Earth's Orbit TEKS 8.7(A)

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.

Recall

2. How long does it take Earth to make one revolution around the Sun?

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.

LAB Manager

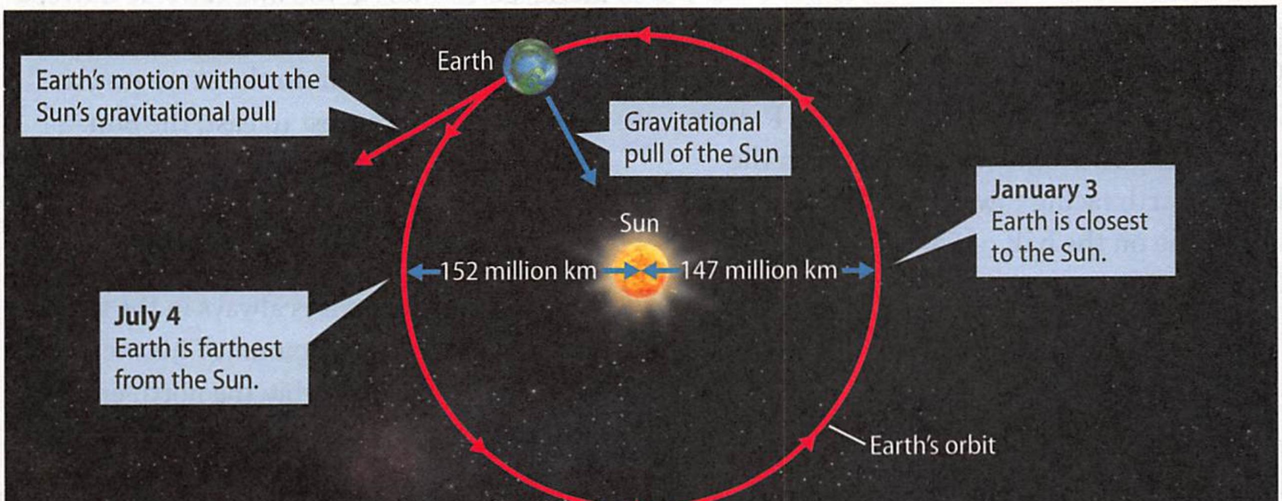
MiniLAB: *What keeps Earth in orbit?*

TEKS 8.1(A); 8.2(A), (C), (E); 8.4(A), (B)

Summarize

3. What produces Earth's revolution around the Sun?

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.



Earth's Rotation Axis

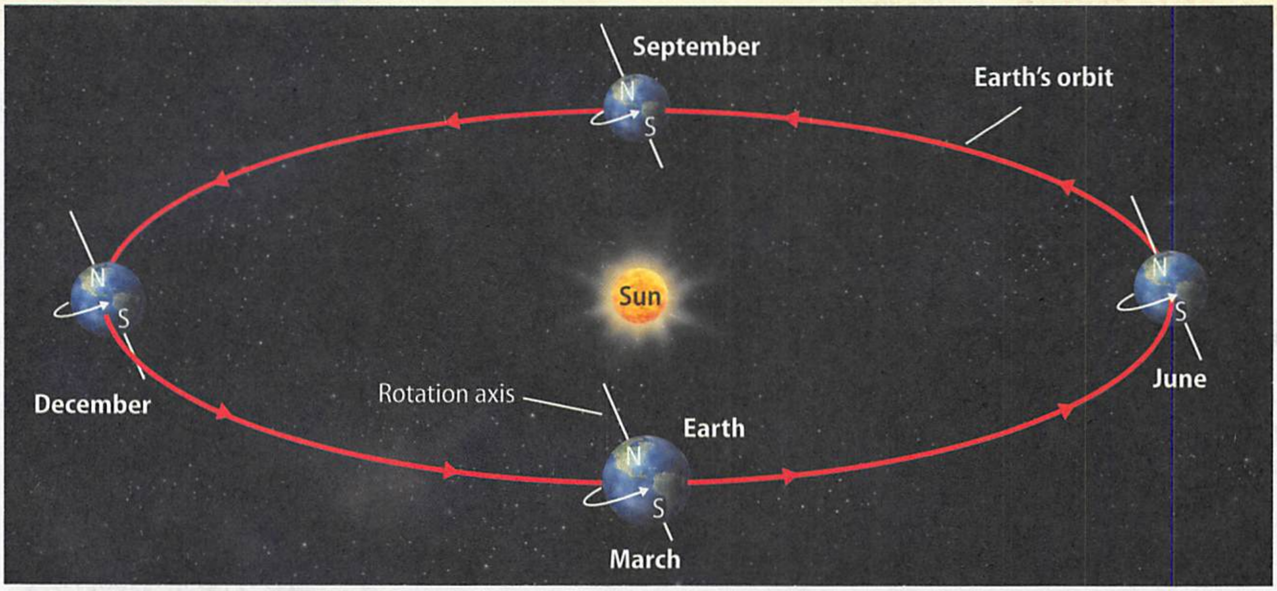


Figure 3 This diagram shows Earth's orbit, which is nearly circular, from an angle. Earth spins on its rotation axis as it revolves around the Sun. Earth's rotation axis always points in the same direction.

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. This imaginary line is tilted 23.5° from vertical. Most globes show Earth tilted in this way. *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.

Explain

4. Highlight what direction Earth rotates on its axis. Underline what is caused by Earth's rotation.

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.

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.

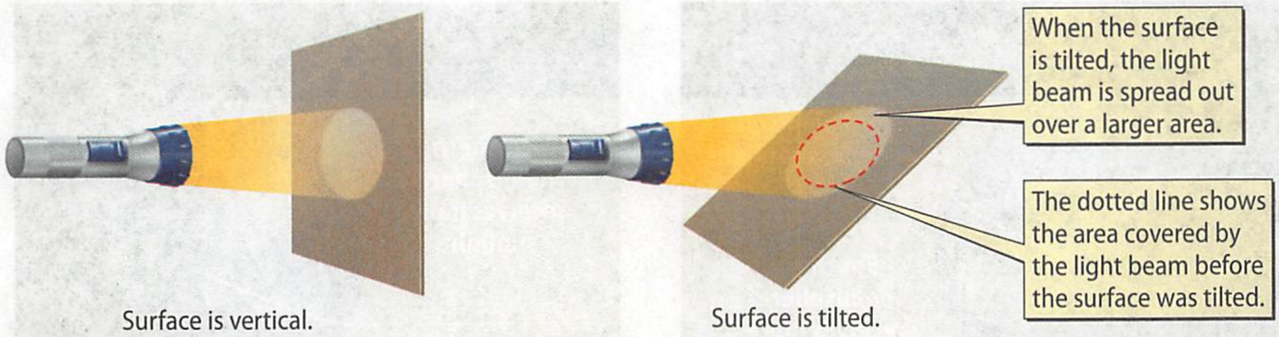


Figure 4 The light energy on a surface becomes more spread out as the surface becomes more tilted relative to the light beam.

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.

Infer

5. Why is Earth warmer at the equator and colder at the poles?

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.

Academic Vocabulary

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

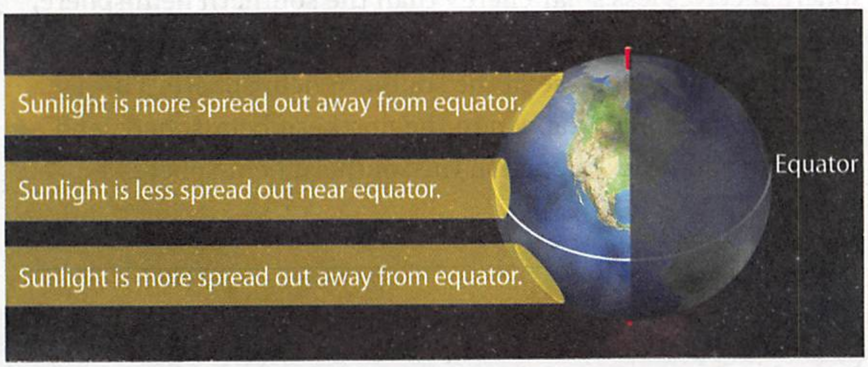


Figure 5 Energy from the Sun becomes more spread out as you move away from the equator.

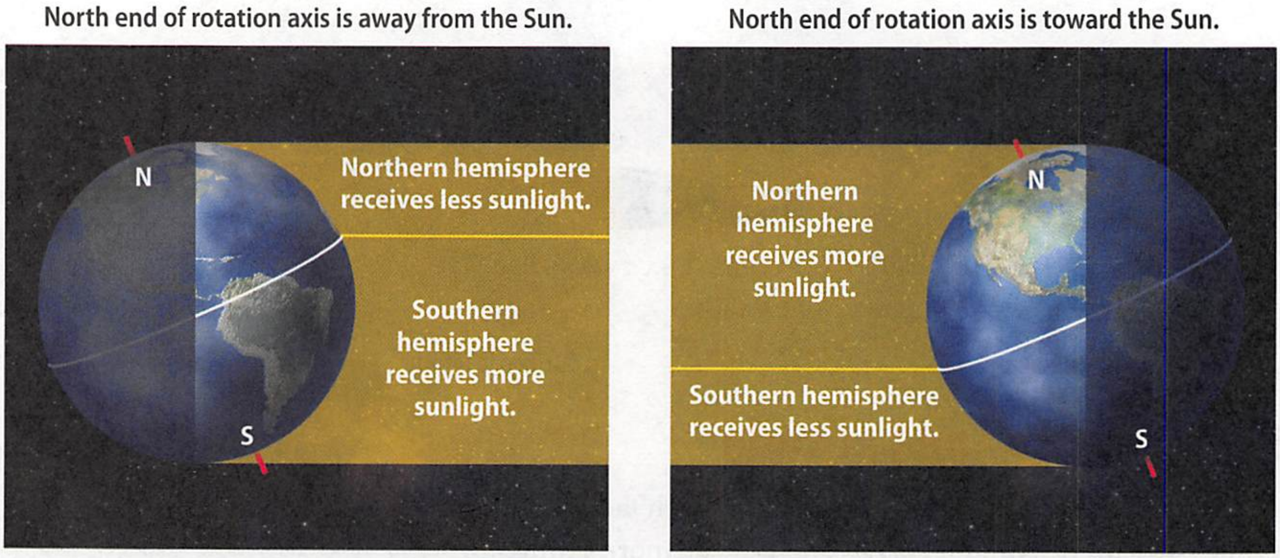


Figure 6 The northern hemisphere receives more sunlight in June, and the southern hemisphere receives more sunlight in December.

Seasons TEKS 8.7(A)

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 Math TEKS 8.1(A), (B)

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 kilometers by the conversion factor

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

Practice

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

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Understand

6. Underline what causes the seasons to change.

Earth's Seasonal Cycle

Figure 7 The seasons change as Earth moves around the Sun. Earth's motion around the Sun causes Earth's tilted rotation axis to be leaning toward the Sun and away from the Sun.

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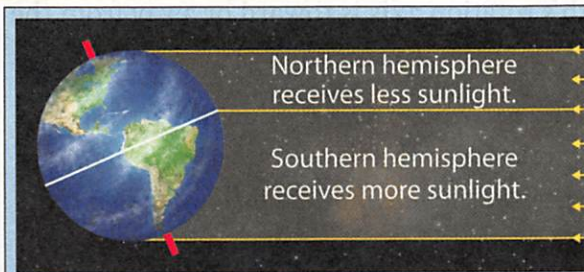
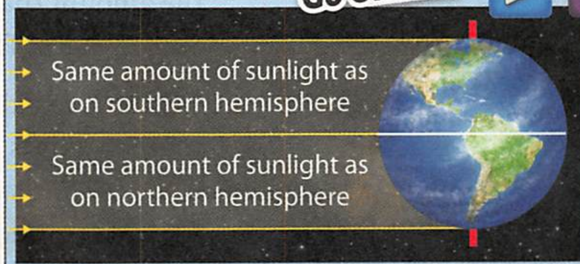


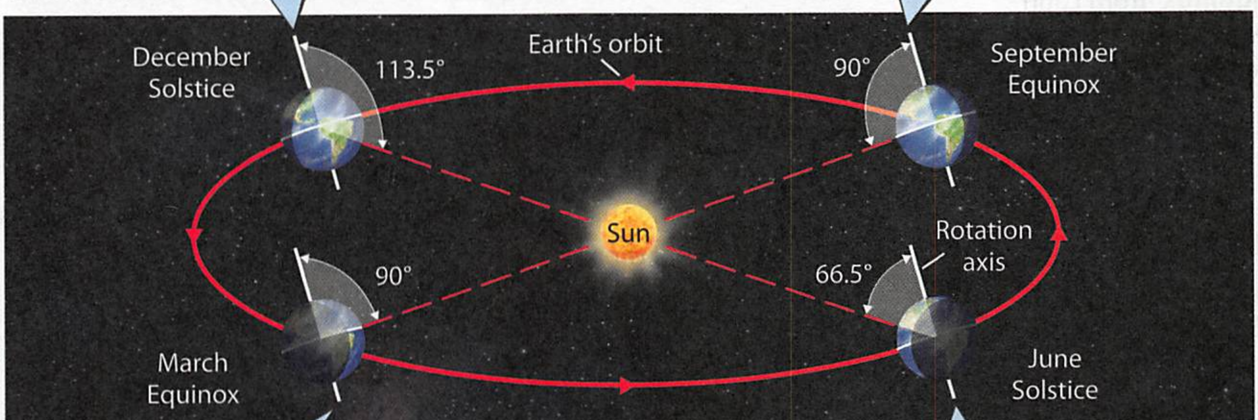
December Solstice

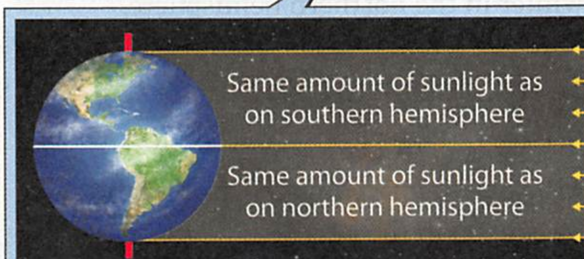
The December solstice is on December 21 or 22.
On this day
- the north end of Earth's rotation axis is away from the Sun;
- days in the northern hemisphere are shortest and nights are longest; winter begins;
- days in the southern hemisphere are longest and nights are shortest; summer begins.



September Equinox

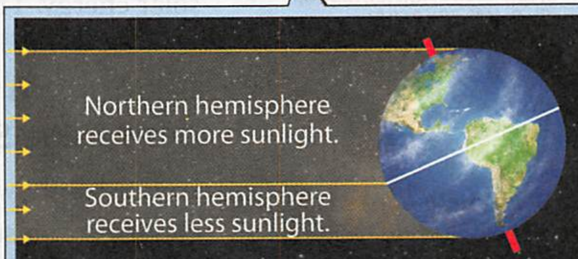
The September equinox is on September 22 or 23.
On this day
- the north end of Earth's rotation axis leans along Earth's orbit;
- there are about 12 hours of daylight and 12 hours of darkness everywhere on Earth;
- autumn begins in the northern hemisphere;
- spring begins in the southern hemisphere.





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

FOLDABLES®

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.

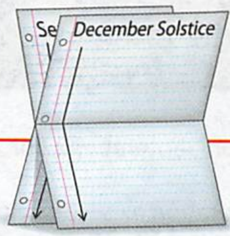


Figure 7 shows that as Earth travels around the Sun, its rotation axis always points in the same direction in space. However, the amount that Earth's rotation axis is toward or away from the Sun changes. This causes the seasons to change in a yearly cycle.

There are 4 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.

Word Origin

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

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.

LAB Manager

Skill LAB: *How does Earth's tilted rotation axis affect the seasons?*

TEKS 8.1(A); 8.2(A), (C), (E); 8.3(A), (B); 8.4(A), (B); 8.7(A)

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.

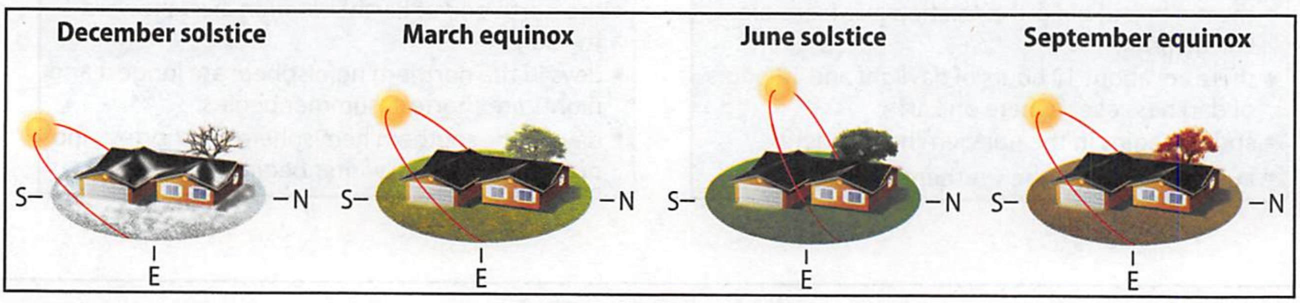


Figure 8 As the seasons change, the path of the Sun across the sky changes. In the northern hemisphere, the Sun's path is lowest on the December solstice and highest on the June solstice.