

Planet, Dwarf Planet, or neither?

**PLUTO**

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# Pluto

- Discovered in 1930 by Clyde Tombaugh
- Originally classified as the ninth planet
- Tends to be an outlier- rocky planet but far from the sun, unusual composition
- Very small in comparison, only 5% of the mass of Mercury
- Eccentric, highly inclined orbit that crosses Neptune's path
- Five known moons, has a thin atmosphere

# Pluto

- Physical characteristics
  - SMA of  $\sim 40$  AU
  - $e = 0.25$
  - Orbital period of  $\sim 248$  years
  - Inclination of  $17^\circ$
  - Radius of  $\sim 1200$  km, about  $0.18 R_e$
  - Mass of  $\sim 0.2\%$  of Earth
  - Atmospheric pressure of  $0.3$  Pa



90°



180°



270°

**Pluto Faces**  
*Hubble Space Telescope • ACS/HRC*

# KBOs/TNOs

- Trans-Neptunian Objects are small bodies that lie outside the orbit of Neptune.
- Kuiper Belt Objects are TNOs that are in the Kuiper Belt region of the Solar System.
- Notable ones include Pluto, Eris, Sedna, and many more.
- The discovery of Eris by Mike Brown in 2005 provided a catalyst for the IAU to formally define what makes a planet.

# Largest known trans-Neptunian objects (TNOs)



**Eris**



**Pluto**



**Makemake**



**Haumea**



**Sedna**



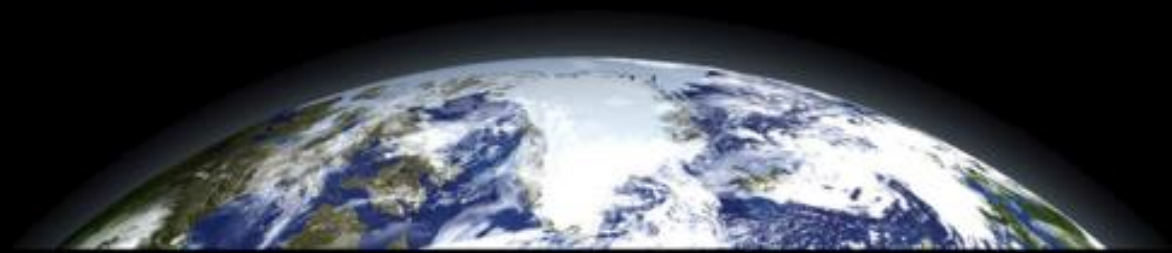
**2007 OR<sub>10</sub>**



**Quaoar**

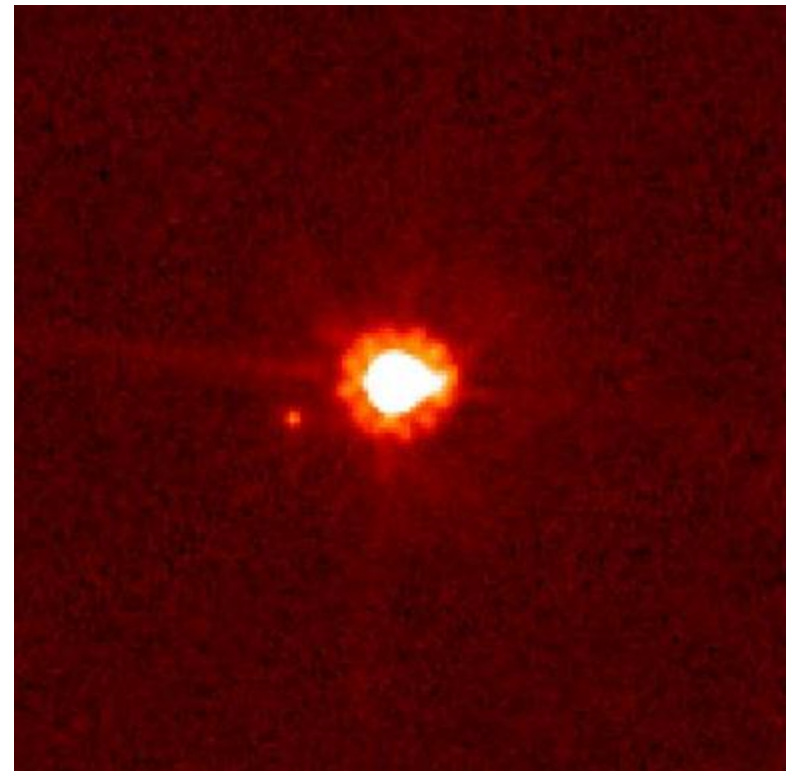


**Orcus**



# Eris

- Discovered in 2005, orbits ~3 times farther than Pluto
- Discovered to be larger and more massive than Pluto- hence the initial description as the “10<sup>th</sup> planet”
- Classified as a dwarf planet in 2006



# What is a planet?

- Historically: ill defined- no real definition of a planet.
- 2006 IAU ruling:
  - The body must directly orbit the Sun, not another object.
  - The body must be in hydrostatic equilibrium.
  - The body must have “cleared its neighborhood”.



# Dwarf Planets

- As defined by the IAU, a dwarf planet fulfills only the first two conditions for planethood.
- As of 2014 the IAU has only officially recognized 5 dwarf planets, but there are dozens of candidates that may fit the criteria.
- Ceres, Pluto, Eris, Makemake, Haumea
- Dwarf planets that lie outside the orbit of Neptune are also called “plutoids”.

Planets

Satellites (natural)

Dwarf planets

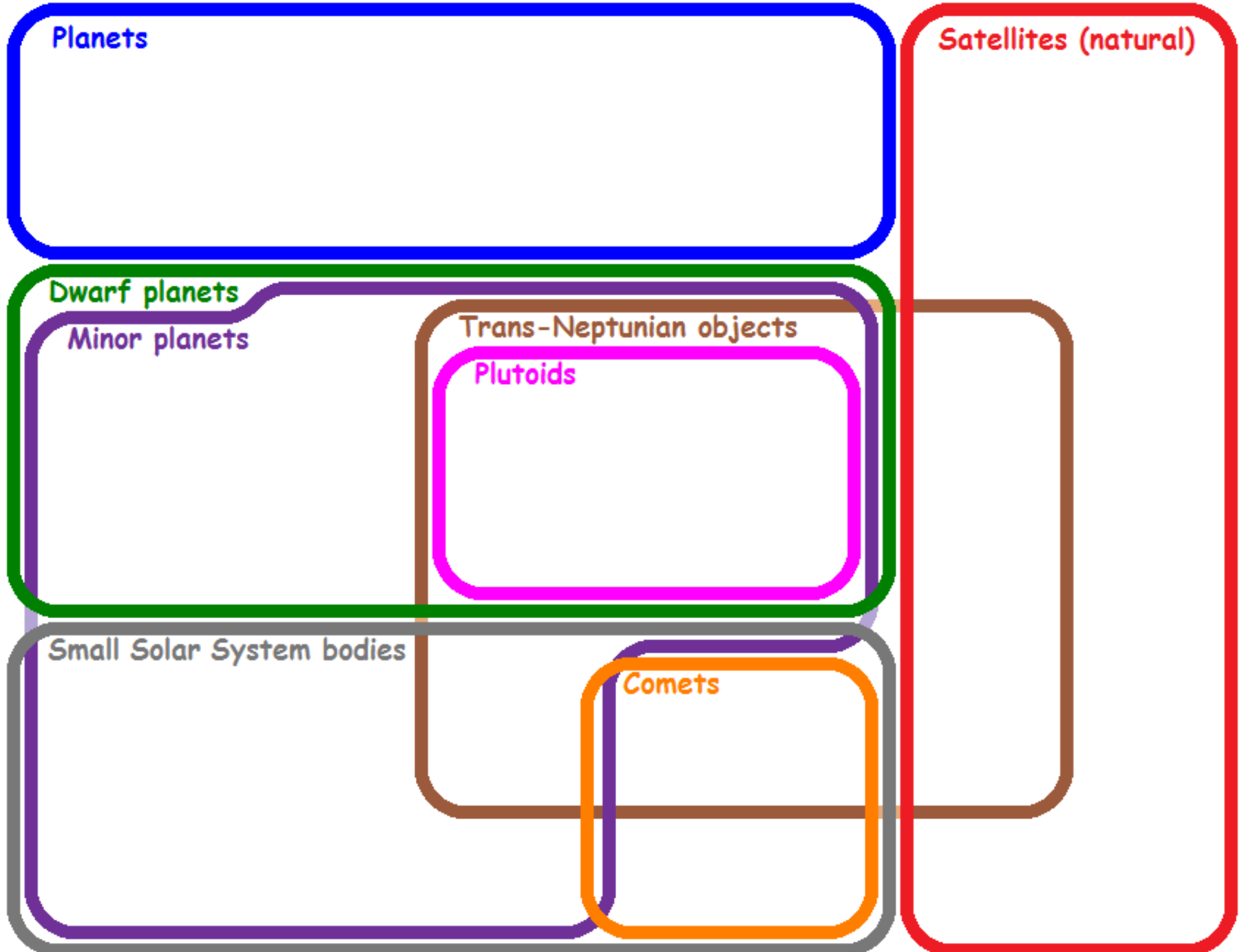
Minor planets

Trans-Neptunian objects

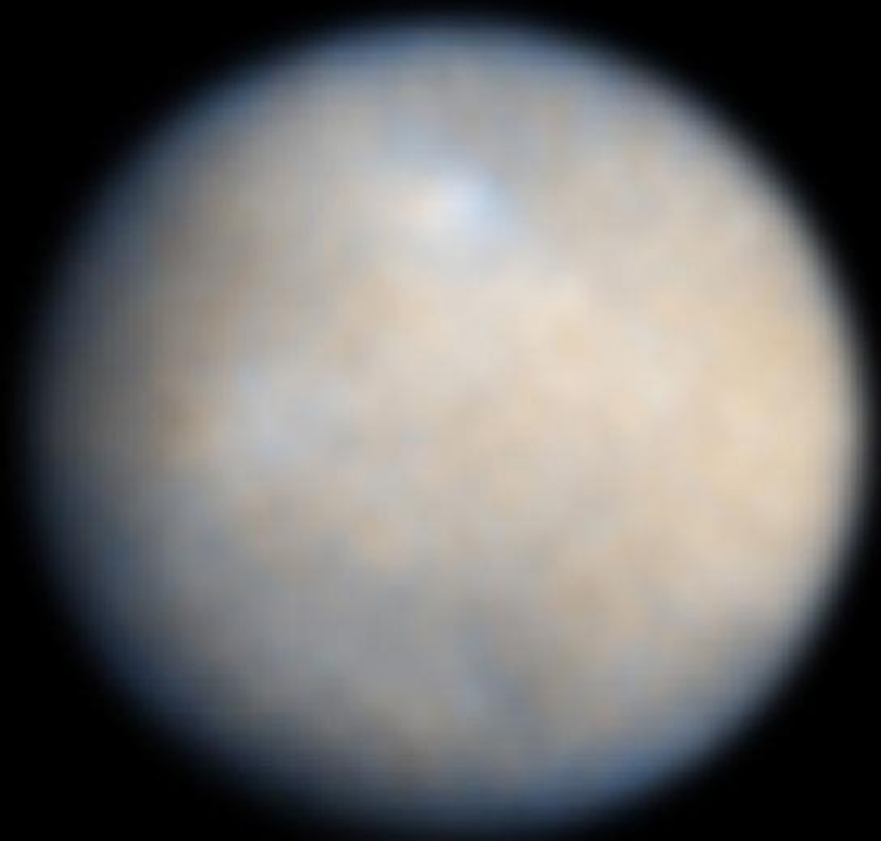
Plutoids

Small Solar System bodies

Comets



# Ceres



# Should Pluto be a planet?

- No
  - Some feel that the backlash is due to sentimentality
  - We've demoted or reclassified planets before
  - We don't know enough yet about Pluto
  - Consistency and applying criteria to others- we'd have dozens of planets
  - Scientific method

# Should Pluto be a planet?

- Yes
  - We don't know enough yet to demote it
  - Pluto may have characteristics that separate it from other dwarf planets
  - A body's location in the solar system should not matter, only the characteristics of the body itself

# New Developments

- Discovery of more moons around Pluto
- New dwarf planet candidates being discovered constantly
- Discovery of other characteristics that straddle definitions
- New Horizons and Dawn in 2015- New Horizons flying by Pluto, and Dawn going into orbit around Ceres



# References

- ["IAU 2006 General Assembly: Resolutions 5 and 6"](#). IAU. August 24, 2006.
- Gorwyn, Adam; [\*Alan Stern: 'A Chihuahua is still a dog, and Pluto is still a planet'\*](#), EarthSky interview, 2010 February 18
- *JPL Solar System Dynamics*. 2014. Web. <http://ssd.jpl.nasa.gov/>.
- Images courtesy of Wikipedia



# Discussion Questions

- What is your position on the issue? Should Pluto be a planet?
- Do you believe other dwarf planets should also be considered planets?
- Some have suggested that large moons, such as Ganymede or Titan, should also be considered planets. Do you agree?