

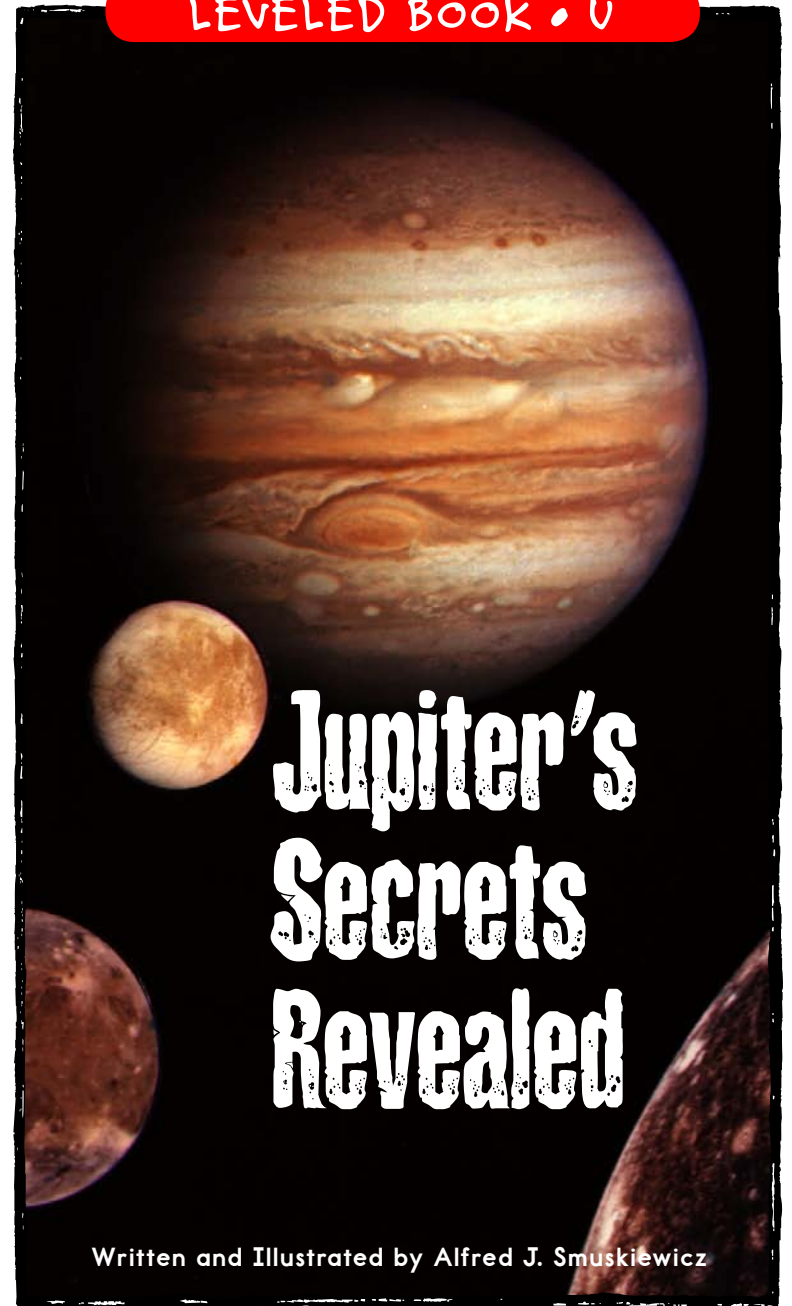
Jupiter's Secrets Revealed

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Written and Illustrated by Alfred J. Smuskiwicz

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August 7, 1985 Sketch

1:00 - SOUTH

CONTINUING THESE LINES UP TO THE EQUATORIAL BELTS - A FEATURE THAT WAS AT (A) AT 12:30, WAS AT (B) AT 1:30.

← BELTS MOVE THIS WAY E

IN CONTRAST TO OTHER RED BELTS - POLAR REGIONS ARE GRAYISH (NORTH AND SOUTH). AFTER EQUATORIAL BELTS, THIS BELT IS MOST PROMINENT. RED SPOT IS JUST OVER HORIZON (CAN'T SEE).

SOUTH POLAR REGION IS VERY FAINT.

2:30 - SW

THERE IS MAJOR CHANGE ONLY IN EQUATORIAL BELTS AND SOUTH POLAR REGION. THERE'S HARDLY ANY CHANGE IN THE PLANET'S OTHER AREAS

SOUTH POLAR REGION HAS DARKENED

EQUATORIAL BAND

GREAT RED SPOT

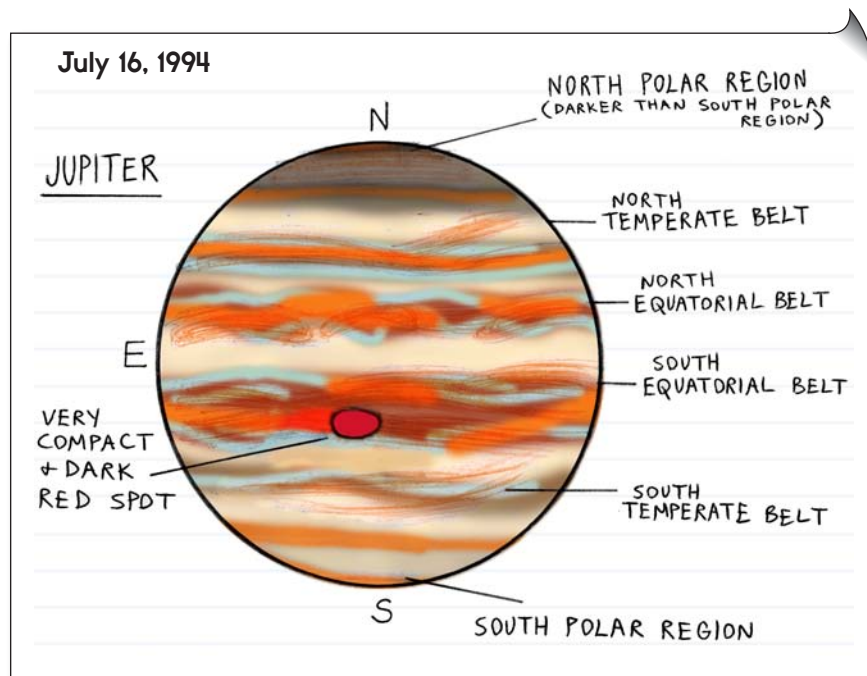
(CONTINUED...)

The Night Jupiter Surprised Me

I enjoy looking at the night sky with my telescope. But I've found that most things you see through a telescope appear the same every time you look at them. That's why I was surprised one night in August 1985 while I was looking at Jupiter. I was drawing a sketch of the planet with a pencil when I noticed that the swirly, colorful stripes on Jupiter were moving and changing right before my eyes! I still remember how excited I was by this discovery—even though it made my sketch harder to finish!

I saw Jupiter change again, right before my eyes, in July 1994. It was the last night that big chunks of a broken-up **comet**—called Comet Shoemaker-Levy 9—collided with the planet. I saw several dark “bruises” on Jupiter where the chunks of the comet hit. I drew pictures of these, too, as I thought about how cool it was to see them through a telescope.

Jupiter is the biggest planet in our **solar system** and one of the brightest objects in the night sky. Seen without a telescope, it looks like a star. I have found Jupiter to be full of surprises, and I think it is the most exciting planet.



What and Where Is Jupiter?

At about 484 million miles (779 million km) from the Sun, Jupiter is five times farther from the Sun than Earth. Jupiter is the fifth planet from the Sun. (Earth is the third planet from the Sun.)



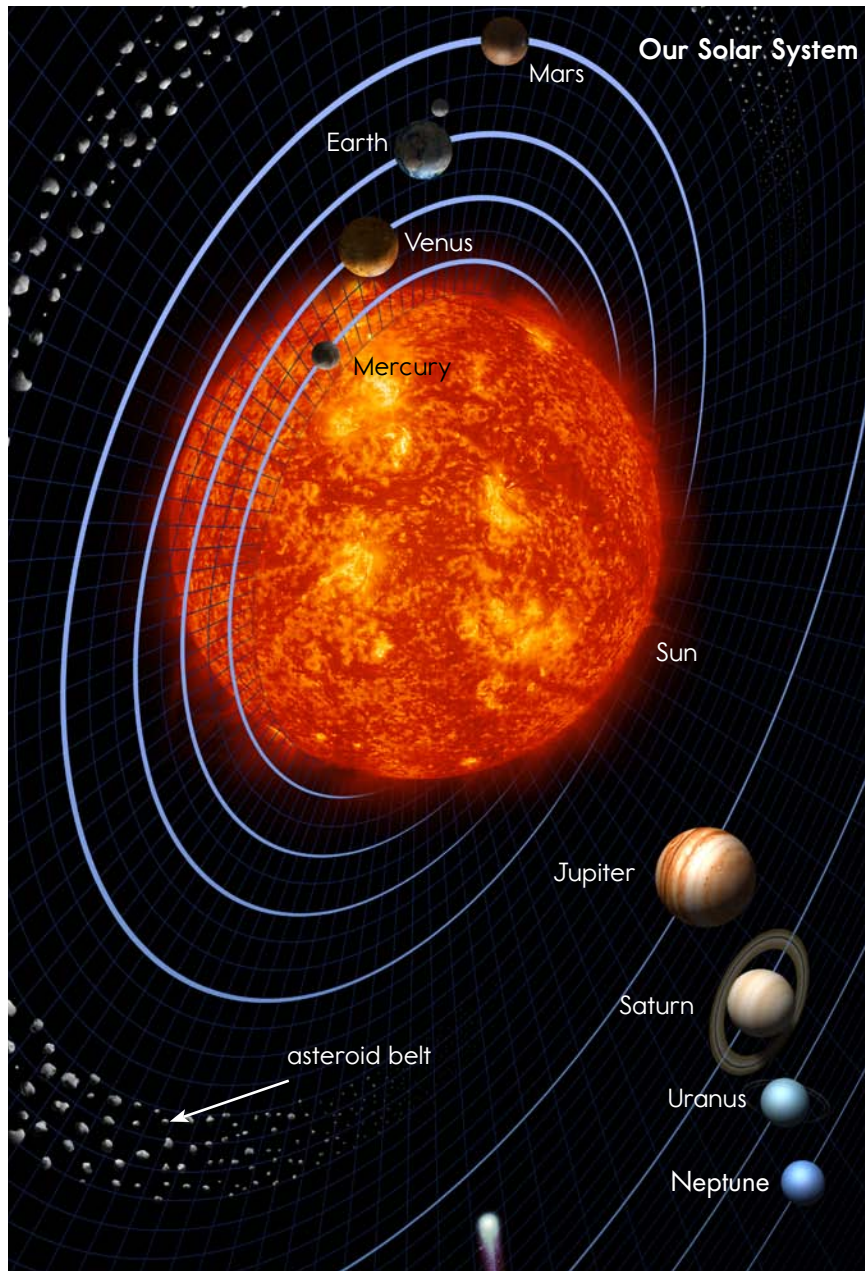
Jupiter is so far away that it takes 12 Earth-years for it to **orbit** the Sun one time.

Jupiter, the giant of our solar system, has a **diameter** of about 89,000 miles (143,000 km) across its middle, or **equator**.

Jupiter is so large that if Earth were a small grape, Jupiter would be a large grapefruit!

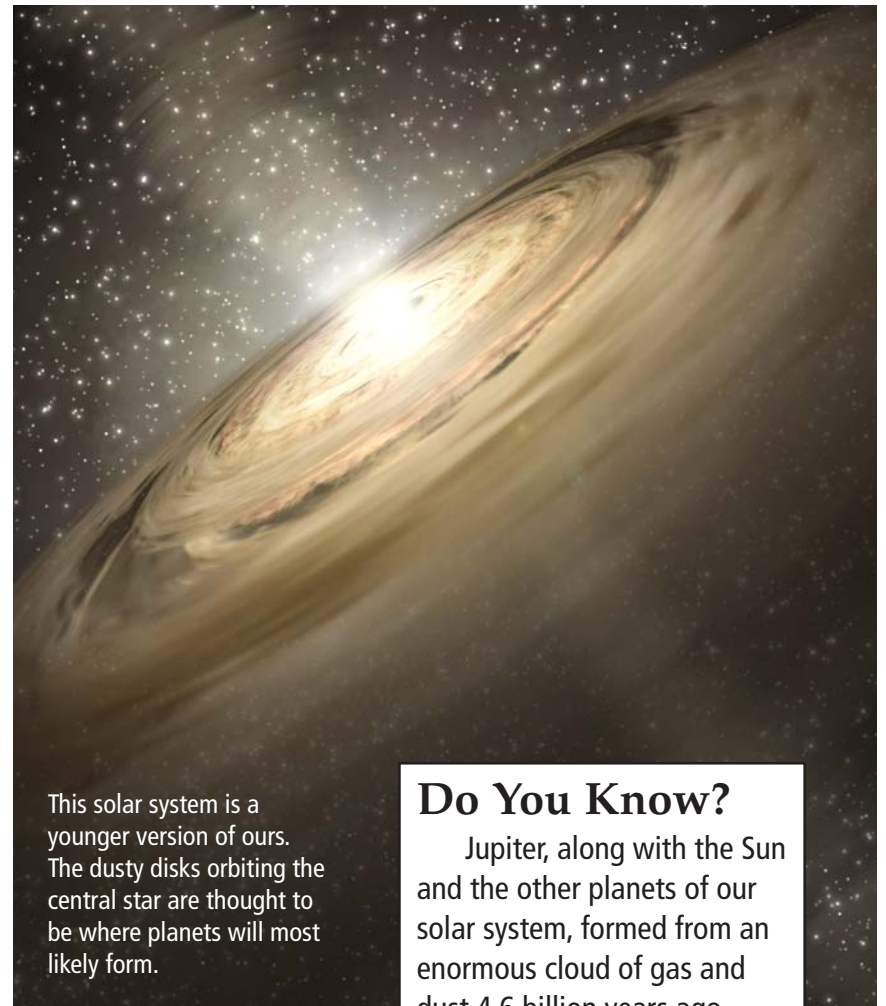
What's In a Name?

Jupiter was named by people who lived in ancient Rome more than 2,000 years ago. To the Romans, Jupiter, who was also known as Jove, was the king of the gods. His weapon was a thunderbolt. The god Saturn, another planet's name, was the first ruler of the universe, according to the Romans, but his children—including Jupiter, Neptune, and Pluto—overthrew him. Jupiter married the goddess Juno, and their children included Mars and Vulcan.



Jupiter orbits the Sun as the fifth planet, in between Mars and Saturn.
Where is Earth in relation to Jupiter?

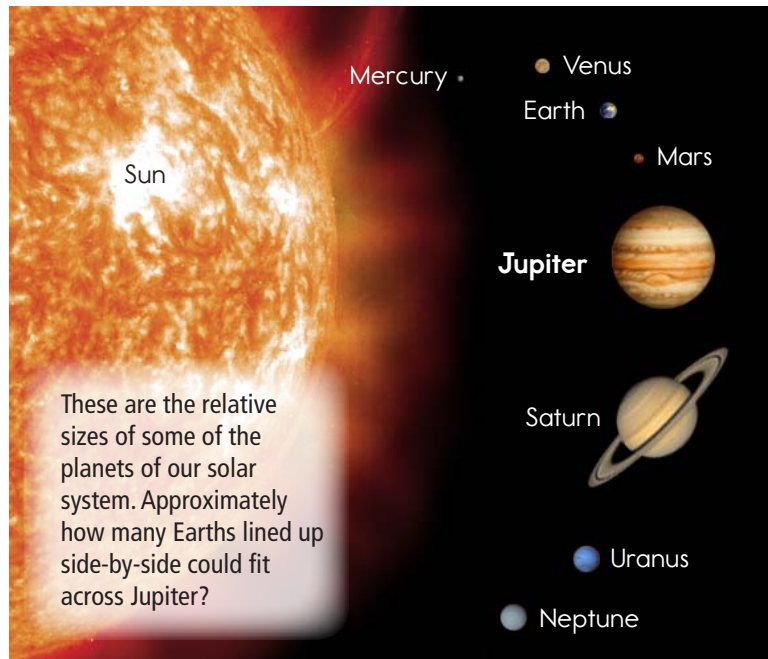
Every 9 hours and 55 minutes, Jupiter rotates once on its **axis**. This is faster than any other planet, so one day on Jupiter is only 9 hours and 55 minutes long. Do you know how long it takes Earth to rotate once on its axis? Hint: How long is one day?



This solar system is a younger version of ours. The dusty disks orbiting the central star are thought to be where planets will most likely form.

Do You Know?

Jupiter, along with the Sun and the other planets of our solar system, formed from an enormous cloud of gas and dust 4.6 billion years ago.



Planet	Diameter (Width) Across Equator (Middle)	Average Distance From Sun
Mercury	3,032 mi (4,879 km)	35,980,000 mi (57,910,000 km)
Venus	7,521 mi (12,104 km)	67,240,000 mi (108,210,000 km)
Earth	7,926 mi (12,756 km)	92,960,000 mi (149,600,000 km)
Mars	4,222 mi (6,794 km)	141,620,000 mi (227,920,000 km)
Jupiter	88,846 mi (142,984 km)	483,780,000 mi (778,570,000 km)
Saturn	74,898 mi (120,536 km)	890,750,000 mi (1,433,530,000 km)
Uranus	31,763 mi (51,118 km)	1,784,860,000 mi (2,872,460,000 km)
Neptune	30,775 mi (49,528 km)	2,793,100,000 mi (4,495,060,000 km)

What Is Jupiter Made Of?

Not all planets are like Earth, which has a solid surface for you to walk on. Jupiter is mostly a big ball of gases and liquids. Like the Sun, it is made mostly of the chemical elements **hydrogen** and **helium**, which are the two lightest elements, but also has water, ammonia, and methane.

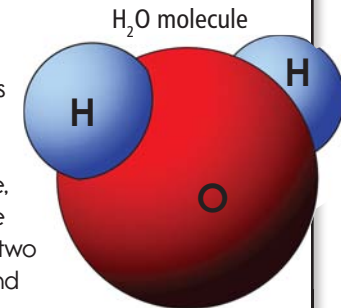
The many swirly, reddish, whitish, and yellowish stripes that I saw on Jupiter through my telescope are made of clouds of gas. The bright, wide stripes are gas clouds called *zones*. The dark, thin stripes are gas clouds called *belts*. The belts and zones move around the planet, but their winds flow in opposite directions—west to east in zones, east to west in belts.

Elements

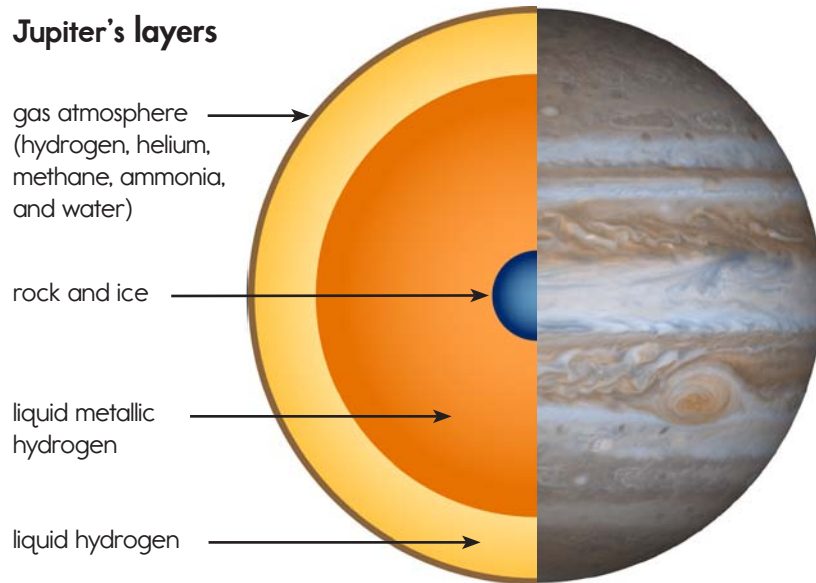
Elements are the simplest materials known. There are 92 known natural elements. All other materials are made from different combinations of these elements.

Molecules

Molecules are the smallest particles of a material or substance. They are made of two or more smaller particles called atoms. For example, the substance water (H_2O) is made of water molecules that consist of two atoms of the element hydrogen and one atom of the element oxygen.



Jupiter's layers



Scientists think that Jupiter is made of several layers, including a gas layer, a liquid hydrogen layer, a liquid metal layer, and a central ball of rock and ice.

Beneath the thin, cloudy **atmosphere**, the gases turn into liquids. The liquids form when the weight and pressure of the clouds above squeeze the gas molecules very close together. Molecules in liquids are closer together than molecules in gases. There is even a deep layer of liquid hydrogen that acts like liquid metal. This metallic hydrogen flows around the inside of the planet.

In the deepest parts of Jupiter, at the planet's very center, there may be a core of rock and ice that is bigger than Earth. However, scientists are still not sure what Jupiter's core is like.

Weather Report from Jupiter

Have you heard the weather report from Jupiter today? I heard reports of average temperatures of about -236 degrees Fahrenheit (-149°C). Now, that's cold! However, it could be as hot as $1,500^{\circ}\text{F}$ (800°C) at the highest cloud tops, where the Sun's rays are strongest.

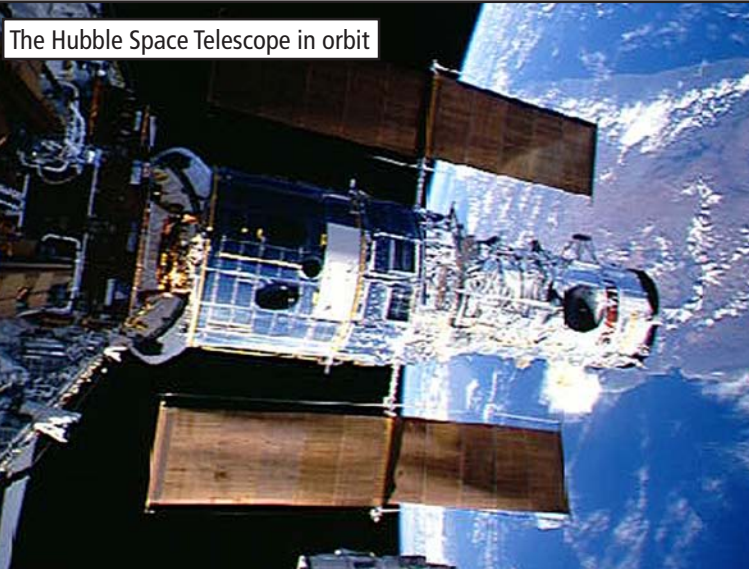
Today, the winds are blowing out of the north at about 400 miles (650 km) per hour. Don't get caught out in one of the hundreds of swirling storms, similar to gigantic hurricanes, all over the planet. The largest storm, called the Great Red Spot, is so big that three Earths could fit across it! This storm, which can be seen through a telescope on Earth, has been raging for more than 300 years.



The weather on Jupiter includes giant storms, such as the Great Red Spot, huge flashes of lightning, and winds blowing hundreds of miles per hour.

Seeing Jupiter from Space

The Hubble Space Telescope has been used to take many sharp photographs of Jupiter and the other planets, as well as galaxies and other objects in deep space. This telescope is able to take very detailed pictures because it orbits Earth high above the atmosphere. (The high orbit allows the telescope to avoid the blurring that the atmosphere can cause in photos taken from the ground.) Astronauts on the space shuttle Discovery placed the Hubble Space Telescope in orbit in 1990. After several additional space shuttle missions to give the telescope new equipment, it was still working in 2006.



Finally, huge flashes of lightning have been reported lighting up the planet's storm clouds.

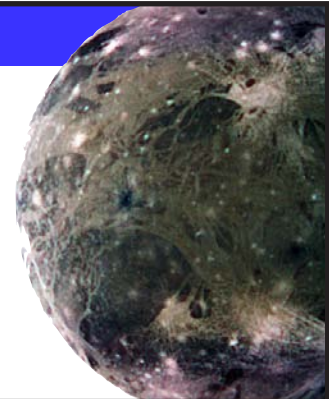
Does this sound like a good day for a picnic to you?

The Moons of Jupiter

At least 63 moons of various sizes orbit Jupiter. Sixteen of these moons are at least 6 miles (10 km) wide. The four largest moons—Io, Europa, Ganymede, and Callisto—were discovered by the Italian **astronomer** Galileo (GAL-uh-LAY-oh) Galilei in 1610. These moons, known as the “Galilean satellites,” can easily be seen with a pair of binoculars.

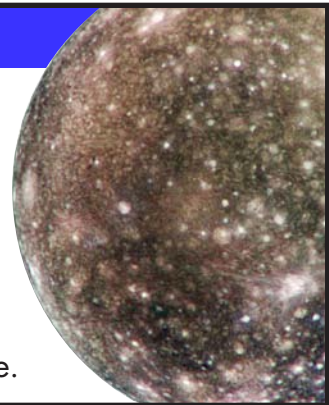
Ganymede

Ganymede (GAN-uh-meed) is Jupiter's largest moon—and the largest moon in the entire solar system. Its surface has many mountains, valleys, and **craters**, as well as ice mixed with rock.



Callisto

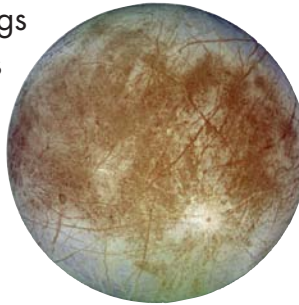
Callisto (kuh-LIHS-toh) is covered with many craters, which were made when comets and **asteroids** crashed into the moon. Like Europa, Callisto may have an ocean of salty water under its surface.



Europa

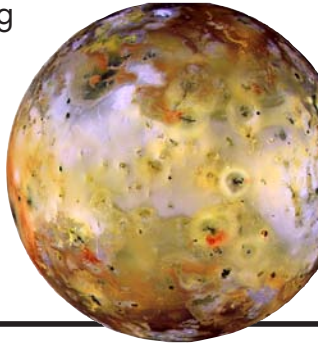
Europa (yu-ROH-puh) has a surface covered with ice. Deep cracks run through the ice, dividing it into large chunks that are like icebergs on Earth, only Europa's icebergs are the size of Earth's cities!

Underneath the cold, cracked ice, there may be a deep, dark ocean of warm water. Scientists think that if this ocean really exists, alien creatures may live in it.



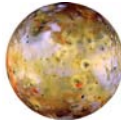



Io

Io (EYE-oh) has more than 300 volcanoes on its surface. These volcanoes shoot out hot plumes of sulfur dioxide gas and bubbling flows of melted rock (lava). Different kinds of chemicals in the lava flows make different colors all over Io's surface, including yellow, red, orange, and green.



Do You Know?

The volcanoes on Io shoot out so much rock and other material from deep inside the moon that Io has actually "turned inside out" many times. And a volcano on Io named Loki gives off more heat than all of Earth's volcanoes combined.

	Moon	Diameter	Avg. Distance From Jupiter
	Io	2,264 mi (3,643 km)	262,000 mi (421,600 km)
	Europa	1,940 mi (3,122 km)	416,900 mi (670,900 km)
	Ganymede	3,270 mi (5,262 km)	664,900 mi (1,070,000 km)
	Callisto	2,996 mi (4,821 km)	1,170,000 mi (1,883,000 km)

Revolutionary Discovery

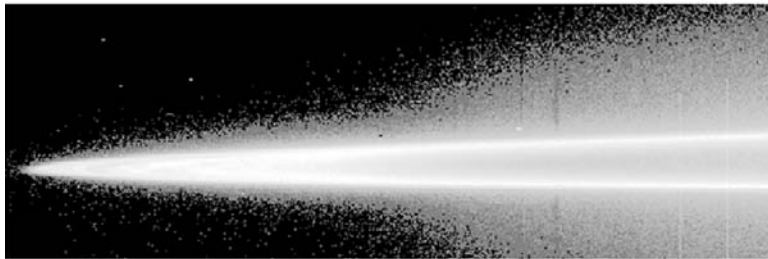
Galileo (1564–1642) made the first important discoveries with a tool that was new during his time—the telescope. Before Galileo used a telescope to discover the four largest moons of Jupiter in 1610, many people believed that the planets and the Sun revolved around Earth. Galileo's discovery that there are moons revolving around Jupiter was the first evidence that not everything moves around Earth. This discovery helped persuade other scientists that Earth and the other planets move around the Sun.

The Rings of Jupiter

People used to think that Saturn was the only planet with rings around it because its rings are the only ones that can be seen through a telescope on Earth. So scientists were surprised in 1979 when cameras on the Voyager spacecraft, which was flying near Jupiter at the time, took pictures of rings around the planet.

The pictures from Voyager showed that Jupiter has four rings that are much thinner than the rings of Saturn. Unlike Saturn's rings, which are made partly of large chunks of ice, Jupiter's rings consist of tiny particles of dust.

Scientists think that Jupiter's rings formed when **meteoroids** crashed into the planet's moons. These crashes threw dust into space, and this dust collected into rings.



Jupiter's main ring can be seen only by spacecraft that fly near the giant planet. The fuzz around the ring is created by the tiny particles that make up the ring.

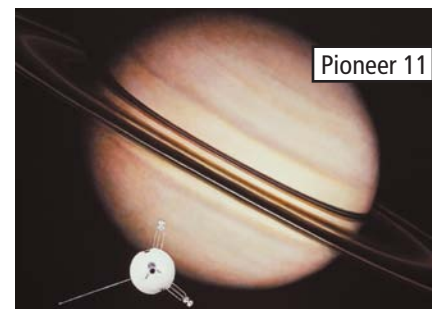
Spacecraft Visits to Jupiter



The U.S. National Aeronautics and Space Administration (NASA) has launched many spacecraft to Jupiter. These robot explorers have sent pictures and other information back to Earth with **radio waves**—the same kind of energy waves that carry signals to radios and televisions.

Pioneer 10 and Pioneer 11

Pioneer 10 and Pioneer 11 were two spacecraft that took the first close-up photographs of Jupiter in 1973 and 1974. These photos showed that the clouds of Jupiter were much more colorful and complex than people had believed.

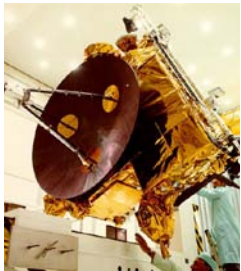


Much of what we know about Jupiter was discovered by the Pioneer, Voyager, Ulysses, and Galileo spacecraft, which were launched by NASA.

Voyager 1 and Voyager 2

In 1979, the Voyager 1 and Voyager 2 spacecraft discovered Jupiter's rings, as well as lightning and auroras on Jupiter. Auroras are colorful displays of light, similar to aurora borealis (northern lights) or aurora australis (southern lights) on Earth, that are created when energy particles from the Sun hit gas particles in Jupiter's atmosphere. The Voyagers also discovered that Jupiter's moons have many big features, such as volcanoes, ice, and craters.

Ulysses



The Ulysses spacecraft passed close to Jupiter in 1992 and again from 2003 to 2004. It measured the strength of the **magnetic field** around Jupiter and studied the charged particles trapped by the field.

Galileo

Galileo was the first spacecraft to orbit Jupiter. It circled Jupiter between 1995 and 2003, studying



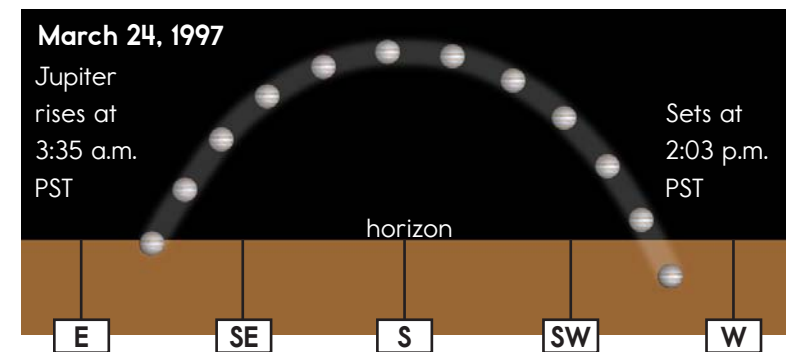
the mysterious planet and its moons. Galileo also released a small probe that parachuted into Jupiter's atmosphere. This probe had instruments that measured wind speed and the amounts of different chemicals in the atmosphere.

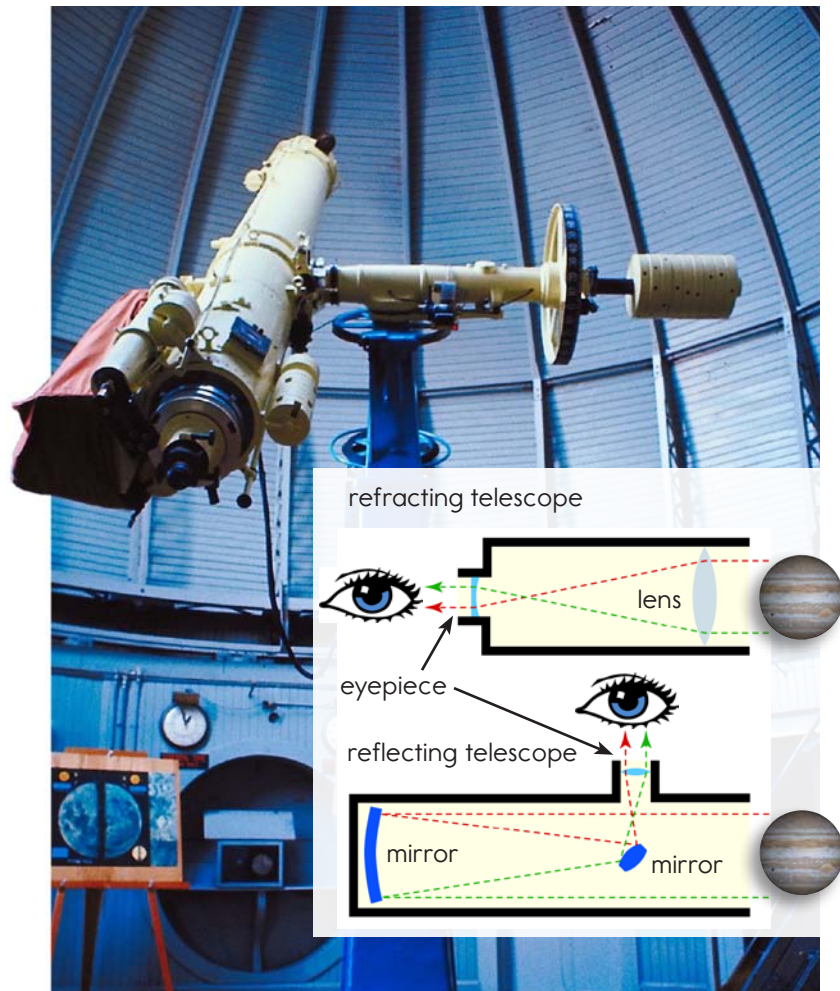
How You Can Watch Jupiter

Jupiter looks like a bright star that you can see in the southern part of the sky only at certain times of the year. To know exactly where and when to look for Jupiter, check the weather or **astronomy** section in your local newspaper. You can also check an astronomy magazine or website.

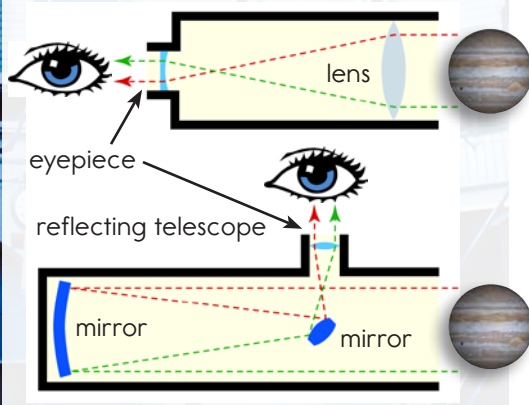
If you look at Jupiter with binoculars, you will be able to see the planet's four largest moons and watch them change their position around Jupiter from one night to the next.

With a telescope of medium power, you can see the belts and zones on Jupiter as well as the Great Red Spot, which also all change from night to night. It's fun to sketch what you see, but if you have a certain kind of telescope, you can use a camera to take photos instead.





refracting telescope



Do You Know?

Two main kinds of telescopes are the refracting telescope and the reflecting telescope. A refracting telescope uses a large lens to focus light rays from an object to a point inside the telescope. A reflecting telescope focuses light rays with mirrors. With either kind of telescope, you look at the focused point of light rays through an eyepiece to see a magnified image of the object.

What's Next for Jupiter?

Jupiter is an exciting planet because it's a big ball of surprises. Scientists are always learning new things about this enormous planet, and you never know what they might discover next.

Scientists are working on many new plans to learn more about Jupiter and its moons. According to one of these plans, the United States and Europe would send a spacecraft to land on Jupiter's moon Europa. This craft would then melt through the moon's icy surface to study the ocean that scientists think might exist inside Europa, leading to the possible discovery of ocean life on this moon.



There's a lot to look forward to with Jupiter. Perhaps someday you will be able to discover an amazing new fact about this surprising giant in the sky!

Do You Know?

Jupiter's spin is slowing down because it is being pulled by the gravity of its moons. The same thing is happening to Earth because of its moon!

Glossary

asteroids	small rocky objects that revolve around the Sun (p. 14)
astronomer	a scientist who studies planets, stars, galaxies, and other objects in the universe (p. 14)
astronomy	the study of objects in space (p. 20)
atmosphere	a layer of gases surrounding a planet, star, or moon (p. 11)
axis	an imaginary line around which an object, such as a planet, spins (p. 8)
comet	an astronomical object made of ice and dust that develops a long, bright tail as it nears the Sun (p. 5)
craters	holes in the ground caused by the impact of objects from space (p. 14)
diameter	the length of a straight line drawn through the center of a circle or a sphere from one side to another (p. 6)
equator	an imaginary circle around the middle of a planet (p. 6)
helium	often a gas; the second lightest chemical element (p. 10)
hydrogen	often a gas; the lightest chemical element (p. 10)

magnetic field	the region around a magnet or planet where magnetic force can be felt (p. 19)
meteoroids	particles of metallic or stony matter that travel through space (p. 17)
orbit	the path that one celestial body, such as a planet or moon, follows around a larger celestial body, such as the Sun (p. 6)
radio waves	patterns of electric and magnetic force that carry information in radio and television broadcasts (p. 18)
solar system	the Sun and the celestial bodies that revolve around it (p. 5)

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