DWARF PLANETS

ASTRONOMY

DWARF PLANETS

Dwarf Planets in the Solar System

In 2006, the organization responsible for classifying celestial bodies, the International Astronomical Union (IAU) decided that a new class of objects was needed. Pluto, considered a planet since its discovery in 1930, was reclassified into the new "dwarf planet" category. To date, five dwarf planets have been found, although some astronomers expect there may be as many as 50 in the solar system.

DWARF PLANETS

	ERIS	PLUTO	HAUMEA	MAKEMAKE	CERES
Year of discovery	2003	1930	2003	2005	1801
Diameter (mean)	1,445 miles 2,326 km	1,430 miles 2,302 km	892.3 miles 1,436 km	882 miles 1,420 km	591.8 miles 952.4 km
Orbital period (Earth years)	561.4	247.9	281.9	305.34	4.6
Distance from sun (times Earth's distance)	68	39.5	43.1	45.3	2.8
Orbital inclination (degrees)	46.9	17.14	28.2	29	10.59
Rotation period	25.9 hours	6.39 Earth days	3.9 hours	22.5 hours	9.1 hours
Moons	1	5	2	0	0

DWARF PLANETS

Planets must:

- Be in orbit around Sun.
- Have enough mass so gravity makes them round.
- Have cleared their orbit of similar objects.
- If they don't meet this criteria, they are considered to be dwarf planets.
- Today we know of five: Pluto, Ceres, Eris, Haumea, and Makemake.
- Except for Ceres, all are in the Kuiper Belt.

Not all astronomers are happy with the whole dwarf planet thing.

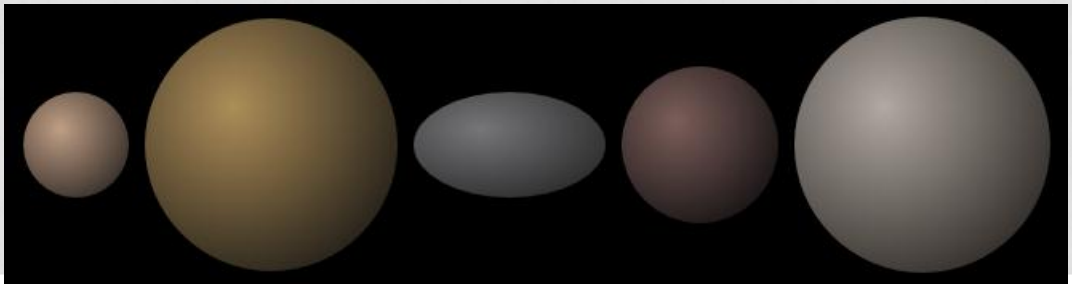
WHAT IS DWARF PLANET?

Dwarf planets share many of the same characteristics as planets thought there is one significant difference. The International Astronomical Union's definition of a dwarf planet is:

A "dwarf planet" is a celestial body that

- *is in orbit around the Sun*
- *has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape*
- *has not cleared the neighborhood around its orbit*
- *is not a satellite.*

The key difference is that a planet has cleared other objects in the area of it's orbit while a dwarf planet has not.



DWARF PLANETS

THE DWARF PLANETS

Name	Distance from Sun	Diameter at Equator
Ceres	413,700,000 km (2.77 AU)	950 km
Pluto	5,874,000,000 km (39.26 AU)	2,306 km
Haumea	6,452,000,000 km (43.13 AU)	1,739 km
Makemake	6,850,000,000 km (45.79 AU)	1,502 km
Eris	10,120,000,000 km (68.01 AU)	2,326 km

The largest dwarf planet in the solar system is Eris followed by Pluto, Makemake and Haumea with the smallest being Ceres. The order of the dwarf planets from closest to Sun outwards is Ceres, Pluto, Haumea and Makemake with Eris being the furthest from the Sun.

TNO'S

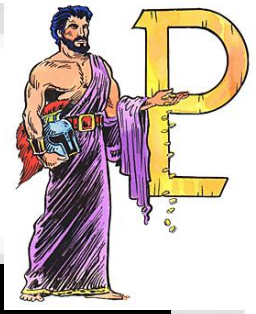

Largest known trans-Neptunian objects (TNOs)
Dysnomia
Charon
Eris
Pluto
Makemake
Haumea
Sedna
Orcus
Quaoar
Varuna

PLUTO

PLUTO DWARF PLANET PROFILE

Mass: 13,050,000,000,000 billion kg (0.00218 x Earth)
Diameter: 2,306 km
Known Satellites: 5
Notable Satellites: Charon, Nix, Hydra, Kerberos and Styx
Orbit Distance: 5,874,000,000 km (39.26 AU)
Orbit Period: 246.04 Earth years
Surface Temperature: -229°C
Discovery Date: 18th February 1930
Discovered By: Clyde W. Tombaugh

PLUTO



Pluto is named after the Greek god of the underworld:
This is a later name for the more well known Hades and was proposed by Venetia Burney an eleven year old schoolgirl from Oxford, England.

Pluto was reclassified from a planet to a dwarf planet in 2006:
This is when the IAU formalised the definition of a planet as "A planet is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit."

Pluto was discovered on February 18th, 1930 by the Lowell Observatory:
For the 76 years between Pluto being discovered and the time it was reclassified as a dwarf planet it completed under a third of it's orbit around the Sun.

Pluto has five known moons:
They are Charon (discovered in 1978,), Hydra and Nix (both discovered in 2005), Kerberos originally P4 (discovered 2011) and Styx originally P5 (discovered 2012) official designations S/2011 (134340) 1 and S/2012 (134340) 1.

Pluto is the second largest dwarf planet:
Eris is the largest with an average diameter of 2,326km while Pluto has a diameter of 2,306km.

Pluto is smaller than a number of moons:
These are Ganymede, Titan, Callisto, Io, Europa, Triton, and the Earth's moon. Pluto has 66% of the diameter of the Earth's moon and 18% of its mass.

PLUTO

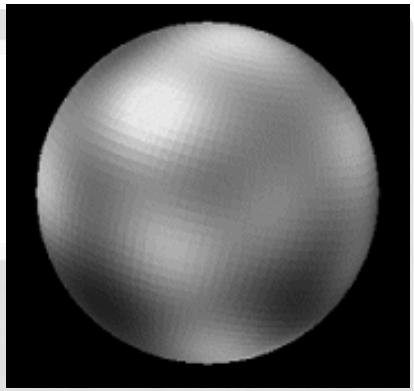
Pluto has a eccentric and inclined orbit:
This takes it between 4.4 and 7.4 billion km from the Sun meaning Pluto is periodically closer to the Sun than Neptune.

No spacecraft have visited Pluto:
Though in July 2015 the spacecraft New Horizons, which was launched in 2006, is scheduled to fly by Pluto on it's way to the Kuiper Belt.

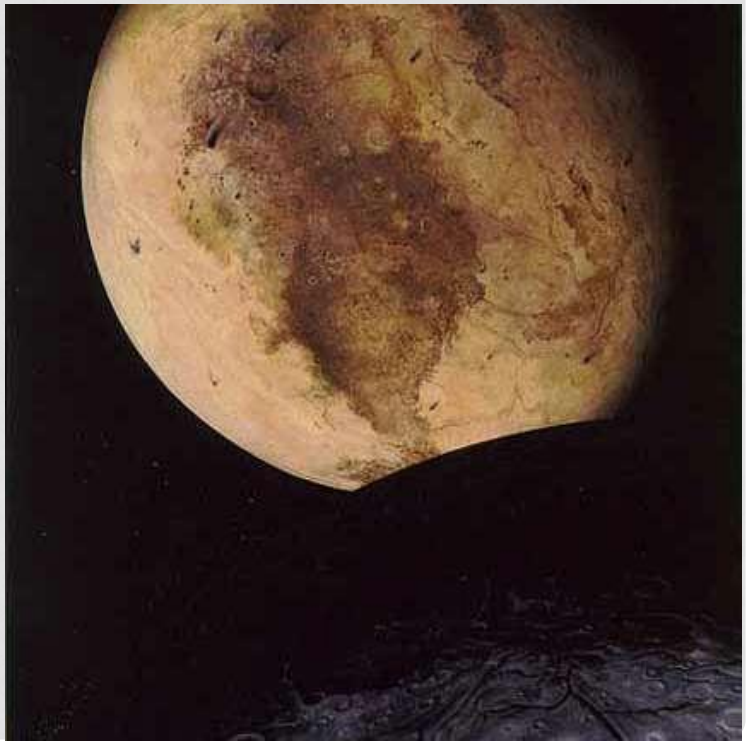
Pluto's location was predicted by Percival Lowell in 1915:
The prediction came from deviations he initially observed in 1905 in the orbits of Uranus and Neptune.

Pluto sometimes has an atmosphere:
During Pluto's elliptical when Pluto is closer to the Sun its surface ice thaws and forms a thin atmosphere primarily of nitrogen with a little methane and carbon monoxide. When Pluto travels away from the Sun the atmosphere then freezes back to it's solid state.

PLUTO



- Once thought of as the furthest planet from the sun.
- 2/3rds the size of our moon.
- Pluto takes 248 years to make one orbit around the sun!
- Discovered in 1930 by Clyde Tombaugh using a blink comparator. This allowed astronomers to quickly look for differences in two photographs shot on different nights of the same part of the sky.

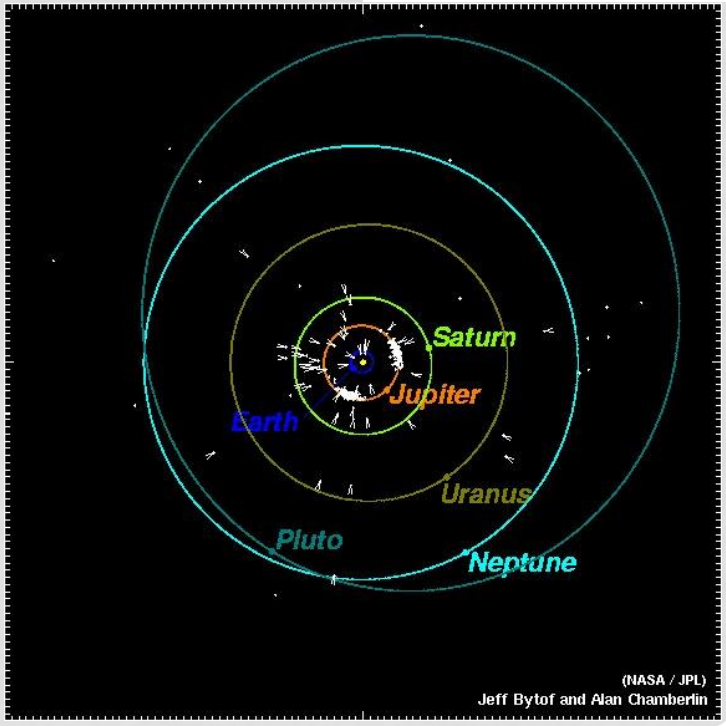


PLUTO'S ATMOSPHERE

- When Pluto comes close enough to the sun, the surface of solid Nitrogen sublimates to produce a substantial atmosphere with winds and clouds.
- Because the planet is so small, however, it does not have enough gravity to bind an atmosphere for very long. Thus Pluto's atmosphere is being rapidly produced and rapidly lost at the same time.
- This means that the atmosphere is not in equilibrium.
- Similar to comets when they get close to the Sun.

PLUTO'S ORBIT

- Pluto has the most eccentric orbit of all the planets in the solar system. Its orbit takes it to 49.5 AU at its farthest point from the Sun. And its orbit takes it as close as 29 AU to the Sun.
- That means that Pluto's orbit draws within the orbit of Neptune, as can be seen in this drawing, making Pluto the 8th planet rather than the 9th planet for roughly 20 years at a time.
- Pluto was the 8th planet from January 1979 to February 1999. Neptune is now the 8th planet for over 200 years!



PLUTO FACTS

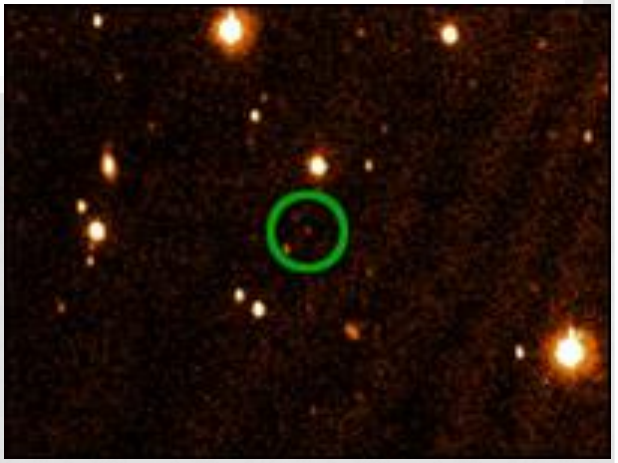
- Diameter: 0.2 Earth
- Distance: 39 AU
- Now considered a dwarf planet.
- Atmosphere: Oxygen and nitrogen atmosphere, almost always frozen. Might have a brief atmosphere when the frozen gases sublimate as Pluto makes its closest approach to the Sun.
- Features: most eccentric orbit, some scientists think it might also have retrograde rotation like Venus.
- Life: too cold. Not likely!

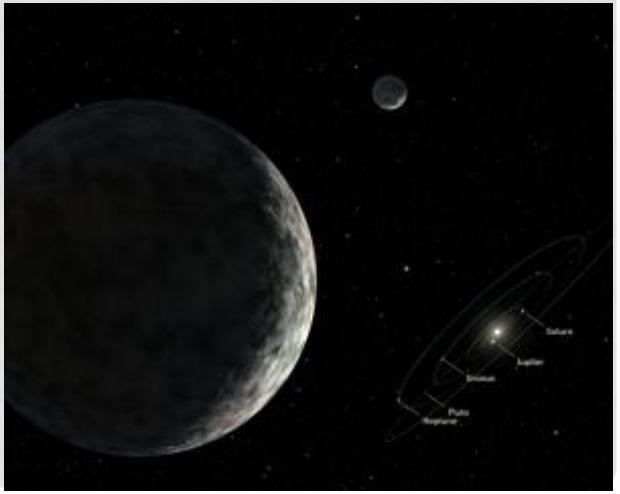
CHARON

- Named for the boatman who ferried the dead into the Underworld.
- Surface seems to be covered with water-ice instead of Pluto's nitrogen-ice.
- Largest moon compared with its planet.
- Two recently discovered tiny moons, called Nix and Hydra, orbit twice as far from Pluto as Charon.

PLUTO DEBATE

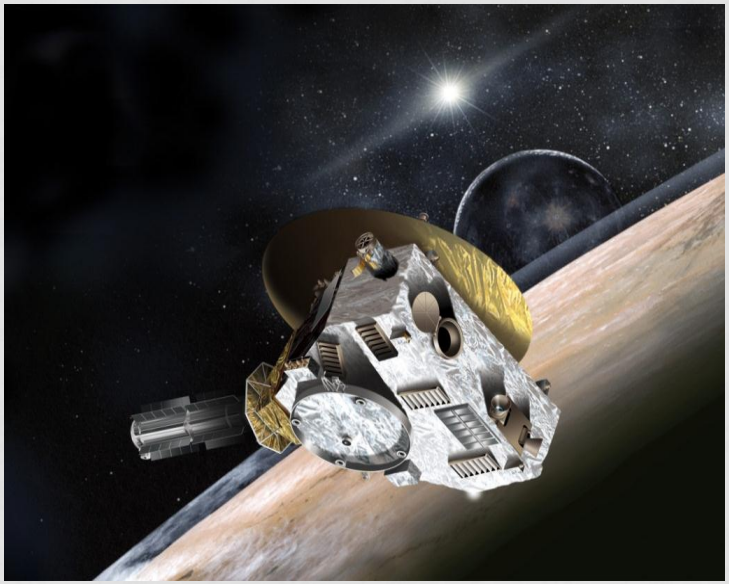
- Is Pluto really a planet?
- In 2006 Pluto was classified as a dwarf planet.
- Pluto is very similar to recently discovered icy worlds found in the Kuiper Belt. So now many scientists consider Pluto just another Kuiper Belt object, which are small icy worlds in the third zone.
- Several have been discovered so far, and it is believed there are thousands more out there.
- In July 2005 a KBO larger than Pluto was discovered. Named Eris, after the Greek/Roman goddess of discord.





NEW HORIZONS SPACECRAFT

- Mission to Pluto: launched January 19, 2006
- As of March 2012, it had covered 22.8 AU, and was outside the orbit of Uranus. It was 2/3rds of the way there!
- It will have a 21 day encounter with Pluto/Charon in July, 2015.
- Hopefully it will then head off to encounter other Kuiper Belt Objects.



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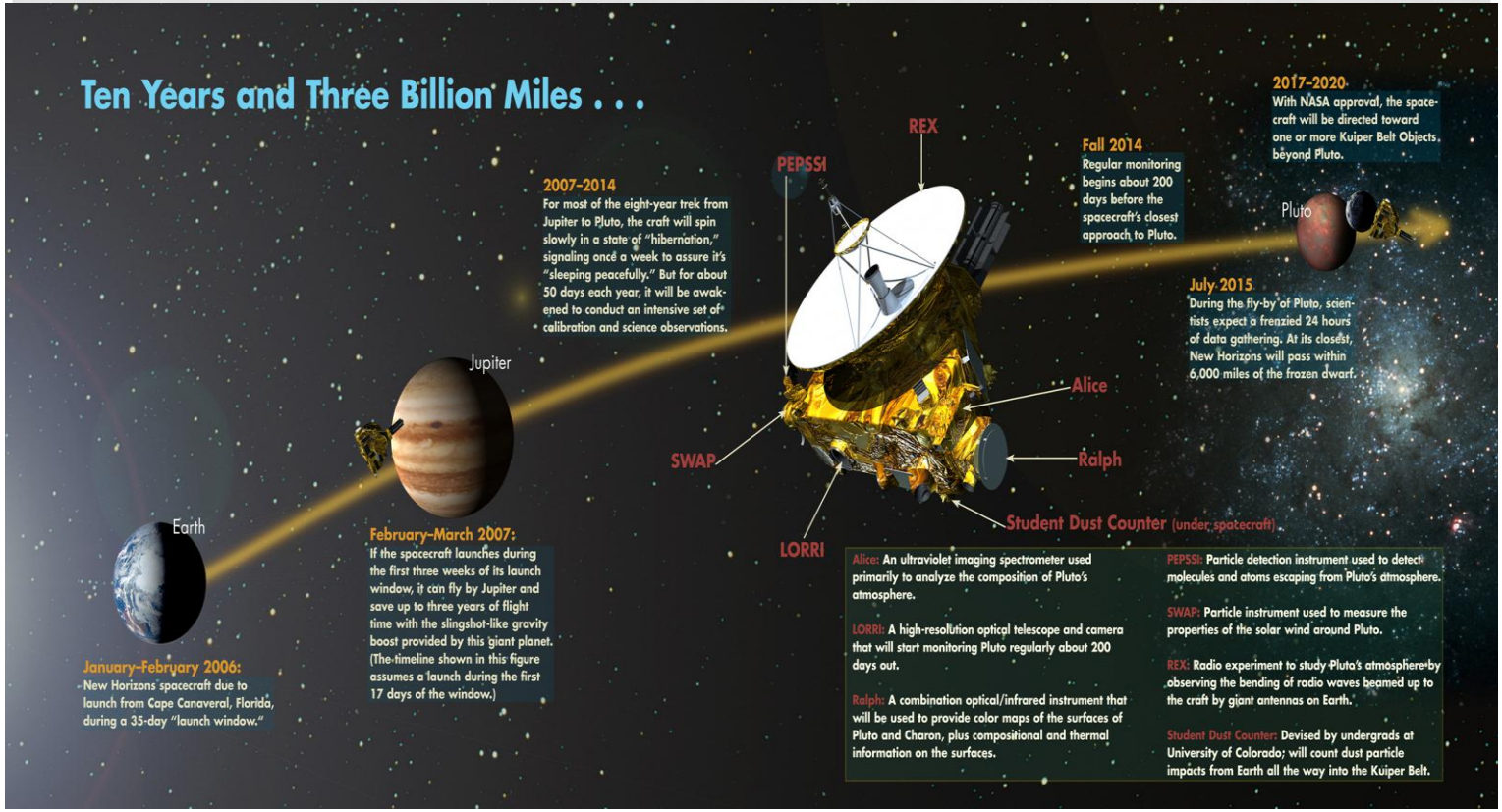

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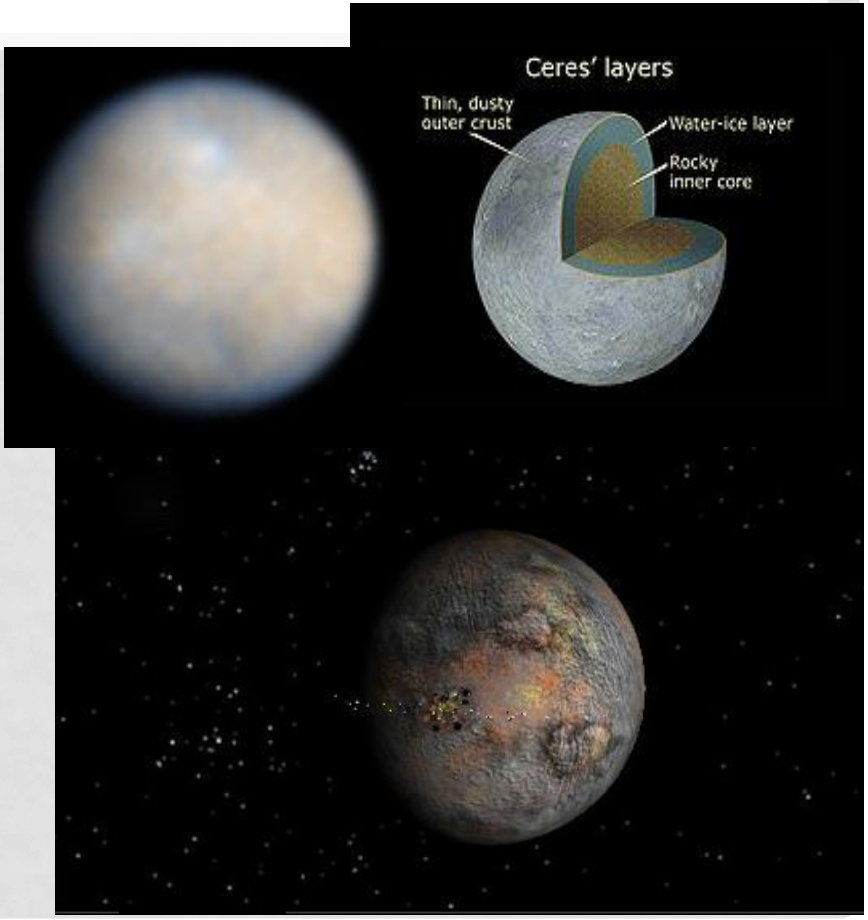
- Features: most eccentric orbit, some scientists think it might also have retrograde rotation like Venus.
- Life: too cold. Not likely!

CERES

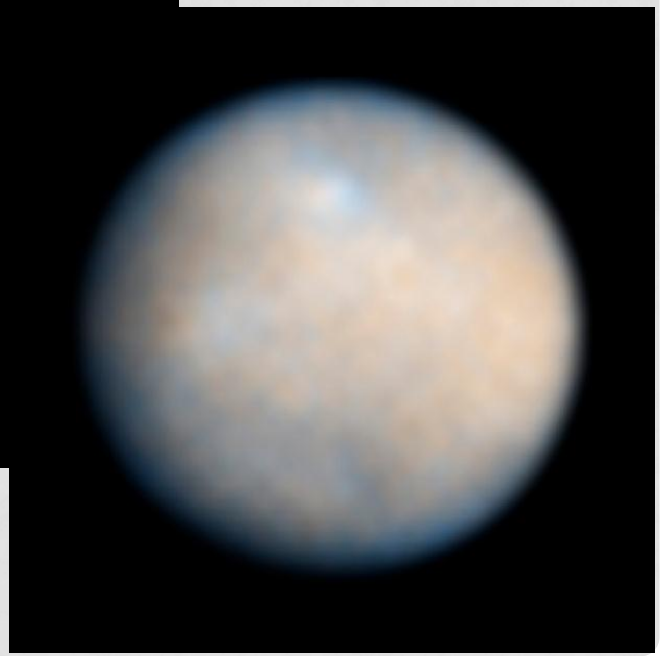
- Largest known asteroid.
- Contains 1/3rd the mass of the Asteroid Belt.
- 950-km wide.
- Believed to have a rocky core, and possibly a liquid layer below the surface.
- The Dawn space probe should visit Ceres arriving in February 2015.



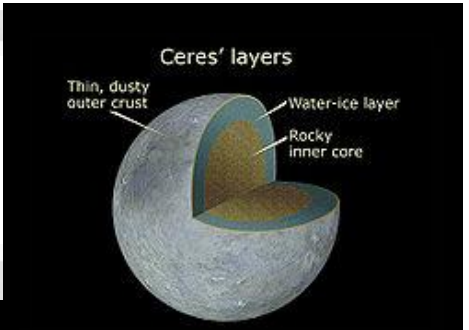
CERES

CERES DWARF PLANET PROFILE

Mass: 943,000,000,000 billion kg (0.00015 x Earth)
Diameter: 950 km
Known Satellites: none
Notable Satellites: none
Orbit Distance: 413,700,000 km (2.77 AU)
Orbit Period: 4.60 years
Surface Temperature: -105°C
Discovery Date: 1st January 1801
Discovered By: Giuseppe Piazzi



CERES



Ceres was the first object considered to be an asteroid:
Italian astronomer Giuseppe Piazzi discovered and named Ceres in early 1801. Though he classified it as a planet, Ceres is now classified as a dwarf planet which accounts for nearly 1/3 of the asteroid belt's mass.

The first visit to Ceres is due in 2015:
NASA's Dawn spacecraft is making its way to Ceres from the asteroid Vesta since September 2012. There is high interest in this mission since Ceres is one possible destination for human colonisation given its abundance of ice, water, and minerals.

Ceres is the closest dwarf planet to the Sun and is located in the asteroid belt making it the only dwarf planet in the inner solar system. Ceres is the smallest of the bodies current classified as dwarf planets.

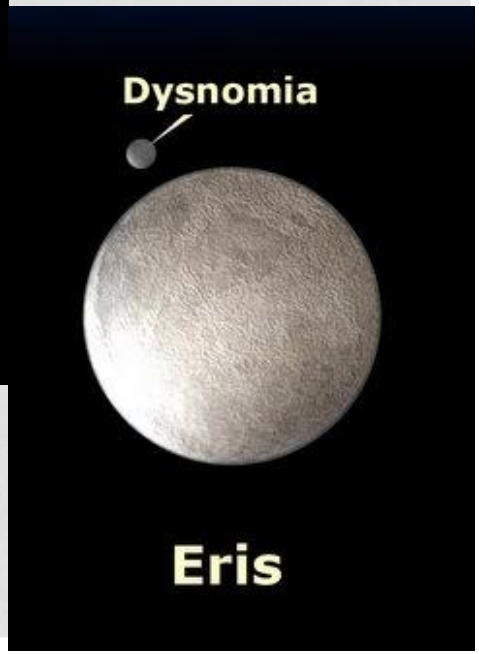
ERIS

- Largest known dwarf planet. Slightly larger than Pluto.
- Orbits 3 times more distant than Pluto. 557 years to make one revolution around the Sun.
- Has one moon, Dysnomia.
- Surface might be covered with frozen methane.

ERIS

ERIS DWARF PLANET PROFILE

Mass: 16,700,000,000,000 billion kg
Diameter: 2,326 km
Known Satellites: 1
Notable Satellites: Dysnomia
Orbit Distance: 10,120,000,000 km (68.01 AU)
Orbit Period: 560.90 Earth Years
Surface Temperature: -231°C
Discovery Date: January 5th 2005
Discovered By: M.E. Brown C.A. Trujillo & D.L. Rabinowitz



ERIS

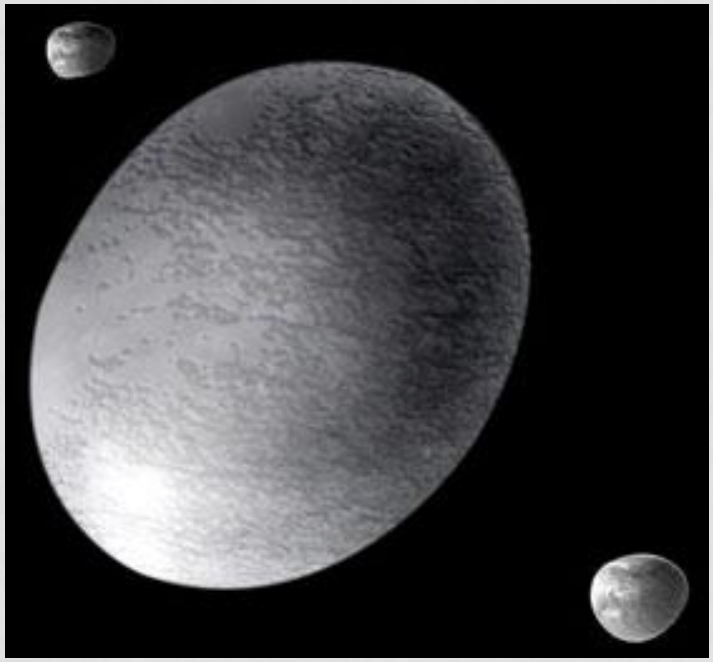
Eris was once considered for the position of tenth planet:
Eris is the most massive dwarf planet in the Solar System, exceeding Pluto's mass by 28%. As such, it was a serious contender to be a tenth planet but failed to meet the criteria set out by the International Astronomical Union in 2006.

Eris was named after the Greek goddess of discord:
Fittingly, picking a name for the object took unusually long – more than 1.5 years after its discovery in 2005. Some of the rejected names were Xena, Lila, and Persephone (Pluto's wife).

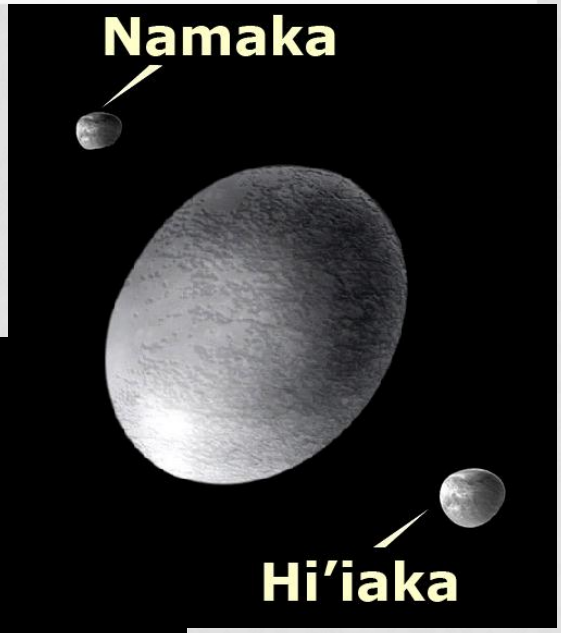
As well as being the largest dwarf planet Eris is also the most massive and the furthest from the Sun.

HAUMEA

- Dwarf planet discovered in 2004.
- Sort of a football shape due to its rapid rotation.
- Mass 1/3rd of Pluto's.
- 285 year orbit.
- Two moons.
- Hawaiian goddess of fertility and childbirth.



HAUMEA



HAUMEA DWARF PLANET PROFILE

Mass: 4,006,000,000,000 billion kg (0.00066 x Earth)
Polar Diameter: 996 km
Equitorial Diameter: 1,960 km – 1,518 km
Known Satellites: 2
Notable Satellites: Hi'iaka & Namaka
Orbit Distance: 6,452,000,000 km (43.13 AU)
Orbit Period: 283.28 Earth Years
Surface Temperature: -241°C
Discovery Date: 28th December 2004
Discovered By: Disputed, Mike Brown & team or José Luis Ortiz Moreno & team

HAUMEA

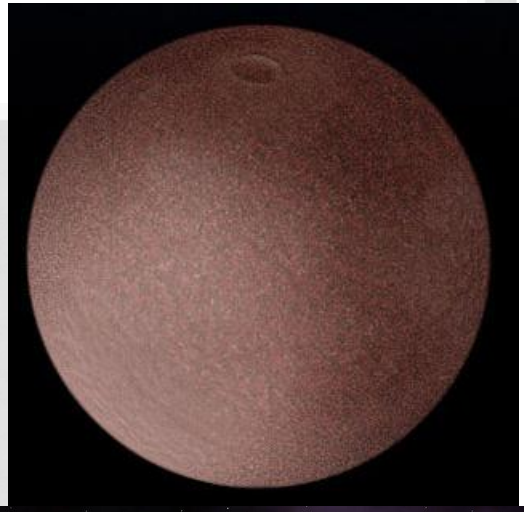
Haumea is the third closest dwarf planet from the Sun and is unique in it's elongated shape making it the least spherical of the dwarf planets.

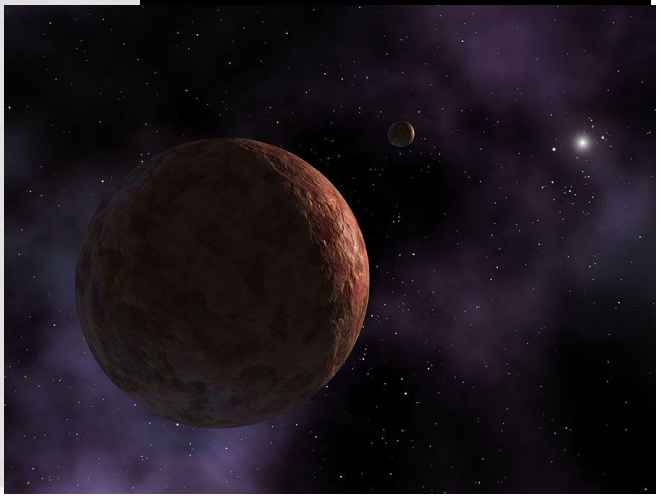
A day on Haumea lasts 3.9 hours:
Haumea's characteristic extreme elongation is probably caused by its rotation, which is so rapid it turned it into an ellipsoid. Its rotational speed as well as its collisional origin also make Haumea one of the densest dwarf planets discovered to date.

Haumea has a spot:
In 2009 a dark red spot was discovered which stands out from surrounding crystalline ice. It's thought this spot could be an area of the dwarf planet that is with a higher concentration of minerals and carbon rich compounds than the rest of the icy surface.

MAKEMAKE

- Third largest dwarf planet, after Eris and Pluto.
- 310 year orbit.
- Reddish appearance, possibly due to frozen methane and ethane on its surface.
- No known moons.
- Rapanui (Easter Island) goddess of fertility

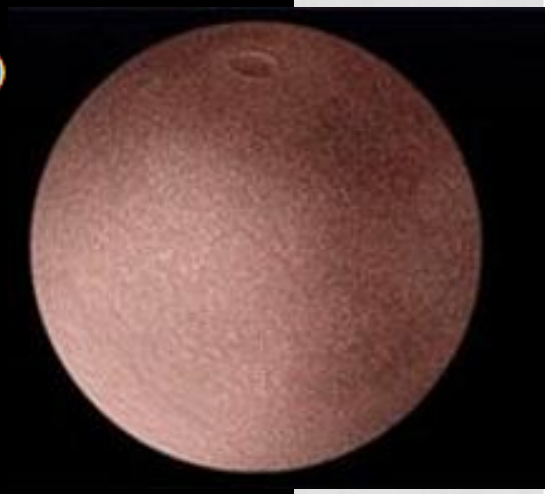




MAKEMAKE

MAKEMAKE DWARF PLANET PROFILE

Mass: 3,000,000,000,000 billion kg (0.0005 x Earth)
Equatorial Diameter: 1,434 km
Polar Diameter: 1,422 km
Known Satellites: none
Notable Satellites: none
Orbit Distance: 6,850,000,000 km (45.79 AU)
Orbit Period: 309.88 Earth years
Surface Temperature: -239°C
Discovery Date: March 31st 2005
Discovered By: Michael E. Brown, Chad Trujillo & David Rabinowitz



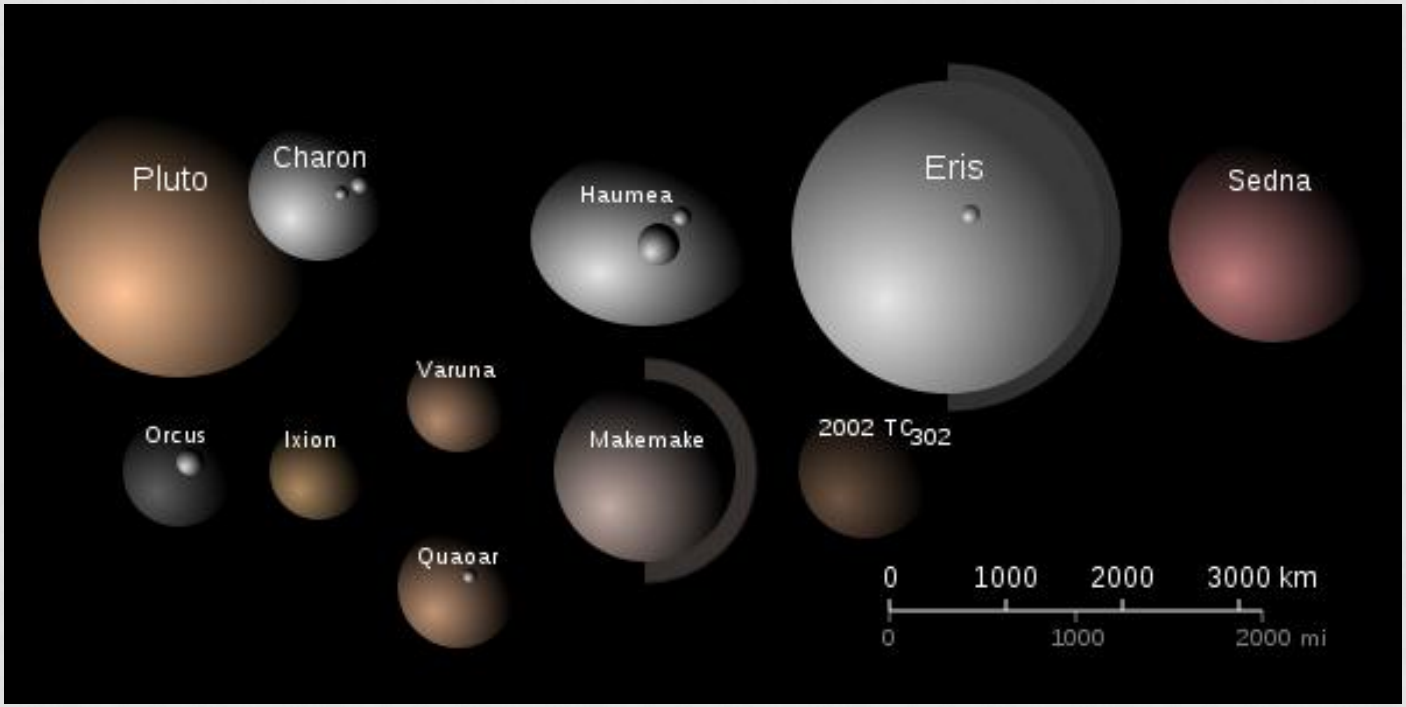
MAKEMAKE

Makemake is the second furthest dwarf planet to the Sun and is the only one of the outer four dwarf planet to not have any moons.

Makemake lacks its expected atmosphere:
Astronomers thought Makemake would have developed an atmosphere similar to Pluto's, its chance passing in front of a bright star in 2011 revealed it mostly lacks a gas envelope. If present, Makemake's atmosphere would likley be methane and nitrogen-based.

ALMOST CERTAIN DWARF PLANETS

- There are at least four Trans Neptunian Objects that might meet the definition of dwarf planet.



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