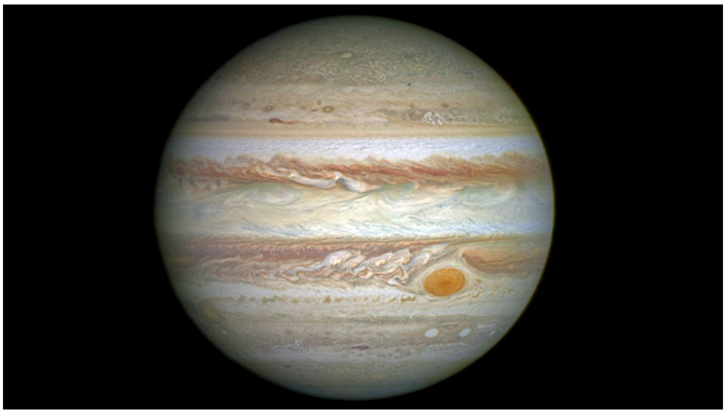
Jupiter



JUPITER is the 5th planet from the Sun, and the largest. It is so large, it comprises about 70% of the mass of all eight planets combined. It also spins on its axis once every 9 hours 55 minutes, faster than any other planet. At this rate of rotation, Jupiter, which is primarily made up of hydrogen and helium gas is fatter in the middle than a true sphere by about 6.5%. Note that this degree of flattening is less than that of Saturn which is the most oblate of all the planets.

The rapid spin of Jupiter creates the most obvious visible feature of brown and white bands at the cloud tops. Winds move around the planet at speeds close to 600 kph as reported by the Galileo spacecraft, a figure that surprised many planetary observers.

The winds do not circulate like they do on earth, where they form wave patterns because of the differences in the temperature at the poles. On Jupiter there is little difference in temperature between the poles and the equator, so the currents form bands.

The white bands are called zones and are cool areas because the gas is expanding and rising to higher altitudes. They are created by upward convection of wind currents from deep within the planet's atmosphere.

The brown bands are called belts, and consist of hot gas descending and compressing as it falls down deeper into the atmosphere of the planet. The zones move counter clockwise in the northern hemisphere and the belts move clockwise. In the southern hemisphere the zones move clockwise and the belts move counter clockwise. From time to time, white ovals called barges appear in the belts. These are temporary, lasting only a few days to a few years, with the exception of the Great Red Spot.

The Great Red Spot, which now appears almost white, is a hurricane that has been raging for at least 300 years, and is about twice the size of Earth, being approx. 12,000 by 24,000 km in size. Jupiter also radiates about twice as much energy than it receives from the Sun. This is thought to be caused by internal thermal energy left over from when the planet formed some 4.6 billion years ago.

The overall planet, a 'gas giant', is approx. by mass 75% hydrogen and about 25% helium, with trace amounts of other gases. However, Jupiter's atmosphere contains about 89% hydrogen, 10 % helium, with the remaining 1% consisting of ammonia, methane, water and other compounds such as carbon, phosphorous, ethane, acetylene and hydrogen cyanide.

Actually it is a fairly complete example of the original stellar cloud which formed our Sun and the other planets. It has been able to maintain the lighter elements, like hydrogen and helium because of its gravitational field. It does not produce internal heat from fusion, Jupiter is about 80 times too small to fuse hydrogen into helium.

The core temperature of Jupiter is thought to be around 30,000° K, and is probably rocky, the next layer is thought to be liquid metallic hydrogen, and it is from this layer it is believed that Jupiter is able to generate its huge magnetic field. Above the shell of metallic hydrogen is another shell of liquid hydrogen, a veritable submerged ocean about 20,000 km thick (or deep). One can only imagine (though scientists can accurately calculate) the huge pressures at those depths.

The magnetic field of Jupiter is flattened by its rapid rotation, and is shaped like a windsock, stretching outward almost to the orbit of Saturn. At the poles the intense magnetic field generates a "Van-Allen" belt similar to Earth's but is large enough to capture highly energetic particles, which are strong enough to kill a human and damage electronic circuits.

These particles are thought to originate with the volcanic moon Io, and gain their energy by the rapid twisting and rotation of the magnetic field. Jupiter shares another characteristic with Earth - it has an aurora at the poles, and the planet also generates super bolts of lightening in the upper atmosphere, about a million times stronger than on Earth. If you have short waveradio, and a long antenna, you can listen to the storms on Jupiter between 18 - 28 MHz. Jupiter has an important task in our Solar System, in that it acts like a great traffic cop attracting and diverting comets and other visiting space bodies like asteroids. It regularly disturbs the orbits of comets as they begin their journey towards the Sun. Comet Shoemaker-Levy 9 was disturbed so much that it began orbiting Jupiter instead of the Sun. When the comet's orbit came inside of Jupiter's Roche limit in 1992, it broke up into 21 segments, which crashed onto the surface 2 years later in 1994. This phenomena is thought to provide some protection for the inner planets like Earth.

Moons of Jupiter

Jupiter currently has 63 known moons. This number may change with any new discoveries.

Jupiter's four largest moons – Io, Ganymede, Europa and Callisto - hold a prestigious place in scientific history. When Galileo discovered these moons in 1610 with his puny but revolutionary telescope, he turned the then scientific and religious world on its head. He was able to show that these small 'worlds' orbited Jupiter, not Earth, thus challenging the officially held earth-centric cosmology and lending observational support to the 'heretical' heliocentric model. That is, that the planets – and Earth – all orbited the Sun, not the Earth. These four moons have since been dubbed the 'Galilean' moons.

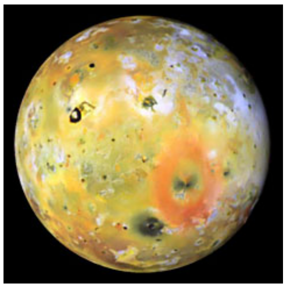
Most of Jupiter's remaining moons are 'puny' in size, ranging down to as small as 2 km. Apart from the Galilean moons, there are only three others in the order of 100 km diameter or larger. Its moons in order of diameter are:

Ganymede – 5,262 km
Callisto – 4,820 km
Io – 3,643 km
Europa – 3,122 km
Himalia – 170 km
Amalthea – 166 km
Thebe – 98 km

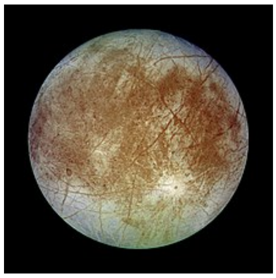
The four Galilean moons are completely different in character and composition, each offering astronomers and scientists a wealth of scientific data and questions to answer.

Ganymede

Callisto



Europa



Io

Ganymede, the largest moon in our solar system, is the third furthest Galilean moon from Jupiter. With a small iron core and then a mantle of rock covered by a crust of ice, it has three different types of terrain: young brightly coloured regions marked by ridges and patterns created by tectonic forces; darker areas covered with impact craters suggesting they are geologically older than the lighter areas; and even darker areas, thought to be the most ancient, going back to its original era of formation.

Callisto, the third largest moon in the solar system and furthest out from Jupiter of the Galilean moons, is approximately the same size as Mercury. It has the distinction of being one of the most cratered objects – moons and planets – in the solar system. Its thick icy/rock surface is absolutely covered with them. There is speculation that beneath Callisto's crust, about 100 km down, is an ocean of salty water.

Io is the closest to Jupiter of the Galilean moons. At 3,643 km diameter, it is marginally larger than our Moon (3,475 km dia.). Io turned scientific heads when, in 1979, Voyager I photographed images of volcanic plumes rising from Io's surface. It is presently the solar systems most known volcanically active body, throwing sulphur compounds high up above Io's surface. This gives Io's surface a geologically young appearance as older surface features are constantly being covered by fresh layers from the volcano eruptions. There are virtually no craters visible on its surface. It is believed that the energy maintaining the volcanic activity comes from the ongoing tidal forces generated between Jupiter and its other major moons, pushing and pulling the moon's internal structure. Io's fascination is enhanced by the existence of lakes of liquid sulphur and sulphur flows from mountains, just like Earth's rivers. All this makes Io a very colourful moon.

Europa is the smallest and second closest of the Galilean moons. It is smaller than our Moon. However, its smaller size is made up for by its huge scientific importance, with current serious speculation about the possibility of some simple form of life in the waters beneath its outer surface. Europa is believed to have a 100 km deep liquid ocean in a layer between its icy crust and rocky mantle. Europa is easily identified in modern images because of its distinctively patterned – or tessellated – surface, caused where the icy surface has cracked and separated, due, it is believed again, to the tidal stresses from Jupiter and the other moons.

Planet Data

Mass (kg) 1.898×10^{27} (317.9 M_E)

Diameter (km) 142,984 (11.21 D_E)

Mean Density (kg/litre) (water =1): 1.2

Mean distance from Sun 5.2 AU (777,776 km)

Rotation period (length of Planet's day): 0.41354 Earth days (9 hrs 55.5 min)

Revolution period (Planet's year): 11.86 Earth years

Obliquity (tilt of axis): 3° 7'

Orbit inclination: 1° 18.5'

Orbit eccentricity (deviation from circular): 0.04837

Mean surface temperature: -148°C

Atmospheric components: 89% hydrogen, 10 % helium, with the remaining 1% consisting of ammonia, methane, water and other compounds such as carbon, phosphorous, ethane, acetylene and hydrogen cyanide.

Observing Jupiter

Jupiter always appears bright in the sky, ranging from -1.8 up to -3, almost rivalling Venus. It appears as a non-twinkling orange-red star, very dominant amongst the starry background. No star, not even Sirius (at -1.47), rivals it in the sky.

Binoculars, depending on their magnification, can clearly show the disc of Jupiter as its angular size varies from 32" to 48", depending on its position with respect Earth's orbit. Amateur telescopes with their higher magnifications will reveal more surface features, including the attractive cloud bands and even, if the seeing is good, the Great Red Spot when it presents itself.

The four largest satellite moons of Jupiter can be seen as points of light with binoculars as they regularly rotate around the planet changing position each night. They are much more distinct in a telescope and you can watch, from night to night, as the moons gradually change relative positions in the equatorial line across the face of Jupiter. Sometimes the shadow of a moon can be seen as a black 'mole' on the planet's cloud tops as the moon passes in front of the planet in our line of sight, and sometimes you can watch as one moon eclipses another or disappears behind the planet's disc. All these Galilean 'events' can be observed by planning ahead, using charts and tables provided in an ephemeris such as Quasar Publishing's 'Astronomy 2010 Australia' or its equivalent for the current year.

Due to its path along the Ecliptic, shared generally by all the other planets, it is not unusual to have attractive conjunctions with other planets or the brighter stars such as Antares, Spica, Regulus and Aldebaran or even a star cluster, such as the Beehive, M44. Conjunctions with the other planets or stars often result in attractive patterns, especially when matched with the Moon, providing opportunities for photography, or simply to enjoy with the naked eye or binoculars.