

1) Clyde William Tombaugh (/ˈtɒmbəʊ/; February 4, 1906 – January 17, 1997) was an American astronomer. He discovered Pluto in 1930, the first object to be discovered in what would later be identified as the Kuiper belt. At the time of discovery, Pluto was considered a planet but was later reclassified as a dwarf planet. Tombaugh also discovered many asteroids. He also called for the serious scientific research of unidentified flying objects, or UFOs.

While a young researcher working for the Lowell Observatory in Flagstaff, Arizona, Tombaugh was given the job to perform a systematic search for a trans-Neptunian planet (also called Planet X), which had been predicted by Percival Lowell and William Pickering.

Tombaugh used the observatory's 13inch astrograph to take photographs of the same section of sky several nights apart. He then used a blink comparator to compare the different images. When he shifted between the two images, a moving object, such as a planet, would appear to jump from one position to another, while the more distant objects such as stars would appear stationary. Tombaugh noticed such a moving object in his search, near the place predicted by Lowell, and subsequent observations showed it to have an orbit beyond that of Neptune. This ruled out classification as an asteroid, and they decided this was the ninth planet that Lowell had predicted. The discovery was made on Tuesday, February 18, 1930,[7] using images taken the previous month.[13] The name "Pluto" was suggested by Venetia Burney, then an 11 year old English schoolgirl, who died in April 2009, having lived to see the reclassification of Pluto as a dwarf planet. It won out over numerous other suggestions because it was the name of the Roman god of the underworld, who was able to render himself invisible, and because Percival Lowell's initials PL formed the first 2 letters. The name Pluto was officially adopted on May 1, 1930.

2) Finding the long sought Planet X was Tombaugh's primary assignment at Lowell. Percival Lowell, who had founded the observatory – and who gained fame for his notion of canals on the planet Mars – had also searched for a Planet X. It remained a priority even after Lowell's death in 1916. Tombaugh was hired to continue Lowell's search. He discovered Pluto a year later, on February 18, 1930.

Clyde Tombaugh using a device to 'blink plates,' that is, to click back and forth between two images of the same patch of sky, taken on two different nights. On those two images, the distant background stars would not appear to move, but closer objects would move from one night to another. Comparing thousands of images, Tombaugh discovered Pluto. Image via Lowell Observatory.

Why were astronomers led to search for a Planet X in the first place? What started the search that ultimately resulted in Pluto's discovery?

At the beginning of the 19th century, astronomers believed something was gravitationally disturbing the orbit of the 7th planet, Uranus. At the time, Uranus was the outermost known planet. The astronomers concluded another planet must exist beyond Uranus, and the location of Neptune was mathematically predicted. Not long afterwards, in 1846, Neptune was found, based on these predictions. But the orbit of Neptune had unexplained irregularities, too. And so astronomers believed there was an unknown planet – a Planet X – beyond Neptune.

The search for it led to Pluto's discovery. Very soon after the discovery of Pluto, astronomers realized it was too tiny to have caused the supposed irregularities in Neptune's orbit. And later the irregularities were explained away by other means. In 2006, the International Astronomical Union changed the status of Pluto from one of nine major planets in our solar system to dwarf planet. There are now numerous bodies in the outer solar system.

Text Descriptions of general asteroid types that your postcard should have talked about:

Asteroids Have Different Compositions

The composition of asteroids varies. Many asteroids have dark surfaces. Scientists think that these asteroids are rich in carbon. Other asteroids are thought to be rocky and to have a core made of iron and nickel. Still other asteroids may have a rocky core surrounded largely by ice. Small, rocky asteroids have perhaps the strangest composition of all. They appear to be piles of rock loosely held together by gravity. Asteroid Itokawa (ee•TOH•kah•wah), shown below, is a rocky asteroid known as a “rubble-pile” asteroid.

Some asteroids contain economic minerals like those mined on Earth. Economic minerals that are found in asteroids include gold, iron, nickel, manganese, cobalt, and platinum. Scientists are now investigating the potential for mining near-Earth asteroids.

1) The target of the NEAR mission is 433 Eros, the first discovered near-Earth asteroid (NEA) and the second-largest. Eros also is one of the most elongated asteroids, a potato-shaped body with estimated dimensions of 20.5 by 8 by 8 miles (33 by 13 by 13 kilometers). Its size qualifies Eros as one of only three NEAs with diameters above 6 miles (10 kilometers).

There is no air and no evidence of water on Eros. Daytime temperature is about 100 deg. C (212 deg. F), while at night it plunges to -150 deg. C (-238 deg. F). Gravity on Eros is very weak but sufficient to hold a spacecraft in orbit.

Eros is one of the S-type (siliceous) asteroids, the most common type in the inner asteroid belt and the subject of debate over their relationship to meteorites. Galileo's flyby observations of Gaspra and Ida (both of which are S-types) did not provide the answer, largely because remotely sensed spectral data cannot accurately determine the relative abundances of key elements. This is a major goal of the NEAR mission to Eros.

2) 433 Eros is an S-type near Earth asteroid approximately 34.4×11.2×11.2 kilometres (21.4×7.0×7.0 mi) in size, the second largest near Earth asteroid after 1036 Ganymed. It was discovered in 1898 and was the first near Earth asteroid discovered. It was the first asteroid orbited by an Earth probe (in 2000). It belongs to the Amor group.

Surface gravity depends on the distance from a spot on the surface to the center of a body's mass. Eros's surface gravity varies greatly because Eros is not a sphere but an elongated peanut-shaped (or potato or shoe shaped) object. The daytime temperature on Eros can reach about 100 °C (373 K) at perihelion. Nighttime measurements fall near -150 °C (123 K). Eros's density is 2.67 g/cm³, about the same as the density of Earth's crust. It rotates once every 5.27 hours.

Data from the Near Earth Asteroid Rendezvous spacecraft collected on Eros in December 1998 suggests that it could contain 20,000 billion kilograms of aluminum and similar amounts of metals that are rare on Earth, such as gold and platinum.[15]

The HIGHLIGHTED information (various colors) includes quotes students should have used or paraphrased in their responses to the question. These quotes come from the parts of the readings I had identified by placing a “red box” to draw student attention to the information relevant to the questions asked.