Exploring the Dwarf Planets

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Exploring the Dwarf Planets

In 1930, Clyde Tombaugh discovered an object in the outer solar system that he identified as a planet. The object was named Pluto. Pluto's moon Charon was discovered in 1978, and four more moons – Nix, Hydra, Kerboros, and Styx – were discovered between 2005 and 2012.

Since 1992, scientists have discovered over 1000 new outer solar system objects – all small bodies -- that orbit the Sun beyond Neptune. And mathematical studies of how planets form from swirling disks of gas and dust have shown that to become a planet, an object has to have enough mass to clear the rubble in its neighborhood.

In 2006, the International Astronomical Union (IAU), which is in charge of assigning designations to celestial bodies, decided that recent discoveries warranted a new definition of "planet." The IAU defined three categories of solar system objects. A "planet" is a celestial body in orbit around a star, with sufficient mass to render it round and to clear its orbital neighborhood of rubble. A "dwarf planet" is a body that is too small to clear its orbital neighborhood. All other bodies (except satellites of other bodies) are now defined as "small solar system bodies" (this category includes asteroids). By adopting this new classification system, the IAU "demoted" Pluto to dwarf planet status – leading to a lot of passionate discussion among scientists, citizens, and late-night talk show hosts!

Scientists can learn a lot about the inside of a dwarf planet by making very precise measurements of its diameter and mass. From these measurements, average densities (mass divided by volume) can be figured out. The density of an object gives us a clue as to whether it is mostly rocky or mostly icy. By combining various mixtures of materials with known densities in the laboratory, we can make a very good guess about a dwarf planet's internal composition.

The table below gives the sizes of the five identified dwarf planets as a percentage of Earth's moon's value in diameter and mass.

Dwarf Planet	Diameter (Moon)	Mass (Moon)	Density (kg/m^3)	Orbit Period (yrs)
Ceres	**27%**	**1.3%**	**2,200**	**4.6**
Pluto	**66%**	**17.8%**	**2,100**	**248**
Haumea	**36%**	**5.5%**	**3,000**	**283**
Makemake	**46%**	**5.4%**	**1,800**	**310**
Eris	**67%**	**22.7%**	**2,500**	**557**

Space Math Challenge!

Typical surface rock on Earth (granite) has a density of about 3,000 kg/m^3, while solid water ice has a density of about 900 kg/m^3. What do you think the dwarf planets are mostly made from? **Now try this:** Suppose two thirds of the volume of a dwarf planet is granite and one third is ice. What is the average density of the dwarf planet?

Answers: Haumea= mostly rock; Makemake= mostly ice; Ceres, Pluto, Eris about 50/50 rock and ice.
Now try this: Density = (2/3)x3000 kg/m^3 + (1/3)x900 kg/m^3 = 2,300 kg/m^3