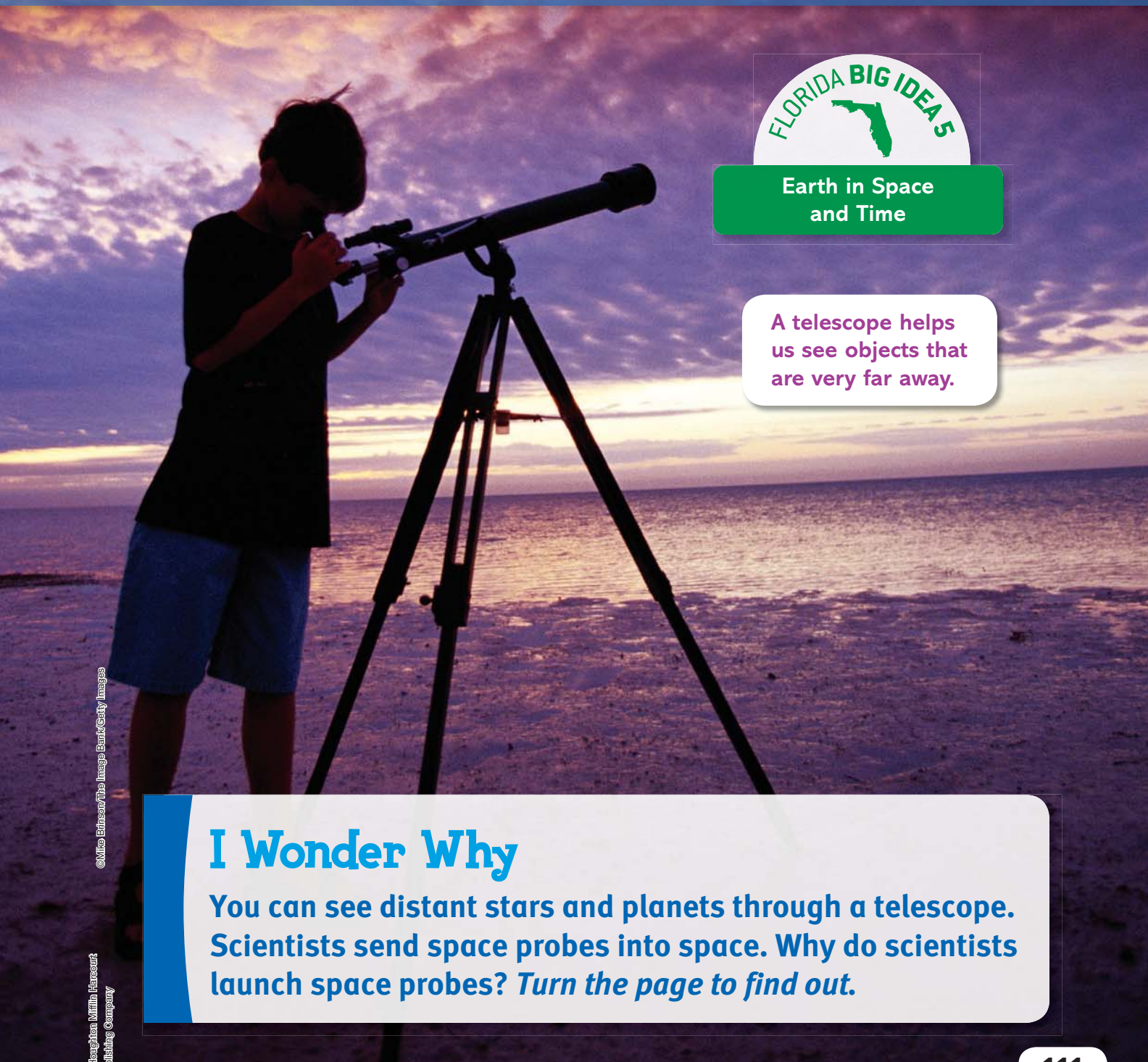
UNIT 3

The Solar System and the Universe



FLORIDA BIG IDEA 5

Earth in Space and Time

A telescope helps us see objects that are very far away.

I Wonder Why

You can see distant stars and planets through a telescope. Scientists send space probes into space. Why do scientists launch space probes? *Turn the page to find out.*

Here's Why

Space probes can take images and collect and analyze samples from objects in the solar system. They provide data that would not be possible to get from Earth with a telescope.

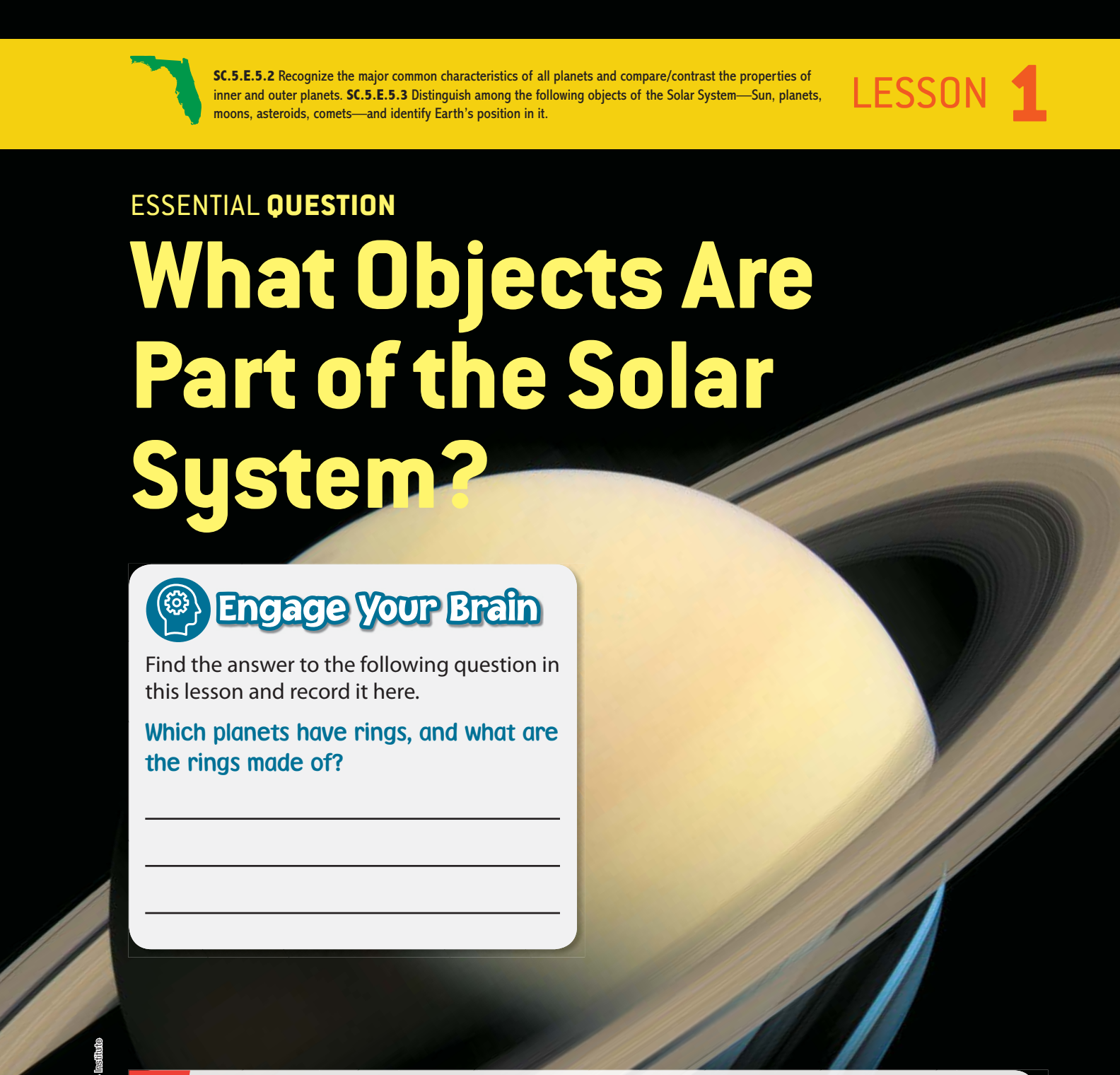
Essential Questions and Florida Benchmarks

Science Notebook

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

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

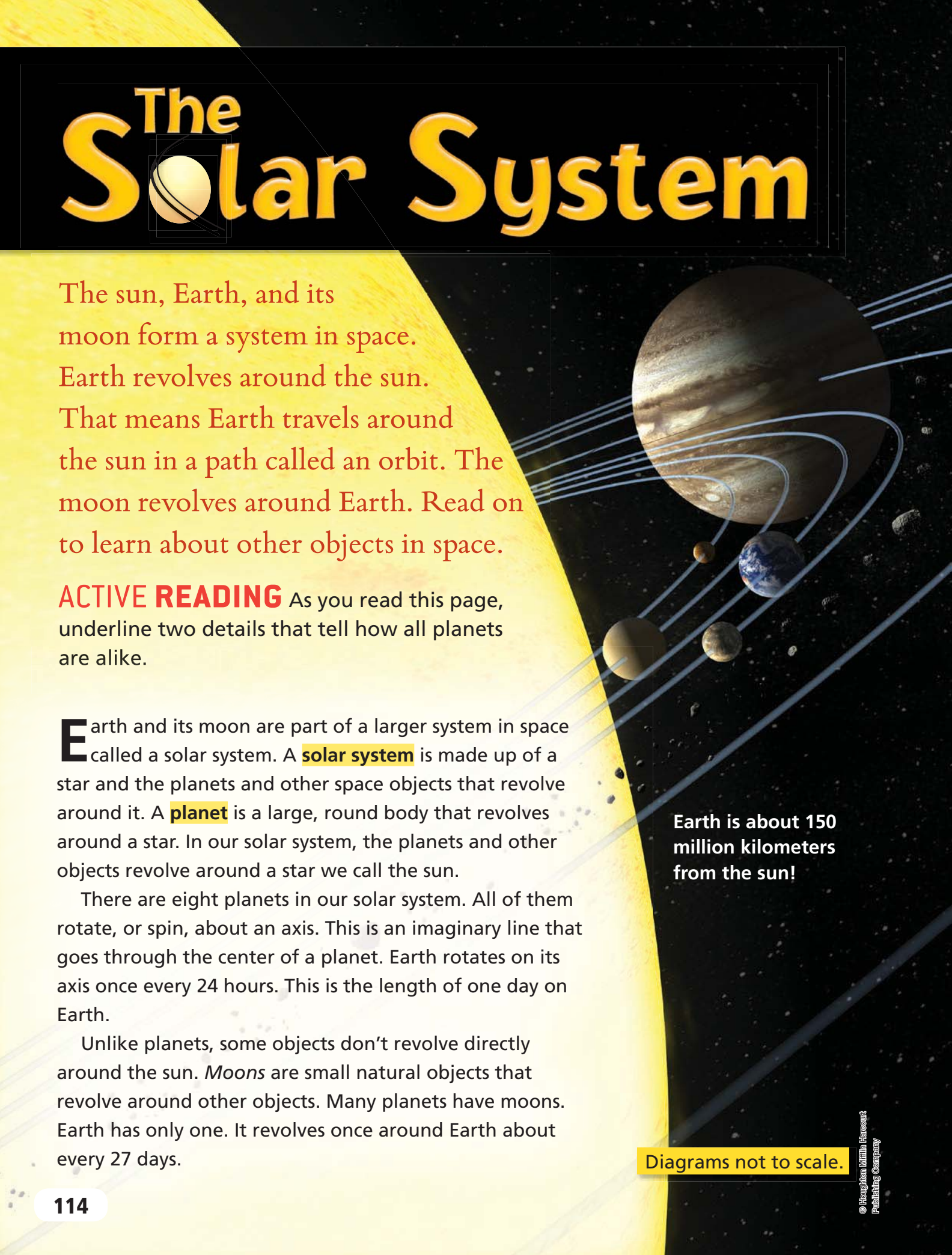
The sun, Earth, and its moon form a system in space. Earth revolves around the sun. That means Earth travels around the sun in a path called an orbit. The moon revolves around Earth. Read on to learn about other objects in space.

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.

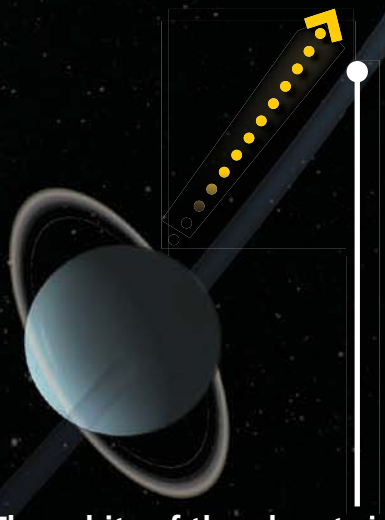
Unlike planets, some objects don't revolve directly around the sun. *Moons* are small natural objects that revolve around other objects. Many planets have moons. Earth has only one. It revolves once around Earth about every 27 days.



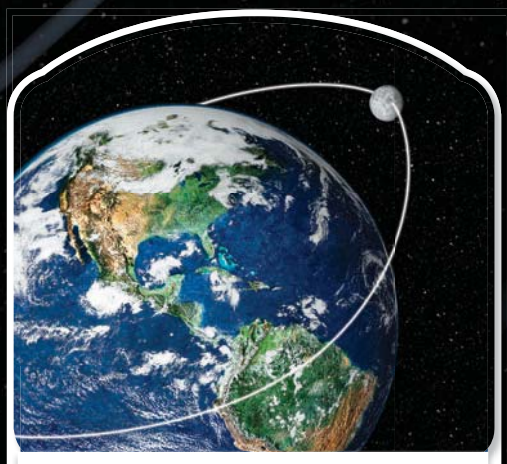
Earth is about 150 million kilometers from the sun!

Diagrams not to scale.

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



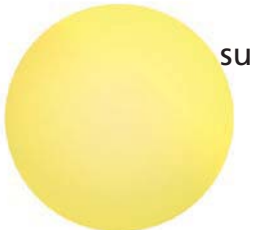
The orbits of the planets in our solar system are not perfect circles. They are oval-shaped, or **elliptical** [eh•LIP•tuh•kuhl].



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

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 in which 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 in which 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 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.

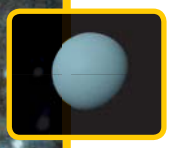
Planets not to scale.

What Makes Them Unique?

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

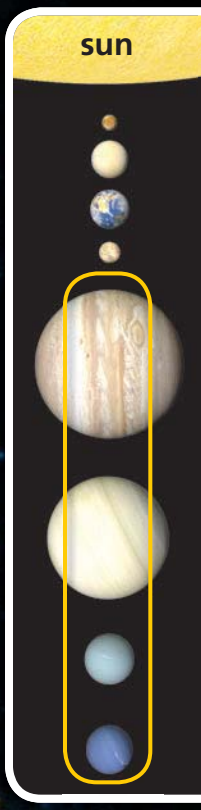
Jupiter

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.

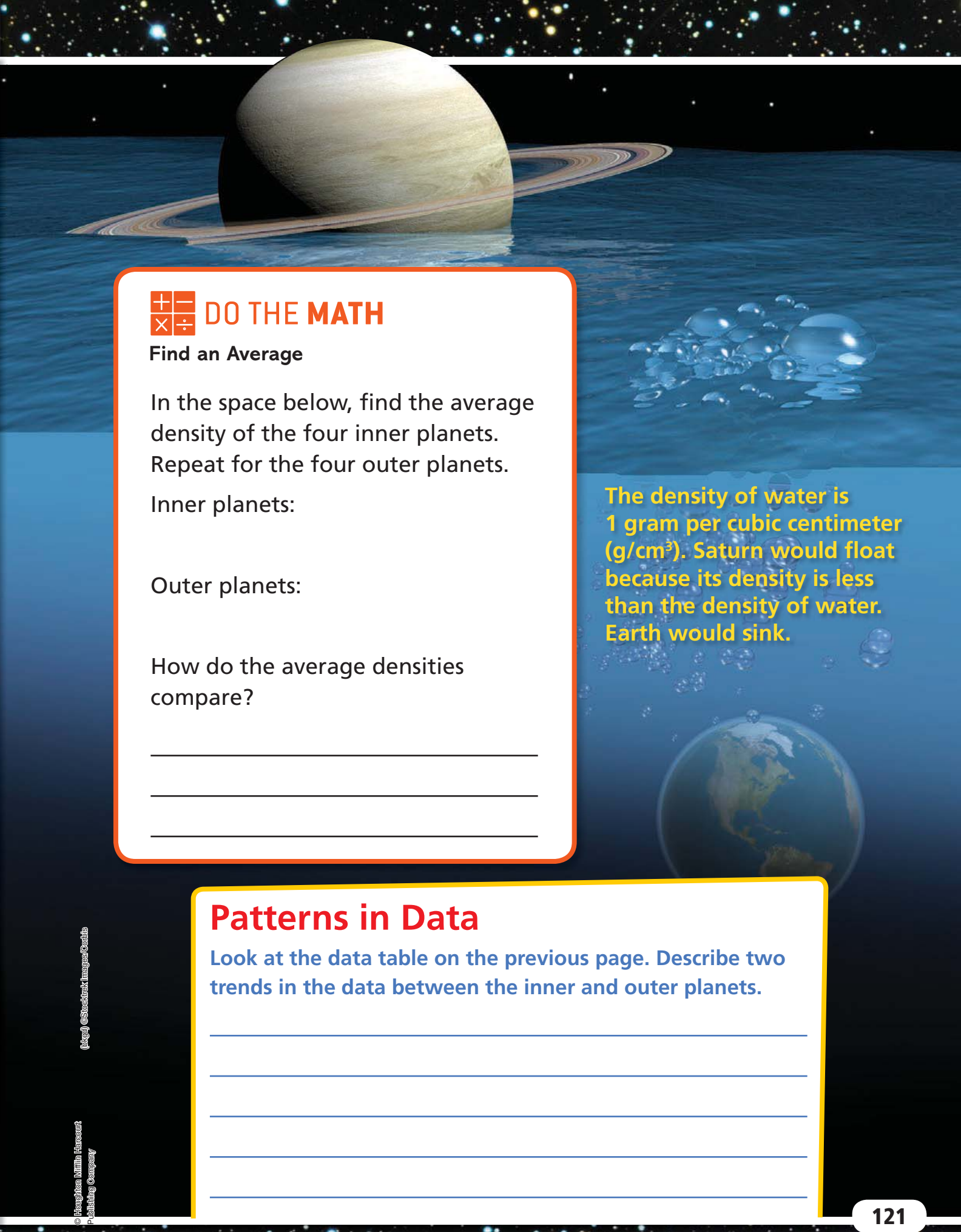
Neptune

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

Look at the data table on the previous page. Describe two trends in the data between the inner 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.

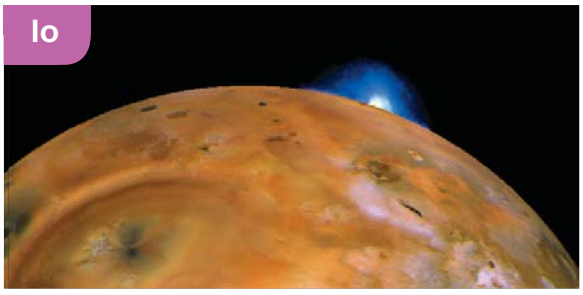
ACTIVE READING As you read these two pages, find and underline two facts about asteroids.

Dwarf Planets

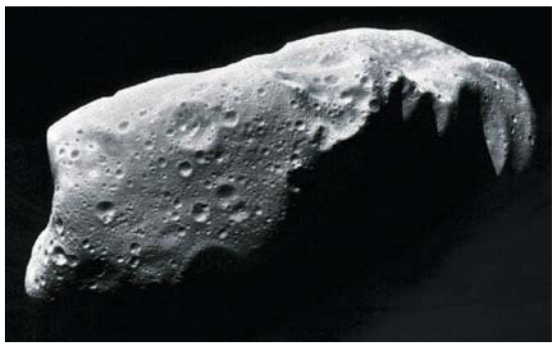
Pluto was once called a planet. But in 2006, it was reclassified as a dwarf planet. **Dwarf planets** are nearly round bodies whose orbits cross the orbits of other bodies. Most are found in a region of the solar system beyond Neptune's orbit called the Kuiper belt. These objects are far away and hard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

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.



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.

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.

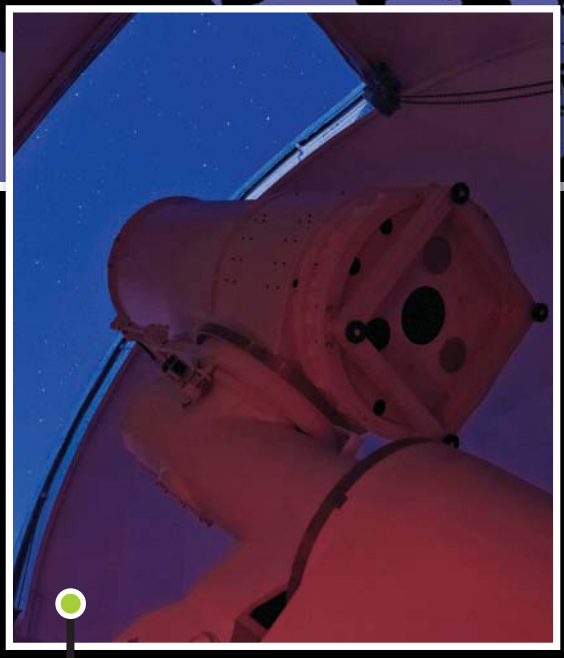
The impact of Shoemaker-Levy 9 caused bubbles of hot gas to rise into Jupiter's atmosphere, as well as dark spots to form on its surface.

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



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

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

Sum It Up

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.

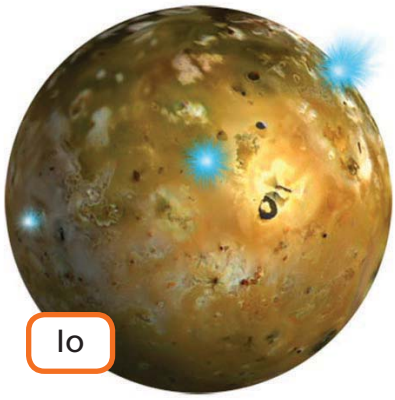
small and dense	longer revolutions	many moons	few moons
giant size	closest to sun	gaseous surface	low density
rings	rocky surface		

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: _____

_____

_____

Brain Check

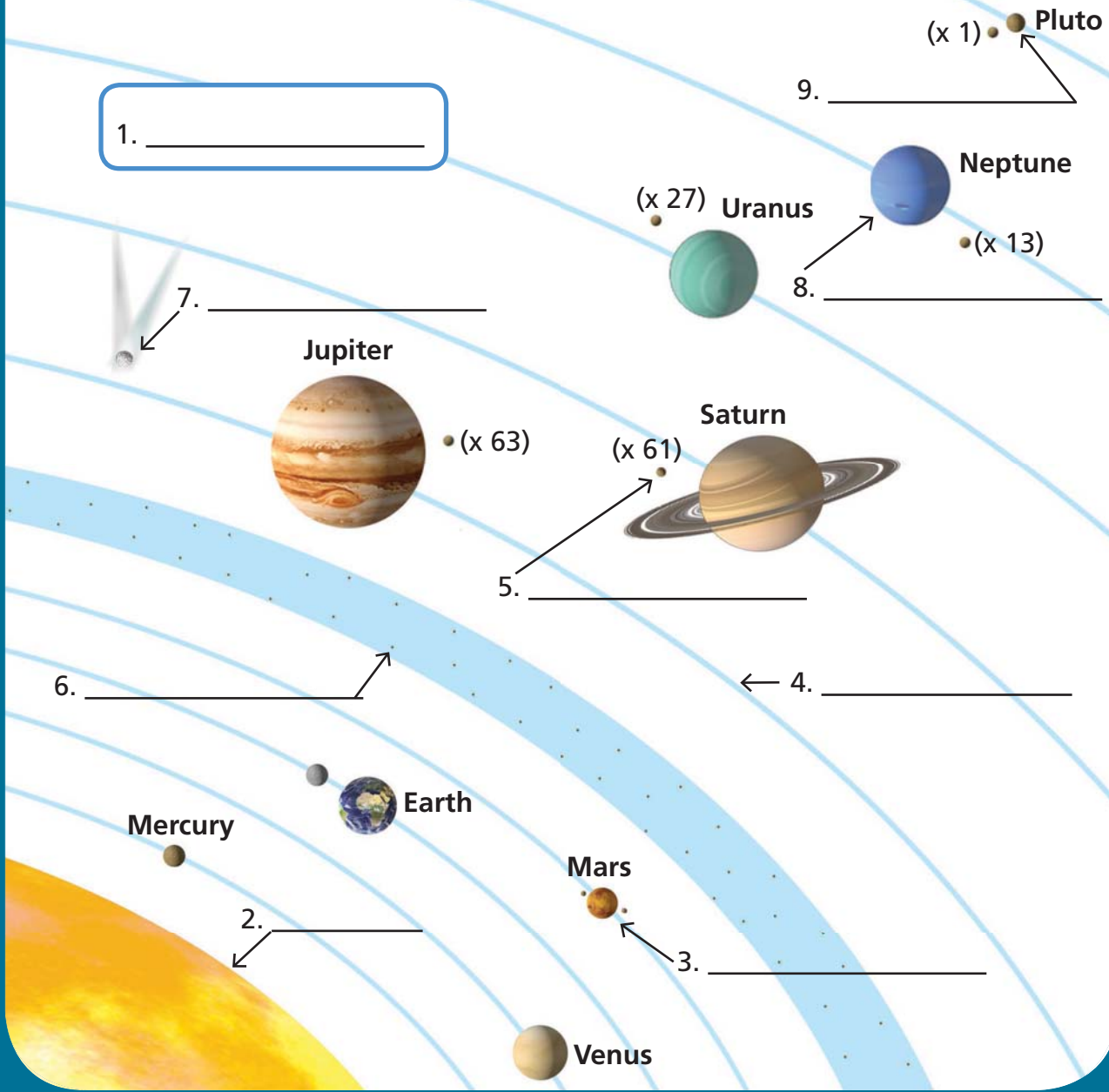
LESSON 1

Name _____

Vocabulary Review

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?

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

_____

_____

_____

_____

_____

_____

_____

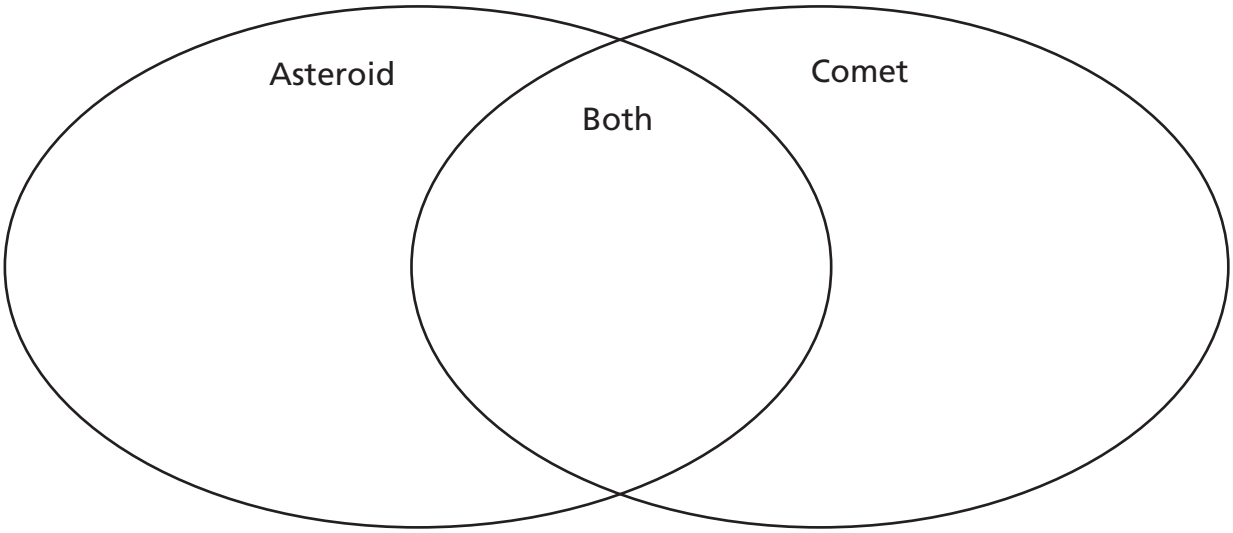
_____

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 in order 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 study space in different ways. Write the statements that apply to each scientist in the correct circle.

Kalpana Chawla

_____

_____

_____

_____

_____

- 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.

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

Claudia Alexander

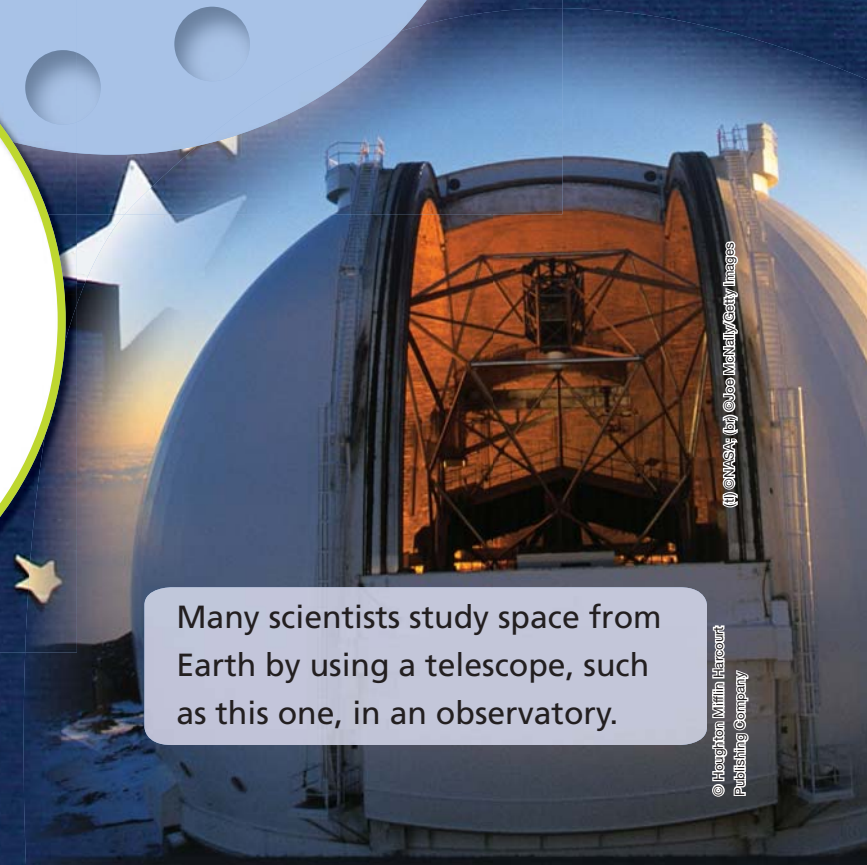
_____

_____

_____

_____

_____



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

Name _____

ESSENTIAL **QUESTION**

How Do We Observe Objects in the Solar System?

Materials

- poster of solar system objects
- binoculars

EXPLORE

In this activity, you will investigate ways scientists observe and record data about objects in the solar system. You will model different kinds of observations.

Before You Begin—Preview the Steps

1. Observe your assigned object from far away. Make as many observations as possible. Record your observations in your Science Notebook.
2. Use binoculars to observe the same object. Record your observations.
3. Pretend that one member of your group is a space probe. This student should walk to the poster and record observations. Have another student gather those observations and return them to your group's table.
4. Review the space probe's observations and write new questions about the object. Send the new questions to the space probe. Review the answers you receive.

Set a Purpose

What do you think you will learn from this experiment?

Think About the Procedure

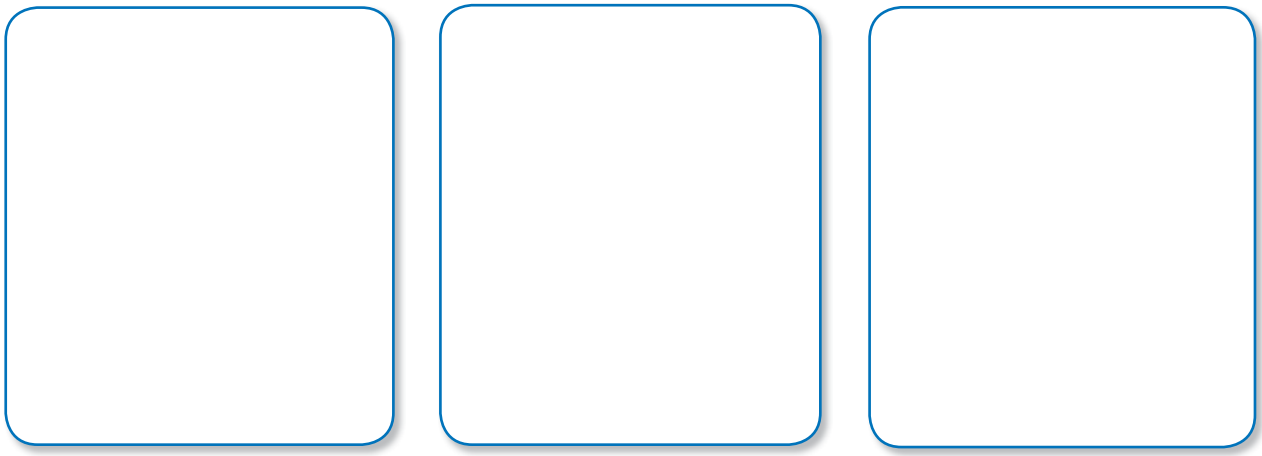
Why do you think you will observe the object in different ways?

Why is it important that you work together as a team in this investigation?

Name _____

Record Your Data

In the space below, record the observations you made, using all three methods.



Draw Conclusions

Think about how scientists view objects in space. What did observing the object from far away represent?

_____

_____

What did using binoculars represent?

_____

_____

What did viewing the object up close represent?

_____

_____

Claims • Evidence • Reasoning

1. Make a claim about how your observations from far away differ from those made using binoculars. Provide evidence to support your claim.

2. Make a claim about how your observations made using binoculars differ from the observations made when a student walked to the poster. Provide evidence to support your claim.

3. Use evidence from your investigation to explain how space probes help scientists learn about objects in space.

4. Think about objects in the solar system. Make a claim about how scientists use time and space relationships to observe them. Explain your reasoning.

5. What other questions you would like to ask about how scientists study objects in space?

SC.5.E.5.1 Recognize that a galaxy consists of gas, dust, and many stars, including any objects orbiting the stars. Identify our home galaxy as the Milky Way.

LESSON 3

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.

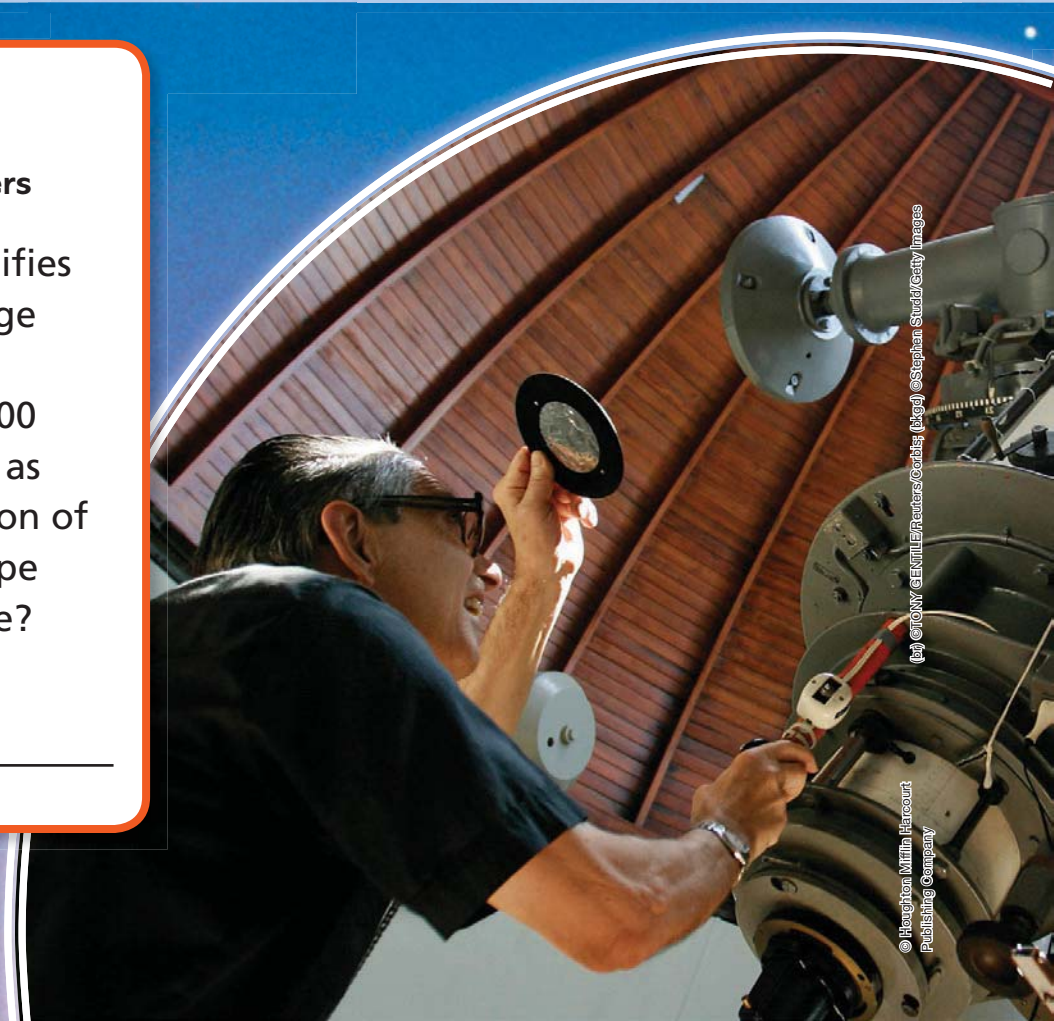
Stars are huge balls of hot, glowing gases that produce their own heat and light. The sun is the star you know the most about. It seems much larger than other stars only because it is much closer to Earth.

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?

_____



(t) ©TONY GENTILE/Reuters/Corbis; (bg) ©Stephan Studd/Getty Images

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

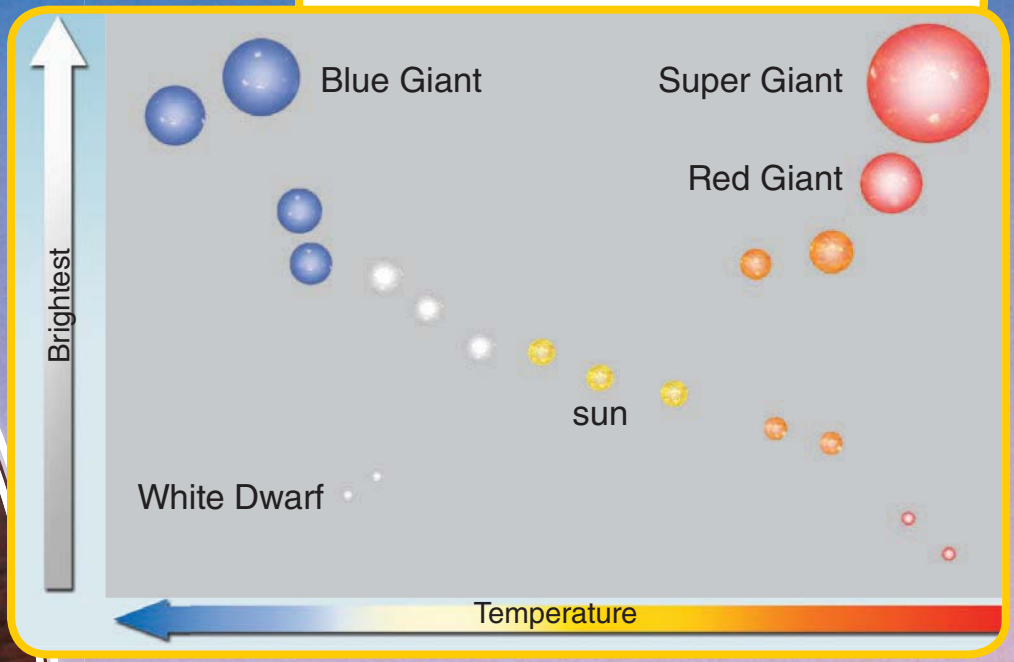
Stars form when gravity causes gas and dust particles found in space to pull together. These particles are squeezed together under great pressure. Eventually, energy stored in the particles is released as heat and light. A star is born.

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

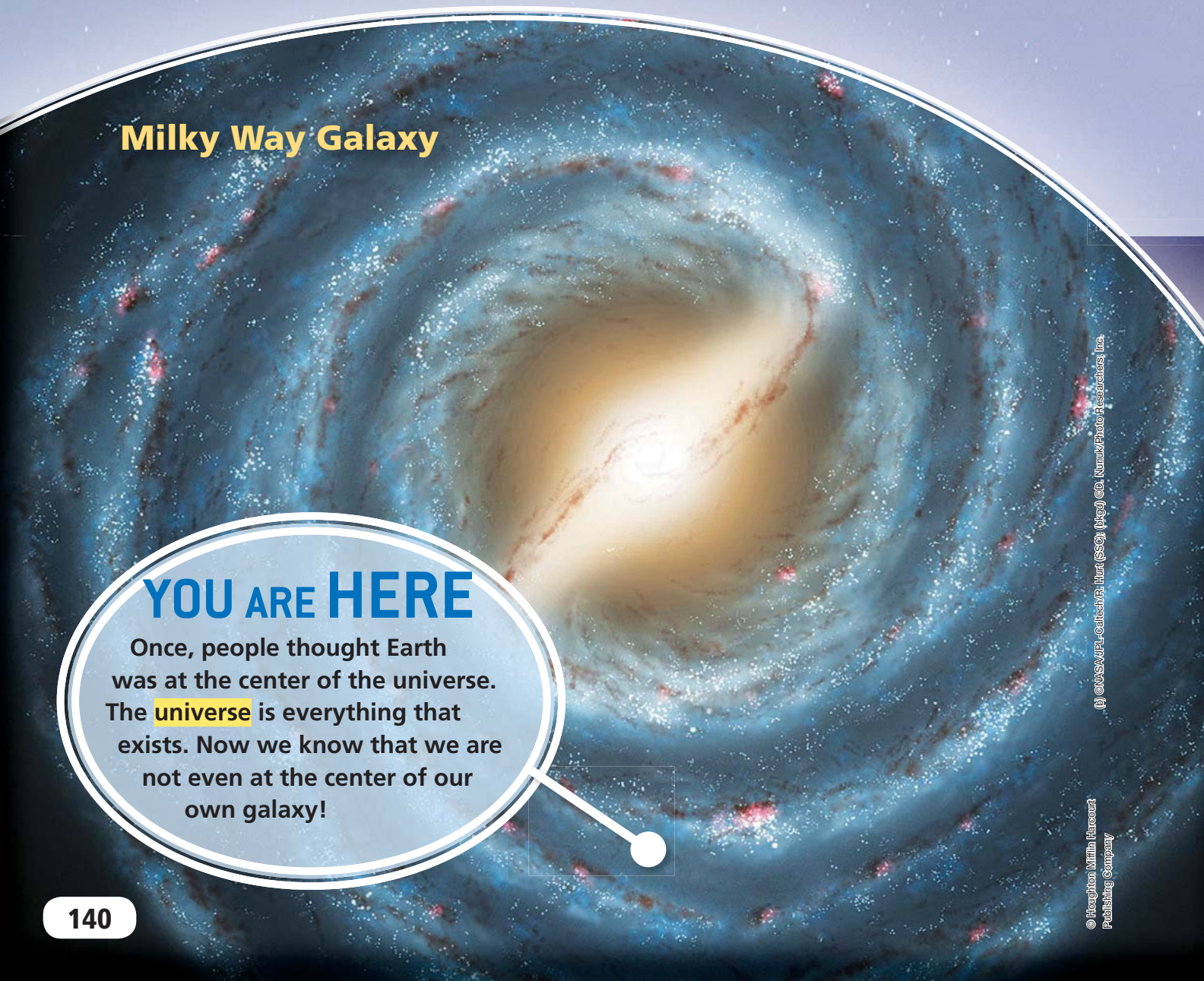
Draw a rectangle around the hottest stars in the diagram. Draw a circle around the brightest stars.



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.

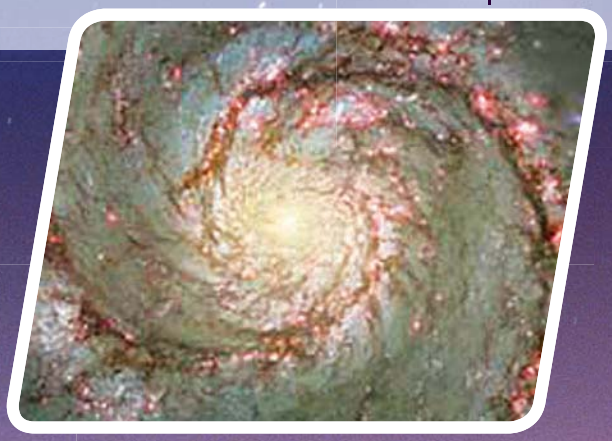
FEATURES OF GALAXIES

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

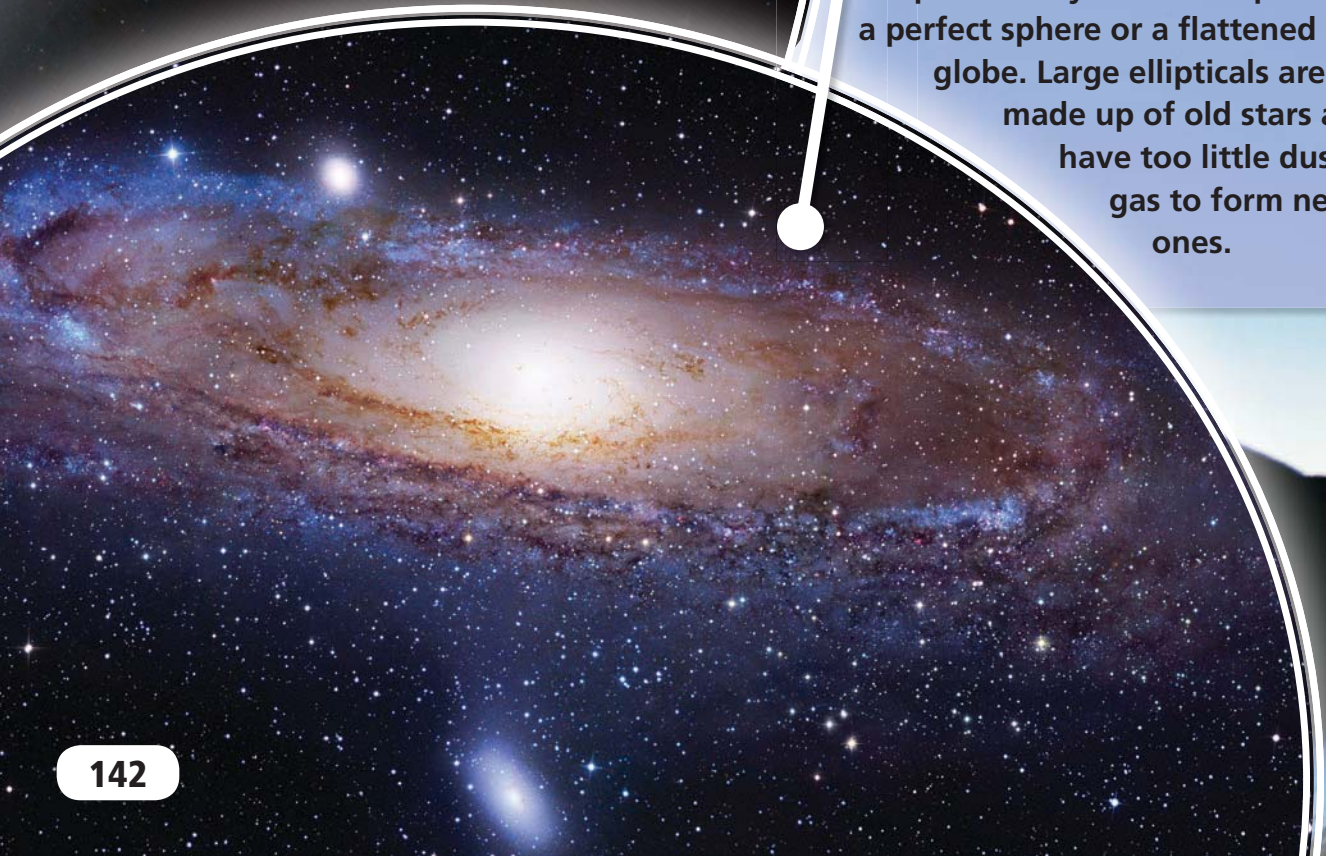
Most of the brightest galaxies in the universe have spiral shapes. But spiral galaxies are not the only type of galaxy. In fact, they make up only about 20 percent of all galaxies. The dimmer *irregular galaxies* and *elliptical galaxies* make up about 80 percent of all galaxies in the universe.

IRREGULAR **GALAXIES**

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

ELLIPTICAL **GALAXIES**

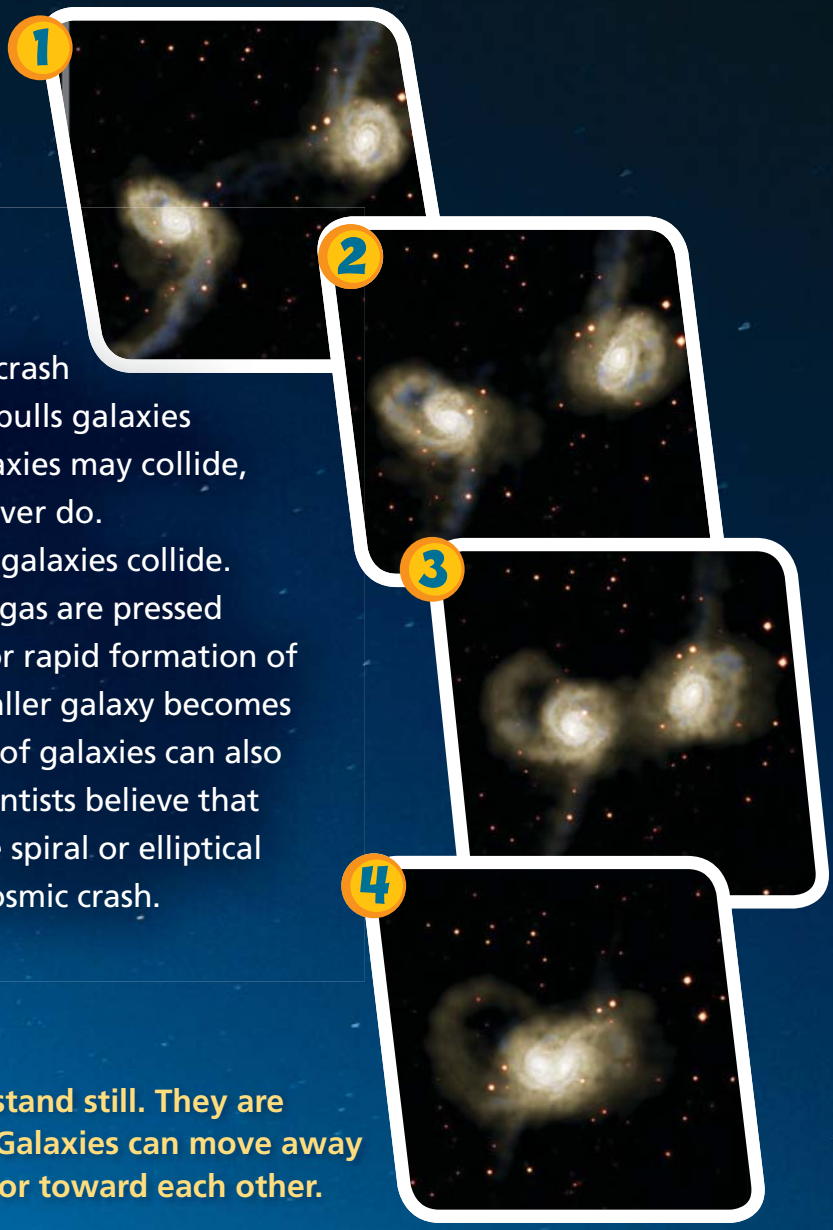
Elliptical galaxies are brightest at their center. About 60 percent of all galaxies in the universe are elliptical. They can be shaped like a perfect sphere or a flattened globe. Large ellipticals are made up of old stars and have too little dust or gas to form new ones.



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.**

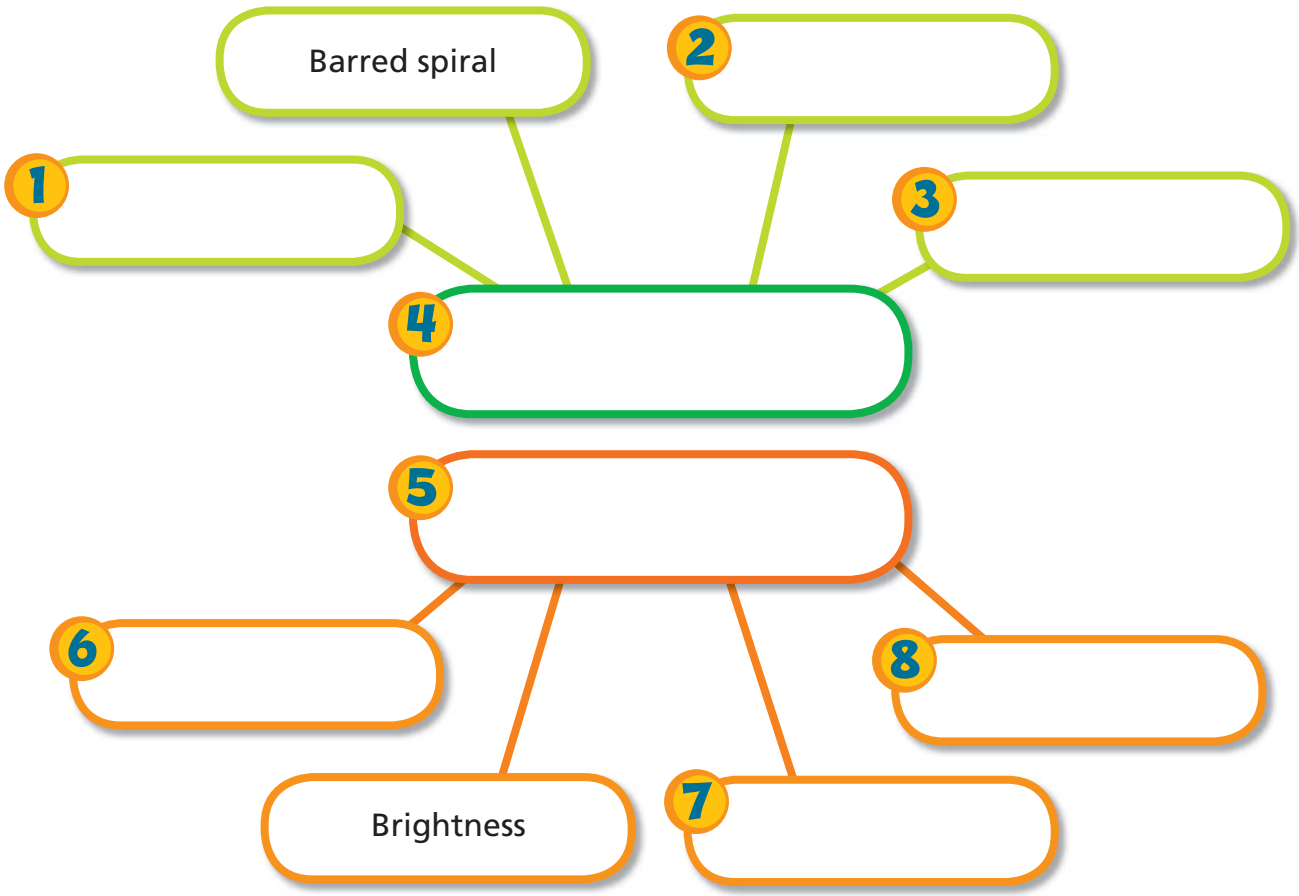
_____

_____

Sum It Up

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	



Name _____

Vocabulary Review

1 Use the clues to unscramble the words in the boxes.

1.	oratsmreno	_____	A person who studies the universe
2.	rirarluge	_____	A galaxy with no particular shape
3.	loocr	_____	Characteristic that is related to a star's temperature
4.	rast	_____	A ball of hot, glowing gases
5.	prails	_____	A pinwheel-like galaxy
6.	xygaal	_____	A group of stars, dust, and gases
7.	plilelitca	_____	A galaxy shaped like a flattened globe
8.	eesrivun	_____	Everything that exists – planets, stars, dust, and gases
9.	mnooyrats	_____	The study of the objects in space and their properties

Apply Concepts

2 What are some ways in which 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.

SC.5.N.1.5 Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."

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?

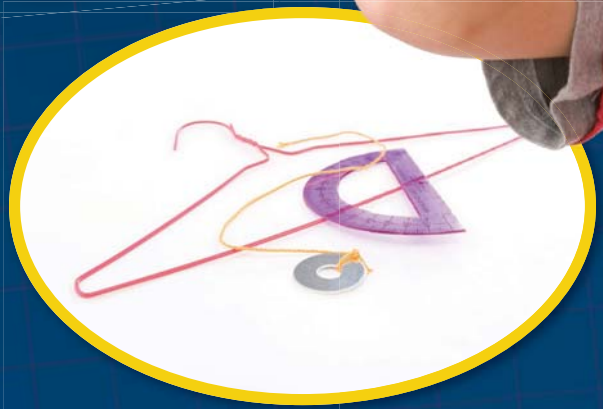
ENGINEERING DESIGN CHALLENGE

Improvise It:
How High Is That Star?

An astrolabe is an ancient tool that was used by many cultures to study the sky. Using this instrument, you could measure the angle of a star above the horizon. That measurement could help you uncover your location and the exact time!

Now, it's your turn to build an astrolabe. Unlike the original astrolabes that were constructed of metal, the one you'll design will be made mostly of plastic. That's because you'll improvise this astronomical device using a familiar classroom tool called a protractor.

astrolabe



(inset) ©SSPL via Getty Images; (tcl) ©Getty Images

What to Do:

1. Learn about historic instruments used to explore the sky. Study each tool's design to learn about it.
2. Find out how the elevation of the North Star above the horizon can be used to determine latitude.
3. Improvise an astrolabe using a classroom protractor. Identify the additional materials you'll need to construct the tool.
4. Draw your design.
5. Now build your astrolabe. Keep improving your design until you are satisfied with it.
6. In the evening, use your astrolabe to find the elevation of the North Star. Record this value.
7. Find out your latitude. Is it the same as the value you recorded in Step 6? Explain any difference.
8. Keep a record of your work in your Science Notebook.

UNIT 3
Benchmark Review

Name _____

Vocabulary Review

Use the terms in the box to complete the sentences.

asteroid
comet
galaxy
solar system
star

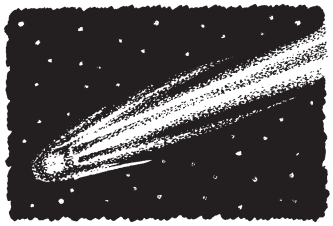
1. Together, a star and all the planets and other objects orbiting it form a(n) _____.

2. A chunk of rock or iron that 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. The picture shows an example of a(n) _____.



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?

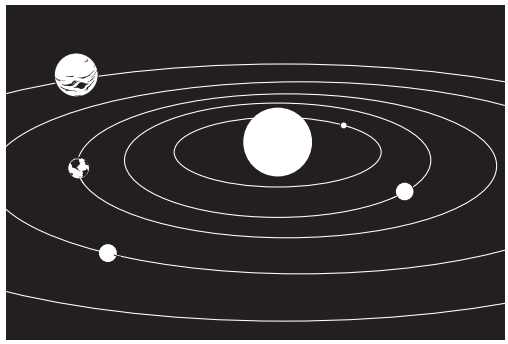
   (A) because models cannot be proven wrong

   (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. The illustration below shows several planets orbiting a star.



What type of group is the figure illustrating?

(F) constellation

(G) solar system

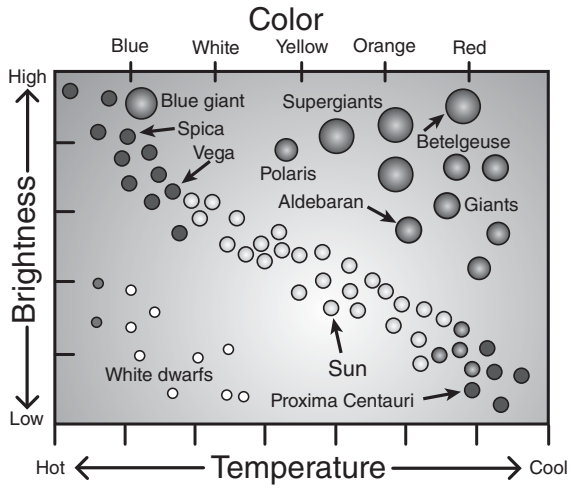
(H) galaxy system

(I) universe

8. Galaxies are composed of many different objects. What kind of objects make up most of the visible matter in a galaxy?

Ⓐ asteroids
Ⓒ dust
Ⓑ planets
Ⓓ stars

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



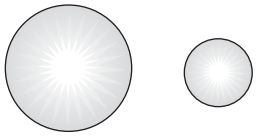
Which of these stars produces the most light?

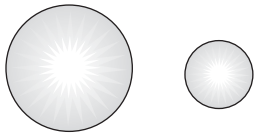
Ⓕ Betelgeuse
Ⓖ Sun
Ⓗ Proxima Centauri
Ⓘ Vega

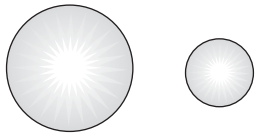
10. Some elliptical galaxies appear to be perfect spheres. How are the stars distributed within this kind of galaxy?

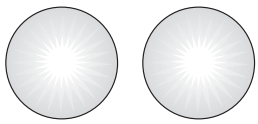
Ⓐ The stars are evenly distributed through the galaxy.
Ⓑ The center is very dense with many stars, and density decreases farther out.
Ⓒ Most of the stars are near the outside of the sphere, with dust clouds in the center.
Ⓓ The stars are spread throughout the sphere in bands that look like the arms of spiral galaxies.

11. There are many different colors of stars. Each of the images below shows two stars of the same color. Which picture and statement is correct?

Ⓕ 
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.

Name _____

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

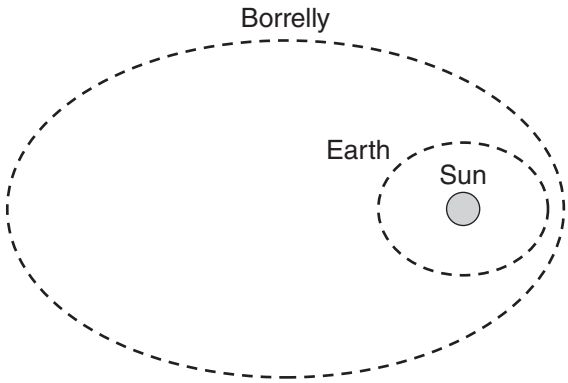
(A) The inner planets travel a greater distance than the outer planets do.

(B) The inner planets have almost round orbits, and the outer planets do not.

(C) The outer planets rotate as they orbit the sun, and the inner planets do not.

(D) The outer planets take longer to orbit the sun than the inner planets do.

13. The diagram below shows the orbit of Earth and the orbit of Borrelly.



Which of these types of space objects is Borrelly most likely to be?

(F) an asteroid

(G) a moon

(H) a comet

(I) a star

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

(A) Earth

(B) Mercury

(C) Saturn

(D) Mars

15. Earth is part of the Milky Way galaxy. How does the Milky Way appear in the night sky from Earth?

(F) a small, very dim group of stars

(G) a faint band of clouds among the stars

(H) a large number of stars in a broad, spiral shape

(I) a large cloudy band of stars spreading across the sky

Apply Inquiry and Review the Big Idea

Write the answers to these questions.

16. When Galileo used his telescope to observe the Milky Way, the stars appeared as small points of light. Write a claim based on this evidence and explain how the evidence supports the claim.

17. Describe the structure of our galaxy and the position of our solar system within our galaxy.

18. 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

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

a.

b.