



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?**

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## ACTIVE READING

### Lesson Vocabulary

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

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## 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.

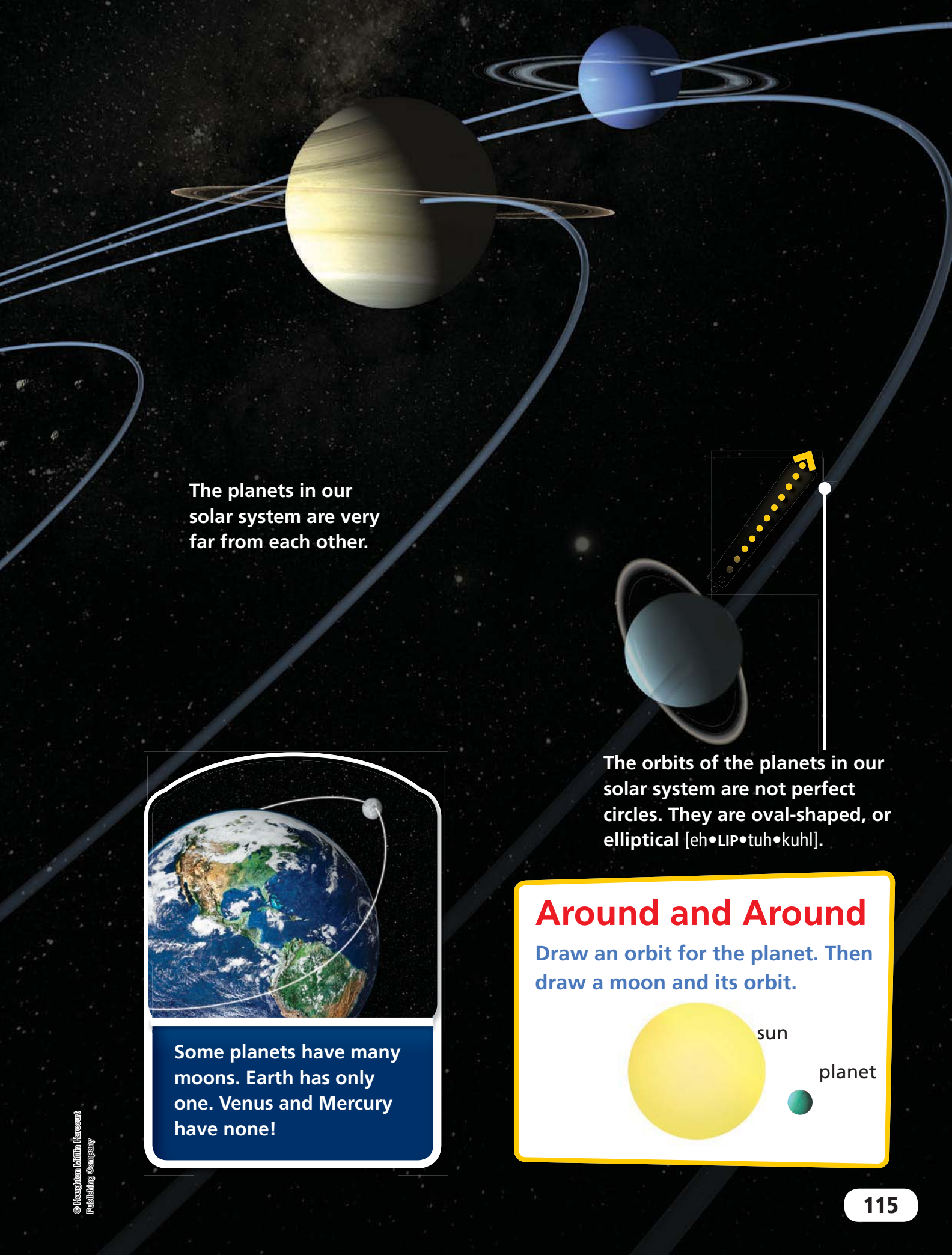
**E**arth and its moon are part of a larger system in space called a solar system. A **solar system** is made up of a star and the planets and other space objects that revolve around it. A **planet** is a large, round body that revolves around a star. In our solar system, the planets and other objects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

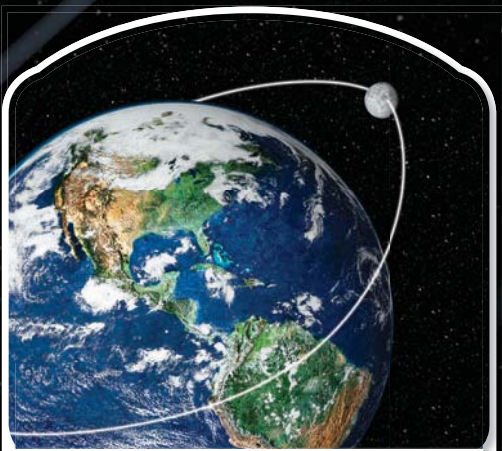
Unlike planets, some objects don't revolve directly around the sun. *Moons* are small natural objects that revolve around other objects. Many planets have moons. Earth has only one. It revolves once around Earth about every 27 days.

Earth is about 150 million kilometers from the sun!

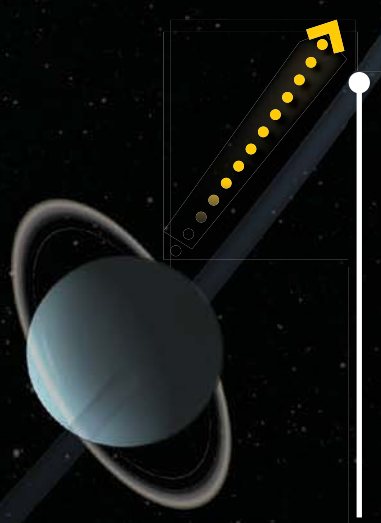
Diagrams not to scale.



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



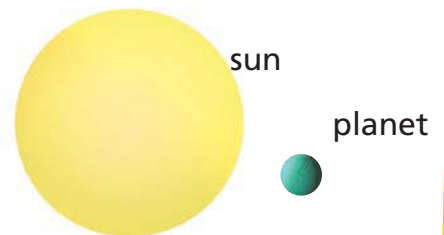
Some planets have many moons. Earth has only one. Venus and Mercury have none!



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 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.

## 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 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.

Planets not to scale.

sun



## 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.

## No Home for Me

List three reasons why people could not live on Venus.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_

## 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.

# 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.

Great Red Spot

**ACTIVE READING** As you read this page, underline ways in which the outer planets are alike.

## 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.

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.

## Saturn

Planets not to scale.

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.



# 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 <sup>3</sup> )	Diameter
<b>INNER PLANETS</b>						
Mercury	88 days	59 days	-173 to 427	0	5.43	4,878 km (3,031 mi)
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)
<b>OUTER PLANETS</b>						
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?

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The density of water is 1 gram per cubic centimeter ( $\text{g/cm}^3$ ). 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.

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# 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

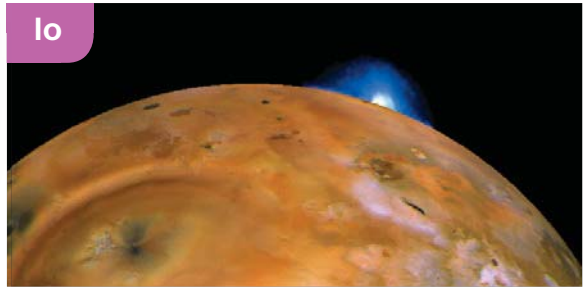


Pluto was once called a planet. But in 2006, it was reclassified as a dwarf planet. **Dwarf planets** are nearly round bodies whose orbits cross the orbits of other bodies. Most are found in a region of the solar system beyond Neptune's orbit called the Kuiper belt. These objects are far away and hard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

Io



## 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!

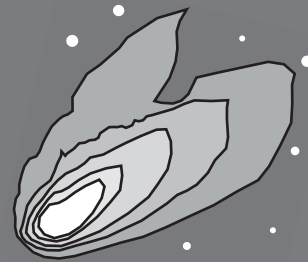
## Meteoroids, Meteors, and Meteorites

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.

**P**ictures 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.

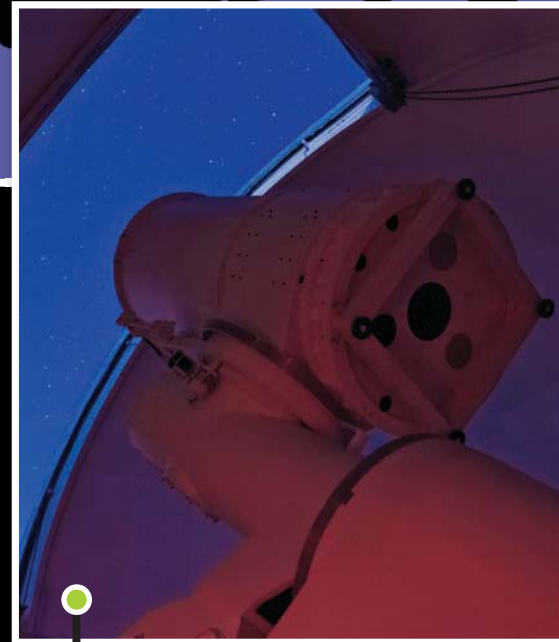
Impacts can happen anywhere on Earth! This map shows some impact crater sites from around the world.



### 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.