

28.3 Outline

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The Gas Giant Planets

Jupiter, Saturn, Uranus, and Neptune are known as the gas giants. They are very large, their interiors are either gases or liquids, and they might have small, solid cores. They are made mostly of lightweight elements such as H, He, C, N, and O, and they are very cold at their surfaces. They have many satellites as well as ring systems.

Jupiter

- largest planet
- makes up 70% of all planetary matter in the solar system.
- appears bright due to 0.52 albedo
- has a banded appearance with a great red spot, which is an atmospheric storm.

Rings

- There are two faint rings around the planet, in addition to a 6400 km wide ring.

Atmosphere and interior

- density of 1.326 g/m³
- below the liquid hydrogen is a layer of liquid metallic hydrogen, this can exist only under conditions of very high pressure.
- electric current exists with the layer of liquid metallic hydrogen and generates Jupiter's magnetic field.
- might have an earth-sized core containing heavier elements

Rotation

- spins once on its axis in a little less than 10 hours (shortest day in the solar system)
- this fast rotation causes Jupiter to form belts (low, warm, dark-colored clouds that sink) and zones (high, cool, light-colored clouds that rise).

Moons

- has 60+ moons
- 4 largest moons:
 - Io, Europa, Ganymede, and Callisto
- all composed of ice and rock
- $\frac{3}{4}$ are larger than Earth's moon
- Io is molten inside and goes through constant eruptions
- astronomers hypothesize that Europa might have a subsurface ocean of liquid water.

Gravity assist

Some satellites use a planet's gravity to pull them farther into space.

Saturn

- second largest planet in the solar system
- has been visited by 5 space probes

Atmosphere and interior

Average density is lower than water

- has a layered cloud system like that of Jupiter

- mostly contains hydrogen and helium with ammonia ice near the cloud tops.
- solid core probably the same as Jupiter
- magnetic field is 1000 x stronger than that of Earth's
(highly unusual among the planets)

Rings

- much broader and brighter than those of the other gas giant planets.
- composed of pieces of ice (small to house sized)
- 7 major rings, each made up of narrower rings, called ringlets.
- many open gaps in the rings
- these are caused by the gravitational effects of Saturn's many moons.
- thin
- have not combined to make a moon because of Saturn's gravity

Origin of the rings

- astronomers think they were left over from collision of asteroids and other objects.

Moons

- 45+ moons
- Titan. Larger than the planet Mercury, and has a dense atmosphere made of N₂ and Methane, which can exist as a gas, liquid, and a solid on its surface.
geologic activity

Uranus

discovered accidentally in 1781

- average temp (-215 degrees Celsius)

Atmosphere

- Uranus is 4 times larger and 15x more massive than Earth.
- blue velvety appearance caused by methane gas
- atmosphere is mostly composed of H₂ and He.
- few clouds
- core is completely fluid except for a small, solid core.
- strong magnetic field

Moons and rings

- at least 27 moons
- faint ring system

Rotation

- The rotational axis of Uranus is tipped so far its north pole almost lies on its orbital plane.
- each pole spends 42 Earth years in darkness and 42 years in sunlight due to this tilt.

Neptune

- Existence was predicted before its discovery.
- last of the gas giant planets.
- orbits the sun almost 4.5 billion km away

Atmosphere

- Uranus is slightly smaller and denser than Uranus, radius is about 4 x as large as Earth's.
- bluish color , caused by methane in the atmosphere
- atmospheric composition , temp. , magnetic field , interior, and rings are similar to those uranus.
- used to have a spot like that of jupiter that later disappeared in 1994.

Moon and rings

- 13 moons
- largest is Triton, which has a thin atmosphere and N geysers.
- Six rings which are composed of microscopic dust particles and extremely hard to see.