

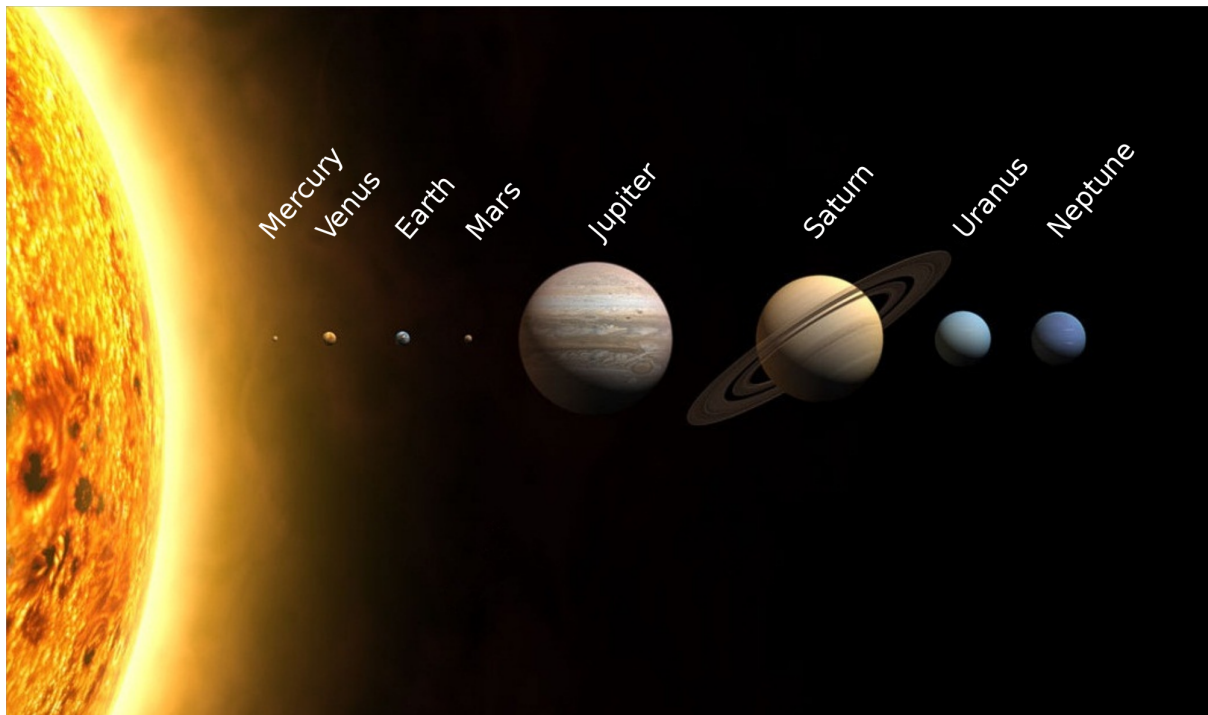
# New Zealand Science Curriculum: Astronomy Year 8

## The Planets of Our Solar System

### Part 1: The Bodies of our Solar System

Our Solar System came into existence approximately 4.6 billion years ago through condensation from a molecular cloud. It includes the Sun, eight planets and five dwarf planets. These bodies are held together in orbits around the Sun through gravitation. Our Solar System also includes the asteroid belt (mostly made up of rocky objects), the dwarf planets - Pluto, Eris and Ceres (an asteroid) and comets, centaurs (minor planets with diameters up to about 260 km) and dust clouds.

Figure 1 (sourced from Wikipedia) shows the Sun and the planets in their correct order of distance from the Sun, but is not drawn to scale.



**Figure 1: Our Solar System**

The most massive object in the Solar System is the Sun (nearly 99.9% of the total mass of our Solar System), and then the planets and dwarf planets, though other smaller bodies exist too. Jupiter is the next largest body, after the Sun. All of the planets orbit the Sun in elliptical orbits. Six planets are orbited by moons.

## **Part 2: The Terrestrial Planets**

Mercury, Venus, Earth and Mars are known as the terrestrial planets. They are closer to the Sun than the other planets and are mostly made up of rocks and/or metals, and have solid surfaces. Most do not have moons, and the Earth is the exception. They tend to be smaller and less massive than the Jovian planets and gas giants.

The terrestrial planets have certain similarities - a metallic core composed mostly of iron (e.g. the Earth) and a mantle (a layer, usually of rock or ice, lying above the core and below the crust).

Many terrestrial planets have craters, mountains, volcanoes and canyons. They also tend to have atmospheres that are much less dense than those of the Jovian planets (see below). These atmospheres are present mainly because of volcanic activity.

## **Part 3: The Jovian Planets**

The four Jovian planets (giant planets) are further from the Sun and are much more massive than the terrestrial planets. Our solar system has four of them - Jupiter, Saturn, Uranus and Neptune.

Two Jovian planets, Jupiter and Saturn, are the two largest planets and both are gas giants. Jupiter and Saturn are made up mostly of hydrogen and helium, but some have water and other, heavier elements. The density of the gas giants is a little more than that of water, though Saturn's density is lower than that of water. As we travel down through the atmosphere of a Jovian planet, both temperature and pressure increase.

Gas giants appear to lack a surface, though they do have a rocky part deep below the surface. They also have several moons and rings, of which Saturn's rings are the best known.

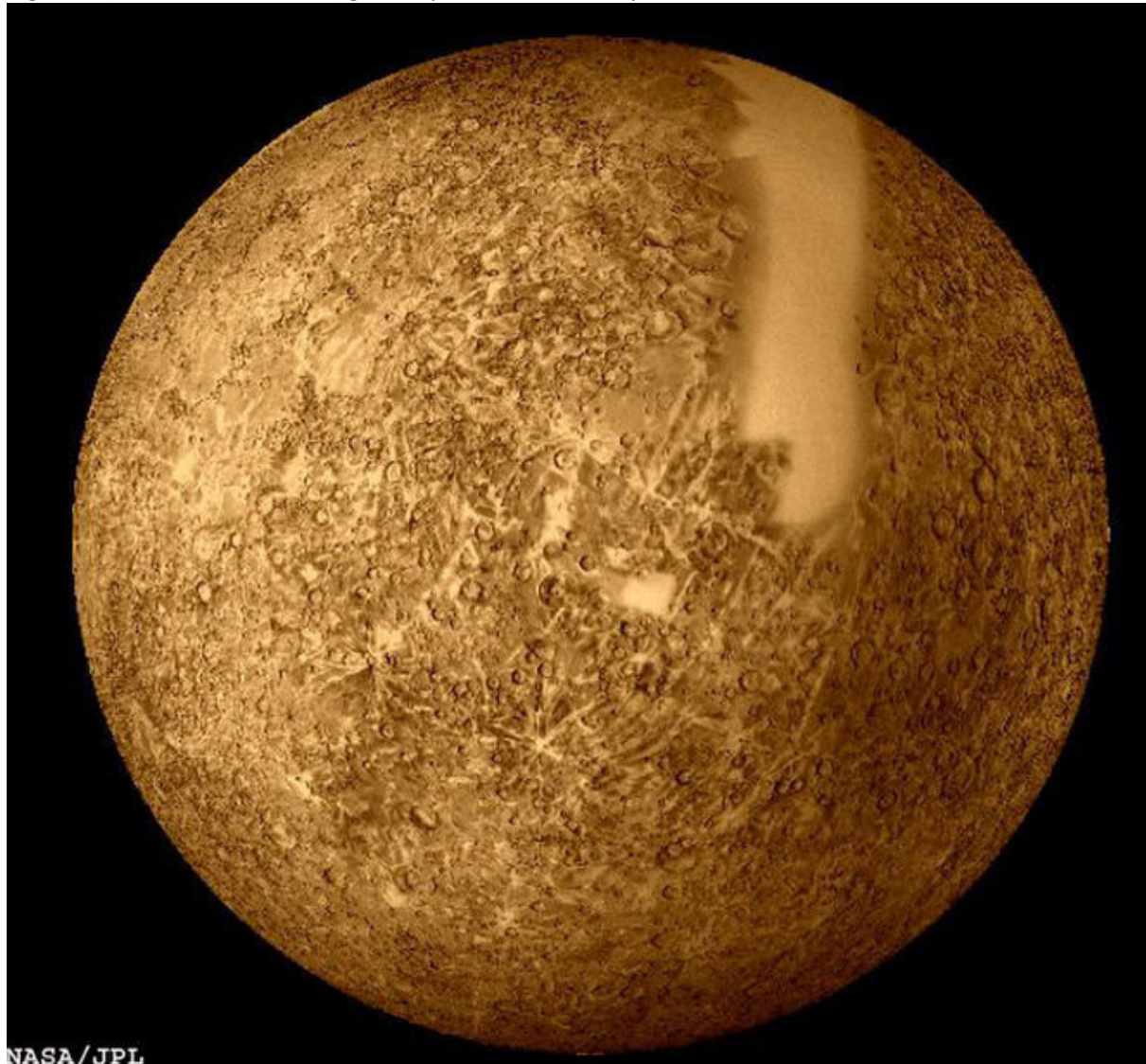
## **Part 4: The Ice Giants**

The two planets farthest away from the Sun are Uranus and Neptune. They are both ice giants and are made up largely of frozen water, ammonia and methane. They have rocky or icy cores and mantles of ices and various other liquids. Their atmospheres are made up of approximately 80% hydrogen, 15% helium and some methane and other hydrocarbons. Methane absorbs red light, and so these planets have a blue-green color.

## Part 5: About each Planet

### Planet Mercury

Figure 2 (sourced from NASA) gives a picture of Mercury.



**Figure 2: Planet Mercury**

Mercury is the closest planet to the Sun and it is the smallest in our solar system. Its diameter is approximately 4,880 km, by comparison with Earth's (12,720 km).

Its surface is covered in numerous craters. It has iced water at its poles and orbits in a very elliptical orbit, so that it looks much bigger to us when closest to Earth (perihelion) than it does when farthest away (aphelion). Its surface temperatures can go above 425 degrees Celsius. In spite of its high temperatures, frozen water may exist at the poles in deep craters that do not receive sunlight.

Mercury is very dense, possibly because of the presence of iron in a very large core. Possibly, its thin atmosphere is created by atoms liberated from the surface by the solar wind.

We can see Mercury, but it is often difficult to see because it is so close to the Sun.

## Planet Venus

Figure 3 (sourced from Cosmos Magazine) gives a picture of Venus.



**Figure 3: Planet Venus**

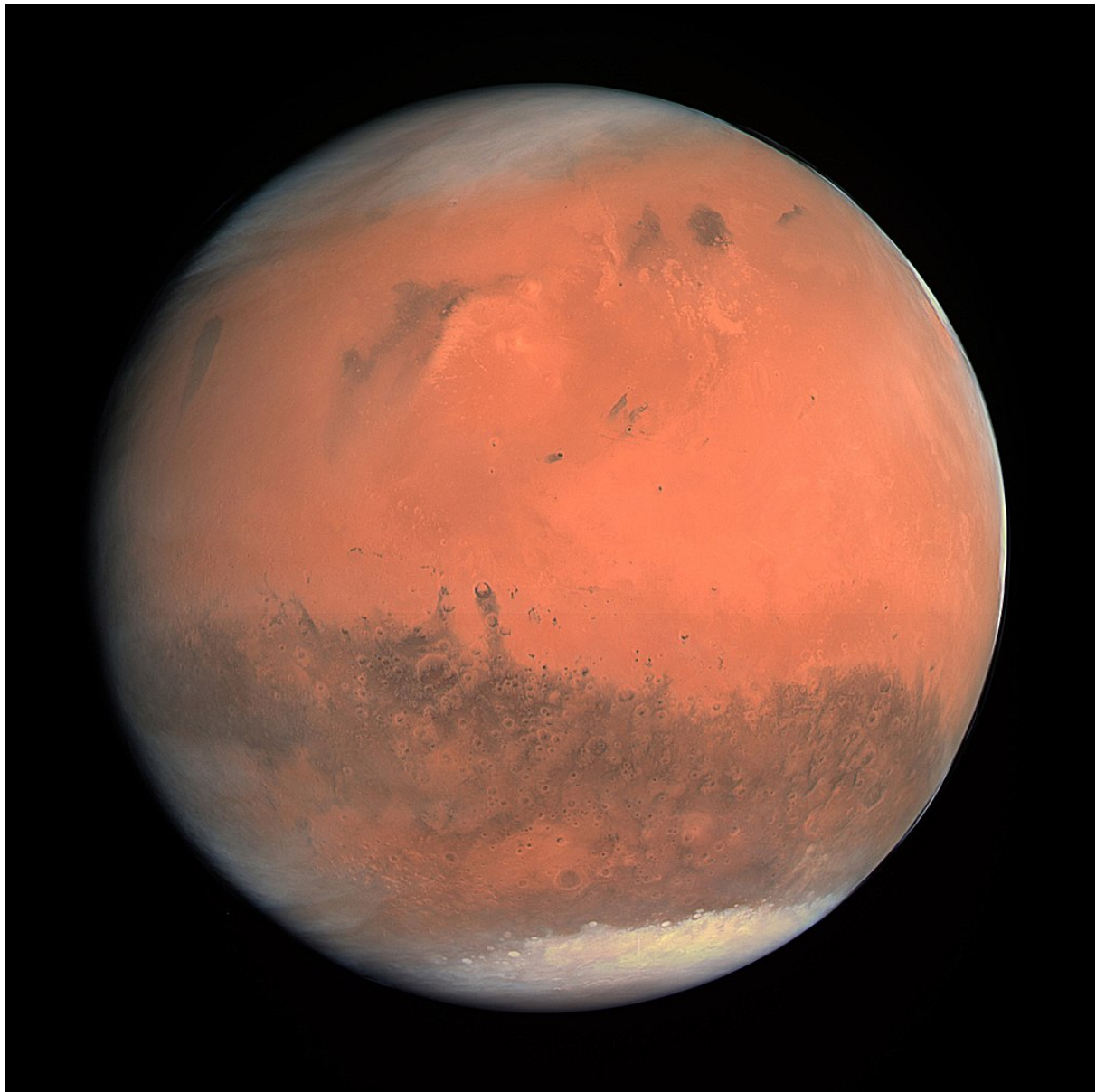
Venus is the brightest of all of the planets in our solar system. It is similar to Earth in diameter, mass, density, composition and gravity. Much of its surface consists of plains, dotted with numerous volcanoes. It spins very slowly, so that its year is actually shorter than its day!

Its atmosphere comprises carbon dioxide and sulphuric acid, and possibly some water. Venus' atmosphere is the densest of all of the planets and this atmosphere traps heat - just like Earth's greenhouse effect. Thus, Venus' surface temperatures are the highest of all planets in our solar system - up to 465 Celsius.



## Planet Mars

Figure 4 (sourced from Wikipedia) gives a picture of Mars.



**Figure 4: Planet Mars**

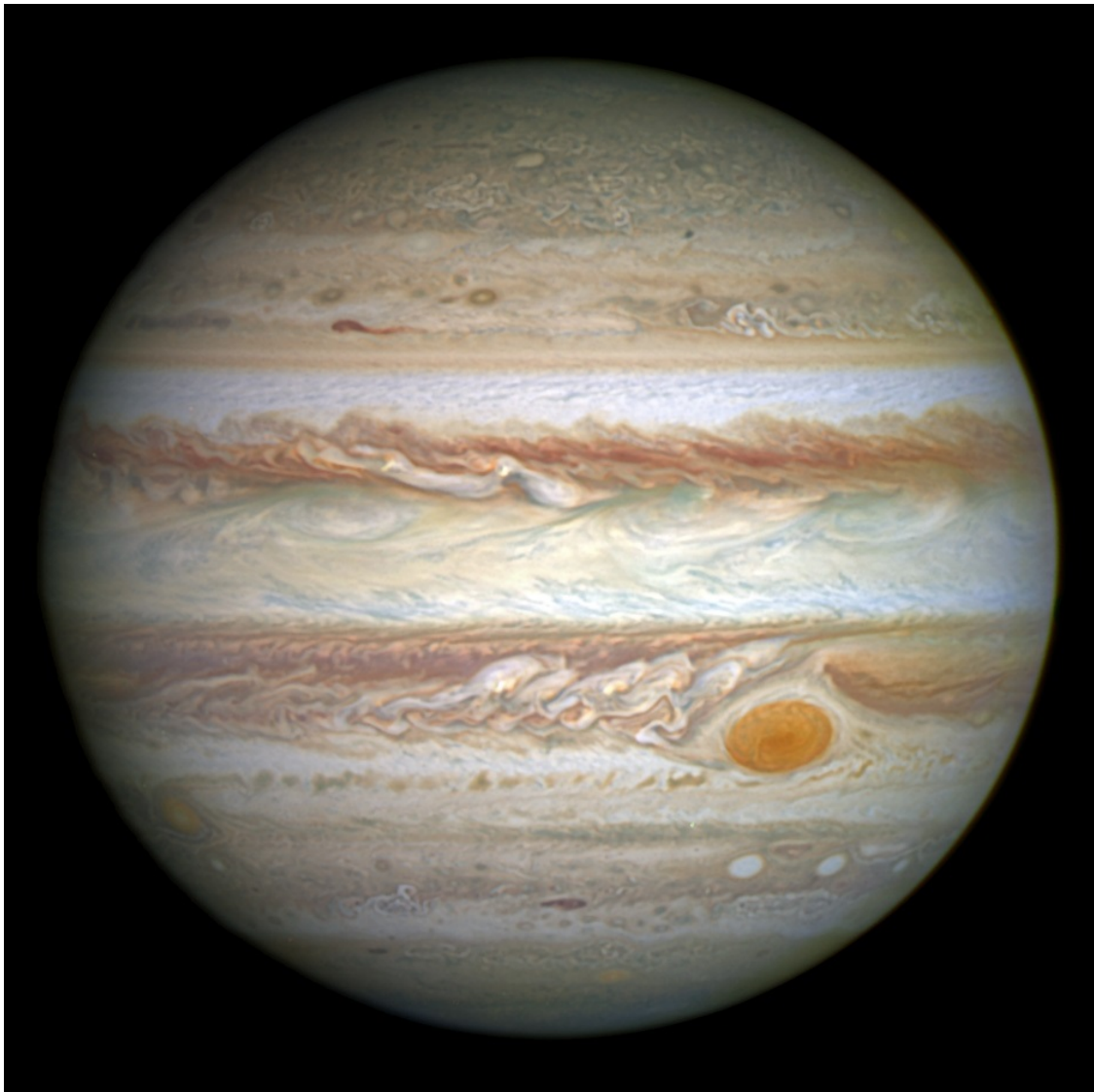
Mars has a diameter of about 6,794 km, a little bigger than half of Earth's diameter. Mars orbits the Sun every 687 Earth days. However, its day (24 hours, 39 minutes) is very similar to an Earth day. Mars's rotation axis is tilted at 25.19 degrees - very similar to the Earth's tilt, so Mars has seasons, just as the Earth does.

Its red color is caused by reddish dust in the atmosphere. Mars has a very light atmosphere, composed mostly of carbon dioxide (more than 95%), nitrogen, and a little oxygen and water.

Mars has the largest, tallest mountain that we are aware of - Olympus Mons - 25 km tall, by comparison with 8.8 km of Earth's Mount Everest.

## Planet Jupiter

Figure 5 (sourced from Wikipedia) gives a picture of Jupiter.



**Figure 5: Planet Jupiter**

Jupiter is the biggest planet in our solar system. Its mass is more than twice that of all the other planets put together. Its atmosphere is largely comprised of hydrogen and helium (with a small quantity of other gases).

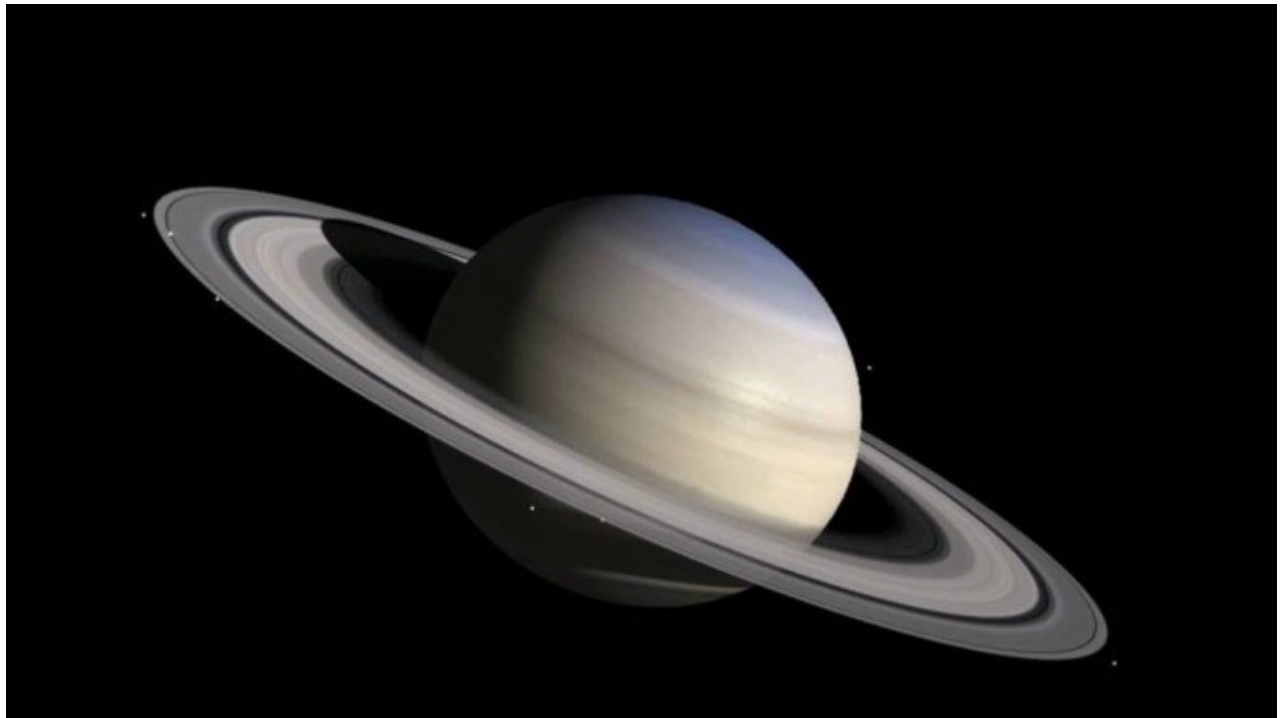
Jupiter spins on its axis in less than 10 hours, so its day is 10 hours long - the shortest day of any of the planets. Its orbit around the Sun takes about 11.9 Earth years - so that's the length of Jupiter's year.

With a telescope you can see Jupiter's dark and light belts, resulting from very powerful winds that move at up to 650 km/h. You can also see the Red Spot – this is what we can see of a giant storm.

Jupiter has four large moons (Io, Europa, Ganymede, and Callisto) and many smaller moons orbit around it - totaling at least 63 moons.

## Planet Saturn

Figure 6 (sourced from Astronomy Trek) gives a picture of Saturn.



**Figure 6: Planet Saturn**

Saturn is the second largest planet in our solar system (Jupiter is the largest). Its diameter is about nine times that of Earth. Its mass is approximately 95 times that of Earth, though its density is low - about 13% that of Earth.

Saturn's orbit around the Sun seems very long to us - 29.5 Earth years. Like Jupiter, Saturn spins very rapidly and its day lasts about 10.5 hours, on average.

Saturn's atmosphere comprises approximately 75% hydrogen and 25% helium. Saturn is covered in white ammonia, giving it a white-yellow color.

Saturn's rings include rock bodies and ice particles. Though very clear through a telescope, the rings are less than one kilometer thick. Saturn has more than 62 moons and numerous other small bodies that we call moonlets.

## Planet Uranus

Figure 7 (sourced from Steemit) gives a picture of planet Uranus.



**Figure 7: Planet Uranus**

Uranus is made up of ices, including water, methane and ammonia. Various kinds of rock make up the remainder of this planet.

Uranus is tilted at 98 degrees to the ecliptic (Earth's is 23 degrees), the greatest tilt of all of the planets. Thus, it orbits the sun on its side. The interior of Uranus rotates every 17 hours and 14 minutes and it orbits the Sun in every 84 Earth years.

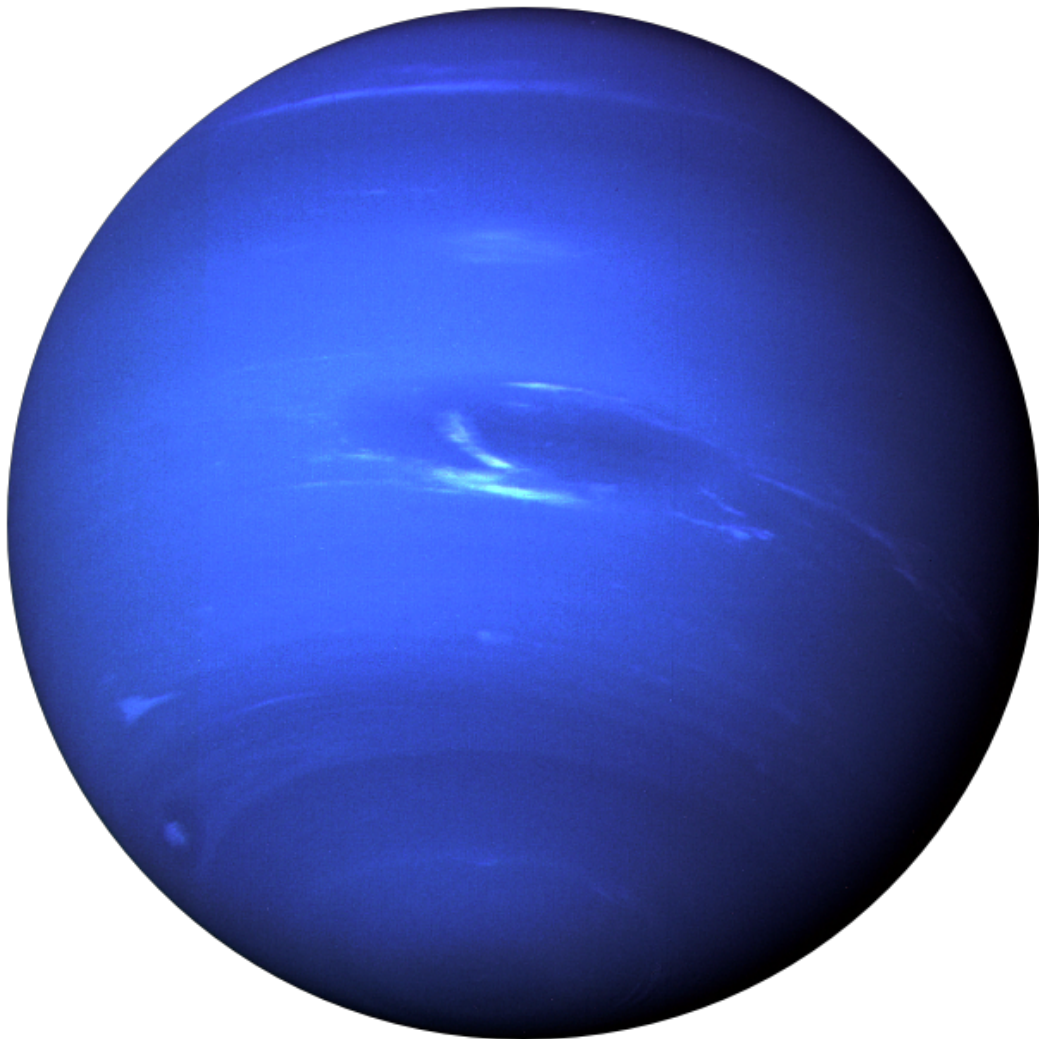
Uranus has the coldest atmosphere of our planets. Its atmosphere has clouds, possibly involving water and methane. Its winds can reach 250 m/s or 900 km/h.

Uranus possesses 27 moons, of which 18 orbit around its equator. Like Saturn, it has rings - at least nine rings - a few km wide and mostly made up of bodies between 0.2m and 20m across.



## Planet Neptune

Figure 8 (sourced from Space Facts) gives a picture of planet Neptune.



**Figure 8: Planet Neptune**

Neptune is a gas giant - the farthest planet from the Sun. It is the fourth-largest planet (49,000 km in diameter) and its mass is a little more than 17 times that of the Earth.

Because it is so far from the Sun, Neptune receives very little sunlight (which in other planets stimulates weather in the atmosphere). However, its winds can travel at speeds of up to 2,400 km/h. Neptune's winds are the fastest that we know of in the solar system.

Neptune rotates about its axis about every 16 hours, so that's the length of its day. It orbits the Sun every 165 years.

Neptune's blue color could result from absorption of red light by methane in its atmosphere, but could also partly result from the presence of compounds that have not yet been identified. Beneath its atmosphere, Neptune has water, ammonia and methane ices.

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