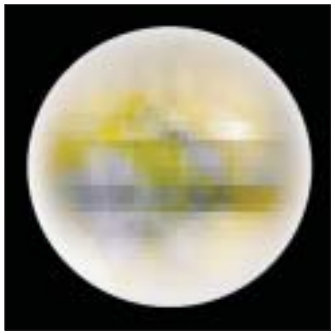
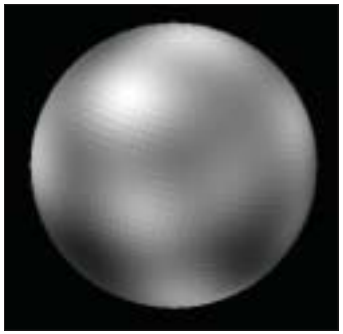
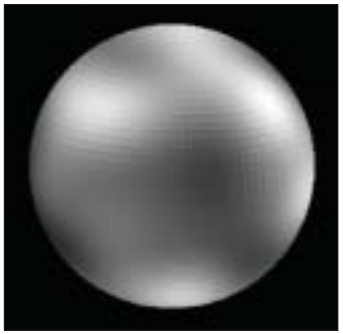
National Aeronautics and
Space Administration

Pluto and Charon







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Pluto and Charon ♇

Long considered to be the smallest, coldest, and most distant planet from the Sun, **PLUTO** may also be the largest of a group of objects that orbit in a disk-like zone of comets beyond the orbit of Neptune.

Discovered by American astronomer Clyde Tombaugh in 1930, Pluto takes 248 years to orbit the Sun. Pluto's most recent close approach to the Sun was in 1989. Between 1979 and 1999, Pluto was actually closer to the Sun than Neptune, providing rare opportunities to study this small, cold, distant world and its companion moon, **CHARON**.

Most of what we know about Pluto we have learned since the late 1970s from Earth-based observations, the *Infrared Astronomical Satellite (IRAS)*, and the *Hubble Space Telescope*. Many of the key questions about Pluto, Charon, and the outer fringes of our solar system await close-up observations by a robotic space flight mission.

Pluto and Charon orbit the Sun in a region where there may be a population of hundreds or thousands of similar bodies that were formed early in solar system history. The gravitational influence of the giant planets may have ejected these bodies to much larger distances from the solar system. The recent discovery of several bodies about the size of Charon in the region beyond Pluto has bolstered this theory. These objects are currently referred to interchangeably as trans-Neptunian objects, Edgeworth-Kuiper Disk objects, Kuiper Belt objects, or ice dwarves.

Pluto is about two-thirds the diameter of Earth's Moon and may have a rocky core surrounded by a mantle of water ice. Due to its lower density, its mass is about one-sixth that of the Moon. Pluto appears to have a bright layer of frozen methane, nitrogen, and carbon monoxide on its surface. While it is close to the Sun, these ices thaw, rise, and temporarily form a thin atmosphere, with a pressure one one-millionth that of Earth's 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. Because Pluto's orbit is so elliptical, Pluto grows much colder during the part of each orbit when it is traveling away from the Sun. During this time, the bulk of the planet's atmosphere freezes.

In 1978, American astronomers James Christy and Robert Harrington discovered that Pluto has a satellite (moon), which they named Charon. Charon is almost half the size of Pluto and shares the same orbit. Pluto and Charon are thus essentially a double planet. Charon's surface is covered with dirty water ice and doesn't reflect as much light as Pluto's surface.

No spacecraft have ever visited Pluto. Because Pluto is so small and far away, it is difficult to observe from Earth. In the late 1980s, Pluto and Charon passed in front of each other repeatedly for several years. Observations of these rare events allowed astronomers to make crude maps of each body. From these maps it was learned that Pluto has polar caps, as well as large, dark spots nearer its equator.

Fast Facts

Namesake	Roman God of the Underworld
Mean Distance from the Sun	6 billion km
Orbital Period	248 years
Orbital Eccentricity	0.25
Orbital Inclination to Ecliptic	17.2°
Inclination of Equator to Orbit	~120°
Rotational Period	6 d 23 m (retrograde)
Diameter	2,390 km
Mass	0.0022 of Earth's
Density	1.1 g/cm^3
Gravity	0.08 of Earth's
Atmosphere (primary components)	Nitrogen, Carbon Monoxide, Methane
Mean Temperature at Solid Surface	57.8 K
Moon	1 (Charon)
Charon's Diameter	1,186 km
Rings	None known

Significant Dates

1930	Clyde Tombaugh discovers Pluto.
1955	Pluto's 6.4-day rotation period is discovered.
1976	Methane on Pluto's surface is discovered.
1978	James Christy and Robert Harrington discover Charon.
1985–91	Pluto-Charon mutual eclipses.
1988	Pluto's atmosphere is discovered.
1992	Nitrogen and carbon monoxide are discovered on Pluto's surface.
1994	First *Hubble Space Telescope* maps of Pluto.
2010–25	Predicted atmospheric collapse.

About the Images

(Top) The ability of the *Hubble Space Telescope* to distinguish Pluto's disk at a distance of 4.4 billion km is equivalent to seeing a baseball at a distance of 64 km. Pluto and its moon Charon are 19,640 km apart. The Hubble observations show that Charon is bluer than Pluto. This means that both worlds have different surface composition and structure. A bright highlight on Pluto suggests it has a smoothly reflecting surface layer (NASA's *Hubble Space Telescope*/European Space Agency's *Faint Object Camera*).

(Left, bottom) Pluto is mostly brown. This map was created by tracking brightness changes from Earth of Pluto during times when it was being partially eclipsed by its moon Charon. The map therefore shows the hemisphere of Pluto that faces Charon. Pluto's brown color is thought dominated by frozen methane deposits metamorphosed by faint but energetic sunlight. The dark band below Pluto's equator is seen to have rather complex coloring, however, indicating that some unknown mechanisms may have affected Pluto's surface (Young, Binzel, Crane/University of Texas McDonald Observatory).

(Center and right, bottom) Opposite hemispheres of Pluto are seen in these maps constructed through computer image processing performed on *Hubble Space Telescope* data. Pluto is an unusually complex object, with more large-scale contrast than any planet except Earth (Stern and Buie, NASA's *Hubble Space Telescope*/European Space Agency's *Faint Object Camera*).

References
1) Hubble Space Telescope: *http://hubble.stsci.edu*
2) Planetary Photojournal: *http://photojournal.jpl.nasa.gov*
3) Stardate: *http://stardate.org/resources/ssguide/pluto.html*

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