night, instead of 24 hours.



HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



Student Worksheet: Seasons Vocabulary

1. Earth's tilt is approximately 23°.
2. The latitude of the equator is 0°.
- 3.
4. The tilt of Earth means less direct solar energy, so temperatures drop in the fall and winter.
5. It takes 24 hours for Earth to rotate one time.
- 6.
7. The sun
8. Summer
9. 365 days
10. axis
11. Earth
- 12.

References

UNITE US Lesson — "The Reason for the Seasons"



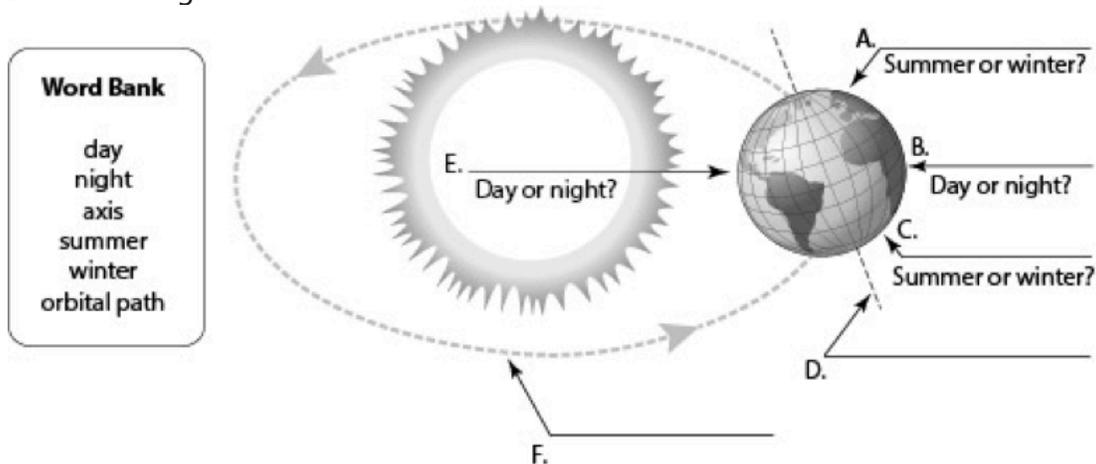
HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



Student Worksheet: "The Four Seasons"

Name _____

1. What hemisphere is north of the equator?
 - a. Northern Hemisphere
 - b. Southern Hemisphere
 - c. Eastern Hemisphere
 - d. Western Hemisphere
2. When it is summer in the Southern Hemisphere, what season is it in the Northern Hemisphere?
 - a. Fall
 - b. Winter
 - c. Spring
 - d. Summer
3. Earth's tilt changes as it rotates around the sun.
 - a. True
 - b. False
4. Label the diagram with the words from the word bank.



5. What would it be like if Earth's axis did not tilt?
6. What would it be like if Earth did not rotate?

HOW DOES EARTH'S ORBIT AFFECT THE SEASONS?



Student Worksheet: "Season's Vocabulary"

Name _____

Directions: Find someone who can complete each statement below. Have him / her do what it says and put his / her initials by the corresponding sentence. Continue until your sheet is complete.

Find someone who ...

1. _____ can demonstrate what it means to tilt and tell the angle of Earth's tilt.
2. _____ can point to the equator on the globe and tell its latitude.
3. _____ has experienced winter in another state and can tell you how it was different from winter in Western Alaska.
4. _____ can explain why temperatures drop in the fall and winter.
5. _____ can demonstrate what it means to rotate and can tell you how long it takes for Earth to rotate one time.
6. _____ can name a holiday in all four seasons.
7. _____ can name the star that is orbited by all of the planets and provides life-giving energy to Earth.
8. _____ can name the season that occurs in a hemisphere that is tilted toward the sun during orbit.
9. _____ can demonstrate what it means to orbit and can tell how long it takes for Earth to orbit the sun one time.
10. _____ can name the imaginary line around which Earth rotates.
11. _____ can name the third planet from the sun.
12. _____ has experienced summer in another state and can tell you how it was different from summer in Western Alaska..

