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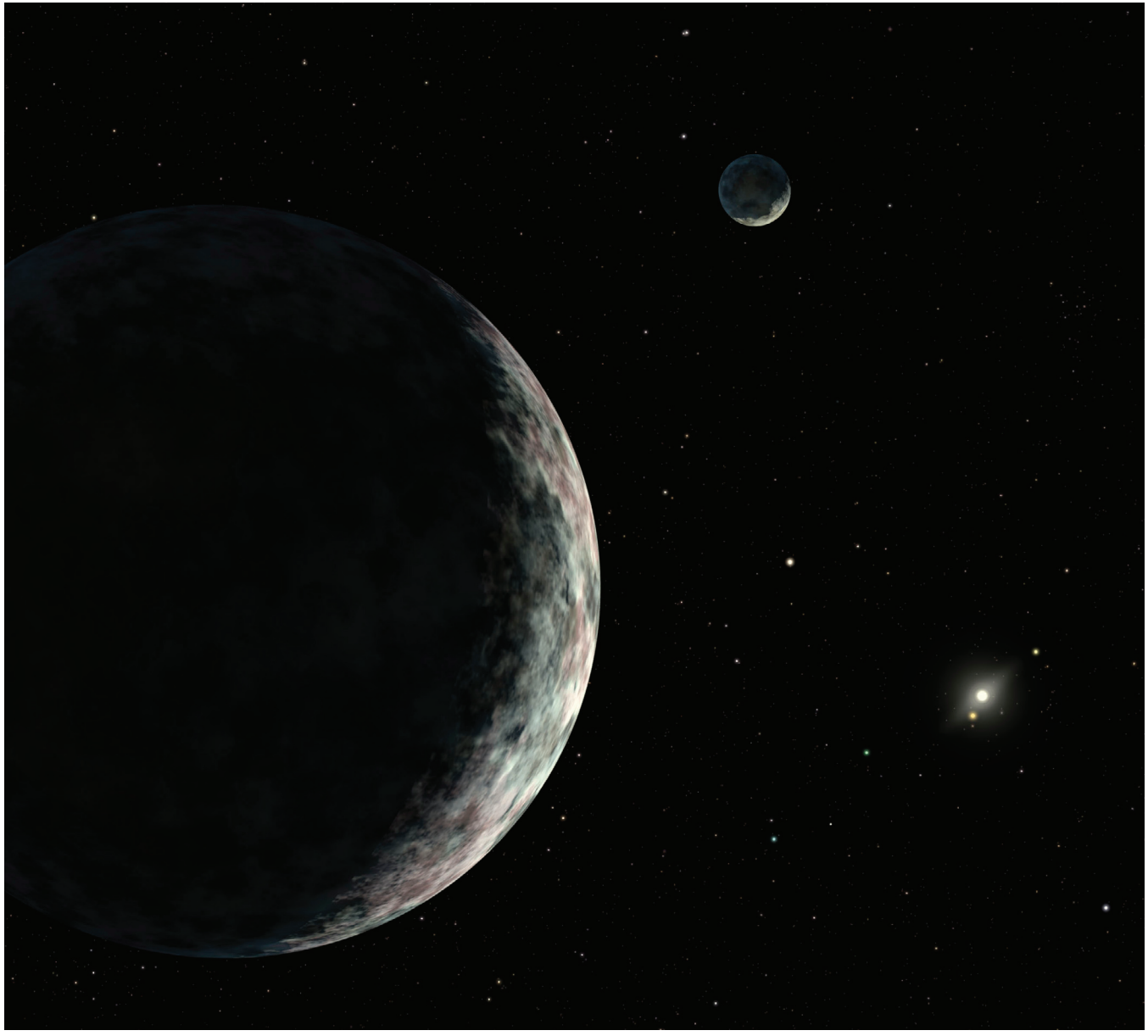
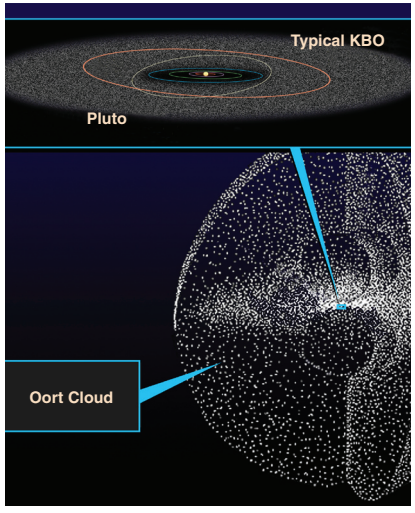
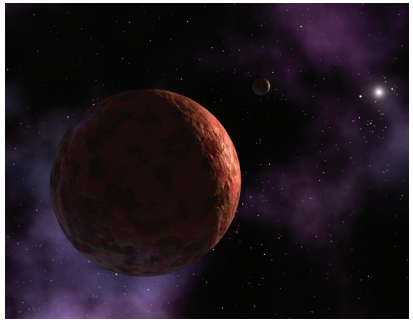
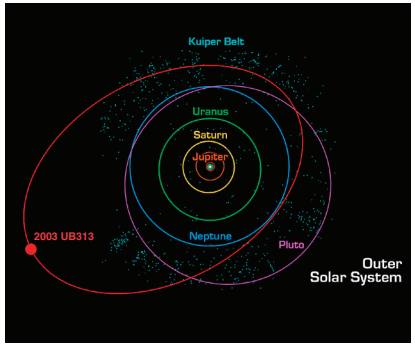
Kuiper Belt and Oort Cloud









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Kuiper Belt and Oort Cloud

In 1950, Dutch astronomer Jan Oort proposed that certain comets came from a vast spherical shell of icy bodies near the edge of the solar system. This giant swarm of objects is now named the Oort Cloud, occupying space at a distance between 5,000 and 100,000 astronomical units. (One astronomical unit, or AU, is the mean distance of Earth from the Sun: about 150 million kilometers or 93 million miles.)

The Oort Cloud contains billions of icy bodies in solar orbit. Occasionally, passing stars disturb the orbit of one of these bodies, causing it to come streaking into the inner solar system as a long-period comet. These comets have very large orbits and are observed in the inner solar system only once. In contrast, short-period comets take less than 200 years to orbit the Sun and they travel along the plane in which most of the planets orbit. They come from a region beyond Neptune called the Kuiper Belt, named for astronomer Gerard Kuiper, who proposed its existence in 1951. The Kuiper Belt, extending out to about 50 AU around the Sun, is populated with thousands of small icy bodies.

In 1992, astronomers detected a reddish speck about 42 AU from the Sun — the first time a Kuiper Belt object (or KBO for short) had been sighted. More than 1,000 KBOs have been identified since 1992. (They are sometimes called Edgeworth–Kuiper Belt objects, acknowledging another astronomer who also is credited with the idea, or they are simply called transneptunian objects — TNOs.)

One of the largest KBOs is Quaoar (2002 LM60), named by its discoverers after the mythical creation-force figure of the Tongva tribe of the Los Angeles basin. Quaoar orbits the Sun every 288 years about a billion miles beyond the orbit of Pluto (somewhere around 42 AU). Quaoar was photographed in 1980, but was not recognized as a KBO until 2002. An even larger KBO (2004 DW, now officially named Orcus) was found at a distance of about 45 AU from the Sun. It is considered a "plutino" or "little Pluto" because of its similar orbit with the planet.

In March 2004, a team of astronomers announced the discovery of a planet-like object, or planetoid, orbiting the Sun at an extreme distance, in the coldest known region of our solar system. The planetoid (2003 VB12), since named Sedna for an Inuit goddess who lives at the bottom of the frigid Arctic ocean, approaches the Sun only briefly during its 10,500-year solar orbit. Sedna is about one-quarter to three-eighths the size of the planet Pluto. At the farthest point in its long, elliptical orbit, Sedna is 130 billion kilometers (84 billion miles) from the Sun — that's about 86 AU, compared with the mean distances of Neptune (about 30 AU) and Pluto (about 39 AU).

The discoverers of Sedna describe it as an inner Oort Cloud object, because it never enters the Kuiper Belt — Sedna never comes closer to the Sun than 76 AU. Sedna is quite an oddity: nobody expected to find an object like it in the largely empty space between the Kuiper Belt and the Oort Cloud. Possibly the Oort Cloud extends much farther in towards the Sun than previously thought, or perhaps Sedna is yet another type of object from the very early solar system, trapped between the Kuiper Belt and the Oort Cloud.

Because KBOs are so distant, their sizes are difficult to measure. The given diameter of a KBO depends on assumptions about how its brightness relates to its size. To estimate size based on brightness, one assumes what percentage of sunlight the object's surface reflects; this percentage is known as the albedo. Thinking that the albedo of an average KBO is similar to that of comets, astronomers calculated the sizes of KBOs based on the reflectivity of comets, which is about 4 percent. An efficient way to calculate an object's albedo is to measure the heat it radiates in the infrared. In 2004, astronomers using the Spitzer Space Telescope did a survey of KBOs at infrared wavelengths and found that they averaged about 12 percent; thus, KBOs might be smaller objects than astronomers originally thought. However, new discoveries may alter this perception.

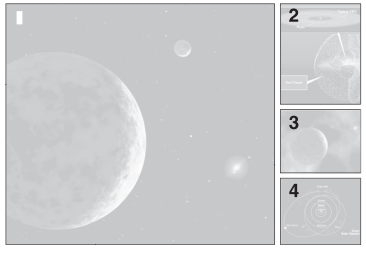
Until recently, all the KBOs found were judged to be significantly smaller than Pluto. In July 2005, a team of scientists announced the discovery of a body that appears to be as large as, or possibly even larger, than Pluto. The object, provisionally designated 2003 UB313, orbits the Sun about every 560 years, its distance varying from about 38 to 98 AU. Initial analysis indicates that the surface is covered with methane ice, similar to Pluto. In September 2005, the team found that 2003 UB313 even has a small moon, thought to be made of water ice.

The discovery of large objects in this frozen outer realm may eventually affect the planetary status of Pluto. This is the nature of planetary astronomy, to reconsider past conclusions in the light of new discoveries and change our theories or definitions to respond to those discoveries. No spacecraft has ever traveled to the Kuiper Belt, but NASA's New Horizons mission, planned to arrive at Pluto in 2015, might be able to penetrate farther into the Kuiper Belt to study one of these mysterious objects.

SIGNIFICANT DATES

1943 — Astronomer Kenneth Edgeworth suggests that a reservoir of comets exists beyond the planets.
1950 — Astronomer Jan Oort theorizes that a vast population of comets may exist on the distant edges of our solar system.
1951 — Astronomer Gerald Kuiper predicts the existence of a belt of icy objects just beyond the orbit of Neptune.
1992 — After five years of searching, astronomers David Jewitt and Jane Luu discover the first Kuiper Belt object, 1992 QB1.
2002 — Scientists using the 48-inch Oschin telescope at Palomar Observatory find Quaoar.
2004 — Astronomers using the Palomar 48-inch Oschin telescope announce the discovery of Sedna (2003 VB12).
2005 — Astronomers announce the discovery of 2003 UB313, a distant icy solar system body that has a small moon.

ABOUT THE IMAGES



1 Artist's concept of 2003 UB313 and its moon. The Sun appears in the distance at right.

2 An illustration of the Kuiper Belt and the Oort Cloud.

3 Artist's concept of Sedna and a hypothetical moon.

4 A diagram showing the highly tilted orbit of 2003 UB313.

FOR MORE INFORMATION

solarsystem.nasa.gov/planets/profile.cfm?Object=KBOs

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