# THE SOLAR SYSTEM

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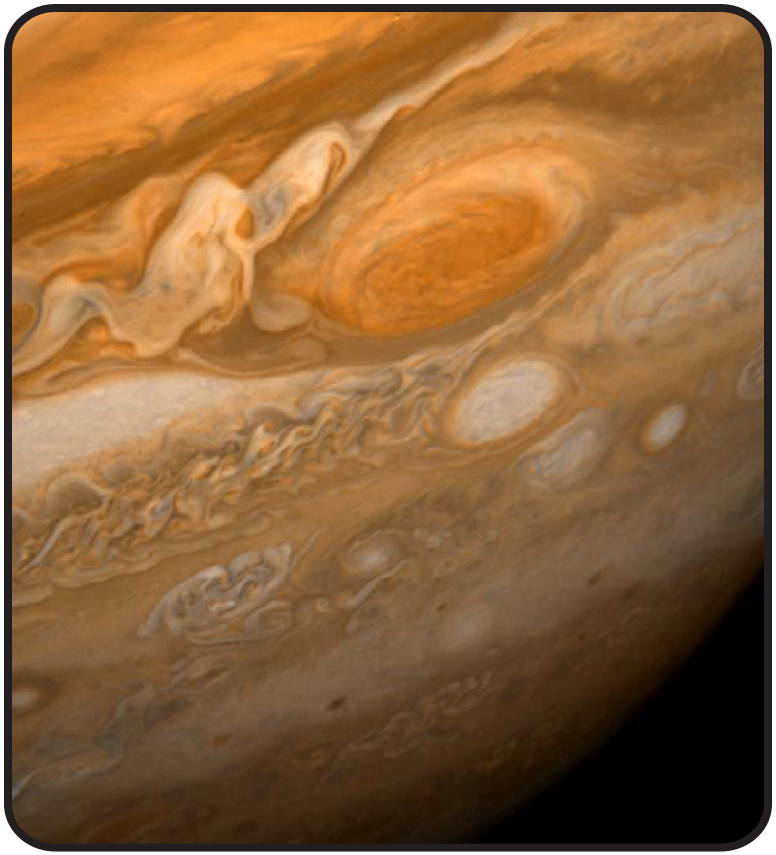

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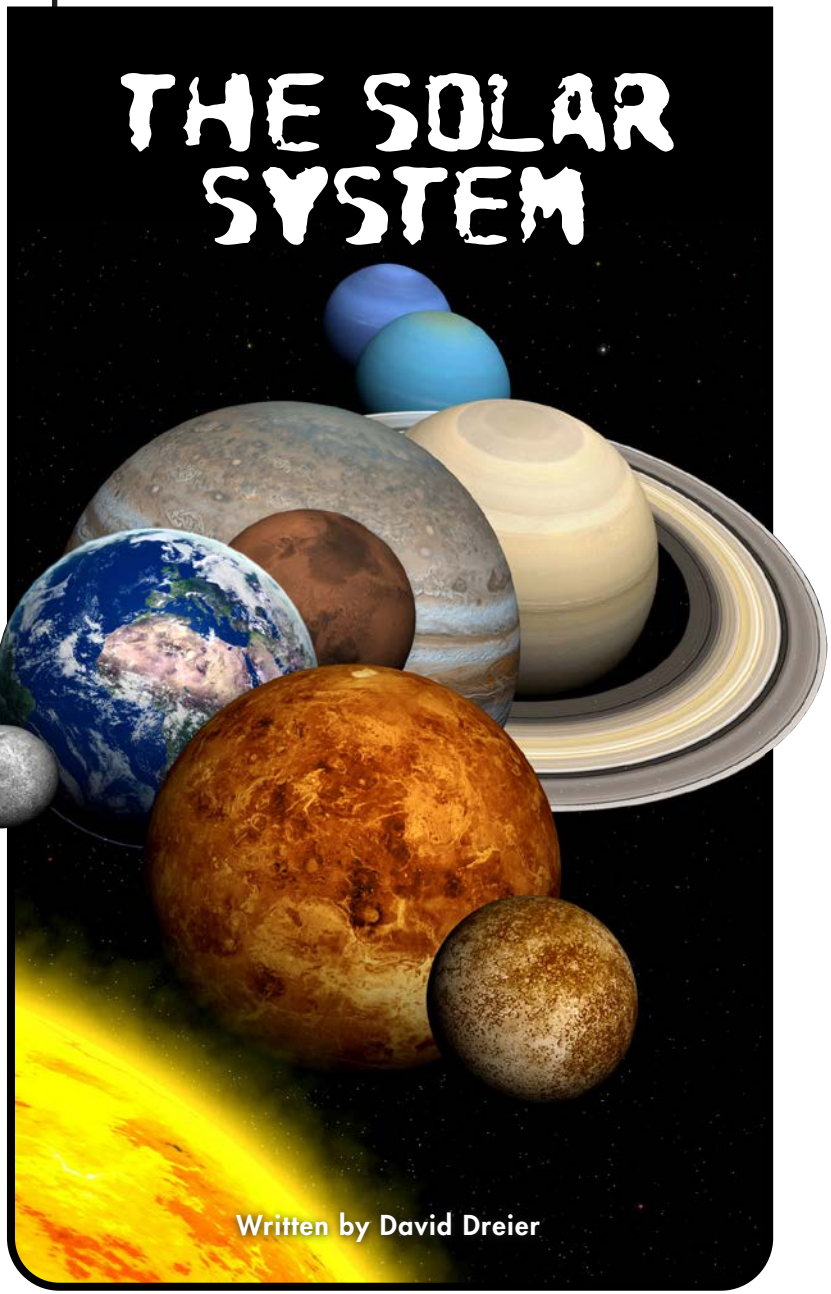


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# THE SOLAR SYSTEM

Written by David Dreier

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| KEY ELEMENTS USED IN THIS BOOK |
| --- |
| **The Big Idea:** Learning about our solar system can give students a sense of wonder and perspective. They can ponder and appreciate Earth's crucial position in our solar system, which makes this planet such an ideal place for us to live. Students may also consider how small our entire world is compared to some of our fellow planets, the Sun, and the vastness of space. For some students, this perspective might provide a sense of scale for their own panoramas and concerns. It may also help students understand why many people are excited about the prospects of discovering and exploring new solar systems, both within our galaxy and beyond. |
| **Key words:** asteroid, asteroid belt, atmosphere, atom, comet, core, crater, diameter, dwarf planet, Earth, fusion, gas, gas giant, gravity, heat, helium, hydrogen, Jupiter, Kuiper Belt, light, liquid, Mars, mass, matter, Mercury, methane, moon, Neptune, nucleus, orbit, oxygen, planet, Pluto, plutoid, revolution, revolve, rotate, rotation, satellite, Saturn, solar system, star, surface, tail, temperature, terrestrial, Uranus, Venus<br><br>**Key comprehension skill:** Interpret graphs, charts, and diagrams<br>*Other suitable comprehension skills:* Cause and effect; compare and contrast; classify information; main idea and details; identify facts; elements of a genre<br><br>**Key reading strategy:** Visualize<br>*Other suitable reading strategies:* Ask and answer questions; summarize; connect to prior knowledge; using a table of contents and headings; using a glossary and boldfaced terms |

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## Introduction

Earth is our home, and the **solar system** is our local neighborhood in the universe. Our solar system is just one of many, near the outer edge of just one of billions of galaxies—huge rotating masses of **stars**—in the universe. But it's special to us because it's where we live. Understanding our own solar system and how it formed might even give us clues about solar systems elsewhere in the universe.

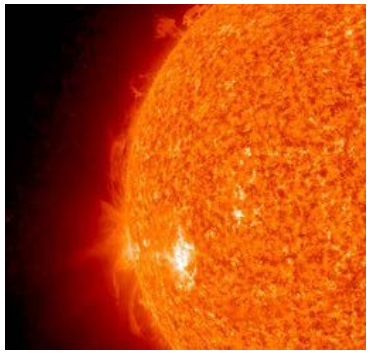
Let's take an imaginary flight from the center of our solar system to its outer edges. We start at the Sun, the center of the solar system. As we move away from the Sun and travel to the very edges of the solar system, we will pass many objects of varying sizes and shapes. All of them, just like Earth, are circling the Sun. Climb aboard our fantasy spaceship! Let's begin our journey.

**THE SUN AND PLANETS OF OUR SOLAR SYSTEM**

## The Sun

The Sun is one of countless stars in the universe. Stars are huge, fiery balls of gas. The Sun is medium-sized compared to other stars—it only looks larger because it is much, much closer to us. The Sun is about 150 million kilometers (93 million mi.) from Earth, while other stars are trillions of kilometers away.

The Sun—like other bright stars—is made mostly of hydrogen gas. Hydrogen is the lightest element in the universe. Atoms of hydrogen in the Sun's center are forced together by extreme heat and pressure. In this joining process, called *fusion*, four hydrogen atoms produce one atom of helium. Fusion releases huge amounts of energy that cause the Sun to be extremely hot and bright. Temperatures in the Sun vary greatly. The hottest part of the Sun is its **core**. The surface of the Sun is much cooler. As hydrogen atoms form helium, the supply of hydrogen decreases.





**WOWSER!**

Over time, the Sun's supply of hydrogen will almost run out. The Sun will then begin to cool down. But it will take 5 billion years for the Sun to use up that much hydrogen!

The Sun is by far the most massive object in our solar system. It contains more than 99 percent of all the mass—quantity of matter—in the solar system.

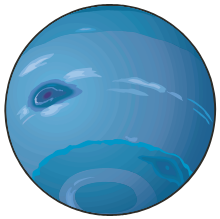
The Sun's tremendous mass gives it extremely strong **gravity**. Gravity is a force of attraction between all objects in the universe. It is gravity that keeps **planets orbiting** the Sun, and **moons** orbiting planets.

| ***Fast Facts*** **About the Sun** | |
|---|---|
| • Diameter: | 1.39 million kilometers (864,000 mi.) |
| • Temperature: | Core: about 15 million °C (27 million °F)<br>Surface: about 5,500°C (10,000°F)<br>Corona: more than 1 million °C (1.8 million °F) |
| • Mass, compared with Earth: | 332,000 times as massive |

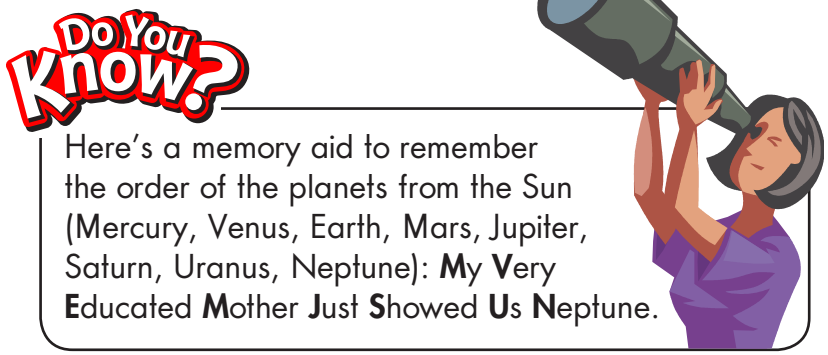
## The Planets

Our trip through the solar system will take us by eight planets. The number used to be nine. But in 2006, the most distant planet, Pluto, lost its standing as a planet.

Scientists place the planets into two groups. One group is the four planets closest to the Sun: Mercury, Venus, Earth, and Mars. These planets are called the **terrestrial** (tuh-RES-tree-ul) planets because they have solid, rocky surfaces. The word *terrestrial* means "like Earth."



The outer four planets—Saturn, Jupiter, Uranus, and Neptune—are called **gas giants**. These planets are big balls of gas and do not have a solid surface.




Here's a memory aid to remember the order of the planets from the Sun (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune): **M**y **V**ery **E**ducated **M**other **J**ust **S**howed **U**s **N**eptune.



## The Terrestrial Planets

The first planet we encounter as we leave the Sun is Mercury, a small, barren planet that is covered with **craters**. Craters are scars on the surface of a planet that form when meteorites or other objects strike it. Mercury looks a lot like Earth's Moon. And like the Moon, it has no atmosphere.

If you were standing on the surface of Mercury, the Sun would look three times larger than it does on Earth. When the Sun is overhead on Mercury, the temperature rises to about 430°C (800°F). After sunset, it drops down to about −170°C (−280°F).

| ***Fast Facts*** **About Mercury** |
| --- |
| • Diameter: 4,879 kilometers (3,032 mi.) |
| • Average distance from the Sun: 58 million kilometers (36 million mi.) |
| • Period of rotation (one turn on axis): 59 Earth days |
| • Period of revolution (one orbit around Sun): 88 Earth days |
| • Number of moons: 0 |

The next planet we will see is Venus. It is the brightest object in our sky, except for the Sun and Moon. It is sometimes called the Morning Star or the Evening Star because it can be seen before dawn or after sunset, when the sky is fairly light.

Venus is a really terrible place. It is covered with thick clouds that trap heat from the Sun. The temperature on Venus is about 470°C (880°F). The planet has more than 1,000 volcanoes and other places where molten rock erupts.

Almost all of Venus's surface is hardened lava. Scientists think that the planet got a whole new surface less than 500 million years ago. Huge lava flows covered almost all of Venus and then became hard rock.

| ***Fast Facts*** **About Venus** |
|---|
| • Diameter: 12,104 kilometers (7,521 mi.) |
| • Average distance from the Sun: 108 million kilometers (67 million mi.) |
| • Period of rotation: 243 Earth days |
| • Period of revolution: 225 Earth days |
| • Number of moons: 0 |



The third planet we will run into on our voyage is the most familiar. It is Earth, our home planet. As far as we know, it is the only planet in our solar system with life. It is also the only planet with large amounts of surface water—oceans, rivers, and lakes.

Earth lies in a region of the solar system called the *habitable zone*. The temperature enables liquid water to exist. Liquid water was vital for the development of life.

The atmosphere of our planet is about one-fifth oxygen. All of Earth's animals breathe oxygen. Oxygen is continuously being produced by the many green plants on Earth.

| ***Fast Facts*** **About Earth** |
|---|
| • Diameter: 12,756 kilometers (7,926 mi.) |
| • Average distance from the Sun: 150 million kilometers (93 million mi.) |
| • Period of rotation: 23.93 hours |
| • Period of revolution: 365.24 days |
| • Number of moons: 1 |

The next planet out from the Sun is Mars. This planet is reddish, with a very thin atmosphere. The color of the planet is caused by rocks containing iron oxide, or rust.

It is cold on Mars. The surface temperature ranges from −87° to −5°C (−125° to +23°F)—always below the freezing point of water, 0°C (32°F). Scientists have discovered that Mars has ice caps at its poles. Long ago, Mars may have had oceans and flowing rivers on its surface. Today, salty water flows in some areas during the warmer months.

Mars is often swept by great dust storms. The planet has the solar system's largest volcano, Olympus Mons. It is 27 kilometers (17 mi.) high.

| ***Fast Facts*** **About Mars** |
|---|
| • Diameter: 6,794 kilometers (4,222 mi.) |
| • Average distance from the Sun: 228 million kilometers (142 million mi.) |
| • Period of rotation: 24.6 Earth hours |
| • Period of revolution: 687 Earth days |
| • Number of moons: 2 |



## Asteroids

You might be surprised to find our tour of the planets interrupted, but between Mars and Jupiter lies a large area full of **asteroids** that also orbit the Sun. This area is called the *asteroid belt*.

Asteroids are chunks of rock left over from the birth of the solar system. They are probably material that never managed to form a planet. Asteroids range in size from small boulders to masses of rock hundreds of kilometers wide. Altogether, there are millions of asteroids.

The largest and most massive object in the asteroid belt is the dwarf planet Ceres. It is about 940 kilometers (584 mi.) in diameter.

**Do You Know?**

Earth has been struck by huge asteroids all through its history. About 65 million years ago, an asteroid about 10 kilometers (6.2 mi.) wide smashed into what is now Mexico. Many scientists think that impact is what killed the dinosaurs.

## The Gas Giants

The next four planets we will encounter on our journey are the gas giants: Jupiter, Saturn, Uranus, and Neptune.

Jupiter is the biggest planet in the solar system. It has a thick atmosphere made mostly of hydrogen and helium. Way down, Jupiter may have an icy core the size of Earth.

Jupiter's atmosphere is divided into large bands stretching around the planet. These bands are caused by strong east-west winds in the atmosphere. A famous feature of the atmosphere is the Great Red Spot, a gigantic spinning storm. It has existed for at least 300 years.

| ***Fast Facts*** **About Jupiter** |
|---|
| • Diameter: 142,984 kilometers (88,486 mi.) |
| • Average distance from the Sun: 778 million kilometers (484 million mi.) |
| • Period of rotation: 9.9 Earth hours |
| • Period of revolution: 11.9 Earth years |
| • Number of moons: 63 |



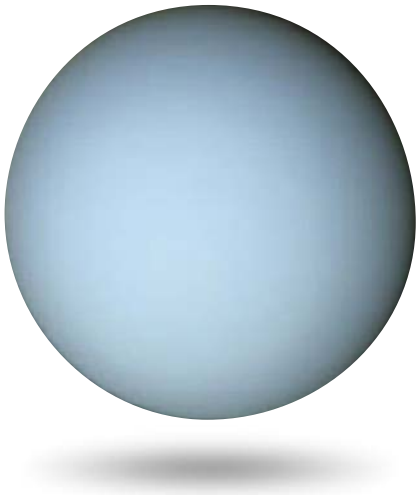
The second gas giant we'll see is Saturn, which is famous for its spectacular rings.

Like Jupiter, Saturn's atmosphere is divided into bands circling the planet. The bands result from winds blowing up to 1,800 kilometers (1,120 mi.) an hour.

Saturn's rings number in the thousands. They extend nearly 300,000 kilometers (186,000 mi.) into space, but they are no more than 1 kilometer (0.62 mi.) thick. The rings are made of countless pieces of rock and ice. Some pieces are the size of sugar grains, and others are as big as a house. Scientists think the rings are the remains of comets and other objects that broke apart near the planet.

| ***Fast Facts*** **About Saturn** |
|---|
| • Diameter: 120,536 kilometers (74,898 mi.) |
| • Average distance from the Sun: 1.4 billion kilometers (886 million mi.) |
| • Period of rotation: 10.7 Earth hours |
| • Period of revolution: 29.4 Earth years |
| • Number of moons: 60 |

Uranus (pronounced either YOOR-uh-nus or yuh-RAY-nus), the third gas giant and seventh planet from the Sun, is a blue-green planet. Its atmosphere contains some of the brightest clouds in the outer solar system.



Uranus gets its color from methane, a gas in the atmosphere. Clouds beneath a layer of methane reflect sunlight back through the methane. The gas absorbs the red portion of the light but allows the blue portion to pass through.

At least 80 percent of Uranus's mass consists of a liquid core. The core is made of frozen water, methane, and ammonia, another gas.

| ***Fast Facts*** **About Uranus** |
|---|
| • Diameter: 51,118 kilometers (31,763 mi.) |
| • Average distance from the Sun: 2.87 billion kilometers (1.78 billion mi.) |
| • Period of rotation: 17.24 Earth hours |
| • Period of revolution: 84 Earth years |
| • Number of moons: 27 |



Do you see that up ahead? It's the last planet on our journey. Neptune is the farthest planet from the Sun. This gas giant has a bluish color, but its color is even brighter than Uranus's. Scientists think that Neptune's color, like that of Uranus, is caused by methane in the atmosphere. But why the color is more intense is not known.

Neptune has a solid core the size of Earth, made of ice and other frozen substances. The planet is so far from the Sun that it receives almost no heat. One of Neptune's moons, Triton, is the coldest place that astronomers have found in the solar system. Its surface temperature is about −235°C (−391°F).

| ***Fast Facts*** **About Neptune** |
|---|
| • Diameter: 49,528 kilometers (30,775 mi.) |
| • Average distance from the Sun: 4.5 billion kilometers (2.8 billion mi.) |
| • Period of rotation: 16.1 Earth hours |
| • Period of revolution: 164.8 Earth years |
| • Number of moons: 13 |

## Dwarf Planets

We're not yet at the end of our journey. Now we'll encounter what astronomers decided in 2006 was a new category of objects orbiting the Sun. They said that small, planetlike objects would now be called **dwarf planets**.

Under the new rules, Pluto became a dwarf planet. Because dwarf planets are like Pluto, the astronomers gave the name *plutoids* to these objects if they exist in the same region of the solar system. Pluto itself became a plutoid.

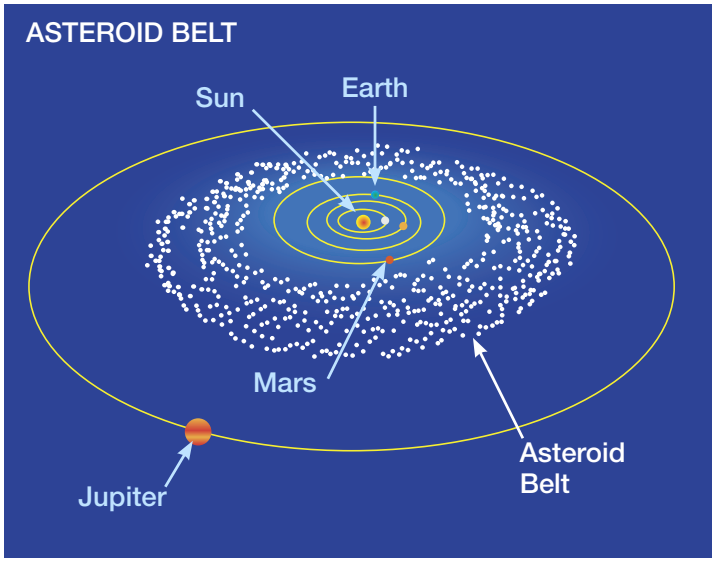
Plutoids orbit the Sun in a remote part of the solar system called the Kuiper (KY-per) Belt. This area is full of icy objects, and astronomers are certain they will find more plutoids there.

Artist's impression of the New Horizons spacecraft encountering a Kuiper Belt object



In 2009, there were four known plutoids. They were Pluto; its larger neighbor, Eris; Makemake (MAA-kee MAA-kee); and Haumea (how-MAY-uh). Makemake is named for a god worshipped by the people of Easter Island in the Pacific Ocean. Haumea, which is shaped like a rounded football, is named for a Hawaiian goddess.

All plutoids are dwarf planets, but not all dwarf planets are plutoids. To be a plutoid, a dwarf planet must orbit beyond Neptune. Ceres is a dwarf planet that is not considered a plutoid because its orbit lies between Mars and Jupiter in the asteroid belt.



## Moons of the Solar System

Throughout our journey, many of the planets we passed had moons orbiting them. The solar system has 171 known moons. A moon is an object that orbits a planet. It is also called a natural **satellite**.

The moon that people know best is, of course, our own Moon. It is one of the largest moons in the solar system. It is dry, airless, and covered with mountains and craters.

Scientists think our Moon was created about 4.5 billion years ago. They believe an object the size of Mars smashed into Earth. Debris thrown into orbit around Earth came together to form the Moon.

The Moon rotates on its axis in the same amount of time that it revolves around Earth. The result is that the same side of the Moon always faces Earth. But there is no permanent "dark side of the Moon." All sides get sunlight as the Moon rotates.



The largest moon in the solar system is Ganymede (GAN-uh-mede), one of Jupiter's satellites. It is 5,276 kilometers (3,278 mi.) in diameter. Ganymede and two other satellites of Jupiter—Europa and Callisto—are of great interest to scientists. They have icy crusts that may cover liquid oceans.

Saturn's moons are also of scientific interest. Titan, the second-largest moon in the solar system, is covered by thick orange clouds. Beginning in 2004, an orbiting spacecraft named Cassini began studying Titan's surface. It used radar, which could see through the clouds. The radar images showed that Titan has mountains, lakes of liquid gases, and an impact crater the size of Iowa.

The moons of the solar system hold many secrets. And they probably have natural resources that Earth can use. They will be extensively studied and explored in the decades to come.

## Comets

**Comets** are some of the most dramatic objects in the solar system. They move slowly across the sky, trailing a bright tail. Then their light fades away.

A comet contains a solid part called the *nucleus*. The nucleus is made of ice, frozen gases, rocks, and dust. As a comet approaches the Sun, the nucleus starts to warm up, freeing much of the dust and gas. A flow of light and particles from the Sun pushes that material away from the comet, forming the tail.

Most comets come from the Kuiper Belt. Others come from a farther-away region called the *Oort Cloud*. Some comets, such as the famous Halley's Comet, make predictable return trips around the Sun. But about a dozen new comets are sighted each year.



## Conclusion

We've taken a quick trip through the solar system and seen many wonderful and fantastic things. Now, when you look up at the Sun, you'll understand how it produces its light. And when you see the Moon rising or observe Venus in the evening sky, you'll know more about them, too.

Our solar system is full of wonders. Telescopes and satellites in space have taken many amazing images of objects in the solar system that you can see in books and online. But you can also see some of these amazing things for yourself. A simple backyard telescope can reveal many of them to your own eyes. Now that you understand our incredible solar system, think about the astounding objects that await further discovery in the universe beyond.

An artist's idea of what another solar system might look like

## Glossary

**asteroids** irregularly shaped rocks that orbit stars (p. 12)

**comets** space objects made of ice and dust that orbit a star and develop a long, bright tail as they near their star (p. 14)

**core** the center of an object (p. 5)

**craters** holes in the ground caused by the impact of an object from space (p. 8)

**dwarf planets** nearly round objects that orbit a star, are smaller than a planet, and are not satellites of another object (p. 17)

**gas giants** large planets that are mainly made up of gases (p. 7)

**gravity** the force that pulls all objects toward each other (p. 6)

**moons** solid objects that travel around a planet; natural satellites (p. 6)

**orbiting** revolving around another object (p. 6)



**planets** very large objects that orbit a star (p. 6)

**satellite** a natural or human-made object that orbits Earth or another object in space (p. 19)

**solar system** a group of objects in space that orbit a star (p. 4)

**stars** bodies in outer space, made of hot gases, that shine in the night sky (p. 4)

**terrestrial** like Earth; describes planets that are rocky and Earthlike in size (p. 7)

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