Lesson 1 Earth's Motion

Skim *Lesson 1 in your book. Read the headings and look at the photos and illustrations. Write three things you want to learn more about as you read the lesson. Write your ideas in your Science Journal.*

Main Idea

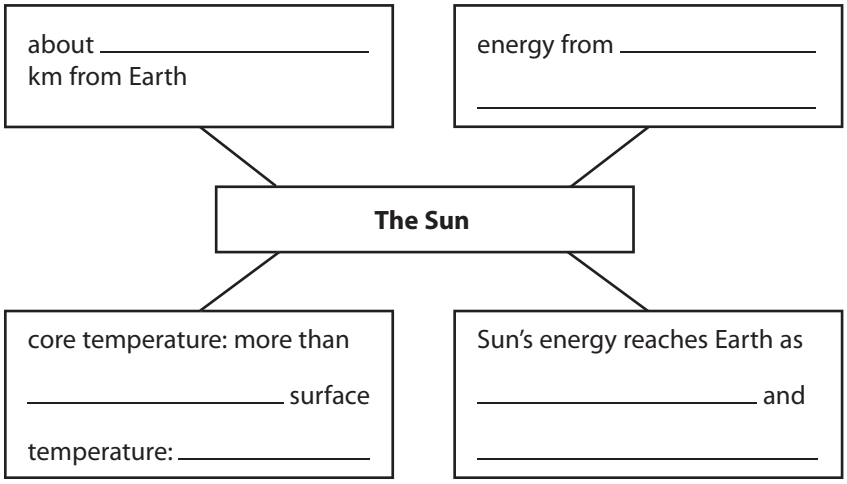
Earth and the Sun

I found this on page _____.

I found this on page _____.

Details

Organize *information about the Sun.*



Complete *information about Earth's* revolution *around the Sun.*

Earth Revolves Around the Sun	
Definition of revolution	
How long it takes Earth to make one revolution around the Sun	
Definition of orbit	
Force that keeps Earth in its orbit around the Sun	

The Sun-Earth-Moon System

Earth's Motion

Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	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.	

Key Concepts

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

Read to Learn

Mark the Text

Identify Main Ideas
Highlight each head in one color. Use another color to highlight key words in the paragraphs under the head that explain or support the head. Use your highlighting to review the lesson.

Earth and the Sun

If you look around you, it does not seem as if Earth is moving. The ground, trees, and buildings do not seem to be moving. But Earth is always in motion. It spins and moves around the Sun. Earth's motion causes changes on Earth. As Earth spins, day changes to night and back to day again. The seasons change as Earth moves around the Sun. Summer turns 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. The Sun is about 150 million km from Earth. The Sun is much larger than Earth. 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.

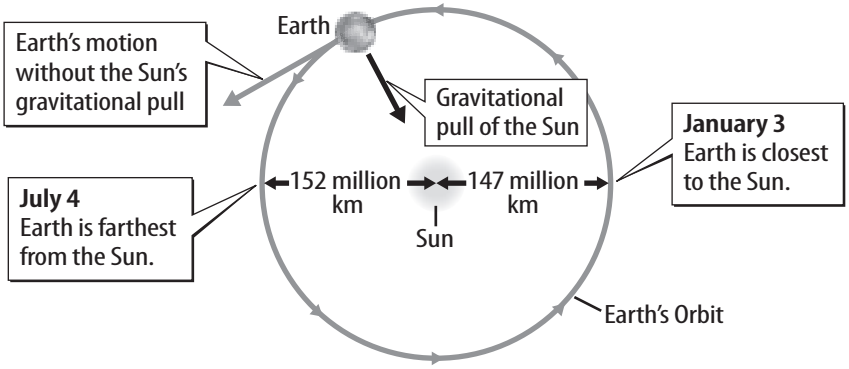
The Sun is a giant ball of hot gases. It emits light and energy. Inside the Sun, the nuclei of atoms combine to produce huge amounts of energy. This process is called nuclear fusion. Nuclear fusion produces so much energy that the Sun's core temperature is more than 15,000,000°C. Even at the Sun's surface, the temperature is about 5,500°C. A small part of the Sun's energy reaches Earth as light and thermal energy.

Reading Check

1. Explain What is one effect of nuclear fusion?

Earth's 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 path an object follows as it moves around another object is an* **orbit.** Earth orbits the Sun in an almost circular path. Earth's orbit is shown below.



Visual Check

2. Describe What is the shape of Earth's orbit around the Sun? (Circle the correct answer.)

a. circle

b. near circle

c. a straight line

The Sun's Gravitational Pull

Earth orbits the Sun because the Sun's gravity pulls on Earth. The strength of gravity's pull between two objects depends on the masses of the objects and the distance between them. An object with more mass has a greater pull of gravity than an object with less mass. Likewise, gravity's pull is greater on objects that are closer together.

Earth's orbit around the Sun, shown above, is like the motion of an object twirled on a string. The string pulls on the object and moves it in a circle. If the string breaks, the object flies off in a straight line. The Sun's gravity is like the string. Gravity keeps Earth revolving around the Sun in a nearly circular orbit. If the pull of gravity between the Sun and Earth stopped suddenly, Earth would fly off into space in a straight line.

Key Concept Check

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

Earth's Rotation

As Earth revolves around the Sun, it spins. *A spinning motion is called* **rotation.** Earth rotates on an imaginary line that runs through its center. *The line on which an object rotates is the* **rotation axis.**

If you could look down onto Earth's North Pole, you would see that Earth rotates in a counterclockwise direction, from west to east. One complete rotation of Earth takes about 24 hours. One rotation completes Earth's cycle of day and night. It is daytime on the half of Earth that faces the Sun. It is nighttime on the half of Earth that faces away from the Sun.

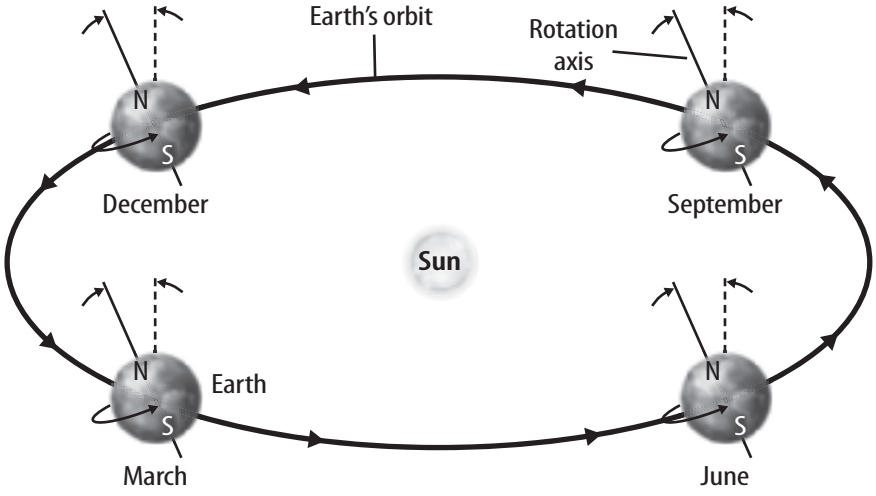
Reading Check

4. Identify In which direction does Earth rotate?

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

Earth rotates from west to east. This makes the Sun appear to move from east to west across the sky. The Moon and stars also seem to move from east to west across the sky due to Earth's west-to-east rotation. Earth's west-to-east rotation causes apparent east-to-west motion in the sky.

The Tilt of Earth's Rotation Axis Earth's rotation axis is tilted, as shown in the figure below. The tilt of Earth's rotation axis does not change. During one-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.



Temperature and Latitude

As Earth orbits the Sun, the Sun shines on the half of Earth that faces the Sun. 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 get different amounts of the Sun's energy.

Energy Received by a Tilted Surface

Suppose you shine a flashlight onto a flat card. The beam shines in a circle on the card. As you tilt the top of the card away from the beam of light, the light becomes more spread out on the card's surface. 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.

Reading Check

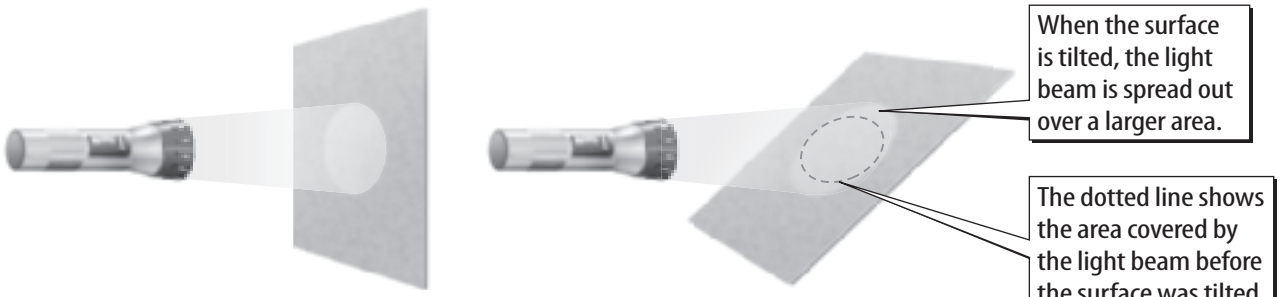
5. Describe What causes the Sun's apparent motion across the sky?

Visual Check

6. Identify Between which months is the north end of Earth's rotation axis away from the Sun?

Reading Check

7. Summarize Why do some parts of Earth's surface get more energy from the Sun than other parts?



Surface is vertical.

Surface is tilted.

Visual Check

8. Determine Is the light energy more spread out on the vertical or tilted surface?

_____

_____

Key Concept Check

9. Cause and Effect Why is Earth warmer at the equator and colder at the poles?

_____

_____

_____

Math Skills

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.

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

$$= 91{,}100{,}000 \text{ miles}$$

10. Convert Units When Earth is 152,000,000 km from the Sun, how far is Earth from the Sun in miles?

_____

The Tilt of Earth's Curved Surface

Instead of being flat and vertical like the card shown above on the left, Earth's surface is curved and tilted, somewhat like the card on the right. Earth's surface becomes more tilted as you move away from the equator and toward the poles. As a result, regions of Earth near the poles receive less energy than areas near the equator. This is why Earth is warmer at the equator and colder at the poles.

Seasons

You might think that summer happens when Earth is closest to 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! The tilt of Earth's rotation axis and Earth's motion around the Sun cause 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 does. See the figure on the right on the next page.

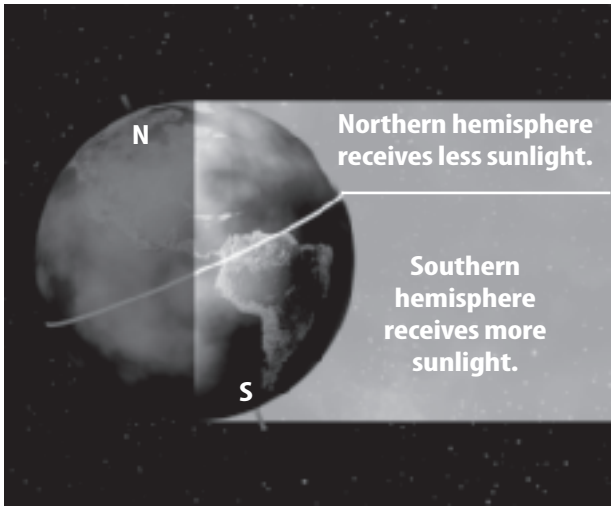
Temperatures are higher in the northern hemisphere and lower in the southern hemisphere. Daylight hours last longer in the northern hemisphere. Nights last longer in the southern hemisphere. It is spring and summer in the northern hemisphere and fall and winter in the southern hemisphere.

Fall and Winter in the Northern Hemisphere

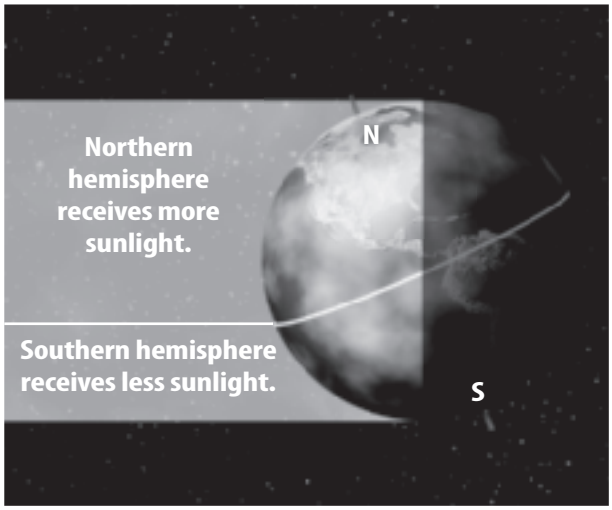
During the other half of Earth's orbit, the north end of the rotation axis is away from the Sun, as shown in the left figure on the next page. Then, the northern hemisphere receives less energy from the Sun than the southern hemisphere does.

Temperatures are cooler in the northern hemisphere and warmer in the southern hemisphere. It is fall and winter in the northern hemisphere. At the same time, spring and summer occur in the southern hemisphere.

North end of rotation axis points away from the Sun.



North end of rotation axis points toward the Sun.



Solstices, Equinoxes, and the Seasonal Cycle

As Earth travels around the Sun, Earth's rotation axis always points in the same direction in space. But the amount that Earth's rotation axis is toward or away from the Sun changes. This causes the yearly cycle of the seasons.

There are four days each year when the direction of Earth's 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 or away from the Sun.*

March Equinox to June Solstice The north end of the rotation axis slowly points more and more toward the Sun. As a result, the northern hemisphere slowly receives more solar energy. Spring takes place in the northern hemisphere.

June Solstice to September Equinox The north end of the rotation axis still points 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 points more and more away from the Sun. The northern hemisphere receives less and less solar energy. Fall takes place in the northern hemisphere.

December Solstice to March Equinox The north end of the rotation axis still points away from the Sun but does so less and less. As a result, the northern hemisphere starts to receive more solar energy. This is winter in the northern hemisphere. Earth's seasonal cycle is summarized in the table on the next page.

Visual Check

11. Label the left figure to indicate whether it is summer or winter in the northern hemisphere.

FOLDABLES®

Make a bound book from two sheets of paper to organize information about each season and its solstices and equinoxes.

Key Concept Check

12. Conclude How does the tilt of Earth's rotation axis affect Earth?

Visual Check

13. Show Highlight in one color the seasons that begin on each solstice and each equinox in the northern hemisphere. Use a different color to highlight the seasons that begin on each solstice and equinox in the southern hemisphere.

Reading Check

14. Recall When is the Sun highest in the sky in the northern hemisphere?

_____

_____

Earth's Seasonal Cycle

December Solstice	March Equinox
• The December solstice is on December 21 or 22. • The north end of Earth's axis is leaning farthest from the Sun. The south end is closest. • The northern hemisphere has its fewest number of daylight hours, and winter begins. • The southern hemisphere has its greatest number of daylight hours, and summer begins.	• The March equinox is on March 20 or 21. • Both ends of Earth's rotation axis are equal distances from the Sun. • There are about 12 hours of daylight and 12 hours of night everywhere on Earth. • Spring begins in the northern hemisphere. • Fall begins in the southern hemisphere.
June Solstice	**September Equinox**
• The June solstice is on June 20 or 21. • The north end of Earth's axis is leaning closest to the Sun. The south end is farthest away. • The northern hemisphere has the greatest number of daylight hours, and summer begins. • The southern hemisphere has the fewest number of daylight hours, and winter begins.	• The September equinox is on September 22 or 23. • Both ends of Earth's rotation axis are equal distances from the Sun. • There are about 12 hours of daylight and 12 hours of night everywhere on Earth. • Fall begins in the northern hemisphere. • Spring begins in the southern hemisphere.

Changes in the Sun's Apparent Path Across the Sky

As the seasons change, the Sun's apparent path across the sky also changes. In the northern hemisphere, the Sun's path through the sky is highest on the June solstice. Similarly, the Sun's path is lowest on the December solstice.

Mini Glossary

equinox: a day when Earth's rotation axis is leaning along Earth's orbit, neither toward nor away from the Sun

orbit: the path an object follows as it moves around another object

revolution: the motion of one object around another object

rotation: a spinning motion

rotation axis: the line on which an object rotates

solstice: a day when Earth's rotation axis is the most toward or away from the Sun

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that describes how solstices and equinoxes differ.

2. In the two boxes in the first column, draw Earth to show how it rotates and how it revolves. Then complete the other parts of the table.

Earth's Rotation	**What is rotation?** Rotation is the spinning of an object around an axis.	**What does Earth's rotation cause?**
Earth's Revolution	**What is revolution?**	**What does Earth's revolution cause?** seasons

What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

Connect ED

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson's resources.

END OF LESSON

Main Idea

I found this on page _____.

Details

Arrange *facts about Earth's* rotation.

Earth's Rotation

Rotation is a _____ motion.

A rotation axis is

_____

_____

_____.

One complete Earth rotation is called a

_____ and

takes _____ hours.

Earth's rotation axis is always

_____ in the same direction by the same amount.

Earth's rotation makes objects in the sky appear to _____

_____.

Temperature and Latitude

I found this on page _____.

Analyze *the interaction of sunlight with Earth's surface.*

Cause →	Effect
Curved surface of Earth	The energy in a beam of sunlight is spread out more at _____ than at _____. This makes Earth _____ at the poles and _____ at the equator.

Seasons

I found this on page _____.

Identify *the direction of the north end of Earth's* rotation axis *for each of the four seasons. Put a check mark in the appropriate column.*

Direction in which Earth's rotation axis is leaning			
Season	**Toward the Sun**	**Away from the Sun**	**Neither toward nor away**
Winter			
Spring			
Summer			
Fall			

Main Idea

Details

I found this on page _____.

Define solstice *and* equinox.

Solstice: _____

_____

Equinox: _____

_____

I found this on page _____.

Identify *which season is beginning in the northern hemisphere for each point in Earth's* orbit. *Then indicate whether the amount of solar energy received by the northern hemisphere is increasing or decreasing throughout each season.*

Point in Orbit	Season Beginning in the Northern Hemisphere	Change in Solar Energy Received
December solstice		
March equinox		
June solstice		
September equinox		

I found this on page _____.

Describe *the height of the apparent path of the Sun through the sky in the northern hemisphere at each* solstice.

December solstice: _____

June solstice: _____

Synthesize It Suppose that Earth's axis were tilted 90 degrees instead of 23.5 degrees. What might the seasons be like?

_____

_____

_____

_____

_____

_____

_____