

Our Planetary System (Chapter 7)

Most planetary orbits are nearly circular and almost in the Sun's equatorial plane. The rotational axes of most planets are nearly perpendicular to their orbital plane. The directions of the rotation of the Sun, the rotation of most planets, and the orbits of most planets are the same (counter-clockwise when viewed from above the Sun's north pole). The rotations and orbits of most large moons follow the same patterns, but around their parent planet instead of the Sun.

The Sun contains most of the mass of the solar system, is mostly hydrogen and helium, has a radius 100x greater than Earth's, and a surface temperature of 5800 K. Its gravity controls the orbits of the planets and its heat and light control their climate.

The inner four planets, Mercury, Venus, Earth, and Mars are called terrestrial planets. Their only large moon, Earth's Moon, is sometimes classified with them as a "terrestrial planet". Mercury orbits at 0.39 AU from the Sun, has no atmosphere and no moons, a radius 0.38x that of Earth, a rocky mantle over a large metal core, and a rotational period that is exactly 2/3 its orbital period. Its surface is heavily cratered. Venus orbits at 0.72 AU from the Sun, has a very thick, hot, and cloudy CO₂ atmosphere, no moons, a radius 0.98x that of Earth, a rocky mantle over a metal core, and a very long day. Mountains, valleys, and old volcanoes are present on its surface. Earth has a thick N₂/O₂ atmosphere, a large moon, a rocky mantle over a metal core, oceans, and life. Mars has a very elliptical orbit, an average distance from the Sun of 1.52 AU, a thin CO₂ atmosphere, 2 small moons, a rocky mantle over a small iron core, a radius 0.53x that of Earth, and lots of geology.

Millions of small rocky bodies called asteroids orbit between Mars and Jupiter. They have rugged shapes and no atmospheres. Their orbits are affected by Jupiter's gravity. Meteorites are pieces of asteroids.

The next four planets, Jupiter, Saturn, Uranus, and Neptune are called jovian planets. Jupiter and Saturn are mostly hydrogen and helium, whereas Uranus and Neptune contain a larger proportion of ices (water, methane, ammonia). Jupiter and Saturn are about 10x the radius of Earth, whereas Uranus and Neptune are about 4x the radius of Earth. All four have deep atmospheres, with bands of clouds, many moons, and rings around their equators. Their largest moons are also active and interesting worlds.

Pluto has a very elliptical orbit and an average distance from the Sun of 39.2 AU. Pluto's radius is 0.18x that of Earth and its surface temperature is 40 K. It has a large moon, Charon. Many objects similar to Pluto have been discovered with similar orbits. Pluto is both a planet and a large Kuiper Belt object. Comets are few km-sized pieces of dirty ice on very, very elliptical orbits whose surfaces boil off gas when heated by the Sun.

These features of the solar system must be explained by any acceptable theory of solar system formation.