

Pluto and Charon

Pluto's discovery in 1930 resulted from an attempt to find a planet beyond Neptune that was theorized to be disturbing the orbits of Uranus and Neptune. Astronomers initially calculated Pluto's mass based on its presumed effect on the two giant outer planets. With the 1978 discovery of Pluto's large moon, Charon, astronomers could compute Pluto's mass for the first time, and it proved to be far too small to account for discrepancies in the orbits of Uranus or Neptune.

Pluto is classified as a dwarf planet and is also a member of a group of objects that orbit in a disc-like zone beyond the orbit of Neptune called the Kuiper Belt. This distant realm is populated with thousands of miniature icy worlds, which formed early in the history of the solar system. These icy, rocky bodies are called Kuiper Belt objects or transneptunian objects.

Pluto's 248-year-long elliptical orbit can take it as far as 49.3 astronomical units (AU) from the Sun. (One AU is the mean distance between Earth and the Sun: about 150 million kilometers or 93 million miles.) From 1979 to 1999, Pluto was actually closer to the Sun than Neptune, and in 1989, Pluto came to within 29.7 AU of the Sun, providing rare opportunities to study this small, cold, distant world. Pluto's orbit occasionally brings it closer to the Sun than the Kuiper Belt.

Pluto is about two-thirds the diameter of Earth's Moon. Exotic ices like methane and nitrogen frost coat its surface. Owing to its size and lower density, Pluto's mass is about one-sixth that of Earth's Moon. Its density indicates that it is partially composed of ices, not rocky materials. Pluto is more massive than Ceres — the dwarf planet that resides in the asteroid belt between Mars and Jupiter — by a factor of 20.

When Pluto is close to the Sun, its surface ices thaw, rise, and temporarily form a thin atmosphere. Pluto's low gravity (about 6 percent of Earth's) causes the atmosphere to be much more extended in altitude than our planet's atmosphere. Pluto becomes much colder during the part of each orbit when it is traveling far away from the Sun, and it is thought that the bulk of the planet's atmosphere freezes during this time.

Pluto's very large moon, Charon, is almost half the size of Pluto. Charon is so big that the two are sometimes referred to as a double dwarf planet system. The distance between them is 19,640 kilometers (12,200 miles). The Hubble Space Telescope photographed Pluto and Charon in 1994 when Pluto was about 30 AU from Earth. These photos showed that Charon is grayer than Pluto (which is red), indicating that they have different surface compositions and structure.

In 2005, scientists photographing Pluto with the Hubble Space Telescope in preparation for the New Horizons mission found two tiny moons orbiting in the same plane as Charon, but two to three times farther away from Pluto than Charon. Named Nix and Hydra, the two moons are thought to be perhaps 50 to 100 kilometers (31 to 62 miles) in diameter. In 2011, Hubble observers found an even smaller moon (later named Kerberos), and in 2012, yet another tiny moon was discovered (later named Styx). The space telescope is being used to scour the Pluto system to uncover potential orbital debris hazards to the New Horizons spacecraft, which will be traveling at about 48,280 kilometers per hour (30,000 miles per hour). The New Horizons team may be able to plan observations of these newly discovered moons. By July 2013, the spacecraft was halfway to Pluto — beyond the orbit of Uranus and heading for its Pluto rendezvous in 2015.

Charon's orbit around Pluto takes 6.4 Earth days, and one Pluto rotation (a Pluto day) takes 6.4 Earth days. Charon neither rises nor sets but "hovers" over the same spot on Pluto's surface, and the same side of Charon always faces Pluto — this is called tidal locking. Compared with most of the planets and moons, the Pluto-Charon system is tipped on its side, like Uranus. Pluto's rotation is retrograde: it rotates "backwards," from east to west (Uranus and Venus also have retrograde rotation). It isn't known whether Pluto has a magnetic field, but its small size and slow rotation suggest little or no magnetic field.

Because Pluto and its family of moons are so small and far away, they are extremely difficult to observe from Earth. Careful analyses of images taken by the Hubble Space Telescope have allowed astronomers to make rudimentary maps showing areas of relative brightness and darkness.

FAST FACTS

Namesake	Roman god of the underworld
Mean Distance from the Sun	5,906.38 million km (3,670.05 million mi)
Orbit Period	247.92 Earth years (90,553 Earth days)
Orbit Eccentricity (Circular Orbit = 0)	0.2488
Orbit Inclination to Ecliptic	17.14 deg
Inclination of Equator to Orbit	119.61 deg
Rotation Period	6.387 Earth days (retrograde)
Equatorial Radius (Pluto)	1,180 km (733 mi)
Equatorial Radius (Charon)	600 km (373 mi)
Mass	0.0022 of Earth's

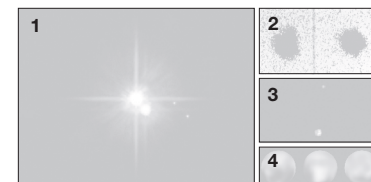
Density (Pluto)	2.03 g/cm ³
Gravity	0.65 m/sec ² (2.1 ft/sec ²)
Atmosphere Primary Components	nitrogen, carbon monoxide, methane
Surface Temperature	-233 to -223 deg C (-387 to -369 deg F)
Known Moons*	5
Rings	None known

*As of July 2013.

SIGNIFICANT DATES

- 1930 — Clyde Tombaugh discovers Pluto.
- 1977-1999 — Pluto's lopsided orbit brings it slightly closer to the Sun than Neptune. It will be at least 230 years before Pluto moves inward of Neptune's orbit for 20 years.
- 1978 — American astronomers James Christy and Robert Harrington discover Pluto's unusually large moon, Charon.
- 1988 — Astronomers discover that Pluto has an atmosphere.
- 2005 — Scientists using the Hubble Space Telescope announce the discovery of two additional moons of Pluto.
- 2006 — NASA's New Horizons mission launches to explore Pluto and the Kuiper Belt region.
- 2011-2012 — Three more small moons are found, bringing the total of known moons to five.

ABOUT THE IMAGES



1 Pluto, Charon (just below and to the right of Pluto), and the tiny moons Nix and Hydra were imaged by the Hubble Space Telescope.

2 Astronomers investigating a changing bulge in Pluto images eventually determined that Pluto had a companion — Charon, a large moon nearly half Pluto's size.

3 The Hubble Space Telescope resolved Pluto and Charon as separate discs in the 1990s, enabling better measurements of both bodies.

4 Surface maps of Pluto created from Hubble Space Telescope images reveal a complex-looking world with white, dark-orange, and charcoal-black terrain.

FOR MORE INFORMATION

solarsystem.nasa.gov/pluto