

The Solar System

The Outer Planets

Key Concepts

- How are the outer planets similar?
- What are the outer planets made of?

Study Coach

Create a Quiz Write a quiz question for each paragraph. Answer the question with information from the paragraph. Refer to these questions and answers as you review the chapter.

Visual Check

1. Compare Which outer planet is the largest?

..... Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

| Before | Statement | After |
|--------|--|-------|
| | 5. The outer planets are also called the gas giants. | |
| | 6. The atmospheres of Saturn and Jupiter are mainly water vapor. | |

..... Read to Learn

The Gas Giants

The outer planets are Jupiter, Saturn, Uranus, and Neptune. The figure below shows the sizes of the outer planets compared to each other and to Earth. As you can see, their sizes are much greater than Earth's size. The outer planets are mostly made of hydrogen and helium. These elements are usually gases on Earth. Gases change to liquids at high pressure. This property of gases affects the outer planets. The outer planets are called the gas giants.

The outer planets have strong gravitational forces due to their large masses. The strong gravity creates tremendous atmospheric pressure that changes gases to liquids. Thus, the outer planets mainly have liquid interiors. In general, the outer planets have a thick gas and liquid layer covering a small, solid core.

Outer Planets



Jupiter

Jupiter is the largest planet in the solar system. Its diameter is more than 11 times the diameter of Earth. Its mass is more than twice the mass of all the other planets combined. Jupiter takes almost 12 Earth years to complete one orbit of the Sun. Yet it rotates faster than any other planet. Its period of rotation is less than 10 hours. Jupiter and all the outer planets have a ring system.

Jupiter's Atmosphere

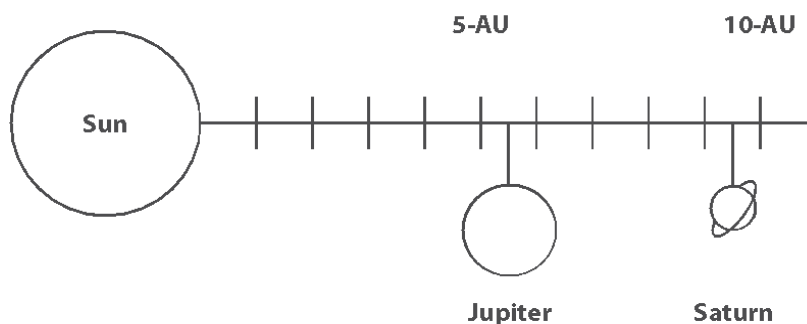
The atmosphere on Jupiter is about 90 percent hydrogen and 10 percent helium. The thickness of the atmosphere is about 1,000 km. The atmosphere holds several layers of dense, colorful clouds. Jupiter's fast rotation stretches the clouds into swirling bands of color. The Great Red Spot on the planet's surface is a storm of swirling gases.

Jupiter's Structure

Jupiter is about 80 percent hydrogen and 20 percent helium. Swirling gas covers a thick layer of liquid hydrogen over a solid core. The pressure at 1,000 km below the outer edge of the cloud layer is great. There, the hydrogen gas turns into a liquid. The core is probably rock and iron. 🔑

The Moons of Jupiter

Jupiter has at least 63 moons, more than any other planet. In 1610, Galileo Galilei discovered Jupiter's four largest moons. As a result, *the four largest moons of Jupiter—Io, Europa, Ganymede, and Callisto—are known as the Galilean moons.* Collisions between Jupiter's moons and meteorites likely



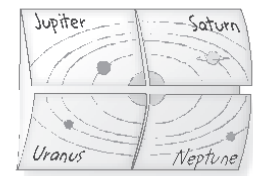
created the particles that make up the planet's faint rings.

Saturn

The figure above shows the distances from the Sun of the fifth and sixth planets. Saturn is the sixth planet from the Sun. Like Jupiter, Saturn rotates rapidly and has bands of clouds. Saturn is about 90 percent hydrogen and 10 percent helium. It is the least-dense planet.

FOLDABLES®

Make a four-door book to organize your notes on the outer planets.



Key Concept Check

2. Describe what makes up each of Jupiter's three distinct layers.

Math Skills

A ratio is a quotient—it is one quantity divided by another. Ratios can be used to compare distances.

For example, Jupiter is 5.20 AU from the Sun. Neptune is 30.05 AU from the Sun. Divide the larger distance by the smaller distance:

$$\frac{30.05 \text{ AU}}{5.20 \text{ AU}} = 5.78$$

Neptune is 5.78 times farther from the Sun than Jupiter is.

3. Use Ratios The figure on the right shows that Saturn is 9.58 AU from the Sun. Jupiter is 5.20 AU from the Sun. How many times farther from the Sun is Saturn than Jupiter?

 **Key Concept Check**

4. Describe what makes up Saturn and its ring system.


 **Key Concept Check**

5. Identify the substances that make up the atmosphere and the thick, slushy layer on Uranus.

 **Key Concept Check**

6. Compare How do the atmosphere and interior of Neptune compare with those of Uranus?


Saturn's Structure

Saturn is made up mostly of hydrogen and helium. Like Jupiter, Saturn's structure has an outer layer of gas, a thick layer of liquid hydrogen, and a solid core. Saturn's seven bands of rings are the largest in the solar system. The main ring system is more than 70,000 km wide. However, the ring system is likely less than 30 m thick. Ice particles mainly make up the rings. The particles range in size from specks to chunks as large as a house. 

Saturn's Moons

Saturn has at least 60 moons. Its five largest moons are Titan, Rhea, Dione, Iapetus, and Tethys. Most of Saturn's moons are chunks of ice that are less than 10 km in diameter. Titan, the largest moon, is the only moon in the solar system with a dense atmosphere. In 2005, the *Huygens* (HOY guns) space probe landed on Titan.

Uranus

Uranus is the seventh planet from the Sun. It has narrow, dark rings. The diameter of Uranus is about four times that of Earth. The *Voyager 2* space probe explored the planet when it flew by Uranus in 1986. The deep atmosphere of Uranus is mostly hydrogen and helium. There is also a small amount of methane. Beneath the atmosphere is a thick, slushy layer of water, ammonia, and other materials. Uranus might also have a solid, rocky core. 

Uranus's Axis and Moons

The sideways tilt of Uranus's axis of rotation is different from those of the other planets. Uranus's axis is tilted so that the planet moves around the Sun like a rolling ball.

Uranus has at least 27 moons. The two largest moons, Titania and Oberon, are much smaller than Earth's moon. Titania has an icy, cracked surface. At one time, an ocean might have covered Titania's surface.

Neptune

Like Uranus, Neptune has an atmosphere of mostly hydrogen and helium, with a little methane. Like Uranus, Neptune's interior is frozen water and ammonia with a core of rock and iron.

Neptune has at least 13 moons and faint dark rings. Triton (TRI tun) is Neptune's largest moon. Triton is made of rock, with an icy outer layer. Triton's surface is frozen nitrogen. Geysers on the surface erupt nitrogen gas. 