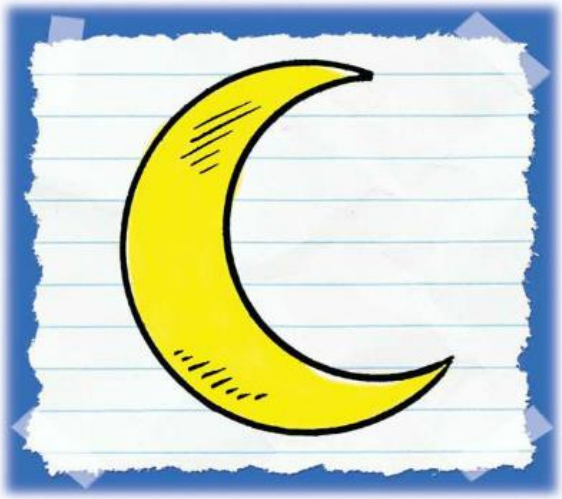
FLORIDA
Chapter 1

PAGE KEELEY SCIENCE PROBES



Phases of the Moon

Many people have different ideas about what causes us to see different parts of the Moon (moon phases). Which idea below best matches your thinking?

A: Earth casts a shadow on the Moon that allows us to see only the lit part.

B: The Moon moves into the Sun's shadow, blocking out part of the Moon's light.

C: The part we see depends on where the Moon is in relation to Earth and the Sun.

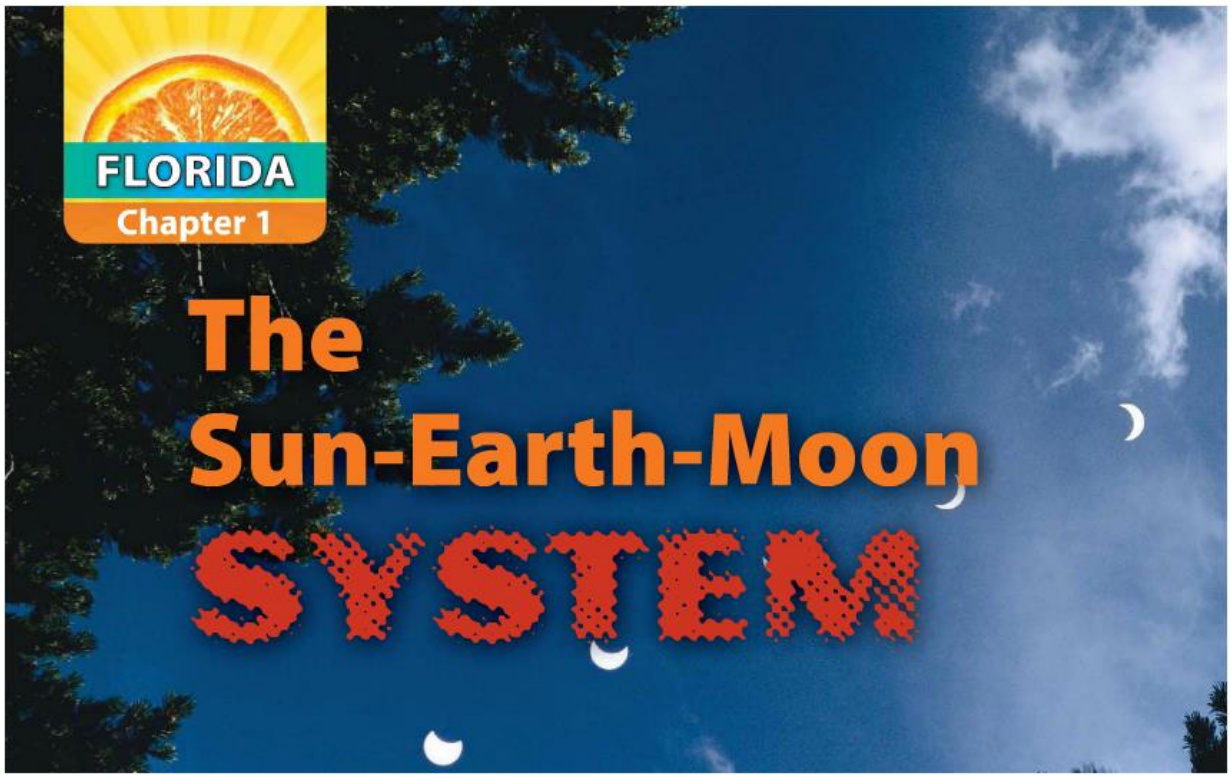
D: The Sun's movement around Earth causes different parts of the Moon to be reflected.

E: The Moon's rotation causes different parts of the Moon to be reflected back to Earth.

F: None of these; I think there is something else that causes us to see different moon phases.

SUBMIT SAMPLE ANSWERS CLEAR

Explain your thinking. Describe your ideas about why we see different phases of the Moon.


FLORIDA
Chapter 1
The
Sun-Earth-Moon
SYSTEM


Esp.

FLORIDA BIG IDEAS

1 The Practice of Science

5 Earth in Space and Time

The Big Idea

Think About It! What natural phenomena do the motions of Earth and the Moon produce?

Look at this time-lapse photograph. The "bites" out of the Sun occurred during a solar eclipse. The Sun's appearance changed in a regular, predictable way as the Moon's shadow passed over a part of Earth.

1. How do you think the Moon's movement can change the Sun's appearance?

2. What predictable changes do you think Earth's movement causes?

3. What other natural phenomena do you think the motions of Earth and the Moon cause?

SUBMIT SHOW ANSWERS CLEAR

Get Ready to Read What do you think about the Sun, Earth, and the Moon?

Do you agree or disagree with each of these statements? As you read this chapter, see if you change your mind about any of the statements.

	AGREE	DISAGREE
1 Earth's movement around the Sun causes sunrises and sunsets.	☐	☐
2 Earth has seasons because its distance from the Sun changes throughout the year.	☐	☐
3 The Moon was once a planet that orbited the Sun between Earth and Mars.	☐	☐
4 Earth's shadow causes the changing appearance of the Moon.	☐	☐
5 A solar eclipse happens when Earth moves between the Moon and the Sun.	☐	☐
6 The gravitational pull of the Moon and the Sun on Earth's oceans causes tides.	☐	☐

Lesson 1

Earth's MOTION

ESSENTIAL QUESTIONS

- How does Earth move?
- Why is Earth warmer at the equator and cooler at the poles?
- Why do the seasons change as Earth moves around the Sun?

Vocabulary

orbit p. 12
revolution p. 12
rotation p. 13
rotation axis p. 13
solstice p. 17
equinox p. 17

Florida NGSSS

LA.8.2.2.3 The student will organize information to show understanding or relationships among facts, ideas, and events (e.g., representing key points within text through charting, mapping, paraphrasing, summarizing, or comparing/contrasting);

MA.6.A.3.6 Construct and analyze tables, graphs, and equations to describe linear functions and other simple relations using both common language and algebraic notation.

SC.8.E.5.1 Recognize that there are enormous distances between objects in space and apply our knowledge of light and space travel to understand this distance.

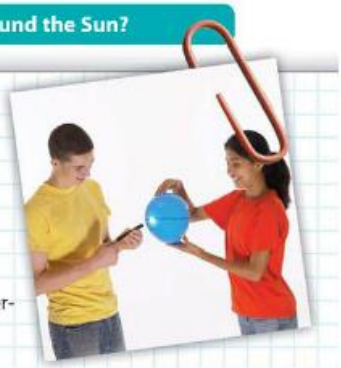
SC.8.E.5.4 Explore the Law of Universal Gravitation by explaining the role that gravity plays in the formation of planets, stars, and solar systems and in determining their motions.

SC.8.E.5.9 Explain the impact of objects in space on each other including:
1. the Sun on the Earth including seasons and gravitational attraction
2. the Moon on the Earth, including phases, tides, and eclipses, and the relative position of each body.

SC.8.N.1.1 Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

Inquiry Launch Lab

15 minutes



Does Earth's shape affect temperatures on Earth's surface?

Temperatures near Earth's poles are colder than temperatures near the equator. What causes these temperature differences?

Procedure

1. Read and complete a lab safety form.
2. Inflate a **spherical balloon** and tie the balloon closed.
3. Using a **marker,** draw a line around the balloon to represent Earth's equator.
4. Using a **ruler**, place a lit **flashlight** about 8 cm from the balloon so the flashlight beam strikes the equator straight on.
5. Using the marker, trace around the light projected onto the balloon.
6. Have someone raise the flashlight vertically 5–8 cm without changing the direction that the flashlight is pointing. Do not change the position of the balloon. Trace around the light projected onto the balloon again.

Think About This

1. Compare and contrast the shapes you drew on the balloon.

2. At which location on the balloon is the light more spread out? Explain your answer.

3. Key Concept Use your model to explain why Earth is warmer near the equator and colder near the poles.

SUBMIT SHOW ANSWERS CLEAR

Inquiry Floating in Space?

1. From the *International Space Station*, Earth might look like it is just floating, but it is actually traveling around the Sun at more than 100,000 km/h. What natural phenomena do you think Earth's motion might cause?

SUBMIT SHOW ANSWERS CLEAR

Earth and the Sun

If you look outside at the ground, trees, and buildings, it does not seem like Earth is moving. Yet Earth is always in motion, spinning in space and traveling around the Sun. As Earth spins, day changes to night and back to day again. The seasons change as Earth travels around the Sun. Summer changes to winter because Earth's motion changes how energy from the Sun spreads out over Earth's surface.

The Sun

The nearest star to Earth is the Sun, which is shown in **Figure 1.** The Sun is approximately 150 million km from Earth. Compared to Earth, the Sun is enormous. The Sun's diameter is more than 100 times greater than Earth's diameter. The Sun's mass is more than 300,000 times greater than Earth's mass.

Deep inside the Sun, nuclei of atoms combine, releasing huge amounts of energy. This process is called nuclear fusion. The Sun releases so much energy from nuclear fusion that the temperature at its core is more than 15,000,000°C. Even at the Sun's surface, the temperature is about 5,500°C. A small part of the Sun's energy reaches Earth as light and thermal energy.

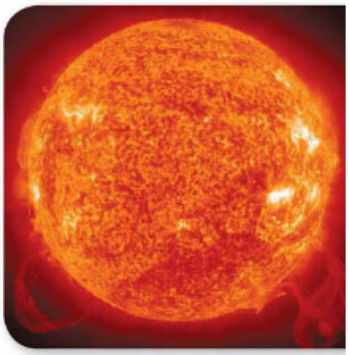
Click below.

abc

Active Reading **2. Point Out** Circle the temperatures of the Sun's core and its surface.

SUBMIT SAMPLE ANSWERS CLEAR

Figure 1 The Sun is a giant ball of hot gases that emits light and energy.



Inquiry LAB STATION SC.8.N.1.1, SC.8.E.5.9

Try It!

MiniLab ***What keeps Earth in orbit?*** at connectED.mcgraw-hill.com

Apply It!

After you complete the lab, answer the question below.

1. How did you model Earth's revolution around the Sun?

SUBMIT SHOW ANSWERS CLEAR

Earth's Orbit

As shown in **Figure 2,** Earth moves around the Sun in a nearly circular path. *The path an object follows as it moves around another object is an* **orbit**. *The motion of one object around another object is called* **revolution**. Earth makes one complete revolution around the Sun every 365.24 days.

The Sun's Gravitational Pull

Why does Earth orbit the Sun? The answer is that the Sun's gravity pulls on Earth. The pull of gravity between two objects depends on the masses of the objects and the distance between them. The more mass either object has, or the closer together they are, the stronger the gravitational pull.

The Sun's effect on Earth's motion is illustrated in **Figure 2.** Earth's motion around the Sun is like the motion of an object twirled on a string. The string pulls on the object and makes it move in a circle. If the string breaks, the object flies off in a straight line. In the same way, the pull of the Sun's gravity keeps Earth revolving around the Sun in a nearly circular orbit. If the gravity between Earth and the Sun were to somehow stop, Earth would fly off into space in a straight line.

Click below.

Figure 2 Earth moves in a nearly circular orbit. The pull of the Sun's gravity on Earth causes Earth to revolve around the Sun.

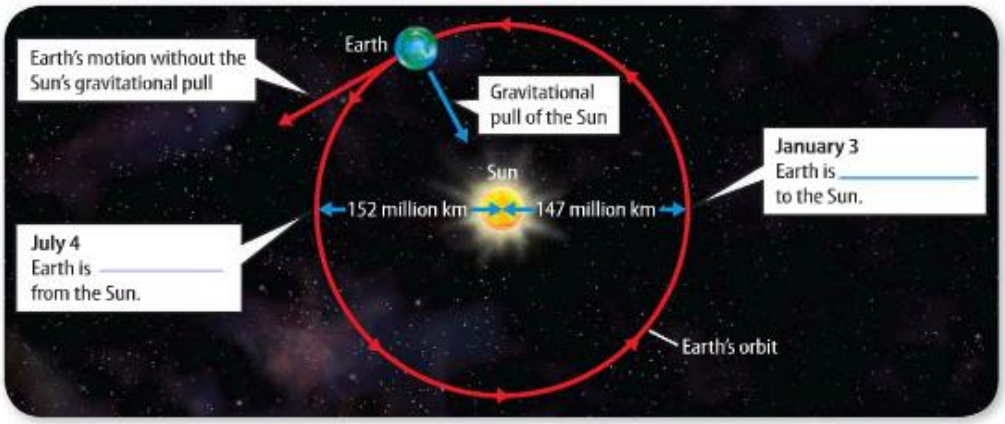
Active Reading **3. Compare** Fill in the blanks in the figure below to show where Earth is farthest from the Sun and where it is closest to the Sun.

line.

4. NGSSS Check **Identify** Underline the cause of Earth's orbit around the Sun. SC.8.E.5.4

SUBMIT SAMPLE ANSWERS CLEAR

abc



SUBMIT SAMPLE ANSWERS CLEAR

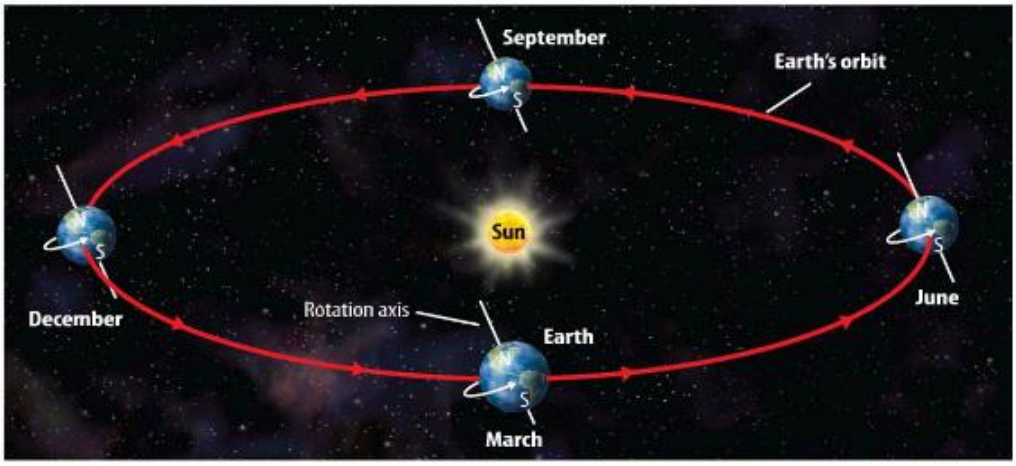


Figure 3 This diagram shows Earth's orbit, which is nearly circular, from an angle. Earth spins on its rotation axis as it revolves around the Sun. Earth's rotation axis always points in the same direction.

5. Visual Check **Analyze** Between which months does the north end of Earth's rotation axis point away from the Sun?

Earth's Rotation

As Earth revolves around the Sun, it spins. *A spinning motion is called* **rotation**. Some spinning objects rotate on a rod or axle. Earth rotates on an imaginary line through its center. *The line on which an object rotates is the* **rotation axis**.

Suppose you could look down on Earth's North Pole and watch Earth rotate. You would see that Earth rotates on its rotation axis in a counterclockwise direction, from west to east. One complete rotation of Earth takes about 24 hours. This rotation helps produce Earth's cycle of day and night. It is daytime on the half of Earth facing toward the Sun and nighttime on the half of Earth facing away from the Sun.

Click below.

abc

Active Reading **6. Identify** Circle the direction of Earth's rotation.

SUBMIT SHOW ANSWERS CLEAR

The Sun's Apparent Motion Each day the Sun appears to move from east to west across the sky. It seems as if the Sun is moving around Earth. However, it is Earth's rotation that causes the Sun's apparent motion.

Earth rotates from west to east. As a result, the Sun appears to move from east to west across the sky. The stars and the Moon also seem to move from east to west across the sky due to Earth's west to east rotation.

To better understand this, imagine riding on a merry-go-round. As you and the ride move, people on the ground appear to be moving in the opposite direction. In the same way, as Earth rotates from west to east, the Sun appears to move from east to west.

Active Reading **7. Apply** Why does the Sun appear to move across the sky from east to west?

The Tilt of Earth's Rotation Axis As shown in **Figure 3**, Earth's rotation axis is tilted. The tilt of Earth's rotation axis is always in the same direction by the same amount. This means that during half of Earth's orbit, the north end of the rotation axis is toward the Sun. During the other half of Earth's orbit, the north end of the rotation axis is away from the Sun.

SUBMIT SAMPLE ANSWERS CLEAR

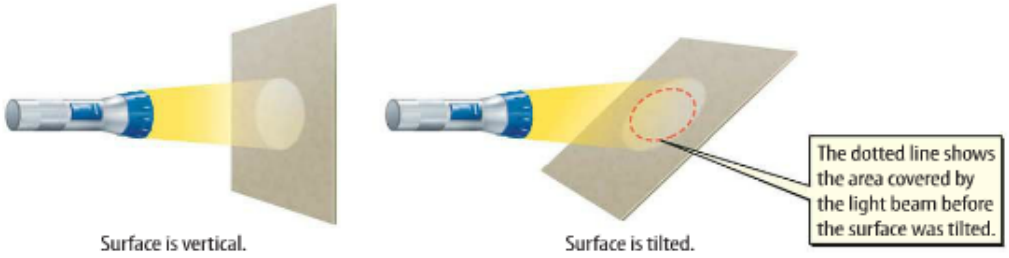


Figure 4 The light energy on a surface becomes more spread out as the surface becomes more tilted relative to the light beam.

8. Visual Check
Analyze How does the area covered by the light differ on the vertical surface and the tilted surface?

SUBMIT SHOW ANSWERS CLEAR

Temperature and Latitude

As Earth orbits the Sun, only one half of Earth faces the Sun at a time. A beam of sunlight carries energy. The more sunlight that reaches a part of Earth's surface, the warmer that part becomes. Because Earth's surface is curved, different parts of Earth's surface receive different amounts of the Sun's energy.

Energy Received by a Tilted Surface

Suppose you shine a beam of light on a flat card, as shown in **Figure 4.** As you tilt the card relative to the direction of the light beam, light becomes more spread out on the card's surface. As a result, the energy that the light beam carries also spreads out more over the card's surface. An area on the surface within the light beam receives less energy when the surface is more tilted relative to the light beam.

ACADEMIC VOCABULARY
equator
(noun) the imaginary line that divides Earth into its northern and southern hemispheres

The Tilt of Earth's Curved Surface

Instead of being flat like a card, Earth's surface is curved. Relative to the direction of a beam of sunlight, Earth's surface becomes more tilted as you move away from the **equator**. As shown in **Figure 5,** the energy in a beam of sunlight tends to become more spread out the farther you travel from the equator. This means that regions near the poles receive less energy than regions near the equator. This makes Earth colder at the poles and warmer at the equator.

9. NGSSS Check
Explain Use the figure to explain why Earth is warmer at the equator and colder at the poles.
SC.8.E.5.9

SUBMIT SHOW ANSWERS CLEAR

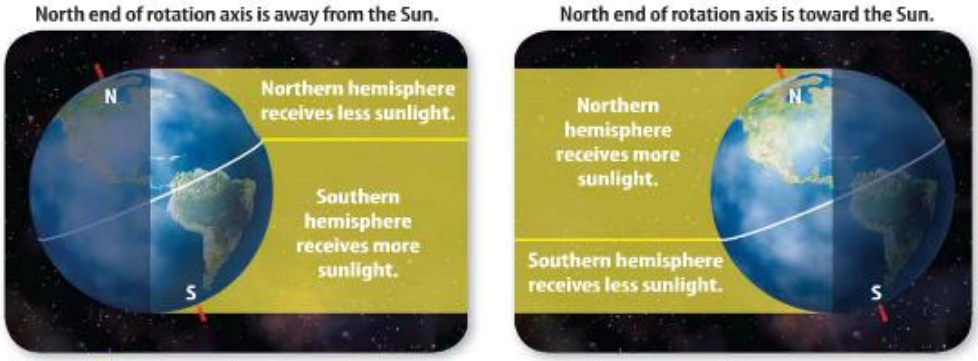


Figure 6 The northern hemisphere receives more sunlight in June, and the southern hemisphere receives more sunlight in December.

Active Reading **10. Apply** How does the tilt of Earth's rotation axis affect Earth's weather?

Seasons

SUBMIT SHOW ANSWERS CLEAR

You might think that summer happens when Earth is closest to the Sun and winter happens when Earth is farthest from the Sun. However, seasonal changes do not depend on Earth's distance from the Sun. In fact, Earth is closest to the Sun in January! Instead, it is the tilt of Earth's rotation axis, combined with Earth's motion around the Sun, that causes the seasons to change.

Spring and Summer in the Northern Hemisphere

During one half of Earth's orbit, the north end of the rotation axis is toward the Sun. Then, the northern hemisphere receives more energy from the Sun than the southern hemisphere, as shown in **Figure 6.** Temperatures increase in the northern hemisphere and decrease in the southern hemisphere. Daylight hours last longer in the northern hemisphere, and nights last longer in the southern hemisphere. This is when spring and summer happen in the northern hemisphere, and fall and winter happen in the southern hemisphere.

Fall and Winter in the Northern Hemisphere

During the other half of Earth's orbit, the north end of the rotation axis is away from the Sun. Then, the northern hemisphere receives less solar energy than the southern hemisphere, as shown in **Figure 6.** Temperatures decrease in the northern hemisphere and increase in the southern hemisphere. This is when fall and winter happen in the northern hemisphere and spring and summer happen in the southern hemisphere.

Math Skills MA.6.A.3.6

Convert Units

When Earth is 147,000,000 km from the Sun, how far is Earth from the Sun in miles? To calculate the distance in miles, multiply the distance in km by the conversion factor.

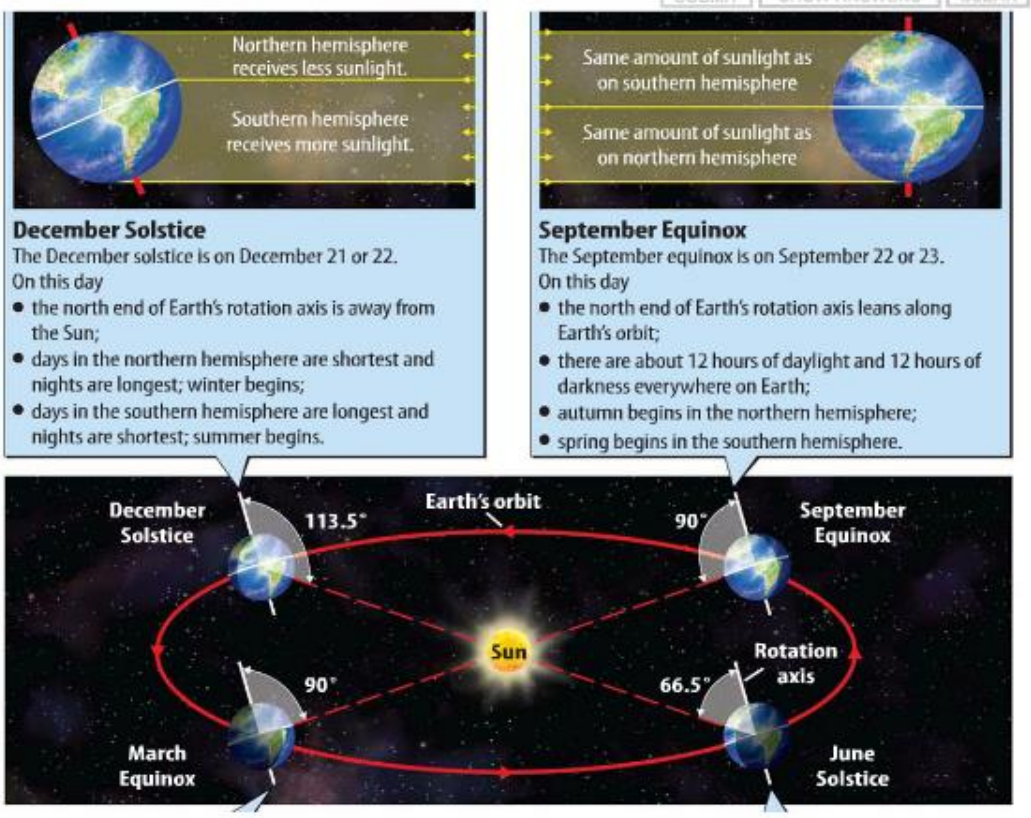
$$147{,}000{,}000 \text{ km} \times \frac{0.62 \text{ miles}}{1 \text{ km}} = 91{,}100{,}000 \text{ miles}$$

11. Practice When Earth is 152,000,000 km from the Sun, how far is Earth from the Sun in miles?

SUBMIT SHOW ANSWERS CLEAR

Figure 7 **12. Compare** When is the angle between Earth's rotation axis and the Sun the largest? When is it the smallest?

SUBMIT SHOW ANSWERS CLEAR



December Solstice
The December solstice is on December 21 or 22.
On this day
- the north end of Earth's rotation axis is away from the Sun;
- days in the northern hemisphere are shortest and nights are longest; winter begins;
- days in the southern hemisphere are longest and nights are shortest; summer begins.

September Equinox
The September equinox is on September 22 or 23.
On this day
- the north end of Earth's rotation axis leans along Earth's orbit;
- there are about 12 hours of daylight and 12 hours of darkness everywhere on Earth;
- autumn begins in the northern hemisphere;
- spring begins in the southern hemisphere.

March Equinox
The March equinox is on March 20 or 21.
On this day
- the north end of Earth's rotation axis leans along Earth's orbit;
- there are about 12 hours of daylight and 12 hours of darkness everywhere on Earth;
- spring begins in the northern hemisphere;
- autumn begins in the southern hemisphere.

June Solstice
The June solstice is on June 20 or 21.
On this day
- the north end of Earth's rotation axis is toward the Sun;
- days in the northern hemisphere are longest and nights are shortest; summer begins;
- days in the southern hemisphere are shortest and nights are longest; winter begins.

Solstices, Equinoxes, and the Seasonal Cycle

Figure 7 shows that as Earth travels around the Sun, its rotation axis always points in the same direction in space. However, the amount that Earth's rotation axis is toward or away from the Sun changes. This causes the seasons to change in a yearly cycle.

There are four days each year when the direction of Earth's rotation axis is special relative to the Sun. *A* **solstice** *is a day when Earth's rotation axis is the most toward or away from the Sun. An* **equinox** *is a day when Earth's rotation axis is leaning along Earth's orbit, neither toward nor away from the Sun.*

March Equinox to June Solstice When the north end of the rotation axis gradually points more and more toward the Sun, the northern hemisphere gradually receives more solar energy. This is spring in the northern hemisphere.

June Solstice to September Equinox The north end of the rotation axis continues to point toward the Sun but does so less and less. The northern hemisphere starts to receive less solar energy. This is summer in the northern hemisphere.

September Equinox to December Solstice The north end of the rotation axis now points more and more away from the Sun. The northern hemisphere receives less and less solar energy. This is fall in the northern hemisphere.

December Solstice to March Equinox The north end of the rotation axis continues to point away from the Sun but does so less and less. The northern hemisphere starts to receive more solar energy. This is winter in the northern hemisphere.

Changes in the Sun's Apparent Path Across the Sky

Figure 8 shows how the Sun's apparent path through the sky changes from season to season in the northern hemisphere. The Sun's apparent path through the sky in the northern hemisphere is lowest on the December solstice and highest on the June solstice.

Active Reading

FOLDABLES® LA.8.2.2.3

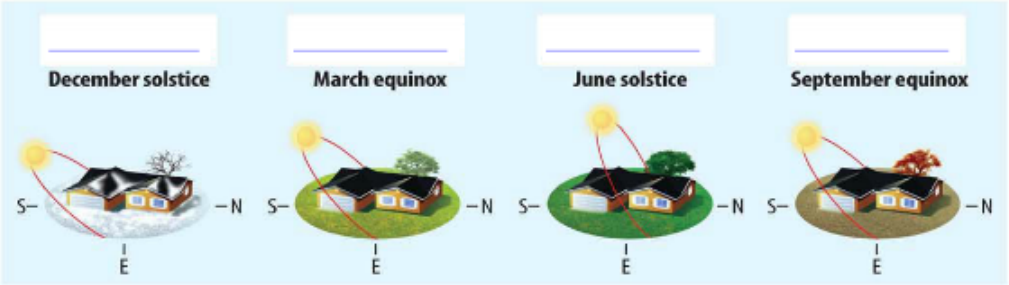
Make a bound book with four full pages. Label the pages with the names of the solstices and equinoxes. Use each page to organize information about each season.

WORD ORIGIN

equinox
from Latin *equinoxium*, means "equality of night and day"

Figure 8 As the seasons change, the path of the Sun across the sky changes.

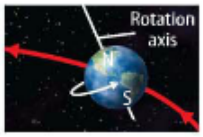
13. Visual Check
Relate In the figure below, fill in the blanks with the season that starts on each solstice or equinox.



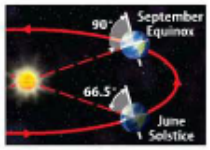
Lesson Review 1

Visual Summary

The gravitational pull of the Sun causes Earth to revolve around the Sun in a near-circular orbit.



Earth's rotation axis is tilted and always points in the same direction in space.



Equinoxes and solstices are days when the direction of Earth's rotation axis relative to the Sun is special.

Use Vocabulary

1. **Distinguish** between Earth's rotation and Earth's revolution.

2. When a(n) _____ occurs, the northern hemisphere and the southern hemisphere receive the same amount of sunlight.

Understand Key Concepts

3. What is caused by the tilt of Earth's rotational axis?
   - (A) Earth's orbit
   - (B) Earth's seasons
   - (C) Earth's revolution
   - (D) Earth's rotation

4. **Contrast** the amount of sunlight received by an area near the equator and a same-sized area near the South Pole. SC.8.E.5.9

5. **Contrast** the Sun's gravitational pull on Earth when Earth is closest to the Sun and when Earth is farthest from the Sun. SC.8.E.5.4

Interpret Graphics

6. **Summarize** Fill in the season table below for the northern hemisphere. LA.8.2.2.3

Season	Starts on Solstice or Equinox?	How Rotation Axis Leans
Summer		
Fall		
Winter		
Spring		

Critical Thinking

7. **Defend** The December solstice is often called the winter solstice. Do you think this is an appropriate label? Defend your answer.

Math Skills MA.6.A.3.6

8. The Sun's diameter is about 1,390,000 km. What is the Sun's diameter in miles?

SUBMIT SHOW ANSWERS CLEAR

Inquiry LAB STATION SC.8.N.1.1 SC.8.E.5.9

Try It!

Skill Lab *How does Earth's tilted rotation axis affect the seasons?* at connectED.mcgraw-hill.com