UNIT 7

The Solar System and the Universe

Big Idea

Earth is part of a solar system, which is made up of many different objects orbiting a sun. Our sun is one star in a universe of many stars.

5.ESS1.1, 5.ESS1.2, 5.ESS1.3, 5.ESS1.4, 5.ESS1.5, 5.ESS1.6

I Wonder Why

Why are most observatories built far from large cities? *Turn the page to find out.*

Here's why Most observatories are built far from cities to avoid the brightening of the night sky caused by artificial outdoor lighting, which can make it impossible to see dim lights from stars.

In this unit, you will explore the Big Idea, the Essential Questions, and the Investigations on the Inquiry Flipchart.

Levels of Inquiry Key ■ DIRECTED ■ GUIDED ■ INDEPENDENT

Track Your Progress

Big Idea Earth is part of a solar system, which is made up of many different objects orbiting a sun. Our sun is one star in a universe of many stars.

Essential Questions

Science Notebook

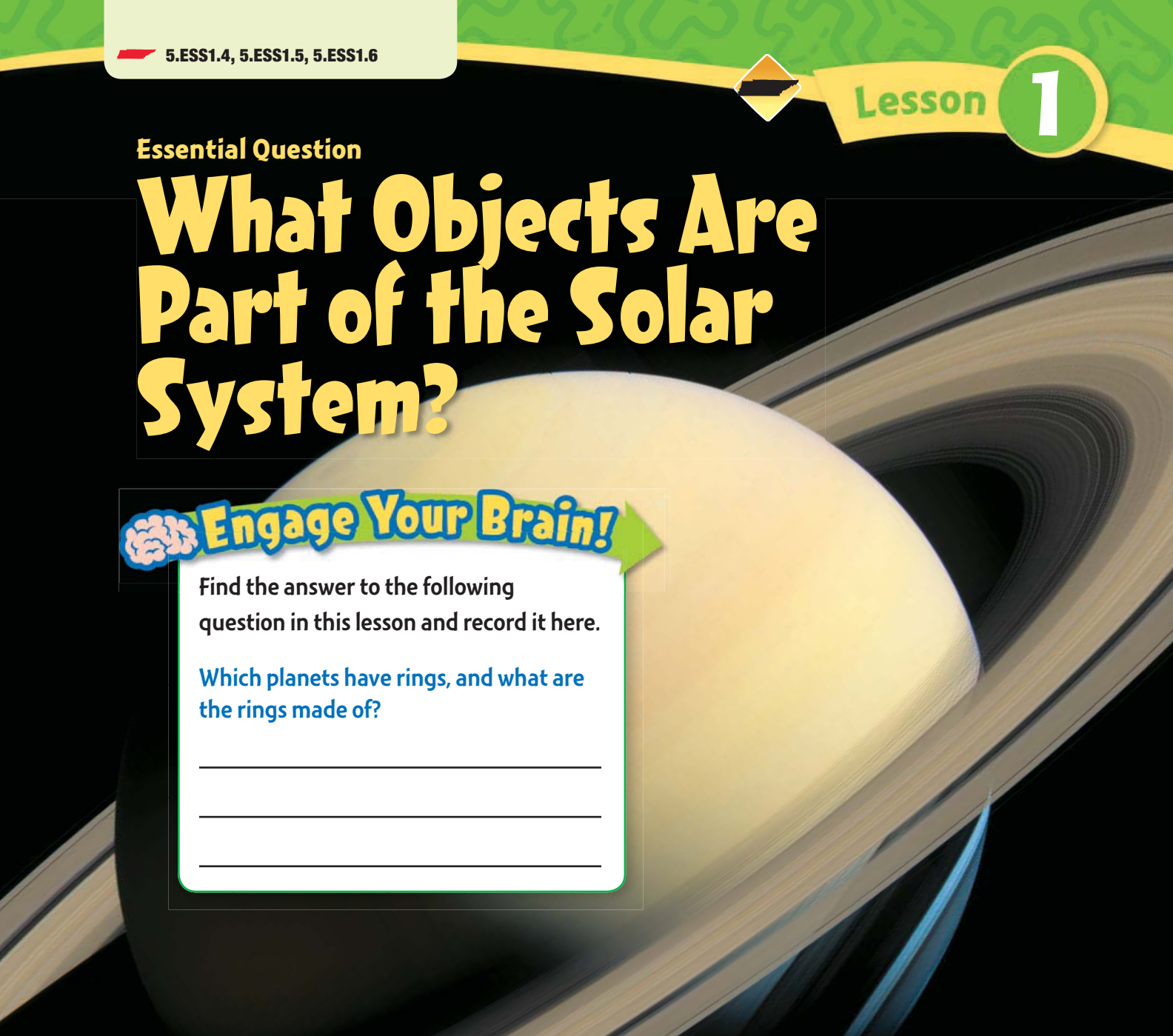
Before you begin each lesson, be sure to write your thoughts about the Essential Question.

5.ESS1.4, 5.ESS1.5, 5.ESS1.6

Lesson 1

Essential Question

What Objects Are Part of the Solar System?



Engage Your Brain!

Find the answer to the following question in this lesson and record it here.

Which planets have rings, and what are the rings made of?

_____

_____

_____

Active Reading

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____ _____

_____ _____

_____

Compare and Contrast

Many ideas in this lesson are connected because they explain comparisons and contrasts—how things are alike and different. Active readers stay focused on comparisons and contrasts when they ask themselves, How are these things alike? How are they different?

The Solar System

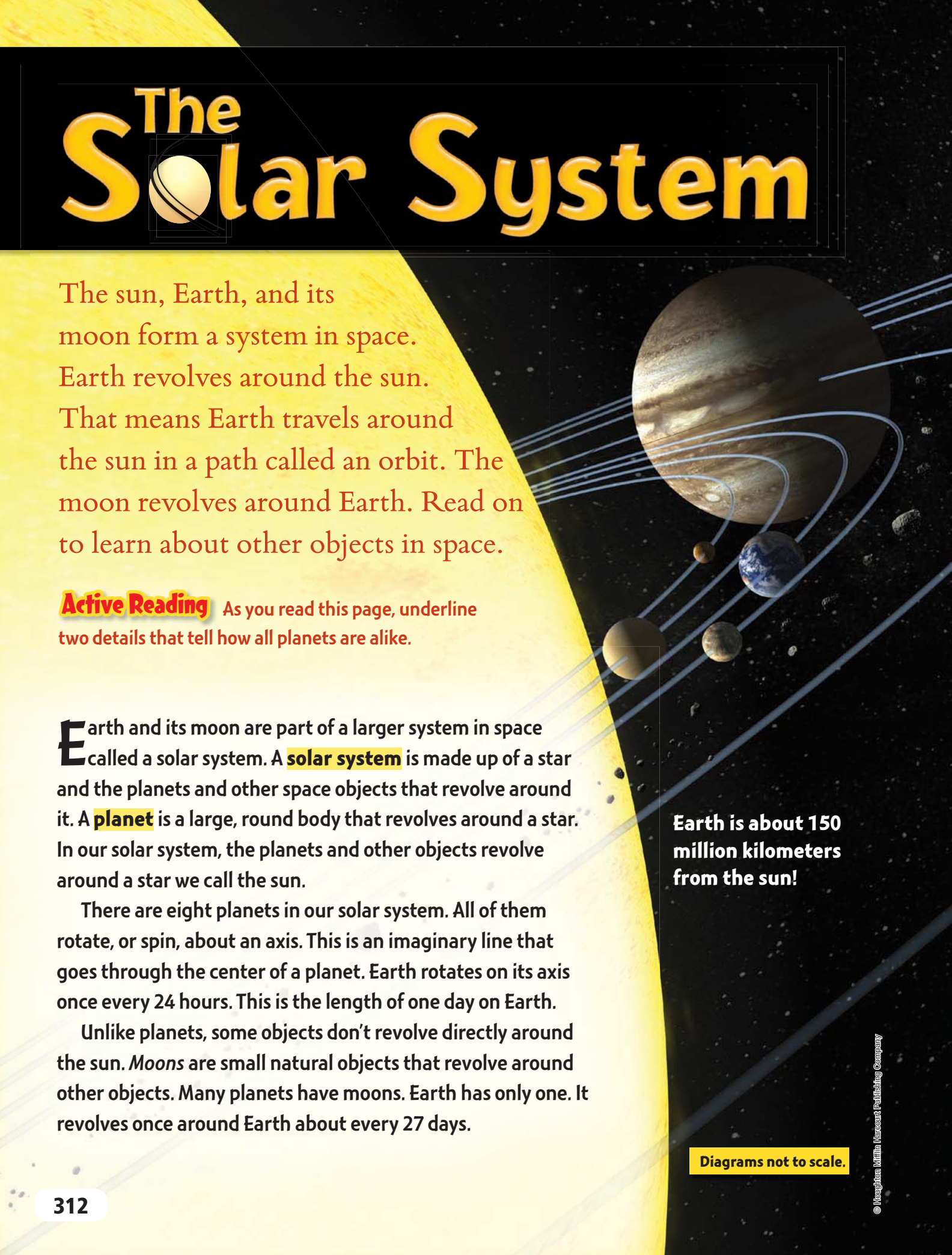
The sun, Earth, and its moon form a system in space. Earth revolves around the sun. That means Earth travels around the sun in a path called an orbit. The moon revolves around Earth. Read on to learn about other objects in space.

Active Reading As you read this page, underline two details that tell how all planets are alike.

Earth and its moon are part of a larger system in space called a solar system. A **solar system** is made up of a star and the planets and other space objects that revolve around it. A **planet** is a large, round body that revolves around a star. In our solar system, the planets and other objects revolve around a star we call the sun.

There are eight planets in our solar system. All of them rotate, or spin, about an axis. This is an imaginary line that goes through the center of a planet. Earth rotates on its axis once every 24 hours. This is the length of one day on Earth.

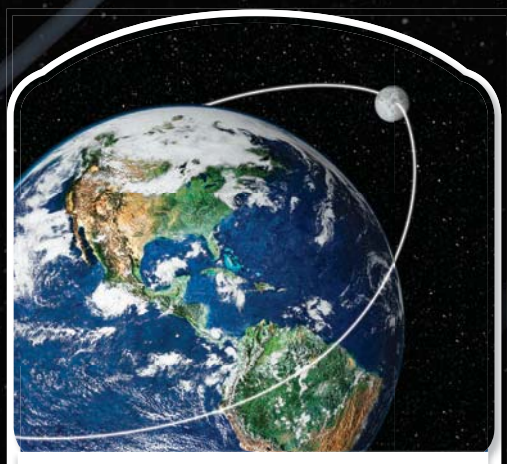
Unlike planets, some objects don't revolve directly around the sun. *Moons* are small natural objects that revolve around other objects. Many planets have moons. Earth has only one. It revolves once around Earth about every 27 days.



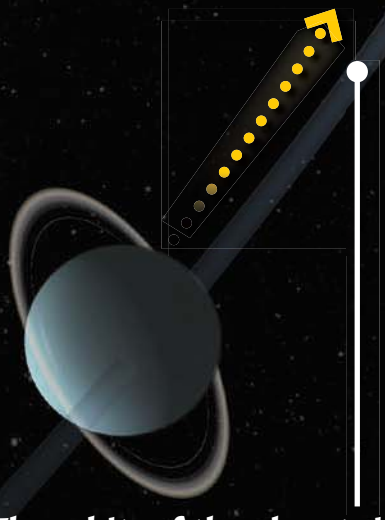
Earth is about 150 million kilometers from the sun!

Diagrams not to scale.

The planets in our solar system are very far from each other.



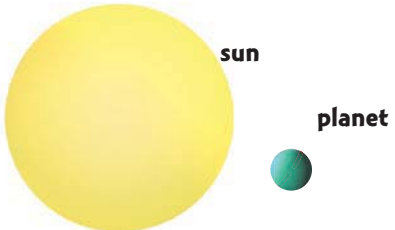
Some planets have many moons. Earth has only one. Venus and Mercury have none!



The orbits of the planets in our solar system are not perfect circles. They are oval-shaped, or **elliptical** [eh•LIP•tuh•kuhl].

Around and Around

Draw an orbit for the planet. Then draw a moon and its orbit.



The Inner Planets

At times, the brightest object in the night sky is not the moon or a star. It is Venus, one of Earth's closest neighbors in space.

Active Reading As you read this page, underline ways the inner planets are alike.

Mercury

Mercury, the smallest planet in our solar system, is less than half the size of Earth. Its surface is filled with craters, much like Earth's moon. Mercury is the closest planet to the sun. On Mercury, the sun would look three times as large as it does on Earth.

Planets in our solar system can be classified based on their distance from the sun. The four inner planets are the closest to the sun. In order from closest to farthest, the inner planets are Mercury, Venus, Earth, and Mars.

The inner planets are very dense and rocky. They have thin atmospheres and small diameters. A planet's diameter is the distance from one side of the planet, through its center, to the other side. The inner planets have large, solid cores at their centers. They have few moons, and their revolution times are short compared to the other planets in the solar system.

Venus

Venus is so hot that lead would melt at its surface! Thick clouds surround Venus, and its atmosphere is made up mostly of carbon dioxide. Lava flows from more than 1,000 volcanoes on Venus's surface.

Planets not to scale.

Earth

Earth is the third planet from the sun. It has an atmosphere made of mostly nitrogen, oxygen, and carbon dioxide. Earth is the only planet known to have abundant liquid water, which helps to keep Earth at temperatures that allow life.

Mars

Sometimes you can see Mars in the night sky. Mars is known as the "Red Planet" because of its red, rocky surface. Giant dust storms often cover the entire planet, forming huge sand dunes. Mars, like the other inner planets, has many volcanoes.

No Home for Me

List three reasons why people could not live on Venus.

1. _____

_____

2. _____

_____

3. _____

_____

The Outer Planets

On a clear night, Jupiter might appear to be a large, bright star in the night sky. But in fact, Jupiter is one of the outer planets in our solar system.

Active Reading As you read this page, underline ways the outer planets are alike.

Jupiter, Saturn, Uranus, and Neptune are the outer planets. In that order, they are the farthest planets from the sun. The outer planets are also called the gas giants, because they are huge and are made up mostly of gases. They don't have a solid surface, and their cores are very small.

Because the gas giants are so far away from the sun, their surfaces are much colder than the inner planets. All of the outer planets have many moons and ring systems. Saturn's ring system is more visible than those of the other outer planets.

Jupiter

Jupiter is the largest planet in the solar system. In fact, all of the other planets would fit inside Jupiter! Its Great Red Spot is about as wide as three Earths. The red spots are massive, spinning storms. Jupiter's faint rings were discovered by the *Voyager 1* space probe in 1979.

Great Red Spot

Saturn

Saturn, the second largest planet, has thousands of rings around it. The rings are made up of ice and chunks of rock. Some of Saturn's moons are found inside these rings. Like Jupiter, Saturn has large storms.

Planets not to scale.

What Makes Them Unique?

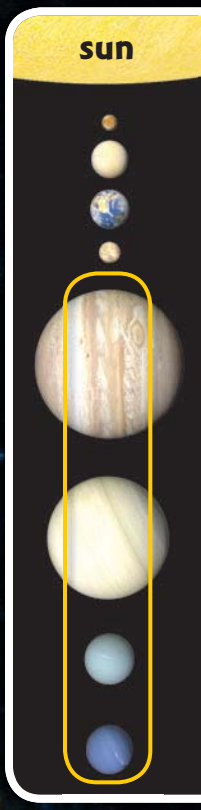
Write one thing that is unique about each of the outer planets.

Jupiter

Saturn

Uranus

Neptune



Uranus

The axis of Uranus is tilted so far that, compared to other planets, it rotates on its side. This makes seasons on Uranus last more than 20 years! Deep inside Uranus, heated gases bubble and burst onto the surface, causing bright clouds to form. Uranus has a system of at least 13 faint rings.

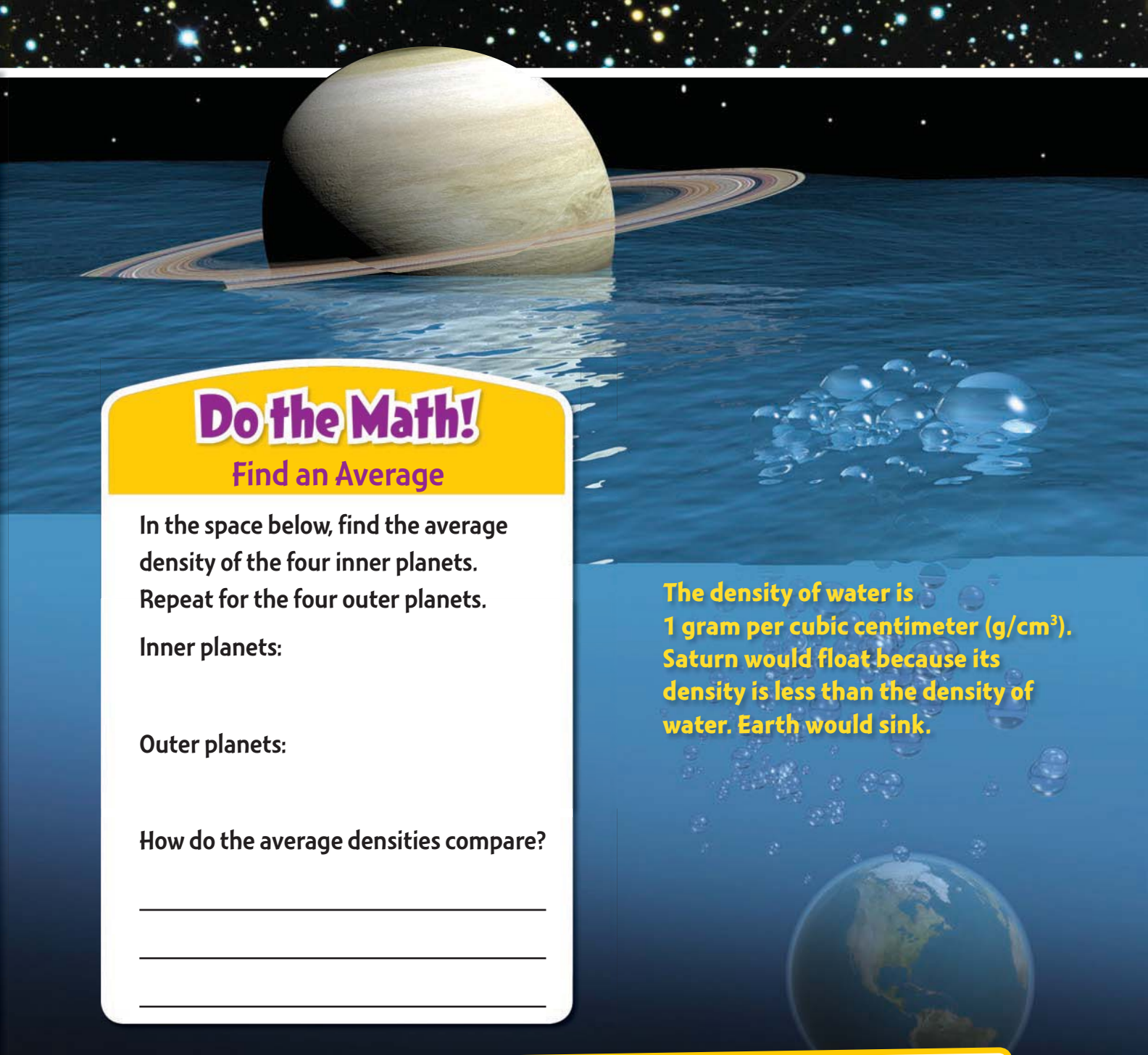
Neptune

Neptune is the windiest planet in our solar system. Its winds move at speeds of about 2,000 km/hr (1,243 mi/hr). These winds blow Neptune's Great Dark Spot around the planet. This spot is a storm, about the size of Earth, known to vanish and reform! Neptune has nine rings around it.

Compare Inner and Outer Planets

Size, surface features, and distance from the sun are just some differences between the inner and outer planets. Look at this chart to learn about other differences.

Planet	Period of Revolution (in Earth days and years)	Period of Rotation (in Earth hours and days)	Temperature (°C) (inner planets: surface range; outer planets: top of the clouds)	Number of Moons	Density (g/cm^3)	Diameter
INNER PLANETS						
Mercury	88 days	59 days	−173 to 427	0	5.43	4,878 km (3,031mi)
Venus	225 days	243 days	462	0	5.24	12,104 km (7,521 mi)
Earth	365 days	1 day	−88 to 58	1	5.52	12,756 km (7,926 mi)
Mars	687 days	about 1 day	−87 to −5	2	3.94	6,794 km (4,222 mi)
OUTER PLANETS						
Jupiter	12 years	about 10 hours	−148	67	1.33	142,984 km (88,846 mi)
Saturn	29 years	about 10 hours	−178	62	0.70	120,536 km (74,898 mi)
Uranus	84 years	about 17 hours	−216	27	1.30	51,118 km (31,763 mi)
Neptune	165 years	about 16 hours	−214	14	1.76	49,528 km (30,775 mi)



Do the Math!

Find an Average

In the space below, find the average density of the four inner planets. Repeat for the four outer planets.

Inner planets:

Outer planets:

How do the average densities compare?

The density of water is 1 gram per cubic centimeter (g/cm^3). Saturn would float because its density is less than the density of water. Earth would sink.

Patterns in Data

Use the data table on the previous page to categorize the physical properties and motion of inner planets and outer planets.

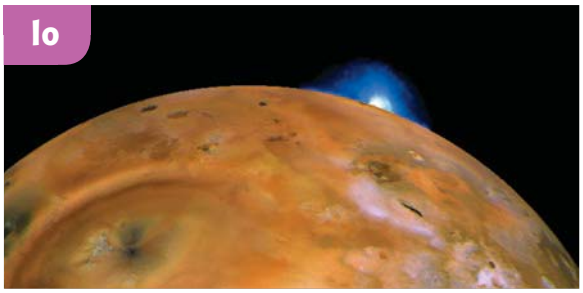
The Flying Objects

Besides planets, there are many other bodies that orbit the sun. Let's find out more about some of them.

Active Reading As you read these two pages, find and underline two facts about asteroids.

Moons

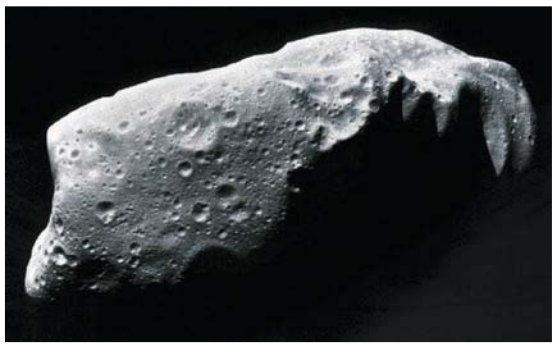
Other moons are very different from Earth's moon. Europa, one of Jupiter's moons, may have a liquid ocean under a layer of ice. Another of Jupiter's moons, Io [EYE•oh], has the most active volcanoes of any body in the solar system.



Dwarf Planets

Pluto was once called a planet. But in 2006, it was reclassified as a dwarf planet. **Dwarf planets** are nearly round bodies whose orbits cross the orbits of other bodies. Most are found in a region of the solar system beyond Neptune's orbit called the Kuiper Belt. These objects are far away and hard to study. Quaoar, shown above, was discovered in 2002.

Asteroids



Asteroids are rock and iron objects that orbit the sun. Millions of them are found in the wide region between Mars and Jupiter known as the *asteroid belt*. Some asteroids are as small as a city block. Others could fill up an ocean. Some asteroids even have their own moons!

Meteoroids, Meteors, and Meteorites

Each day, tons of meteoroids hit Earth's atmosphere. *Meteoroids* are pieces of rock that break off of asteroids and travel through space. Most meteoroids burn up in Earth's atmosphere, causing a streak of light called a *meteor*. Meteoroids that reach Earth's surface are called *meteorites*.

Where's the Sun?

In the drawing of a comet, put an *S* to indicate the direction toward the sun. Put a *T* over each tail.

Comets

A **comet** is a chunk of frozen gases, rock, ice, and dust. Comets have long orbits around the sun. As comets pass close to the sun, part of their frozen surface begins to break away and turn into gases and dust. These particles reflect the sun's light and become visible as long tails. A comet's tails always point away from the sun.

Use Data to Categorize Bodies in Our Solar System

Use data to make a chart that categorizes moons, asteroids, comets, and meteoroids according to their physical properties and motion.

Why It Matters

Space Watch

Some objects in space cross each others' orbits. Often, nothing happens. But sometimes the objects hit each other. Scientists look out for objects that may cross Earth's orbit.

Pictures of the surface of the moon tell a story. Over millions of years, space objects such as comets, meteoroids, and asteroids have impacted, or hit, the moon. Impact craters of all sizes can be found on the moon's surface.

Space objects have also hit other bodies in the solar system. A comet named Shoemaker-Levy 9 impacted Jupiter in 1994. Pictures of the impact were taken by the *Galileo* space probe.

Scientists know that large objects have also hit Earth. In fact, a huge one impacted Earth about 65 million years ago. Many scientists think it caused changes in the environment that killed all the dinosaurs. Luckily, impacts like that one do not happen often.

Scientists use telescopes to scan space for near-Earth asteroids. These are objects that may cross Earth's orbit. Scientists keep track of their size, position, and motion. They analyze this data to determine if the objects could impact Earth.

The impact of Shoemaker-Levy 9 caused bubbles of hot gas to rise into Jupiter's atmosphere, as well as dark spots to form on its surface.

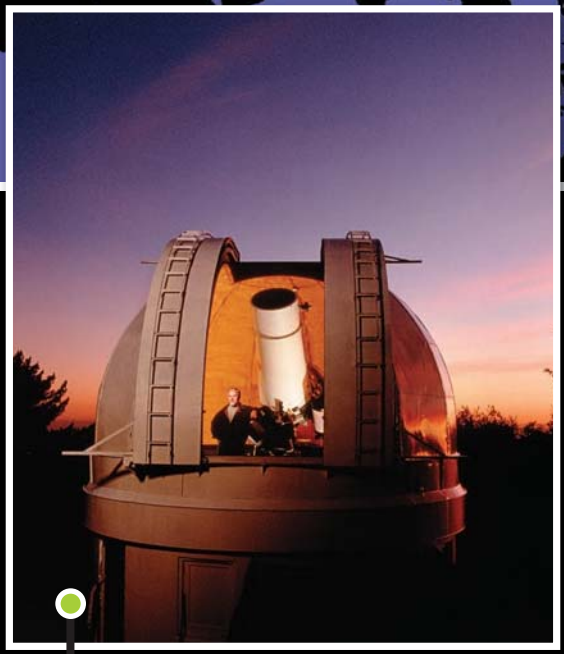
The Barringer Meteor Crater, in Arizona, was formed by a meteorite that struck Earth about 50,000 years ago.

Impacts can happen anywhere on Earth! This map shows some impact crater sites from around the world.

Impact Crater Diameter

- 10–25 km
- 25–50 km
- greater than 50 km

▶ On these pages, underline effects of impacts. Then circle a picture that shows evidence of an impact on Earth.



Observatories have powerful telescopes that enable scientists to track the movement of objects in space.

Sum It Up!

When you're done, use the answer key to check and revise your work.

Read the summary, and then place the information in the list into the correct box below.

The sun is at the center of the solar system. Planets, dwarf planets, moons, and other smaller objects make up the solar system. The eight planets in the solar system can be divided into inner planets and outer planets. Each group has different characteristics.

small and dense	longer revolutions	many moons	few moons
giant size	closest to sun	gaseous surface	low density
rings	rocky surface		

1 **Inner Planets**

2 **Outer Planets**

Fill in the missing information to describe the object shown below.

3

Io

a. Object Type: _____

b. Space Neighbors: _____

c. Key Feature: _____

d. How It's Different from Earth: _____

_____

_____

Answer Key: 1. Inner Planets: small and dense, rocky surface, few moons, closest to sun
2. Outer Planets: gaseous surface, giant size, rings, many moons, low density, longer revolutions
3a. moon 3b. Jupiter and its other moons 3c. active volcanoes 3d. Io orbits a planet. Earth is a planet, so it orbits the sun. Io is farther from the sun than Earth.

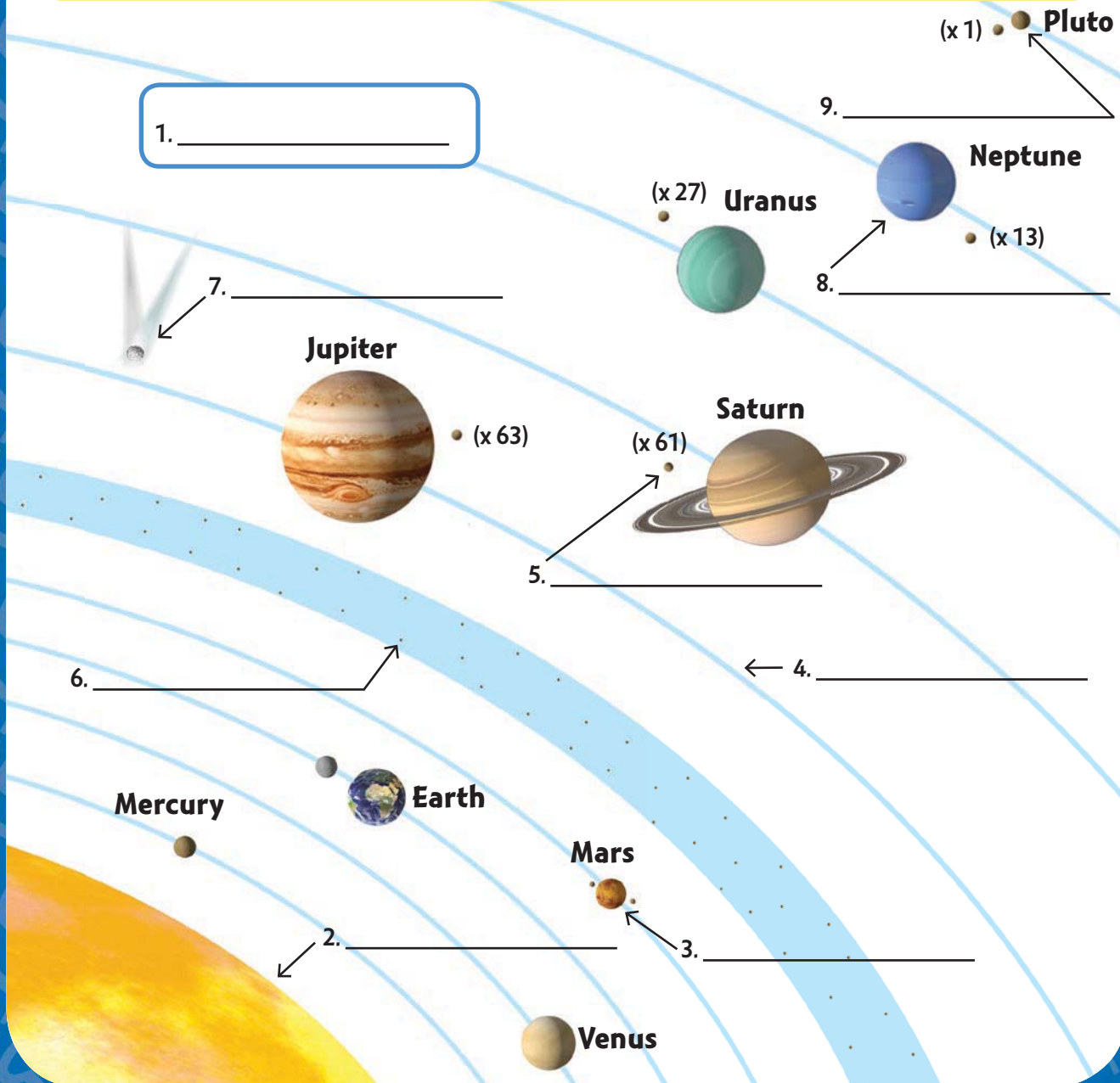
Name _____

Word Play

1 Use each of the terms in the box to label the objects in the diagram below.

planet	comet	asteroid	solar system	dwarf planet
moon	orbit	gas giant	sun	

* Key Lesson Vocabulary



Apply Concepts

2 In the space below, draw pictures to show the key physical characteristics of an inner planet and an outer planet. Then describe your drawings.

3 Describe the features of a comet.

4 What is a meteoroid, and how does it become a meteorite?

Name _____

5 Identify each of the following large objects in the solar system. Write how you are able to identify each one.

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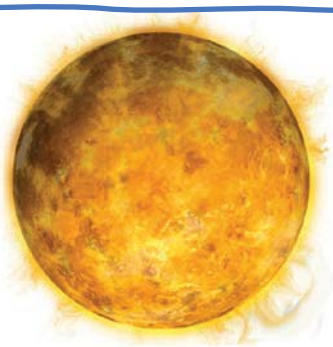
_____



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_____

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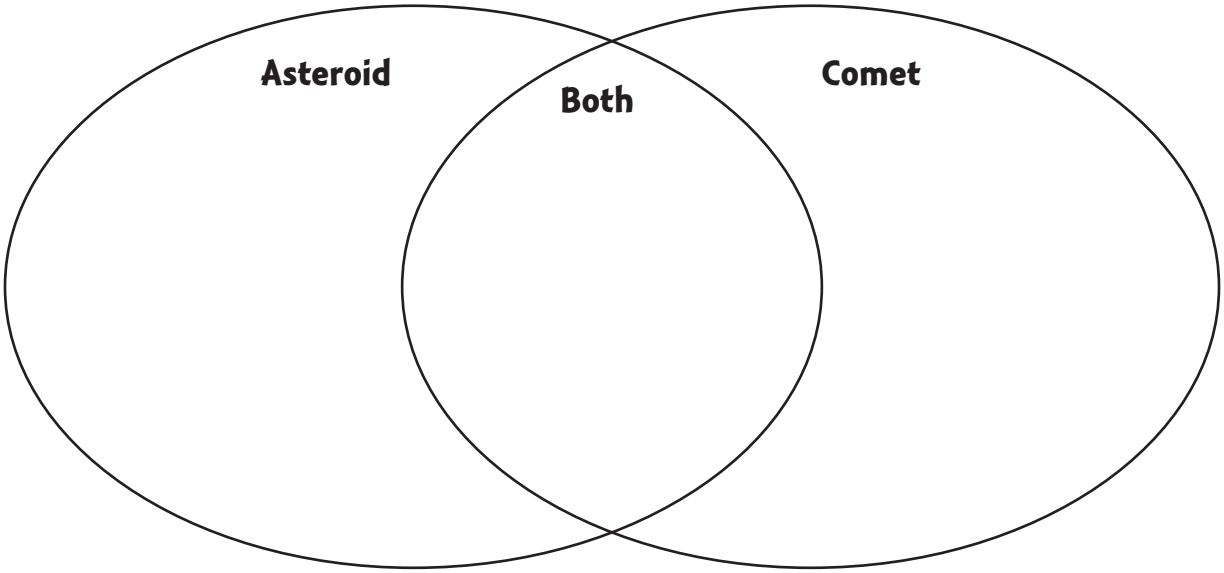
_____

6 A scientist discovers an object in the solar system. She describes it as bigger than an asteroid, smaller than Mercury, and farther from the sun than Neptune. What kind of object could it be? Explain.

_____

_____

7 Complete the Venn diagram to compare and contrast an asteroid and a comet.



8 Draw a picture of an object that might impact a planet. Label and describe the object. What evidence is there that these objects collide with planets and moons?

Take It Home!

See *ScienceSaurus*® for more information about the solar system and beyond.

Meet Two Space Explorers

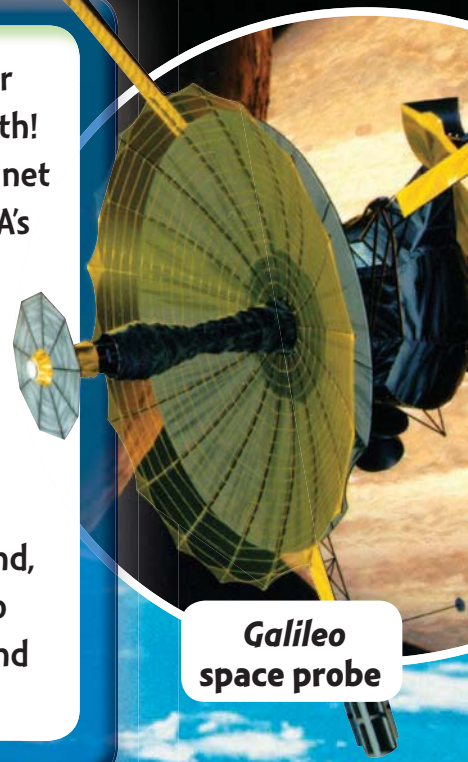
On her first mission, Kalpana Chawla traveled more than six million miles in 15 days!

Kalpana Chawla

As a little girl in India, Kalpana Chawla dreamed about flying airplanes. She came to the United States and earned her degree in aerospace engineering. Chawla could fly many kinds of airplanes. Her dreams had come true! But she kept dreaming. She went to work for NASA and became an astronaut. Soon, Kalpana Chawla became the first Indian-born woman in space! Chawla's last mission was in 2003 on the space shuttle Columbia.

Claudia Alexander

Claudia Alexander explored outer space, too. But she never left Earth! She studied the moons of the planet Jupiter. She was in charge of NASA's *Galileo* mission. The mission sent an unmanned spacecraft to Jupiter. The spacecraft left Earth in 1989. It took six long years to reach Jupiter. Claudia Alexander directed it over 385 million miles! Under her command, *Galileo* was the first spacecraft to take detailed photos of Jupiter and its moons.



***Galileo* space probe**

Two Ways to Study Space

Kalpana Chawla and Claudia Alexander studied space in different ways. Write the statements that apply to each scientist in the correct circle.

The Hubble Space Telescope sends scientists pictures of space from its orbit high above Earth.

- I led space missions without leaving Earth.
- I traveled on the space shuttle.
- I studied the moons of Jupiter.
- I grew up in India and learned to fly many types of airplanes.
- I studied objects in space.

Kalpana Chawla

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Claudia Alexander

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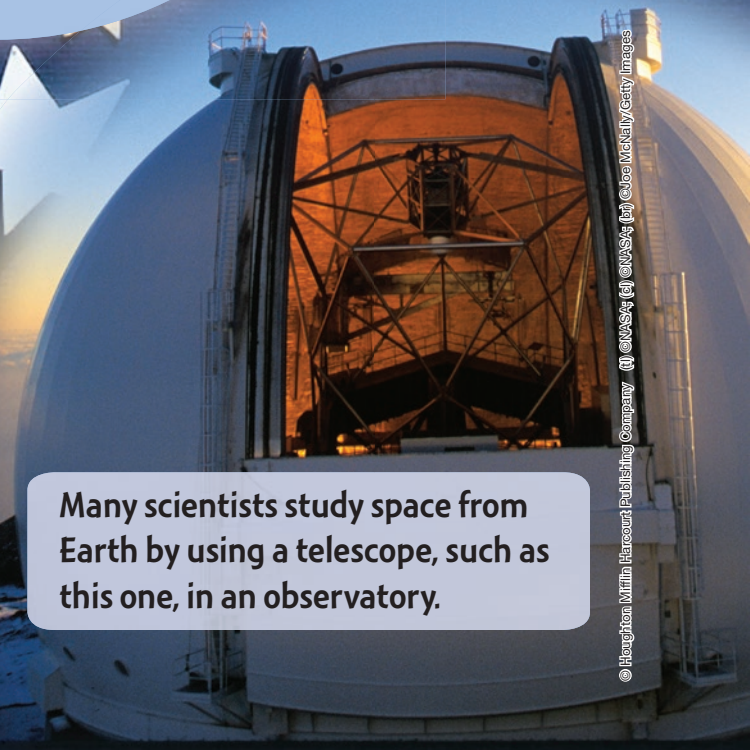


Many scientists study space from Earth by using a telescope, such as this one, in an observatory.

5.ESS1.1, 5.ESS.1.2

Lesson 2

Essential Question

What Are Stars and Galaxies?

Engage Your Brain!

Find the answer to the following question in this lesson and record it here.

Space is not completely empty. There are small particles in space. What happens when these particles come together?

_____

_____

_____

A nebula, such as the Pelican Nebula shown here, is a giant cloud of gas and dust.

Active Reading

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

_____

Signal Words: Details

Signal words show connections between ideas. *For example, for instance,* and *such as* signal examples of an idea. *Also* and *in fact* signal added facts. Active readers remember what they read because they are alert to signal words that identify examples and facts about a topic.

TWINKLING STARS

You see stars as tiny points of white light in the night sky. Stars are not tiny, and they are not all white. Find out how scientists study stars.

Active Reading As you read these two pages, draw boxes around words or phrases that signal a detail or an added fact.

People have always looked at objects in the sky. **Astronomy** is the study of objects in space and their characteristics. *Astronomers* are scientists who study space and everything in it. They use many types of telescopes to observe objects in space, such as stars and planets.

Stars are huge balls of hot, glowing gases that produce their own heat and light. The sun is the star you know the most about. It seems much larger than other stars only because it is much closer to Earth.

Do the Math!

Dividing by 3-digit Numbers

A small telescope magnifies objects 150 times. A large observatory telescope magnifies an object 3,300 times. How many times as great is the magnification of the observatory telescope than the small telescope?

The sun is a medium-size yellow star. Many stars are larger or hotter than the sun. A supergiant, for example, can be more than 100 times the size of the sun.

A STAR IS BORN

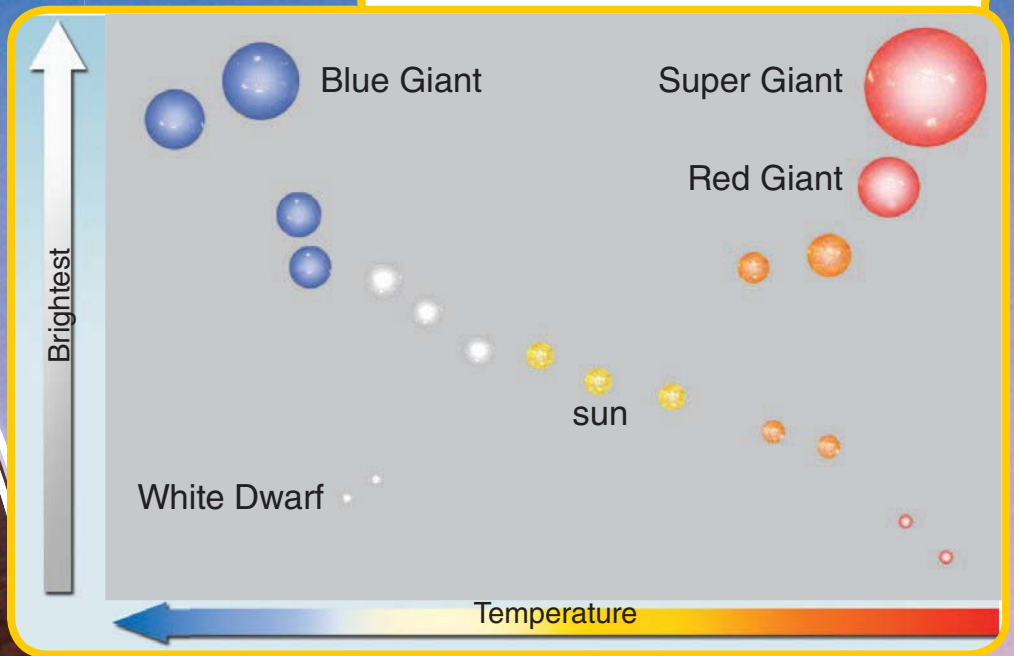
Stars form when gravity causes gas and dust particles found in space to pull together. These particles are squeezed together under great pressure. Eventually, energy stored in the particles is released as heat and light. A star is born.

Stars are classified by their color, temperature, brightness, and size. The color of a star can tell us about its temperature. For example, blue stars are the hottest. A blue star's average temperature is about 15,000 °C.

Stars have a wide range of sizes. White dwarf stars, for instance, can be as small as a planet. Giant and supergiant stars are many times bigger than the average-size star. The largest stars are also usually the brightest. A star's brightness is related to the amount of visible light it gives off.

Super Hot and Just Hot

Draw a rectangle around the hottest stars in the diagram. Draw a circle around the brightest stars.



SO BRIGHT!

Our sun is not the brightest or hottest star in the universe. So why does our sun appear so bright compared to other stars? Read to find out more.

Our sun is only average in brightness and size compared to all the other stars in the universe. In fact, some stars we can see in our night sky, such as the star Deneb, are close to 200,000 times brighter and 200 times larger than the sun! However, these stars are extremely far away, making them appear dimmer than the sun.

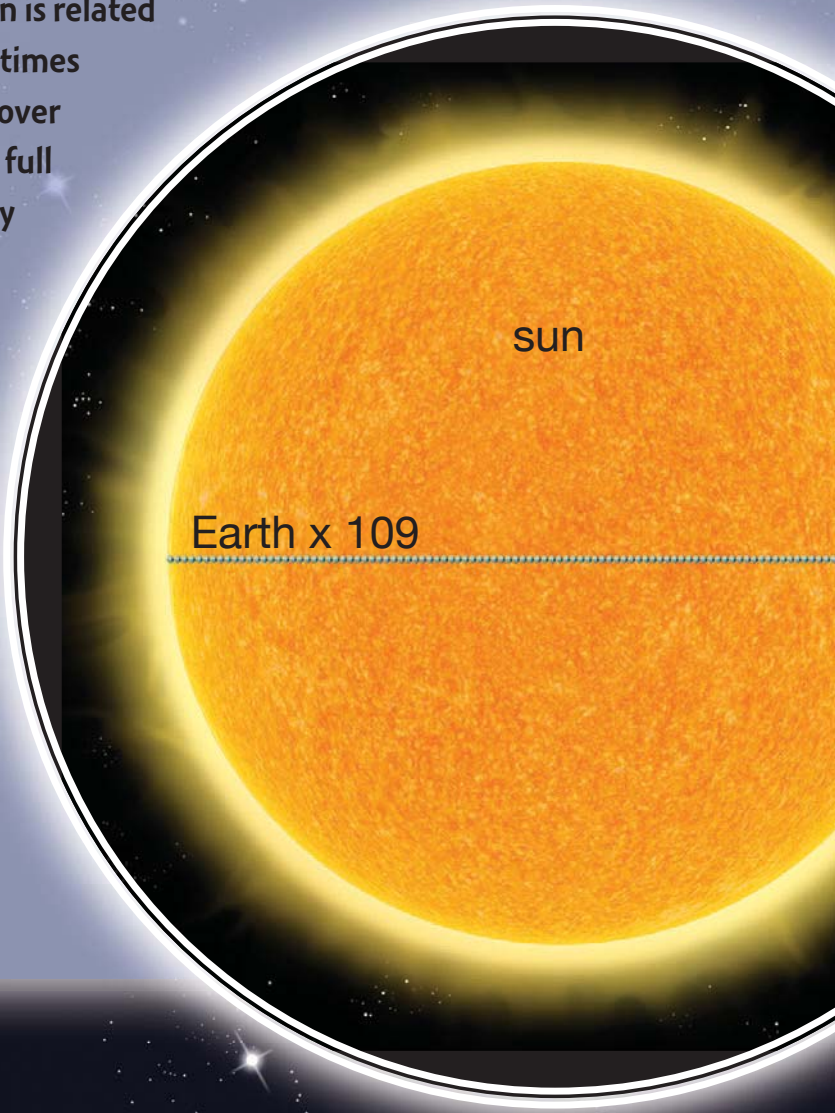
Look at the picture below. In it, two people are holding lights. One person is standing very close to you. The other person is holding a light far in the distance. The light closer to you will look brighter than the light in the distance.

The same is true for stars. Our sun is only about 150 million kilometers from Earth. The sun's light takes only about eight minutes to get to Earth. The star Deneb, on the other hand, is estimated to be over 1,500 light-years away. A *light-year* is the distance light can travel in a year. Therefore, it takes 1,500 years for light to travel from Deneb to Earth. Deneb appears fainter than the sun because it is a much greater distance from Earth than the sun.

Active Reading

As you read these two pages, put a box around words or phrases that signal comparison, such as like, brighter, or greater.

This diagram shows how big the sun is related to Earth. The sun's diameter is 109 times larger than Earth's diameter. Also, over 1 million Earths could fit inside the full volume of the sun! It's huge! So why doesn't the sun fill our whole sky? The reason is because the sun is about 150 million kilometers away. While this distance is "close" compared to all other stars in the universe, it is still a very far distance. Therefore, the sun looks smaller in the sky than it is. Earth's distance from the sun is extremely fortunate, however. This precise distance from the sun is part of the reason Earth can support life.



▶ The star Rigel is about 780 light-years from Earth. Several hundred stars are closer to Earth than Rigel. However, Rigel is the seventh brightest star in our night sky. Why do you think it is so bright compared to other stars that are closer?

GOING GALACTIC

Our solar system is huge. Yet it is only a tiny part of a much larger system in space. Our sun is one star in a group of billions of stars found in the Milky Way galaxy.

Active Reading As you read the next four pages, circle details about the ages of stars in each type of galaxy.

YOU ARE HERE

Once, people thought Earth was at the center of the universe. The **universe** is everything that exists. Now we know that we are not even at the center of our own galaxy!

▶ In the space below, describe the position of the solar system within the Milky Way.

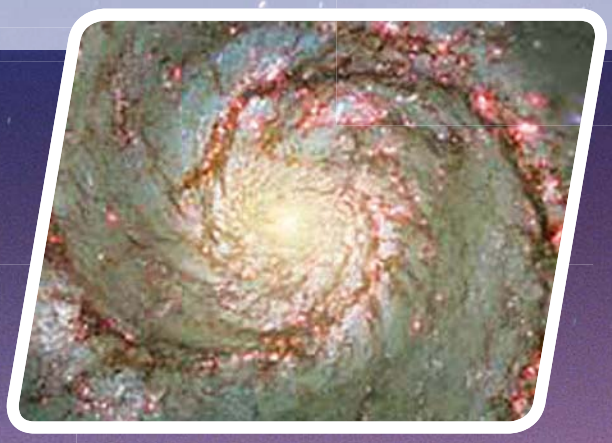
FEATURES OF GALAXIES

A **galaxy** is a group of billions of stars, the objects that orbit the stars, gas, and dust. A galaxy is held together by gravity. There are billions of galaxies in the universe. Galaxies are separated by large distances. On a cloudless night, you might see what looks like a faint band of clouds among the stars. This is a part of our home galaxy, the Milky Way. Most other galaxies can be seen only by using powerful telescopes.

TYPES OF GALAXIES

In the 1920s, astronomer Edwin Hubble was the first to study galaxies. He classified them by shape. Through his telescope, Hubble observed pinwheel-like groups of stars that he called *spiral galaxies*.

Some spiral galaxies, called *barred spiral galaxies*, have a center shaped like a long bar. Recent evidence suggests that the Milky Way is a barred spiral galaxy.



SPIRAL **GALAXIES**

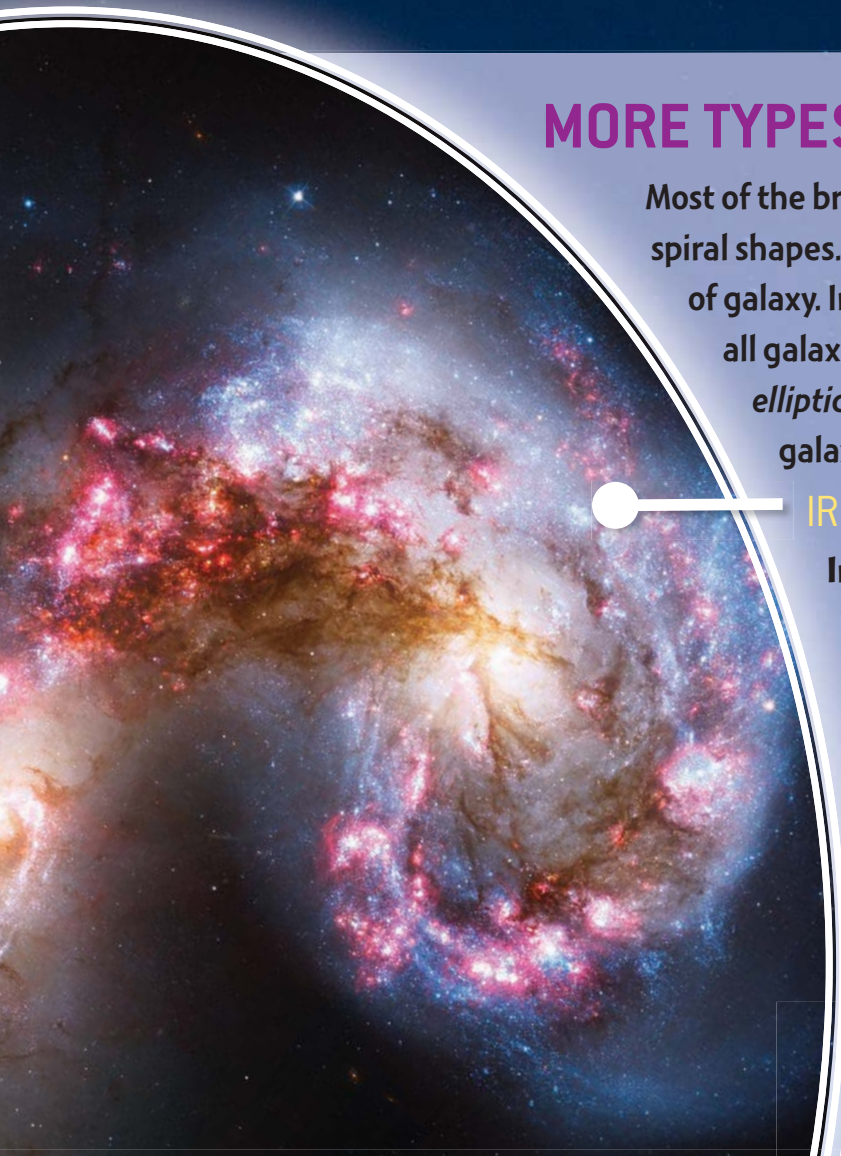
Spiral galaxies consist of a rotating disk of young stars, gas, and dust and a central bulge made of older stars.

BARRED SPIRAL **GALAXIES**

Barred spiral galaxies may have two or more spiral arms. Unlike regular spirals, there are young stars at the center of barred spiral galaxies.

MORE TYPES OF GALAXIES

Most of the brightest galaxies in the universe have spiral shapes. But spiral galaxies are not the only type of galaxy. In fact, they make up only about 20% of all galaxies. The dimmer *irregular galaxies* and *elliptical galaxies* make up about 80% of all galaxies in the universe.



IRREGULAR **GALAXIES**

Irregular galaxies do not have any particular shape. The stars are randomly scattered. There is a lot of gas and dust to form new stars. About 20% of all galaxies are irregular. Some astronomers think that gravity from nearby galaxies causes irregular galaxies to form.

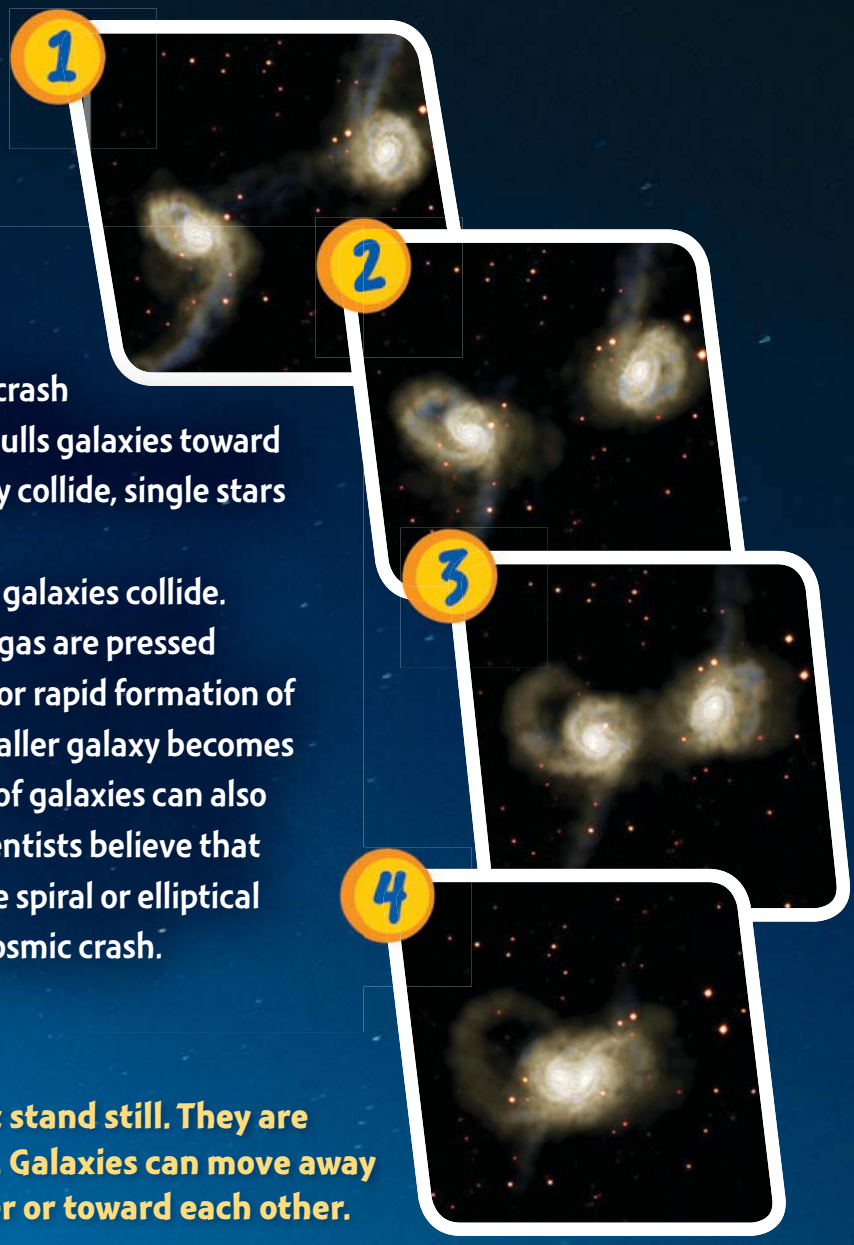
ELLIPTICAL **GALAXIES**

Elliptical galaxies are brightest at their center. About 60% of all galaxies in the universe are elliptical. They can be shaped like a perfect sphere or a flattened globe. Large ellipticals are made up of old stars and have too little dust or gas to form new ones.

COSMIC **CRASHES**

Sometimes galaxies collide, or crash together, in space! Why? Gravity pulls galaxies toward each other. Although galaxies may collide, single stars and planets almost never do.

Many things can happen when galaxies collide. Often, large amounts of dust and gas are pressed together. This causes a starburst, or rapid formation of many new stars. Sometimes, a smaller galaxy becomes part of a larger galaxy. A collision of galaxies can also form a large, irregular galaxy. Scientists believe that many irregular galaxies were once spiral or elliptical galaxies that were involved in a cosmic crash.



Galaxies do not stand still. They are always moving. Galaxies can move away from each other or toward each other.

▶ Look at pictures 1–5. Draw a picture to show what you think will happen next to these two galaxies. Write a sentence to describe it.

Sum It Up!

When you're done, use the answer key to check and revise your work.

The universe is composed of billions of galaxies. Dust, gas, and billions of stars make up a galaxy. The idea web below summarizes information about stars and galaxies. Complete it using the words and phrases from the box.

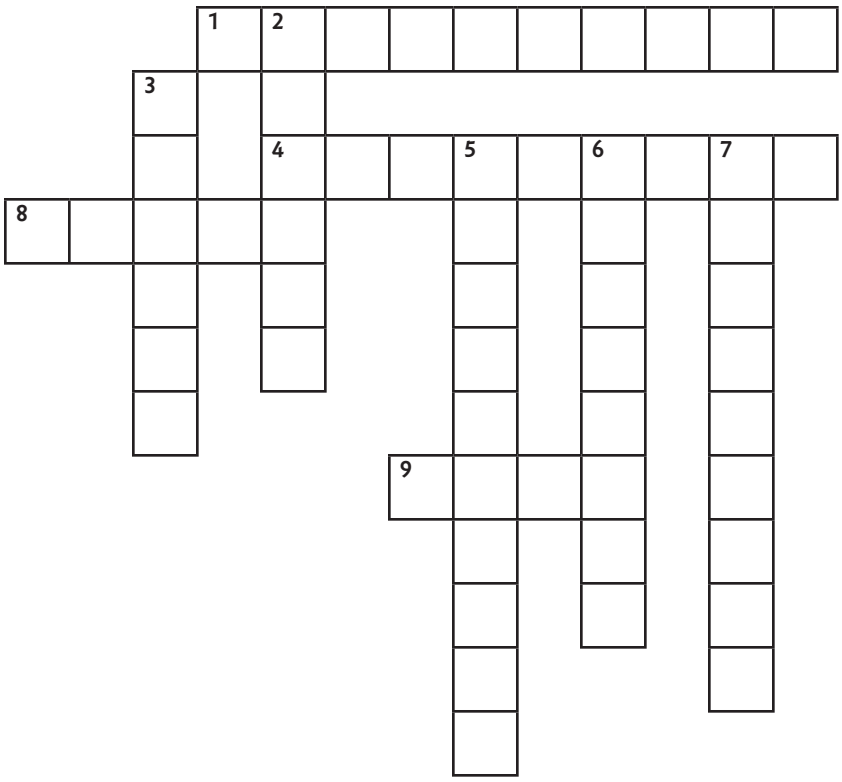
Types of Galaxies	Elliptical	Temperature
Spiral	Characteristics of Stars	Size
Color	Irregular	

Answer Key: 1–3 (in any order): Spiral; Elliptical; Irregular 4. Types of Galaxies 5. Characteristics of Stars 6–8 (in any order): Color; Size; Temperature

Name _____

Word Play

1 Complete the puzzle. If you need help, use the words in the box below the clues.



Across

1. A person who studies the universe
4. A galaxy with no particular shape
8. Characteristic that is related to a star's temperature
9. A ball of hot, glowing gases

Down

2. A pinwheel-like galaxy
3. A group of stars, dust, and gases
5. A galaxy shaped like a flattened globe
6. Everything that exists—planets, stars, dust, and gases
7. The study of the objects in space and their properties

spiral	elliptical	astronomy*	irregular	galaxy*	star*
astronomer	color	universe*			

* Key Lesson Vocabulary

Apply Concepts

2 What are some ways galaxies differ?

_____

_____

3 Look at this picture of a spiral galaxy.

Draw a picture of a barred spiral galaxy.

Tell how the two galaxies are alike and different.

_____

_____

4 Look at these two stars. Compare and contrast them using at least two properties.

red giant

blue star

_____

_____

_____

5 How do these stars compare to the sun?

_____

_____

Take It Home!

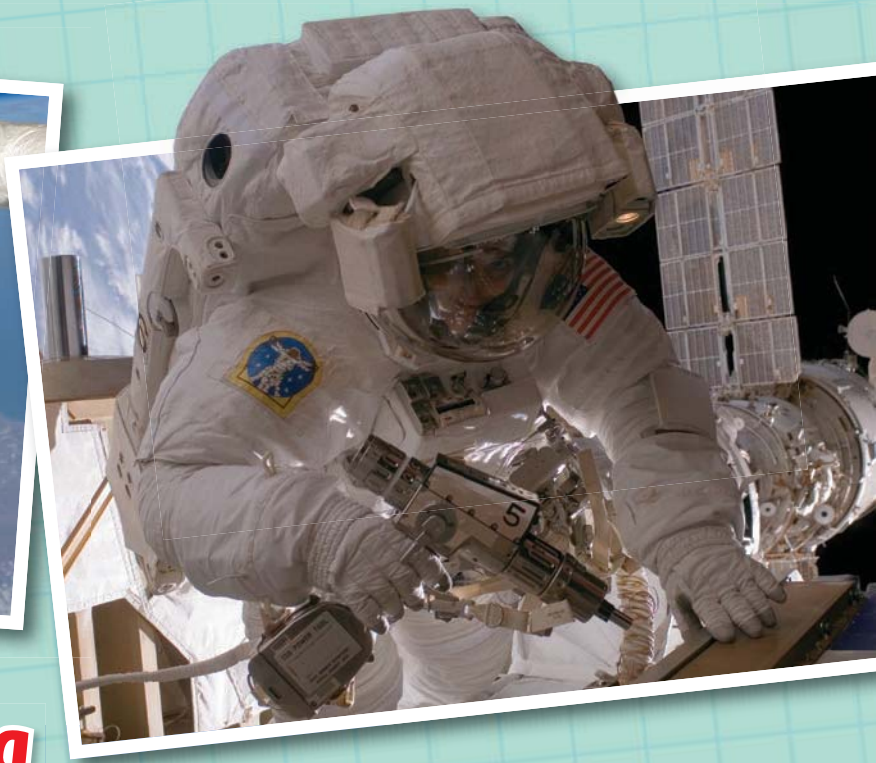
Find out which are the brightest stars that are visible this time of year in your area. With an adult, observe the stars. Make a diagram of the night sky showing where to find the brightest stars.

S.T.E.M.

Engineering & Technology

Tools in Space

An astronaut often has to use screwdrivers or drills to fix things in space. The astronaut's tools are specially designed for a person wearing bulky gloves and floating in orbit. Hand tools must work in the extreme cold vacuum of space and be tethered so they don't float away. A robotic arm helps the astronaut move around outside. However, the astronaut's most important tool is the space suit that maintains an environment in which the astronaut can breathe.



Troubleshooting

Find the astronaut's drill. How is it similar to a drill used on Earth? How is it different?

S.T.E.M.
continued

You are used to doing everything under the pull of Earth's gravity. That's what makes it possible for you feel motions as up, down, and side-to-side. There is no "right side up" in space! It is harder than you might think to work in such an unfamiliar environment.

Turn your book so that the top of this page is closest to you.

Hold your pencil near the eraser. Write your name on the line above so that it reads properly when you turn the page right side up again.

What made this task difficult?

How do engineers account for microgravity when designing the inside of a space station?

Build On It!

Rise to the engineering design challenge—complete **Improvise It: How High Is That Star?** in the Inquiry Flipchart.

Lesson 3

Essential Question

How Do the Sun, Earth, and Moon Move?

Engage Your Brain!

Find the answer to the following question in this lesson and record it here.

The picture shows a solar flare on the sun. How can solar flares affect you on Earth?

_____

_____

_____

_____

Active Reading

Lesson Vocabulary

List each term. As you learn about each one, make notes in the Interactive Glossary.

_____ _____

_____ _____

_____ _____

_____ _____

Signal Words: Cause and Effect

Signal words show connections between ideas. Words signaling a cause include *because* and *if*. Words signaling an effect include *so* and *thus*. Active readers recall what they read because they are alert to signal words that identify causes and effects.

Very Different Orbs

You can't help but notice that the sun and moon are very different from Earth and from each other. What makes them so different? Read on to find out!

Active Reading As you read this page, draw boxes around words or phrases that signal comparison, such as *like, unlike, larger,* and *smaller.*

There are millions of kilometers between the sun, moon, and Earth. Yet we feel heat from the sun and see the whitish color of the moon. These are direct evidence that these bodies are different from our planet.

Earth is often called the "blue planet" because most of its surface is covered by water. On the moon's surface, water wouldn't last long. Without a thick atmosphere like Earth's, liquid water on the moon would freeze or be lost to space.

The sun is a star, which is a huge, hot ball of gases that produces its own light. It's about 109 times larger than Earth. Unlike Earth and the moon, the sun does not have a solid surface. Its atmosphere extends out millions of kilometers. From the sun's surface, solar flares explode into space.

The moon is tiny when compared in size to the sun. Unlike Earth, its temperatures are scorching hot during the day and freezing cold at night. Like Earth, it has features such as mountains and flat plains.

EARTH

Earth is a *planet*, an object that moves around a star, has a nearly round shape, and has cleared its path of most debris. Its characteristics include:

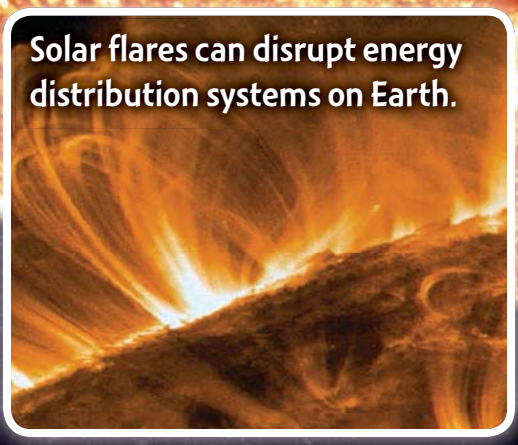
- Diameter: 12,742 km
- Structure: mainly rocky layers, partly liquid core
- Composition: mainly iron, oxygen, silicon, and magnesium
- Atmosphere: mainly nitrogen and oxygen
- Notable features: lots of liquid water and diverse life forms
- Minimum surface temperature: −88 °C
- Maximum surface temperature: 58 °C

The green hue shows plant life that Earth's waters help support.

SUN

The sun produces energy deep in its core. This energy makes the sun glow and provides Earth with heat and light.

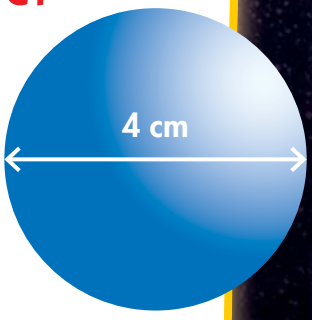
- Diameter: 1,391,016 km
- Structure: gaseous layers
- Composition: hydrogen and helium
- Atmosphere: hydrogen and helium
- Notable surface features: sunspots, solar flares
- Average surface temperature: 5,500 °C

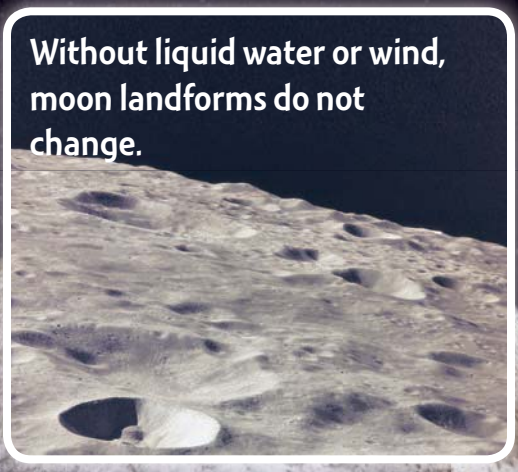


Solar flares can disrupt energy distribution systems on Earth.

How Do They Compare?

This circle is a model of Earth. It is 4 cm in diameter. Use a calculator and data on this page to find the diameter for a moon model. Would the moon model fit inside Earth's model? If so, draw it in.





Without liquid water or wind, moon landforms do not change.

MOON

The moon is visible from Earth because it reflects light from the sun.

- Diameter: 3,475 km
- Structure: rocky layers
- Composition: mainly oxygen, silicon, magnesium, and iron
- Atmosphere: none
- Notable surface features: craters, mountains, plains
- Minimum surface temperature: −233 °C
- Maximum surface temperature: 123 °C

Beyond the Book

Use the information on these pages to construct a 3-ring Venn diagram to compare the physical characteristics of the sun, Earth, and moon. What makes each object unique?

Images are not to scale.

The Sun-Earth-Moon System

The moon moves around Earth as Earth moves around the sun. What keeps these objects from flying off in space?

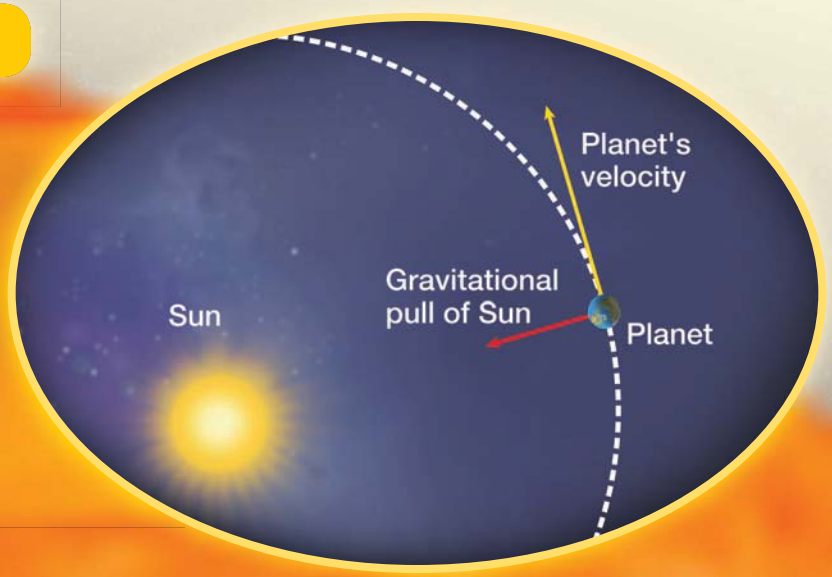
Active Reading As you read these two pages, draw boxes around clue words that signal a cause.

What defines the unit of time we call a year? A year is the time it takes for Earth to **revolve**, or go around, the sun. Any object that revolves around another object in space is called a *satellite.* Earth is a satellite of the sun. Because the moon revolves around Earth, it is a satellite of Earth.

The path one space object takes around another is called an **orbit**. It takes Earth about 365 days to complete its orbit around the sun. The moon's orbit is shorter than Earth's. As a result, it takes the moon just 27 days to revolve once around Earth.

Earth's and the moon's motion around the sun is in part because of gravity. *Gravity* is the force of attraction that exists between all objects. Gravitational attraction between objects depends on two things: the distance between the objects and the masses of the objects.

Gravitational Pull The sun is about 330,000 times more massive than Earth. Its strong gravitational pull keeps all objects near it from flying off into space. Gravity also keeps the moon in its orbit around Earth. Gravitational pull decreases with distance.



Moon

Earth

▶ Scientists have observed that every year the moon gets farther away from Earth. Predict what could happen if the moon gets too far away.

_____

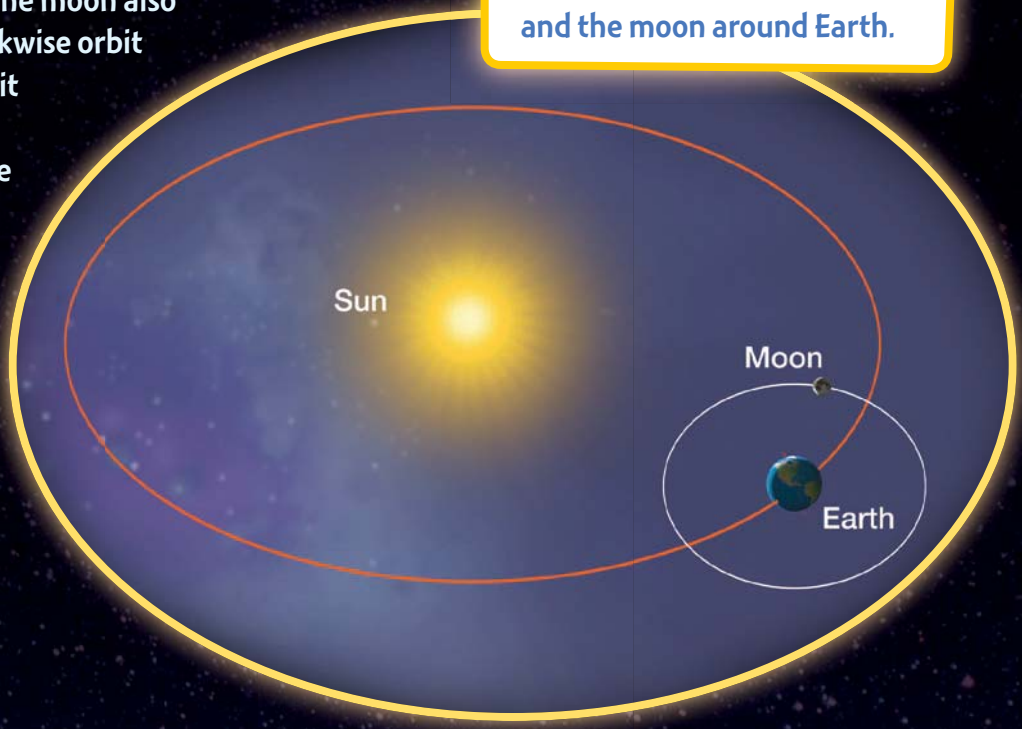
_____

_____

_____

Orbits Earth revolves around the sun in a counterclockwise orbit. The moon also revolves in a counterclockwise orbit around Earth. Earth's orbit around the sun is nearly circular in shape, with the sun nearly in the center of the circle.

▶ Draw arrows to show how Earth revolves around the sun and the moon around Earth.



Images are not to scale.

Eclipses

An eclipse is an event during which one object in space casts a shadow on another object. We experience two types of eclipses here on Earth. Read on to learn more about each type of eclipse and its cause.

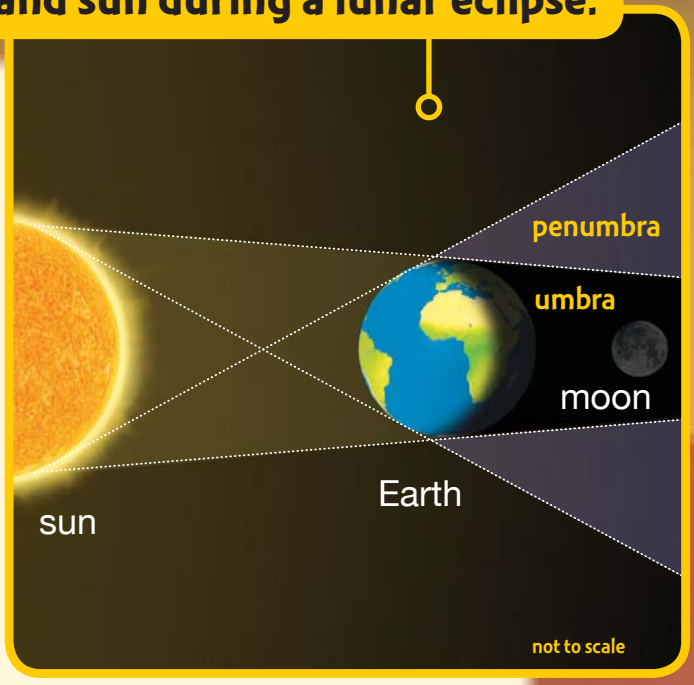
Active Reading As you read these two pages, underline two facts about a solar eclipse and two facts about a lunar eclipse.

LUNAR ECLIPSE

A **lunar eclipse** is an event during a full moon when the moon moves into Earth's shadow. Earth's shadow has two major parts: the *umbra* and the *penumbra*. First, the moon moves into Earth's penumbra, or the lighter and wider shadow. Earth's shadow makes that part of the moon appear dark and red. Sometimes, only part of the moon enters the shadow before it moves out of the shadow again. This is called a partial lunar eclipse.

As the moon revolves, it may enter Earth's *umbra*, or the darkest shadow. If the moon completely enters Earth's umbra, a total lunar eclipse will occur. The entire moon will appear darker and more reddish in color. The moon will then slowly move out of Earth's shadow to appear bright once more.

The positions of Earth, moon, and sun during a lunar eclipse.

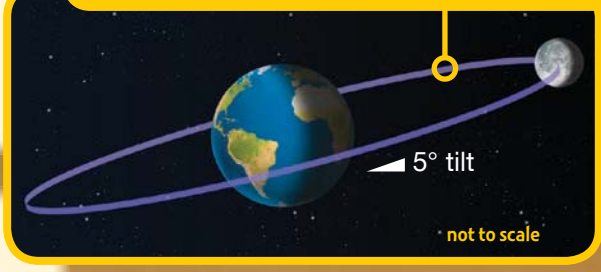


Total lunar eclipse

WHY ISN'T THERE AN ECLIPSE EVERY MONTH?

Solar and lunar eclipses are relatively rare events, occurring only once every one to two years. Why don't we see an eclipse every month? The reason is because the orbit of the moon is tilted 5° to Earth's orbit. (see diagram). The moon's orbit must cross Earth's orbit precisely during a full moon or a new moon for an eclipse to occur.

The moon's orbit is tilted 5°.



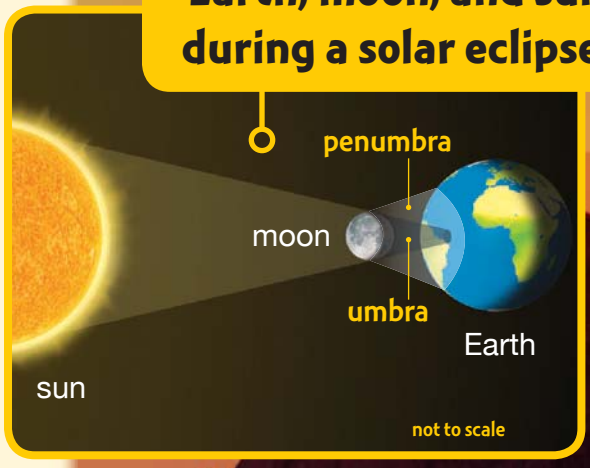
SOLAR ECLIPSE

A **solar eclipse** is an event during a new moon when Earth moves into the moon's shadow. During a total solar eclipse, the moon comes between Earth and the sun, blocking all the sun's disk, as seen in the background picture of this page. The bright white surrounding the blackened sun is the sun's outer atmosphere that we cannot see under normal conditions.

The diagram on the right shows how small an area on Earth is in the moon's umbra. You can see a total solar eclipse only if you are in the umbra's path. This path is only a few hundred kilometers wide, so witnessing a total solar eclipse is rare.

People can see a partial solar eclipse if they are in an area where the penumbra hits Earth. Only part of the sun will look blackened during a partial solar eclipse.

The positions of Earth, moon, and sun during a solar eclipse.



Think About It!

▶ It is much more rare to witness a solar eclipse than a lunar eclipse. Why? Look at the diagrams for clues.

Clear As Day and Night

You've learned that Earth revolves around the sun. What other movement does Earth have?

Active Reading As you read these two pages, find and underline the definitions of *rotates* and *axis*.

Each morning, you see the sun appear to rise in the east. At first, the sun is low in the sky. As the day goes on, it seems to move higher, cross the sky, and set in the west.

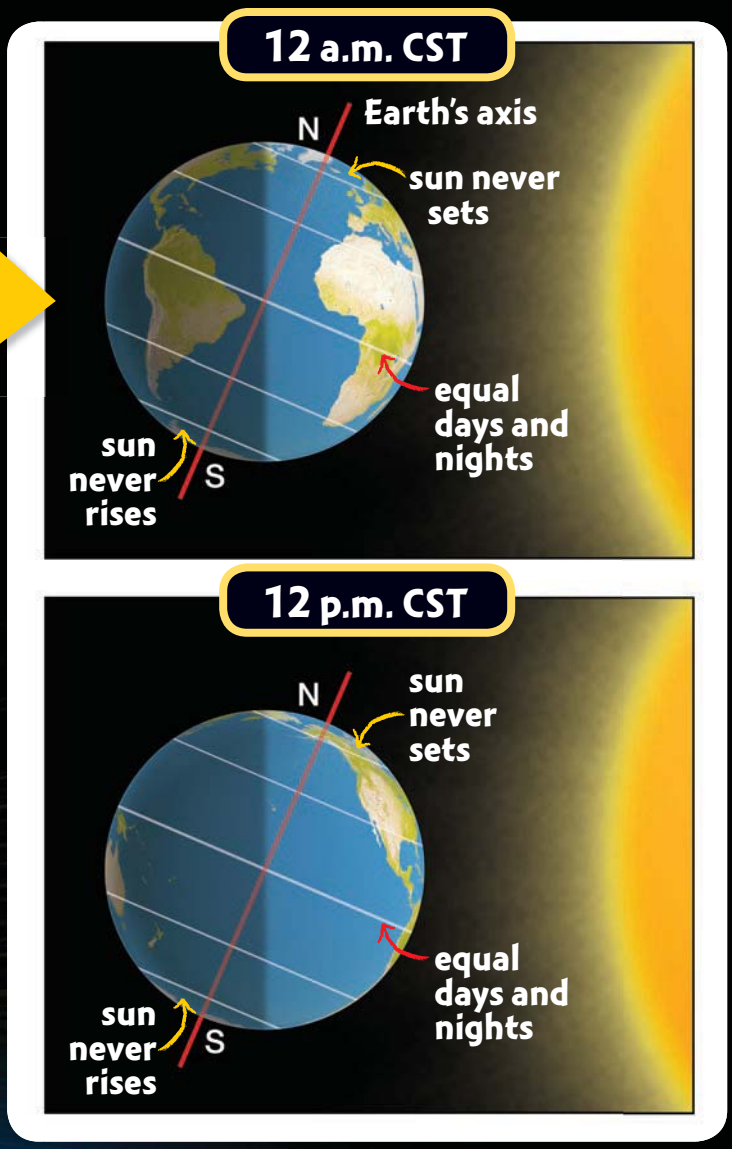
The sun is not actually moving. Instead, Earth **rotates**, or spins around its axis, once every 24 hours. The **axis** is the imaginary line that goes through Earth from pole to pole. The rotation of Earth around its axis also causes the moon and the stars to appear to move across the sky.

Evidence of Rotation You can see evidence of Earth's rotation if you look at the stars at night. The North Star is nearly directly above the North Pole. It does not appear to move as Earth rotates. It's like the hub of a wheel—the stars around it seem to circle around the North Star.

The North Star does not seem to rise, set, or move across the sky.

As Earth rotates, one half of Earth experiences daylight while the other half is in darkness.

Day/Night Cycle The rotation of Earth around its axis causes day and night. Look at the diagrams on the right. At 12 a.m., Houston, Texas, faces away from the sun. The people who live there are most likely sleeping. However, Earth is constantly rotating. In the bottom diagram, it is 12 p.m. and Texas is facing the sun. People there may now be outside in the sunshine. While it is day in Texas, it is nighttime on the opposite side of the world.



This time-lapse photo shows the circular path stars appear to take around the North Star throughout the night.

Do the Math!

Calculate Circumference

Earth takes 24 hours to complete one rotation. It rotates at an average speed of 1,670 km/hour. Calculate Earth's circumference at the equator based on its rotational speed. Show your work below.

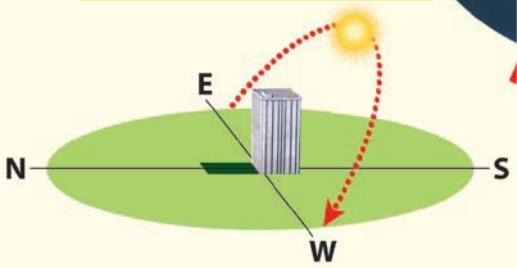
Images are not to scale.

More Earth-Sun Interaction

Earth's rotation around its axis causes night and day. What changes happen on Earth as it also revolves around the sun?

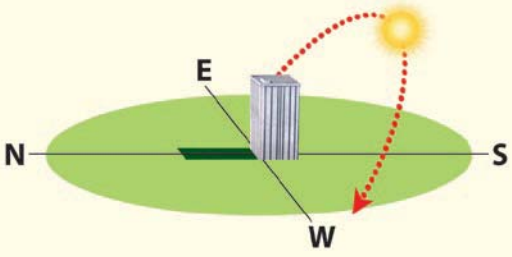
Active Reading As you read these two pages, draw a star next to what you think is the most important sentence. Be ready to explain your reasoning.

Summer Solstice



During summer, Earth's axis points toward the sun. The Northern Hemisphere's summer solstice occurs June 20 or 21. It is the longest day of the year and marks the start of the summer season. Summer days are the longest and warmest. The noon sun is high in the sky, causing shadows to be short.

Fall Equinox



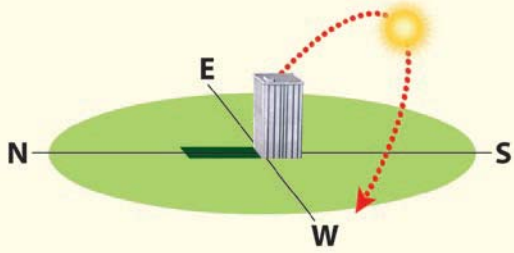
During fall and spring, Earth's axis points neither away nor toward the sun. The fall equinox occurs September 22 or 23 in the Northern Hemisphere. This day marks the start of fall and has equal hours of day and night. In fall, daylight hours grow shorter and the noon sun's height is lower than in summer.

Images are not to scale.

Earth's Orbit

Look at the diagrams of Earth on these pages. Notice that Earth's axis is not straight up and down. Instead, it is tilted at a 23.5 degree angle. The tilt of Earth's axis as it revolves around the sun causes seasons. *Seasons* are short-term changes in climate. Most places on Earth have four seasons: summer, fall, winter, and spring. Seasons happen because different parts of Earth get different amounts of sunlight throughout the year. This causes changes in temperature and length of day.

Spring Equinox

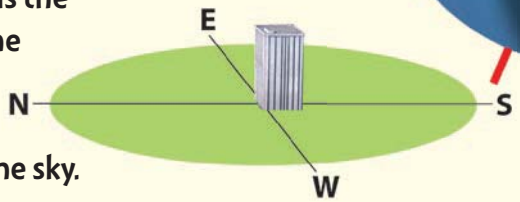


In the Northern Hemisphere, the spring equinox occurs March 20 or 21. In spring, the sun appears higher in the sky than it did in winter, daylight hours grow longer, and temperatures get warmer.

▶ To complete the model, draw the path of the sun as it appears to rise, cross the sky, and set during winter. Then draw the shadow cast by the building.

Winter Solstice

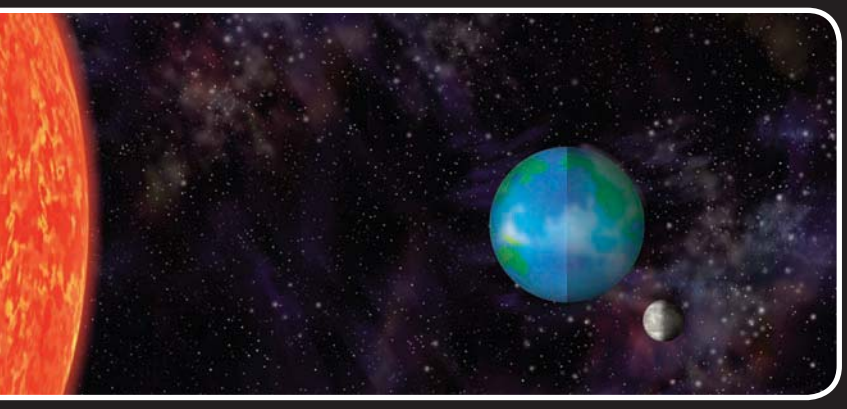
During winter, Earth's axis points away from the sun. The Northern Hemisphere's winter solstice occurs December 21 or 22. It is the shortest day of the year and marks the start of the winter season. Winter days are the shortest and coldest of the year. The sun is never high in the sky.



Moon Phases

One night, you might look at the moon and see a tiny sliver in the sky. A few nights later, you might see a bright, round circle. What makes the moon look so different?

Active Reading As you read the last paragraph, write numbers next to the sentences to show the sequence of moon phases.



As Earth orbits the sun, the moon also orbits Earth. The moon reflects light from the sun. That is the light we see from Earth. As the moon travels in its orbit, different amounts of the moon's lit side can be seen from Earth.

During the new moon phase, the moon is between Earth and the sun. We can't see the moon at all. During a first quarter moon, we see one-half of the moon's lit side.

The moon's shape does not change. The changes in the appearance of the moon's shape are known as **moon phases**.

You know that sunlight reflects from the moon to Earth. Yet the sun lights only half of the moon at any time. The motions of Earth and the moon are responsible for the phases you see. As the moon revolves around Earth, the amount of the lit part that we see from Earth changes. These different amounts of the moon's lighted side are the different phases of the moon.

Each phase of the moon has a different shape. It takes about one month for the moon to complete all of its phases. Then the cycle repeats.

During the new moon phase, we can't see the moon. That is because the lit part of the moon faces away from Earth. As the moon moves in its orbit around Earth, we see more of the moon's lit part. We see a full moon when all of the lit part of the moon faces Earth. Then we see less and less of the lit part again.

Do the Math!

Estimate Fractions and Percentages

What fraction and percent of the moon's lit side is seen during each phase? Complete the table.

	Full moon	First quarter	New moon	Third quarter
Fraction		$\frac{1}{2}$		
Percent		50%		

The lit portion grows larger until we see a full moon. This happens when Earth is between the moon and the sun. As the moon continues in its orbit, we see less of its lit portion. When it is half lit again, it is a third quarter moon.

Patterns in the Sky

The Big Dipper is a part of a star pattern in the night sky. To ancient Greeks, the pattern looked like a giant bear.

Active Reading As you read this page, draw a circle around words or phrases that provide details about constellations.

People have looked at the stars for thousands of years. A star pattern, or **constellation**, is a group of stars that seems to form a picture in the night sky. The early Greeks named constellations after animals or people from stories called *myths*. The Big Dipper is part of a constellation called *Ursa Major*, or Great Bear. Orion is a constellation named after a hunter in a Greek myth.

As Earth rotates on its axis, constellations seem to move across the night sky. Like the sun, constellations seem to rise in the east and set in the west. Stars above the North Pole, however, seem to move in a circle.

The positions of the constellations seem to change with the seasons, because we see different parts of space as Earth revolves around the sun. The stars in the constellations do change a little over time. However, it might take millions of years for a constellation to change its shape!

For thousands of years, people have seen pictures in the stars. They connect the stars to make a pattern or shape.

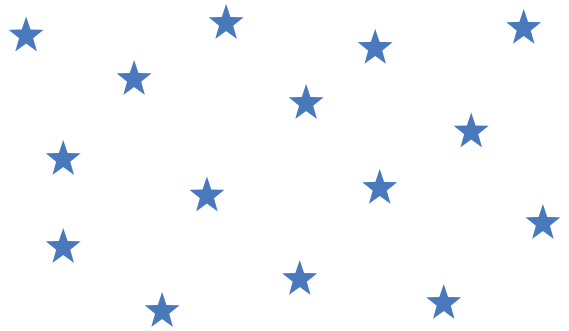
These pictures show stars seen from the same location during summer (at left) and winter (at right). The constellations seem to change their places in the sky.

Connect the Stars

Connect the stars to draw a constellation. Use all or some of the stars. What is the name of your constellation?

_____

_____



The Changing Night Sky

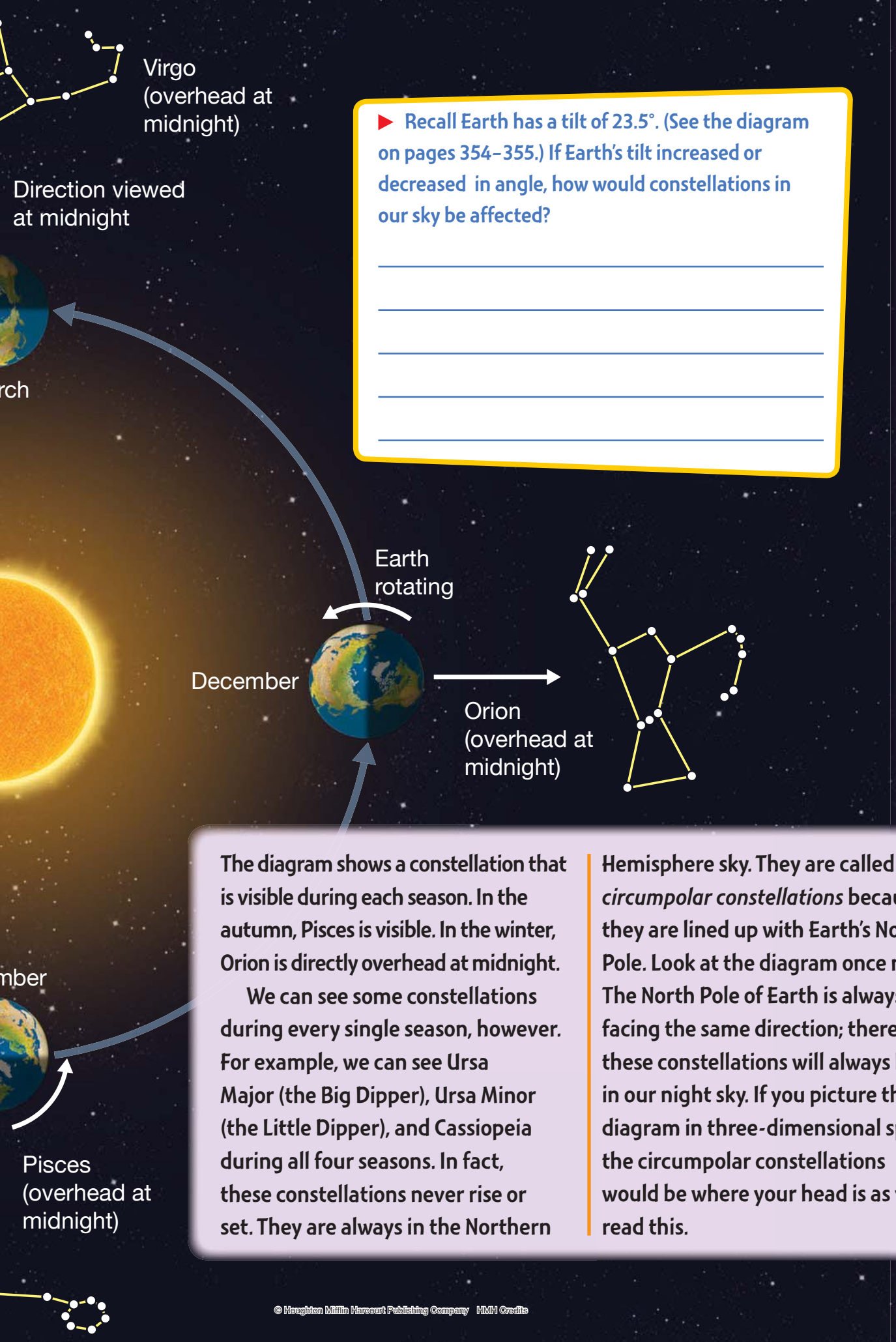
The stars and constellations you see in the night sky during the summer are different from the stars that you see in the winter night sky.

Active Reading

Put parentheses around the explanation describing why other constellations change with the seasons. Underline the explanation describing why we see some constellations during all seasons.

Have you ever been stargazing? If you have, you may have noticed that the night sky seems to change over the year. Some constellations you see during the summer are different from the constellations you see in the fall, winter, and spring. Why? The answer is found in Earth's rotation around the sun. Look at the diagram on these two pages. Notice that as Earth revolves around the sun, the night side of Earth is facing different parts of the universe. Therefore, Earth will be pointing toward different stars during different seasons, which enables those of us in the Northern Hemisphere to see different constellations.

not to scale



▶ Recall Earth has a tilt of 23.5°. (See the diagram on pages 354–355.) If Earth's tilt increased or decreased in angle, how would constellations in our sky be affected?

The diagram shows a constellation that is visible during each season. In the autumn, Pisces is visible. In the winter, Orion is directly overhead at midnight.

We can see some constellations during every single season, however. For example, we can see Ursa Major (the Big Dipper), Ursa Minor (the Little Dipper), and Cassiopeia during all four seasons. In fact, these constellations never rise or set. They are always in the Northern Hemisphere sky. They are called *circumpolar constellations* because they are lined up with Earth's North Pole. Look at the diagram once more. The North Pole of Earth is always facing the same direction; therefore, these constellations will always be in our night sky. If you picture the diagram in three-dimensional space, the circumpolar constellations would be where your head is as you read this.

Sum It Up!

When you're done, use the answer key to check and revise your work.

Fill in the chart below to show how the sun and moon differ from Earth.

Compare sun, Earth, and moon		
	Similarities to Earth	Differences from Earth
sun	The sun has a(n) 1. _____ that extends far into space.	The sun produces 3. _____ _____on its surface that affect communications on Earth.
moon	The moon has a(n) 2. _____ surface and features that include mountains and plains.	Land features on the moon don't 4. _____ _____because there is no liquid water on the moon's surface.

Summarize

Fill in the missing words about the sun-Earth-moon system.

Earth 5. _____ around its axis once every 24 hours. This movement of Earth makes the moon, stars, and 6. _____ appear to move across the sky. This movement also causes the 7. _____ and 8. _____ cycle. Earth 9. _____ around the sun once every 365 days. The time it takes Earth to go once around the sun is called a 10. _____. Earth's revolution and the tilt of its axis cause the 11. _____ to occur. 12. _____ keeps the moon in its orbit around Earth and Earth in its orbit around the sun. 13. _____ in the night sky change with the seasons because Earth revolves around the sun, pointing to different areas of the universe. A 14. _____occurs when the moon moves into Earth's shadow. The moon's revolution around Earth causes 15. _____, or the moon to appear different shapes.

Answer Key: 1. atmosphere 2. rocky 3. solar flares 4. wear away 5. rotates 6. sun 7. day or night 8. day or night 9. revolves or orbits 10. year 11. seasons 12. Gravity 13. Constellations 14. lunar eclipse 15. moon phases

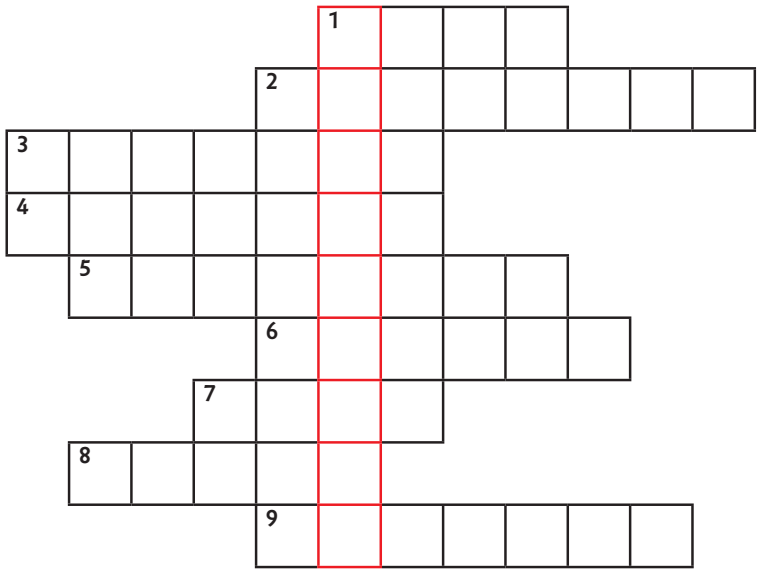
Name _____

Word Play

1

Use the words in the box to complete the puzzle.

1. Has no solid surface and is made up of helium and hydrogen
2. The spinning of Earth around its axis causes this cycle
3. Keeps Earth and the moon in orbit around the sun
4. Earth does this around its axis
5. Earth does this around the sun
6. An object in space that moves around the sun, has a round shape, and has cleared its path of most debris
7. The imaginary line that goes through Earth from pole to pole
8. Earth's path around the sun
9. Short-term changes in climate caused by Earth's movement around the sun



Read the letters going down the column with the red border. Use that word to complete the following riddle.

10. Sally Smith's spaceship goes around and around Earth, so it is a _____.

axis*	day/night	gravity	orbit*	planet	revolves*
rotates*	seasons	star			

* Key Lesson Vocabulary

Apply Concepts

2 Think about the characteristics of the moon. What would you need to survive there?

_____

_____

_____

_____

3 Suppose east is to the left of the drawing. Draw the apparent path of the winter sun across the sky.

4 The data table shows information gathered by students over a year. Examine and evaluate the information in the second and third columns to infer the season for each observation period.

Observation Period	Shadows at Noon	Average Temperature	Season
1	getting shorter	18 °C	
2	shortest	28 °C	
3	getting longer	21 °C	
4	longest	7 °C	

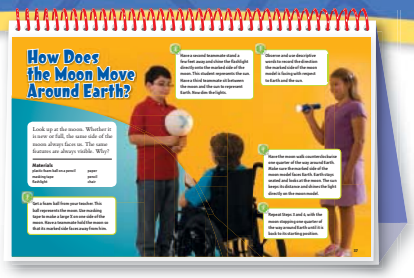
5 Suppose the moon moved farther away from Earth in its orbit. How would this affect eclipses? Why?

_____

_____

Take It Home!

On a sunny day, face north and put a stick in the ground. Observe the shadow cast by the stick. Observe how the shadow changes throughout the day. Explain how these changes are related to Earth's rotation.



Inquiry Flipchart page 37

Lesson 4
INQUIRY

5.ESS1.4

Name _____

Essential Question

How Does the Moon Move Around Earth?

Set a Purpose

What do you think you will learn from this activity?

_____

_____

_____

Think About the Procedure

How does the moon have to move for its marked side to always face Earth?

_____

_____

_____

_____

The student holding the flashlight also moves. Why? How is this different from what we know about the sun?

_____

_____

_____

_____

Record Your Data

Record data you collected below. Draw the position of the marked side of the moon with respect to Earth and the sun. Show the shaded and lit portions of the moon.

Position 1

Position 2

Position 3

Position 4

Draw Conclusions

What happens to the visible part of the moon as it moves through its orbit?

The moon turns as it orbits Earth. When does the moon complete a full rotation?

Analyze the data you recorded on the previous page. Draw to predict the position and appearance of the moon if you were to continue past Position 4. Which moon phase did you draw?

Analyze and Extend

1. Predict patterns in the appearance of the moon over time. Draw and describe the moon phase that takes place when the moon is between Earth and the sun.

2. Use the data you collected to explain why the amount of sunlight on the moon seems to change.

3. A friend thinks that Earth's shadow causes moon phases. Use the data you collected to explain why your friend's idea is incorrect.

4. The same friend also thinks that the moon has a dark side where the sun never shines. How would you use the data you collected to explain why your friend's idea is incorrect?

5. What other questions would you like to ask about moon phases?

Unit 7 Review

Name _____

Vocabulary Review

Use the terms in the box to complete the sentences.

asteroid
solar eclipse
galaxy
solar system
star

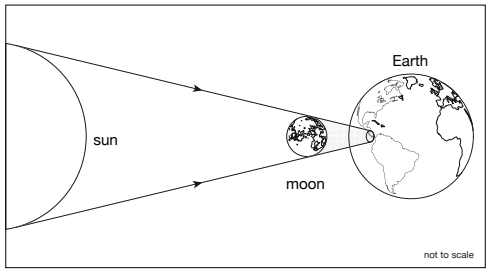
1. Together, a star and all the planets and other objects orbiting it form a(n) _____.

2. A chunk of rock or iron that is less than 1,000 km (621 mi) in diameter and that orbits the sun is called a(n) _____.

3. A huge ball of very hot, glowing gases in space that can produce its own heat and light is called a(n) _____.

4. A group of solar systems that are held together by gravity and classified by shape is called a(n) _____.

5. This diagram shows the position of Earth, the moon, and the sun during a _____.



Science Concepts

Fill in the letter of the choice that best answers the question.

6. Scientists use models to represent or explain things in the natural world. Why are models useful for the study of the solar system?

   (A) because models cannot be proved wrong

   (B) because models are always accepted by all scientists

   (C) because models describe the way things actually are

   (D) because models can be used to describe how things work

7. On a clear night in the summer, Keisha identified the constellation Scorpius in the sky. When she went star gazing five months later, she could not find Scorpius, but could see Gemini instead. Why?

   (A) The stars in Scorpius moved.

   (B) The moon was blocking Scorpius in the sky.

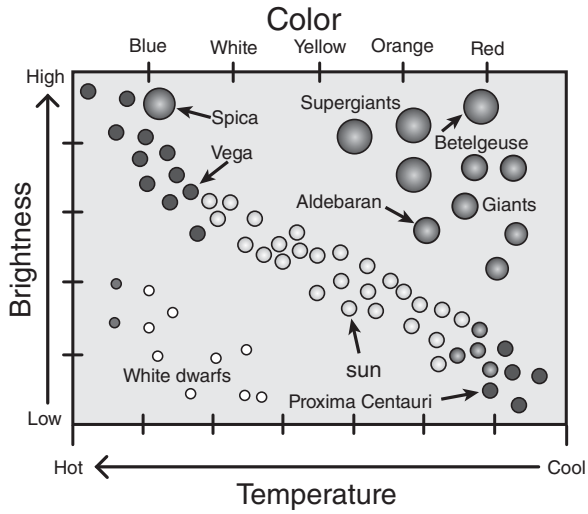
   (C) Earth revolved so it was facing a different part of the universe at night.

   (D) The moon revolved so it was facing a different part of the universe at night.

Science Concepts

Fill in the letter of the choice that best answers the question.

8. Astronomers use the term *brightness* to describe the amount of light a star produces, not how bright a star appears from Earth. The diagram below compares the color, temperature, and brightness of some stars that can be seen from Earth.



Which of these stars produces the **most** light?

Ⓐ Betelgeuse

Ⓑ Proxima Centauri

Ⓒ our sun

Ⓓ Vega

9. During a school field trip to an observatory, Smita used a telescope to observe stars of different colors. Based on the diagram in Question 8, which factor determines a star's color?

Ⓐ its size

Ⓑ its brightness

Ⓒ its temperature

Ⓓ its distance from Earth

10. Ming is doing a project on planets in other solar systems. She learns about a planet called Planet Z. Planet Z is very large and has a thick atmosphere and a low density. Which planet is Planet Z most similar to?

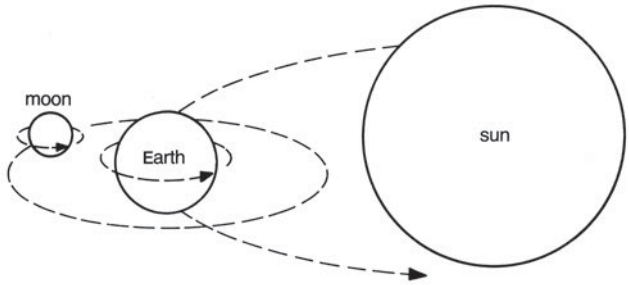
Ⓐ Earth

Ⓑ Mars

Ⓒ Mercury

Ⓓ Saturn

11. The diagram shows movements of objects in space.



What can you conclude from this diagram?

Ⓐ Earth is a satellite of the moon.

Ⓑ The sun revolves around Earth.

Ⓒ Earth and the moon rotate in different directions.

Ⓓ The moon orbits Earth while Earth orbits the sun.

12. Some elliptical galaxies appear to be perfect spheres. How are the stars distributed within this kind of galaxy?

Ⓐ The stars are evenly distributed throughout the galaxy.

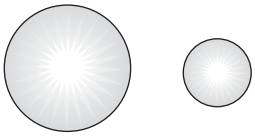
Ⓑ The center is very dense with many stars, and density decreases farther out.

Ⓒ Most of the stars are near the outside of the sphere with dust clouds in the center.

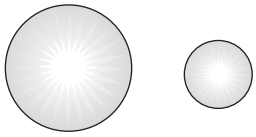
Ⓓ The stars are spread throughout the sphere in bands that look like the arms of spiral galaxies.

Name _____

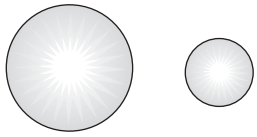
13. There are many types of stars. Each picture below shows two stars of the **same** color that are the same distance from Earth. Which picture and statement is true?

Ⓐ 

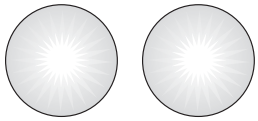
The larger star must be brighter.

Ⓑ 

The smaller star must be hotter.

Ⓒ 

The smaller star must be closer to Earth.

Ⓓ 

Stars that are the same color are usually the same size.

14. All the planets in the solar system orbit the sun. What is the main difference between the orbits of the inner and outer planets?

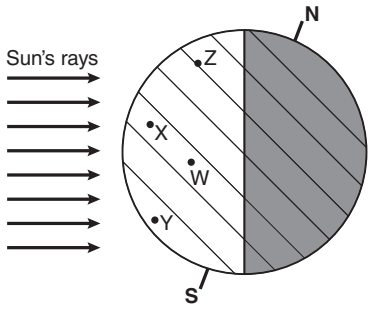
Ⓐ The inner planets and outer planets orbit in different directions.

Ⓑ The inner planets travel a greater distance than the outer planets do.

Ⓒ The outer planets take longer to orbit the sun than the inner planets do.

Ⓓ The outer planets rotate as they orbit the sun, and the inner planets do not.

15. Look at this diagram of Earth.



It is 12 p.m. at point X. What will happen in 12 hours at point X?

Ⓐ Point X will be in daylight.

Ⓑ Point X will be in darkness.

Ⓒ Point X will experience summer.

Ⓓ Point X will orbit once around the sun.

16. Which of the following is evidence of Earth's rotation?

Ⓐ The stars appear to rotate around the North Star.

Ⓑ The moon appears to change shape each month.

Ⓒ The seasons change throughout the year.

Ⓓ The moon stays in orbit around Earth.

Apply Inquiry and Review the Big Idea

Write the answers to these questions.

17. When Galileo used his telescope to observe the Milky Way, the stars appeared as small points of light. What did Galileo's observations demonstrate about stars? How does this compare to our own star, the sun?

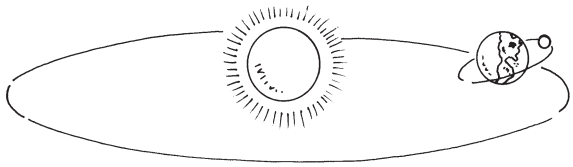
_____

_____

_____

18. The diagram shows the movement of Earth and the moon in space.

Explain what would happen if Earth did not rotate on its axis as it moved around the sun. How would this change the day/night cycle and the apparent movement of the sun across the sky?



_____

_____

_____

19. Sofia observes an object in the night sky. What questions and observations can she use to determine whether the object is a planet or a star?

Questions _____

_____

Observations _____

20. People have developed models of the universe for thousands of years. Identify two observations that a model of the universe would need to explain to be useful.

a. _____

_____

b. _____

_____