

Science

# Earth's Place in Space

by Johanna Biviano



## Before Reading

### Show What You Know

**Before** you read this book, look through it. Read the headings. Look at the pictures.

Draw a chart like the one shown. In the first column it lists objects in the solar system.

**Draw** in the second column a picture of each object.

**Write** in the third column when each object can be seen.

**Write** in the last column what you know about each object.

Object	What It Looks Like	When It Can Be Seen	What I Know About It
Sun			
Planet			
Moon			
Comet			

**After** you read this book, in the last column **write** one thing you learned about each object.



## During Reading

star



estrella

solar system



sistema solar

ellipse



elipse

planet



planeta

satellite



satélite

asteroid



asteroide

comet



cometa

dwarf planet



planeta enano



## During Reading

### Do you understand?

Make a chart like the one shown.

Fact	Opinion

Read the sentences. Decide whether the sentence is a fact or an opinion. **Write** the sentence in the correct column in your chart.

1. The inner planets are small, rocky, and close to the sun.
2. Mars is the most interesting planet.
3. The sun is in the center of our solar system.
4. I believe scientists will find life on another planet.
5. **Write** About Science  
**Write** what you hope scientists will find out as they explore space.

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by Johanna Biviano



PEARSON

Glenview, Illinois  
Boston, Massachusetts  
Chandler, Arizona  
Upper Saddle River, New Jersey

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# Our Sun

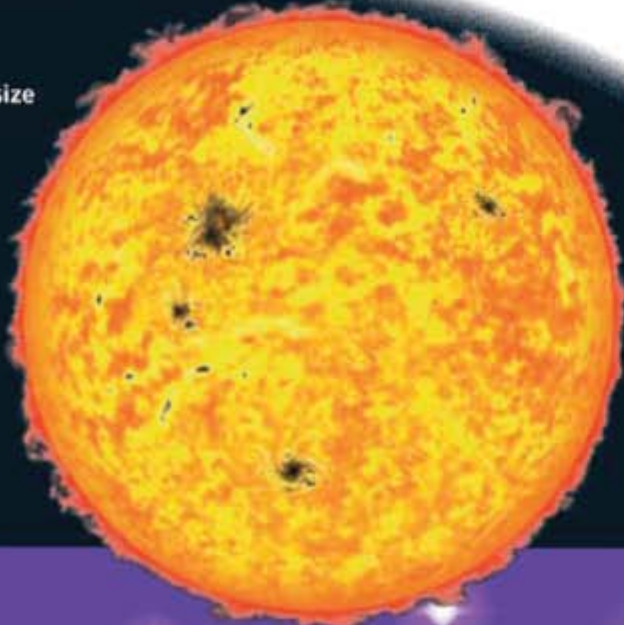
## The Center of Our Solar System

Our Sun is a star. A **star** is a huge ball of very hot gas that gives off energy. Our Sun is the center of the solar system. The **solar system** includes the Sun and its ten planets. It also includes asteroids, comets, and moons.

The Sun is the largest object in the solar system. It makes up 99 percent of the mass of the entire solar system. Earth is tiny compared to the Sun. One billion planets the size of Earth could fit inside the Sun! Compared to other stars, the Sun is average in size. Giant stars can be as big as 100 times the size of our Sun. Supergiant stars can be more than 500 times bigger! Some stars can be as small as Earth.

The Sun gives off energy. Hydrogen particles move at high speeds in the center of the Sun. The particles combine to form particles of helium. This fusion gives off huge bursts of energy.

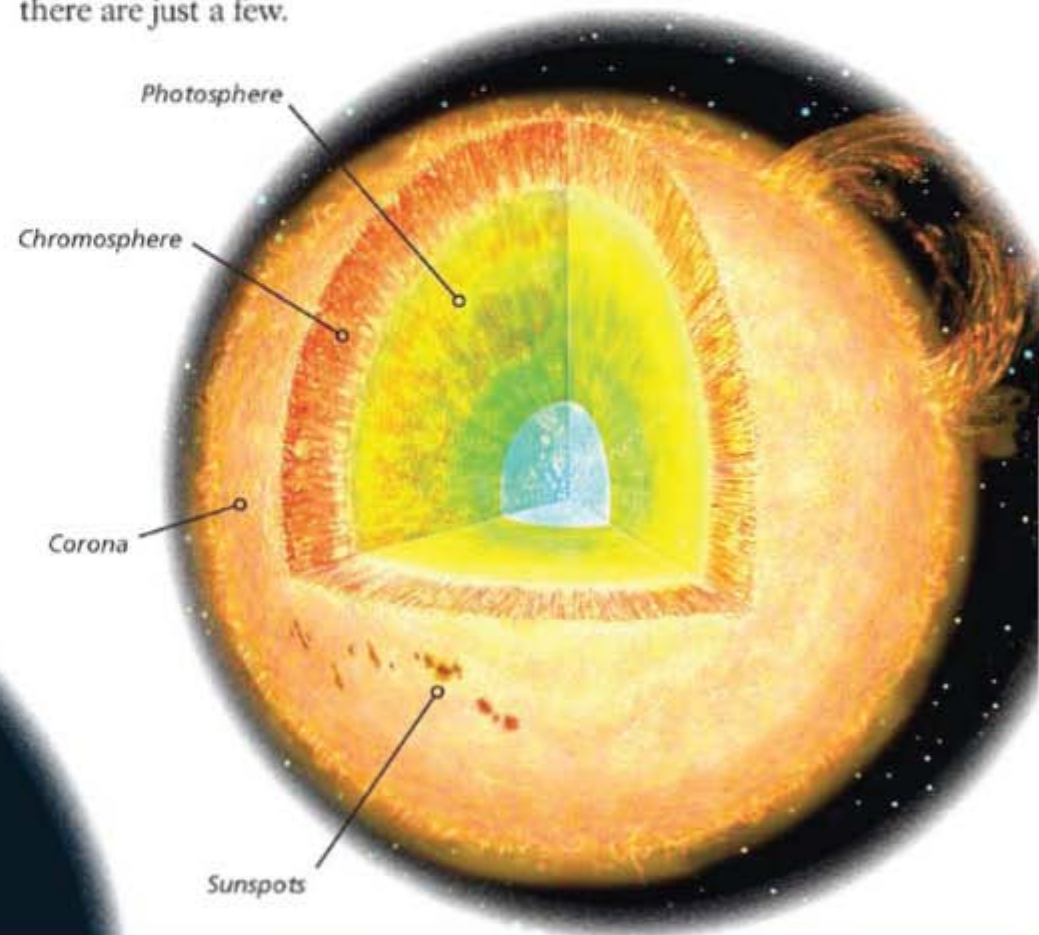
Sunspots may be the size of Earth or larger.



## The Sun's Layers

Unlike the Earth, the Sun has no hard surfaces. It is made up completely of hot gases. Scientists have named layers in the Sun. The inner layer is called the photosphere. It gives off light we can see from Earth. The layer above the photosphere is called the chromosphere. The outer layer is the corona.

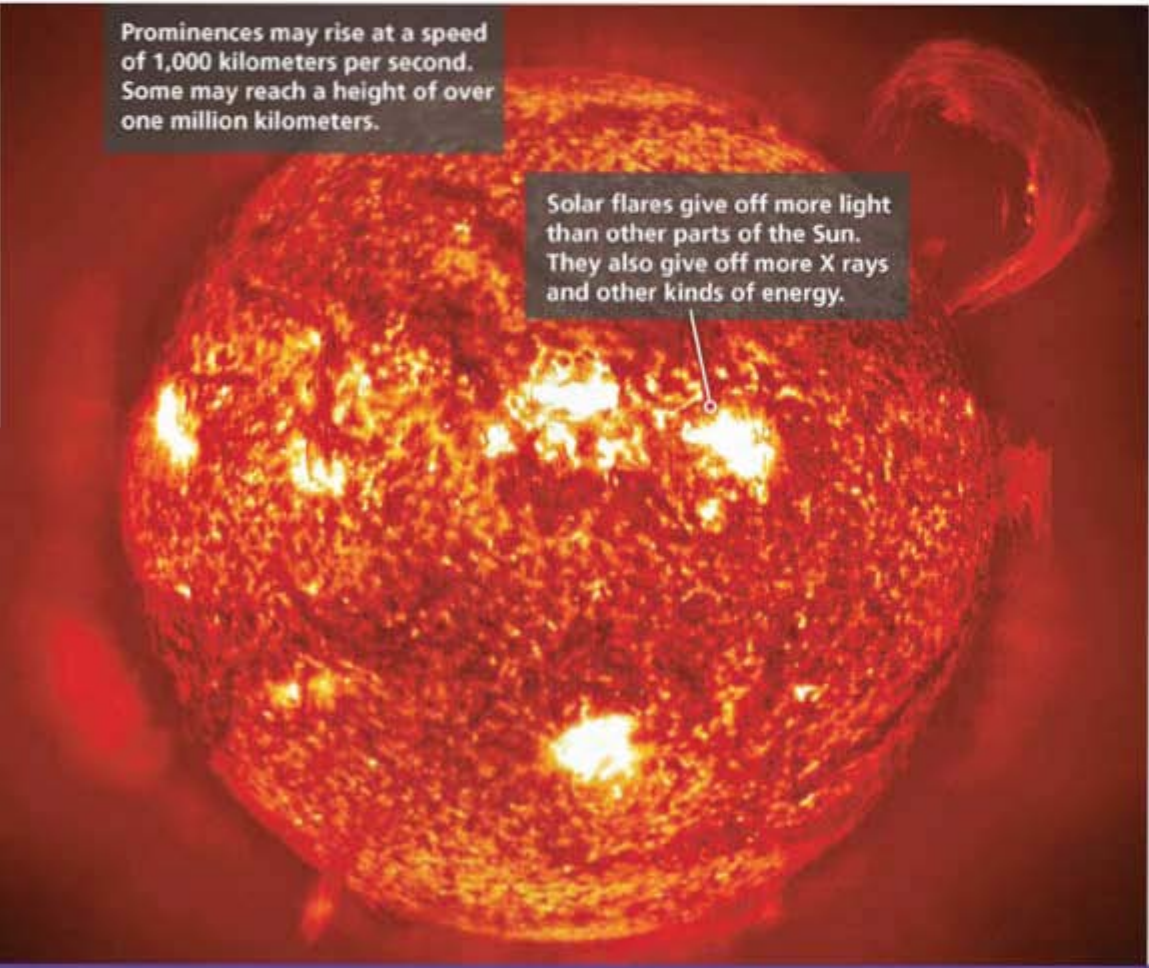
From Earth, we use powerful telescopes to study the Sun's activity. Scientists can see sunspots, dark spots on the face of the Sun. They look dark because they are cooler than other parts of the Sun. Sometimes there are many sunspots, and sometimes there are just a few.



## Solar Eruptions

The chromosphere is very active. Wild loops of gas leap from the chromosphere. These loops are called prominences. They appear and then disappear over a few days or months.

The Sun's gases also erupt in the chromosphere. These eruptions are called solar flares. Solar flares force huge amounts of electromagnetic waves far into the corona. The waves are so huge that they can disturb our radio waves and electrical systems on Earth!



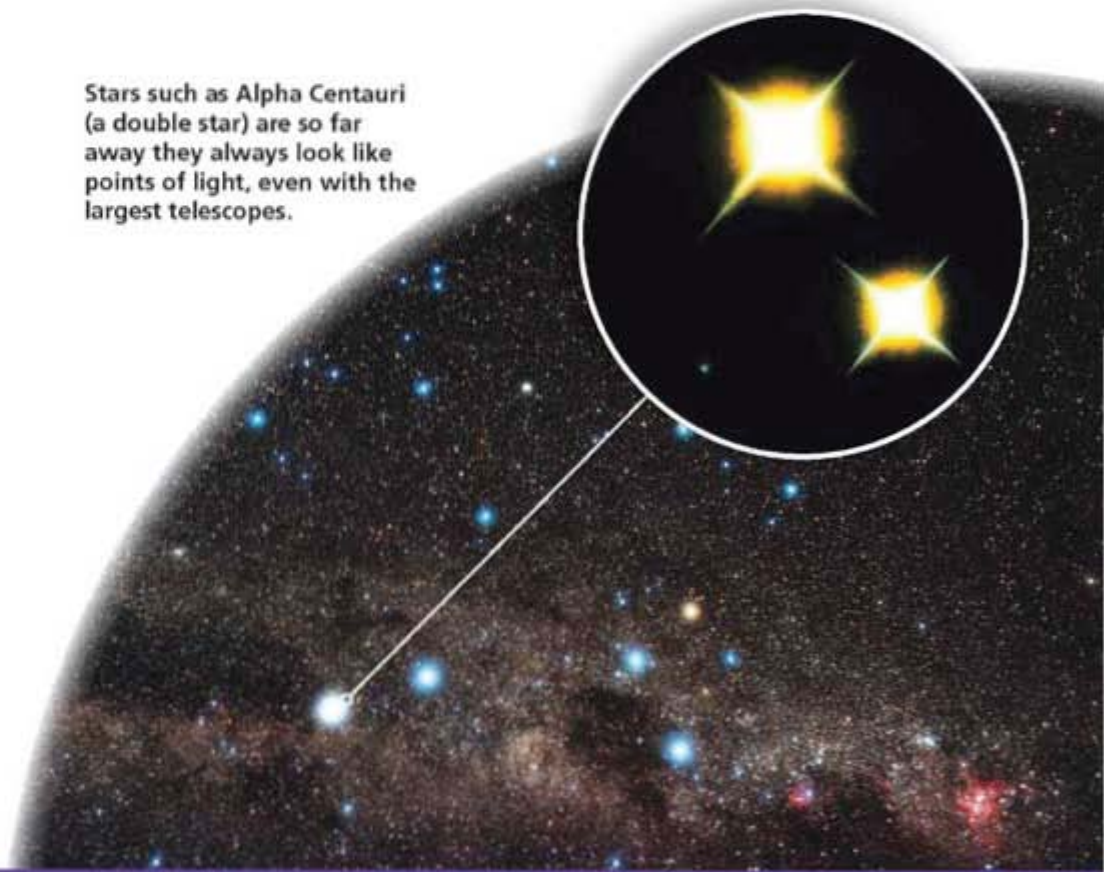
Prominences may rise at a speed of 1,000 kilometers per second. Some may reach a height of over one million kilometers.

Solar flares give off more light than other parts of the Sun. They also give off more X rays and other kinds of energy.

## Traveling Light

The light we see from the Sun takes time to reach us on Earth. We see the sunlight eight minutes after it leaves the Sun. The rest of the stars in the sky are so far away that their light takes a much longer time to reach us.

Scientists measure the distance of these stars by the time it takes their light to travel. They use a measurement of distance called a light-year. One light-year tells you how far light could travel in one year; over 9.4 trillion kilometers! The nearest star to Earth, Alpha Centauri, is more than four light-years away. The light we see coming from Alpha Centauri takes four years to reach our eyes on Earth.



Stars such as Alpha Centauri (a double star) are so far away they always look like points of light, even with the largest telescopes.

# Planets in Orbit

## Our Solar System

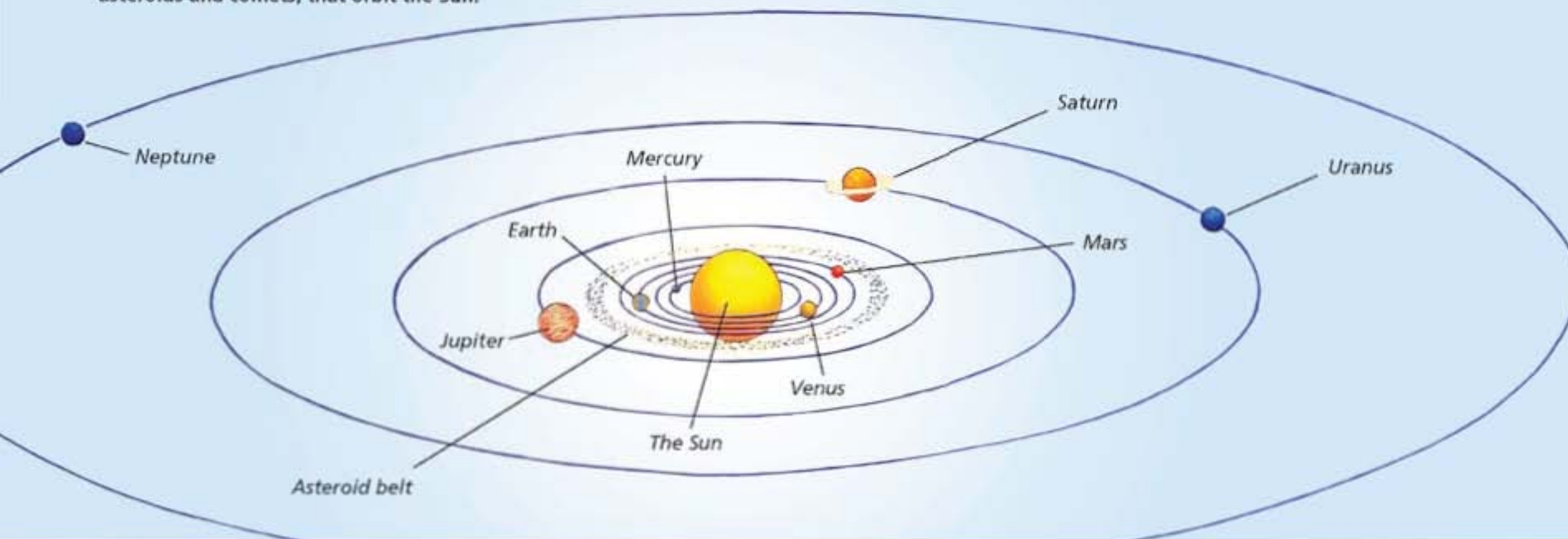
You already know that our solar system is made up of the planets, their moons, and other objects. Each planet revolves around the Sun in its own path. This path is called an orbit. The planets move around the Sun in elliptical orbits. An **ellipse** is a shape like an oval.

A **planet** is a large sphere that orbits a star. The planets in our solar system revolve around the Sun. Planets are cooler and smaller than stars. You can see some planets in the night sky. They seem to shine like stars, but they don't give off their own light. Instead, they reflect the Sun's light.

The solar system includes the planets, their moons, and smaller objects, such as asteroids and comets, that orbit the Sun.

A planet travels in its orbit because of gravity. Gravity is a force of attraction between objects. Because the Sun has much more mass and is close to the objects in the solar system, it attracts each of the planets. The Sun's gravity keeps them in orbit. The planets attract the Sun too, but not as much.

The diagram below shows the eight known planets in the solar system. The four planets closest to the Sun are called the inner planets. The four planets farthest from the Sun are called the outer planets. Asteroids, comets, dwarf planets, and other objects also revolve around the Sun.





## Our Moon in Orbit

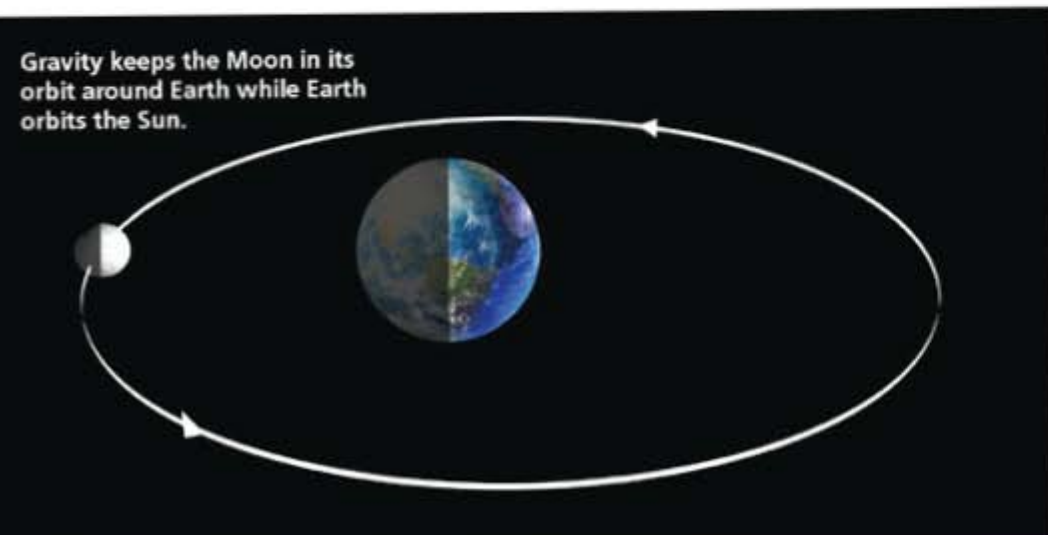
On the night of a full moon the whole sky seems to glow with light. The Moon is a satellite of our planet. A **satellite** is an object that orbits another object in space. Most of the planets in the solar system have at least one moon.

The Moon moves in an elliptical orbit around Earth. The Moon stays in this orbit because of gravity. The Moon's mass is less than that of Earth. So gravity between the Moon and Earth keeps the Moon in orbit.

Both the Earth and Moon orbit the Sun. As the Moon orbits Earth, Earth continues to orbit the Sun. Other planets with moons orbit this way too. The planet's gravity keeps a moon in orbit with the planet. The Sun's gravity keeps the planet-moon system in orbit around the Sun.

## Free Falling

Astronauts look weightless in their space capsules. They float inside the capsule. This happens because the astronauts are in free fall with their space capsule.



Free fall happens when the only force acting on an object is gravity. In space, there is no atmosphere and no drag to act on an object. Only the Earth's gravity pulls on the space capsule as it orbits Earth.

Over three hundred years ago, Sir Isaac Newton was thinking about how orbits work. He used the example of a huge cannon on a tall mountaintop. In his example, one bag of gunpowder could launch a cannonball many miles. Gravity would pull the cannonball down to Earth's surface. With two bags of gunpowder, the cannonball would go farther, but gravity would still pull it down. The cannonball's path would curve around Earth before it fell. Newton thought that if you could shoot a cannon with enough gunpowder, the cannonball would continue in a curved path around Earth. It would keep going, even past the cannon that shot it!

In Newton's example, two things are happening. First, the forward movement of the cannonball keeps it above Earth's surface. Second, gravity causes the cannonball to fall. If there is enough force to keep the cannonball moving, it will be in orbit.

Astronauts become weightless because they are free falling.



# The Inner Planets

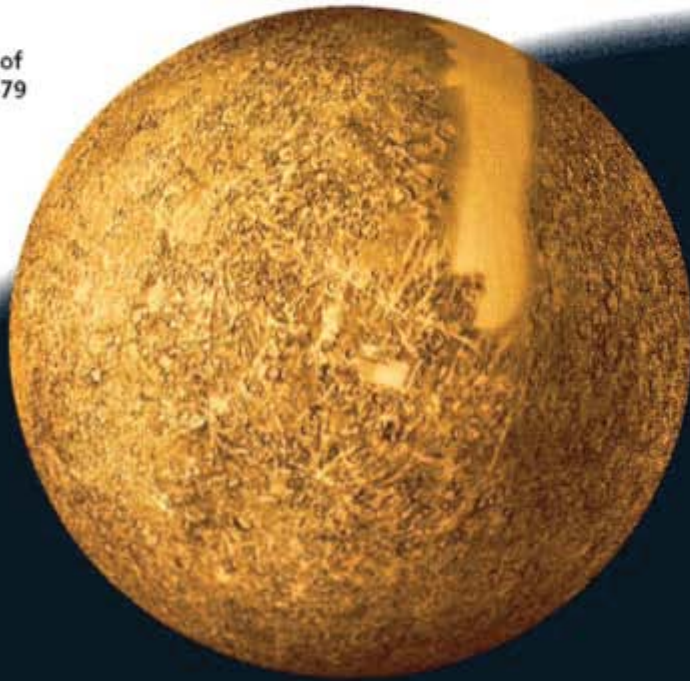
## Mercury

Mercury is the planet closest to the Sun. Mercury is only a little bigger than Earth's moon. Its surface is pocked with thousands of dents. These craters were made when meteorites rained down on Mercury long ago. A meteorite is a rock from space that has struck the face of a planet or moon.

Unlike Earth, Mercury has almost no atmosphere. Because it is so close to the Sun, daytime on Mercury is more than four or five times hotter than the hottest places on Earth. At night, the temperature drops to  $-170^{\circ}$  Celsius.

A space probe called the *Mariner 10* reached Mercury in 1974. Scientists create probes to take pictures and collect other information from space.

The diameter of Mercury is 4,879 kilometers (3,032 miles).



## Venus

Venus is the second planet from the Sun. Venus and Earth are about the same size, but Venus rotates in the opposite direction. Venus and Mercury are both hot, dry, and rocky. Venus is different from Mercury because it has a thick atmosphere of burning hot clouds! The weather on Venus is windy and stormy. Venus is bright in the night sky because its clouds reflect sunlight better than the rocky surfaces of other planets.

The diameter of Venus is 12,104 kilometers (7,521 miles).



## Earth and the Moon

Our planet Earth is the third planet of the inner planets. It is the largest rocky planet in the solar system. Earth is the only planet with liquid water on its surface.

Earth has a thick atmosphere of gases. These gases make life possible on Earth. The atmosphere protects Earth from the Sun's harmful rays, and contains many gases that plants and animals need to survive. Nitrogen, oxygen, carbon dioxide, and water vapor are all necessary to support life. As far as we know, Earth is the only planet in our solar system that supports life.

Our Moon revolves around the Earth. It is a satellite of Earth. Earth's gravity keeps it in orbit. The Moon is about one-fourth the size of Earth. It has many craters and no atmosphere.

The diameter of Earth is 12,756 kilometers (7,926 miles).



## Mars

We know a lot about Mars, the fourth planet from the Sun. Scientists have landed several probes on Mars. In 1976, the *Viking I* landed on Mars. A robot named *Sojourner* explored Mars in 1997, and in 2004, two rovers landed. These rovers, *Spirit* and *Opportunity*, gathered information and sent it back to Earth. Scientists have learned a lot about Mars because of these probes and rovers. They hope to discover evidence of water on Mars.

The soil on Mars contains iron oxide, which gives it its rusty color. This is why Mars is often called the "Red Planet." The two moons of Mars are full of deep craters.

Mars is smaller than Earth, but the two planets have some similarities. Mars has polar ice caps that grow in winter and shrink in summer. A day on Mars is twenty-five hours long, just one hour longer than an Earth day. Mars has a canyon ten times longer than our Grand Canyon, and it has many volcanoes.

Earth and Mars have some big differences. Mars has very little oxygen and does not support life. Winds on Mars sometimes cause dust storms that can cover the whole planet.

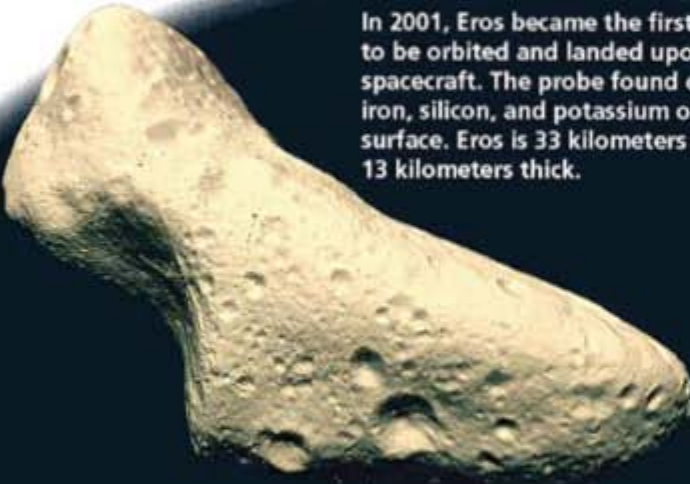
The diameter of Mars is 6,794 kilometers (4,222 miles).



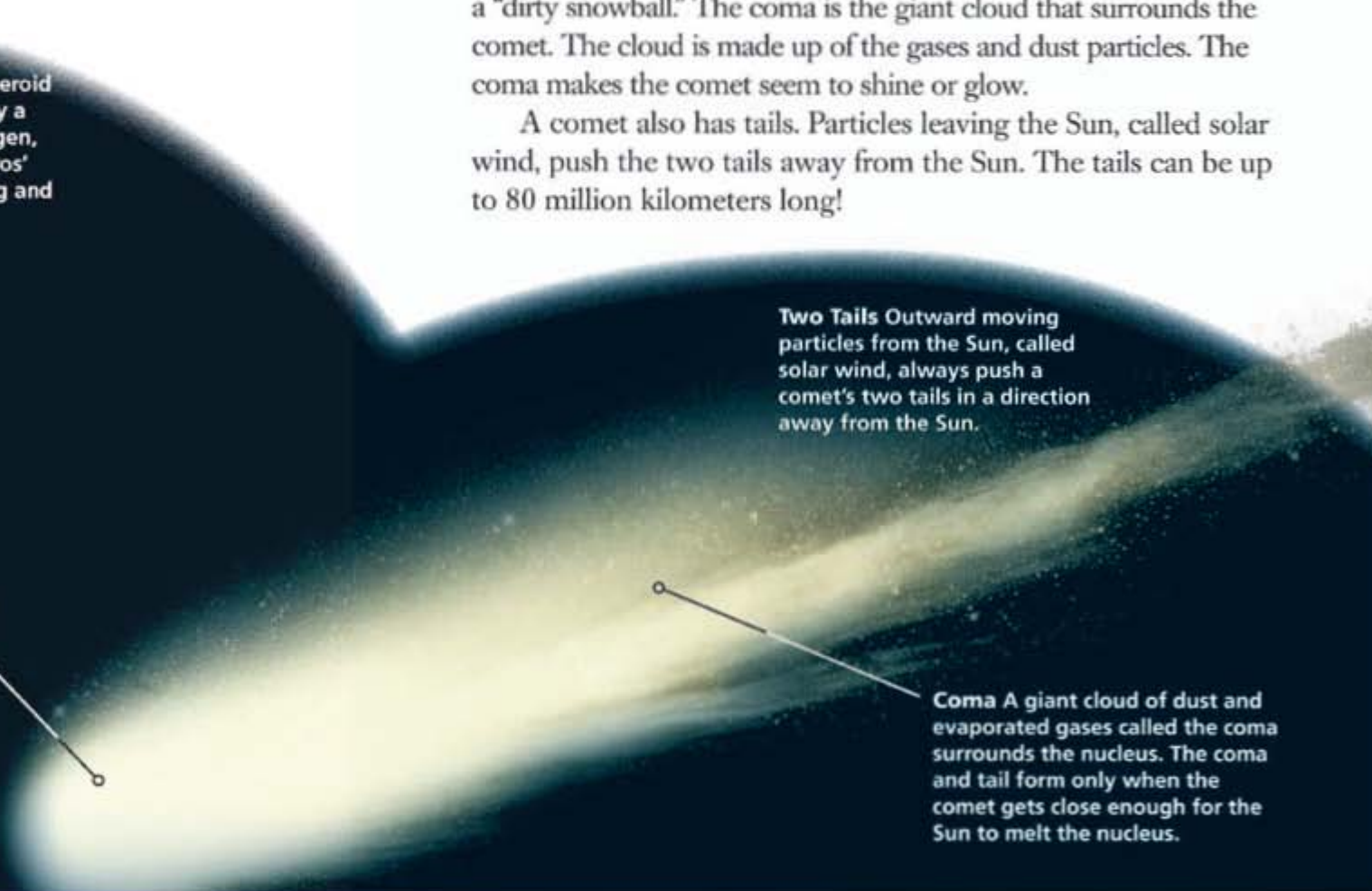
## Asteroids

An **asteroid** is a rocky object up to several hundred kilometers wide that revolves around the Sun. The asteroid belt between Mars and Jupiter has many asteroids that orbit the Sun. These rocky masses can be as small as a pebble, and some orbit other asteroids.

Asteroid orbits are harder to predict than planets or moons. Some have hit planet Earth before! Most asteroids don't enter Earth's atmosphere. They are attracted to Jupiter's gravity.



In 2001, Eros became the first asteroid to be orbited and landed upon by a spacecraft. The probe found oxygen, iron, silicon, and potassium on Eros' surface. Eros is 33 kilometers long and 13 kilometers thick.



**Nucleus** The nucleus of a comet is very small, often only a few kilometers across. Scientists describe the nucleus as a "dirty snowball." It is made of dust and ice—frozen water and frozen gases.

**Two Tails** Outward moving particles from the Sun, called solar wind, always push a comet's two tails in a direction away from the Sun.

**Coma** A giant cloud of dust and evaporated gases called the coma surrounds the nucleus. The coma and tail form only when the comet gets close enough for the Sun to melt the nucleus.

## Comets

A **comet** is a frozen mass of different kinds of ice and dust that is in orbit around the Sun. Comets are tiny compared to planets, and some come from outside our solar system. They follow extremely elliptical orbits. Only a few comets enter our solar system each year. They are hard to see from Earth because they are so small.

There are several parts to a comet. The nucleus is a small ball of frozen water, frozen gases and dust. Scientists call the nucleus a "dirty snowball." The coma is the giant cloud that surrounds the comet. The cloud is made up of the gases and dust particles. The coma makes the comet seem to shine or glow.

A comet also has tails. Particles leaving the Sun, called solar wind, push the two tails away from the Sun. The tails can be up to 80 million kilometers long!

# The Outer Planets

## Jupiter

Jupiter is the fifth planet from the Sun. It is the largest planet in the solar system. Jupiter is a gas giant, a very large planet made up of gases. Hydrogen and helium are the main gases in Jupiter's atmosphere.

Jupiter has many moons, but four of them are very large. These four moons were discovered in 1610 by Galileo. The United States has sent six different space probes to Jupiter.

## Saturn

Saturn, the sixth planet from the Sun, is also a gas giant. It is very large, but less dense than other planets. Saturn is mostly made up of hydrogen and helium.

Saturn looks like it has a hula hoop around it. The hoop is actually the planet's rings. Saturn has seven rings made up of pieces of ice, rock, and dust. Some are big boulders, while others are small grains.

The diameter of Saturn is 120,536 kilometers (74,897 miles).



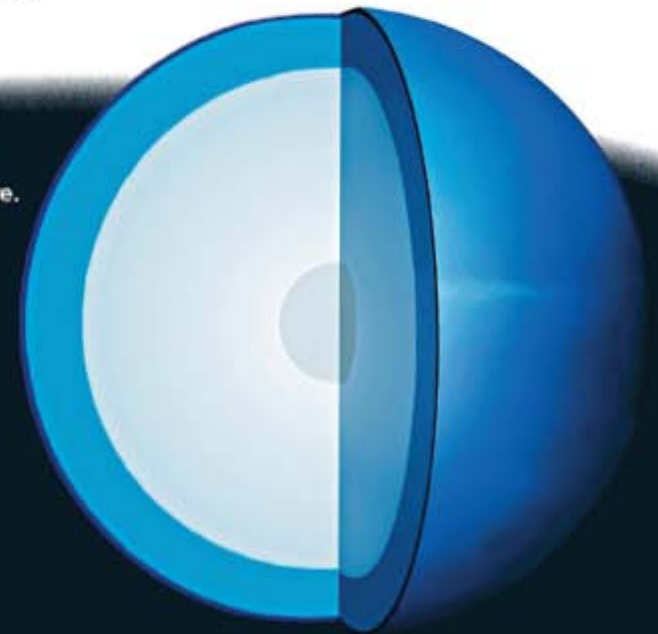
## Uranus

Another gas giant, Uranus, is the seventh planet from the Sun. Uranus is the farthest planet in the solar system that is still visible to the naked eye. It has helium, hydrogen, and methane gas in its atmosphere. Uranus has a fuzzy, blue-green appearance. This comes from liquid methane gas that covers the planet.

Uranus, like Saturn and Jupiter, has rings and many moons. The rings are very difficult to see from Earth, even with telescopes. The rings were a discovery in 1977, when a space probe sent pictures back to Earth.

Uranus is the only planet that rotates on its side. Scientists believe that Uranus collided with a large object when the solar system was just beginning. The collision could have pushed Uranus onto its side.

Uranus is a gas giant with a large liquid core.



## Neptune

The eighth planet from the Sun is Neptune. It is the smallest of the gas giants. It is still a huge planet! It is four times the size of Earth. Neptune is too far from Earth to be seen with the naked eye. Its orbit is so huge that it takes one hundred Earth years for Neptune to orbit the Sun!

Neptune and Uranus are similar planets. They both have methane gas in their atmospheres. This gives Neptune a bluish color like Uranus. Neptune and Jupiter are similar too. They both have bands of clouds and storms. Neptune used to have a large storm called the Great Dark Spot. The *Voyager 2* probe took pictures of it in 1989, five years before it vanished.

Like the other gas giants, Neptune has many moons. Its largest moon, Triton, may be the coldest body in the solar system. Its temperature is about  $-235^{\circ}$  Celsius.

Neptune's ring system

## Pluto

Clyde Tombaugh discovered a small, rocky object in space in 1930. This object is called Pluto. Pluto has a moon, Charon, that is only slightly smaller than Pluto. Pluto has at least two other moons. They are called Nix and Hydra.

Until 2006, Pluto was considered the ninth planet. But Pluto is different from the eight planets in several ways. Sometimes it orbits beyond Neptune. Pluto also is much smaller than the planets.

Now scientists call Pluto a dwarf planet. A dwarf planet is a small, round or ball-shaped object that revolves around the Sun.

## Other Dwarf Planets

In 2005, scientists announced that they had found a dwarf planet that is a little larger than Pluto. The dwarf planet is at least three times farther from the Sun than Pluto. It has at least one moon. This dwarf planet is called Eris. There is also a dwarf planet called Ceres in the asteroid belt.

This image shows Pluto and Charon.

# Glossary

<b>asteroid</b>	a rocky object up to several hundred kilometers wide that revolves around the Sun
<b>comet</b>	a frozen mass of ice and dust with a tail up to 80 million kilometers long that is in orbit around the Sun
<b>dwarf planet</b>	a small, ball-shaped object that revolves around the Sun
<b>ellipse</b>	a shape like an oval
<b>planet</b>	a large, round object that moves around a star, such as the Sun
<b>satellite</b>	an object that orbits another object in space
<b>solar system</b>	a system that includes the Sun and its planets, along with many moons, asteroids, and comets
<b>star</b>	a huge ball of very hot gas that gives off energy



## After Reading

### Did you understand?

**Write** your answers.

1. What objects make up the solar system?
2. What do the inner planets have in common?
3. Which planets are gas giants?
4. Compare a comet and an asteroid.

**Write** how they are alike and how they are different.





## After Reading

### Planets

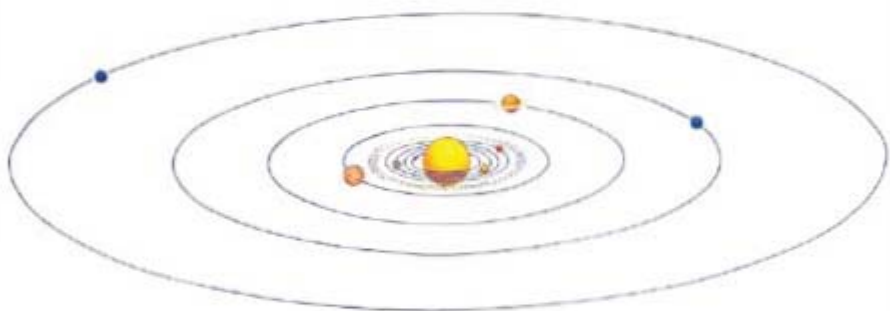
Look at the picture of the planets in the solar system.

Choose one planet to learn more about.

**Draw** a picture of that planet.

**Write** on your picture a fact you learned about the planet.

Share your picture with the class.

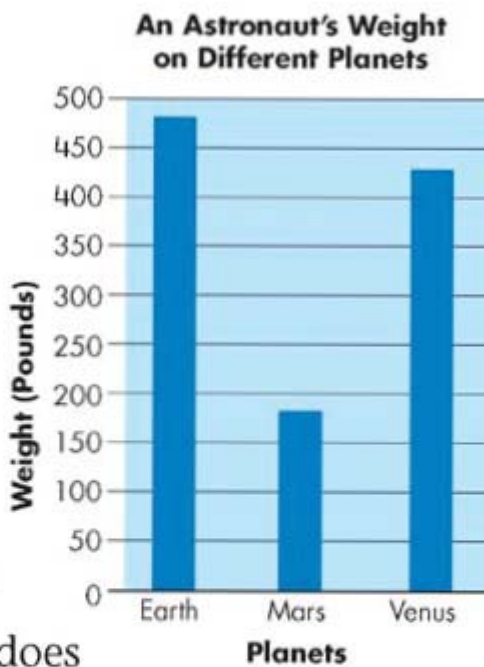


## Weight on Planets

A person's weight on Earth is different from his or her weight on other planets.

**Look** at the graph.  
**Find** the weight of an astronaut on Earth. This weight includes the heavy space suit he or she wears.


**Write** your answers.



1. About how much does the astronaut weigh on Earth?
2. Is the astronaut's weight on Mars more than half or less than half of his or her weight on Venus? Tell how you know.
3. About how much less does the astronaut weigh on Venus than on Earth?

Genre	Comprehension Skill	Text Features	Science Content
Nonfiction	Make Inferences	<ul style="list-style-type: none"> <li>• Captions</li> <li>• Labels</li> <li>• Diagrams</li> <li>• Glossary</li> </ul>	Solar System

## Interactive Science 5


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