Pluto on Trial

Presented by Brandon, Ashley, & Evan

ASTR 312

Goal

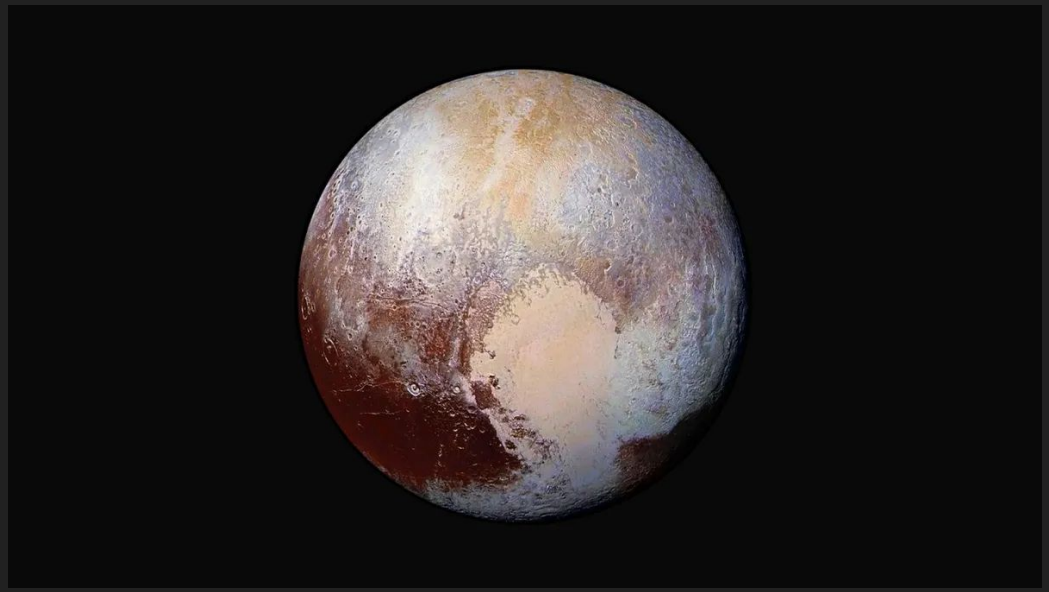


Figure 1: Enhanced colour view of Pluto. Retrieved from https://www.space.com/43-pluto-the-ninth-planet-that-was-a-dwarf.html

- Introduce Pluto, explain its reign as the 9th planet, its demotion, and the public's reaction.
- Throughout the presentation we're going to present opinions and facts discussing whether Pluto's demotion was justified.
- How should we define/classify celestial bodies?
- At the end of the presentation, we'll ask you (the audience) to make a decision based on the information provided.

Pluto: An Icy World

- Discovered February 18th, 1930
- ⅕ the size of Earth with an equatorial diameter of 2,377 kilometers
- 1 day on Pluto is equal to 153 hours or almost 6.5 days on Earth
- 248 year orbit

(NASA, 2025)

Figure 2: Pluto's Heart, NASA. Retrieved from https://science.nasa.gov/dwarf-planets/pluto/facts/

Pluto: An Icy World

- Surface temperature is between -226 and -240 degrees Celsius
- Located 5.9 billion kilometers from the Sun (39x farther than Earth)
- Sunlight takes 5.5 hours to travel from the Sun to reach Pluto
- Was the 9th planet for a total of 76 years, 6 months, and 6 days from February, 1930 to August, 2006

(NASA, 2025)

Figure 2: Pluto's Heart, NASA. Retrieved from https://science.nasa.gov/dwarf-planets/pluto/facts/

Clyde Tombaugh

A **blink comparator machine** was used to discover Pluto in which 50,000 - 400,000 photographs were compared. (Academy of Achievement, 2022)

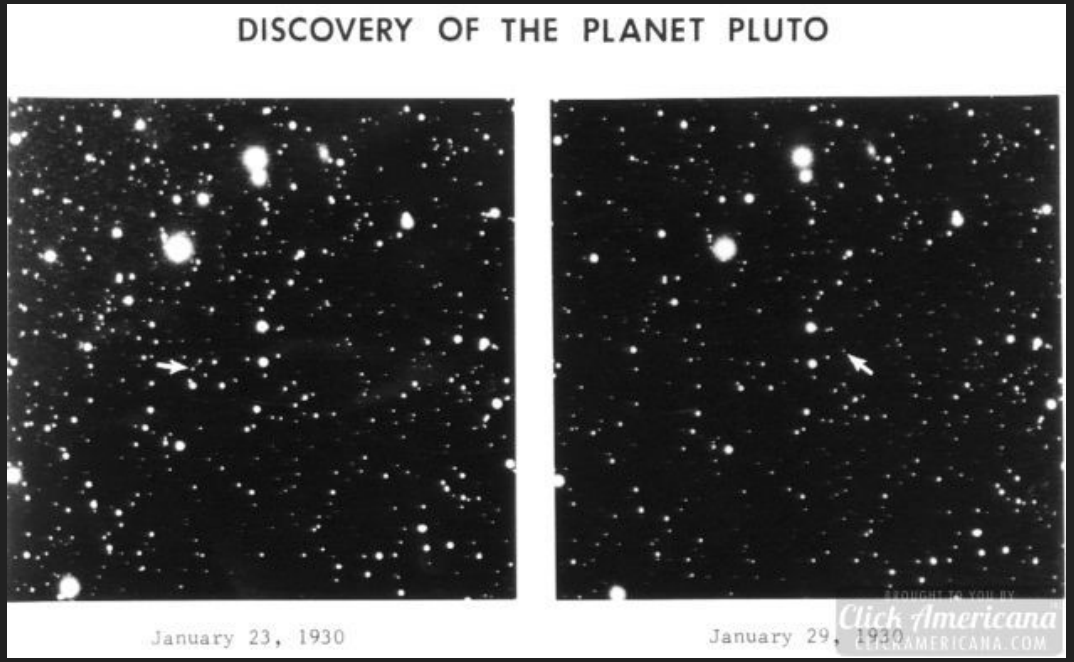


Figure 3: Discovery of Pluto. Retrieved from https://clickamericana.com/topics/science-technology/clyde-tombaugh-discoverer-pluto-1930

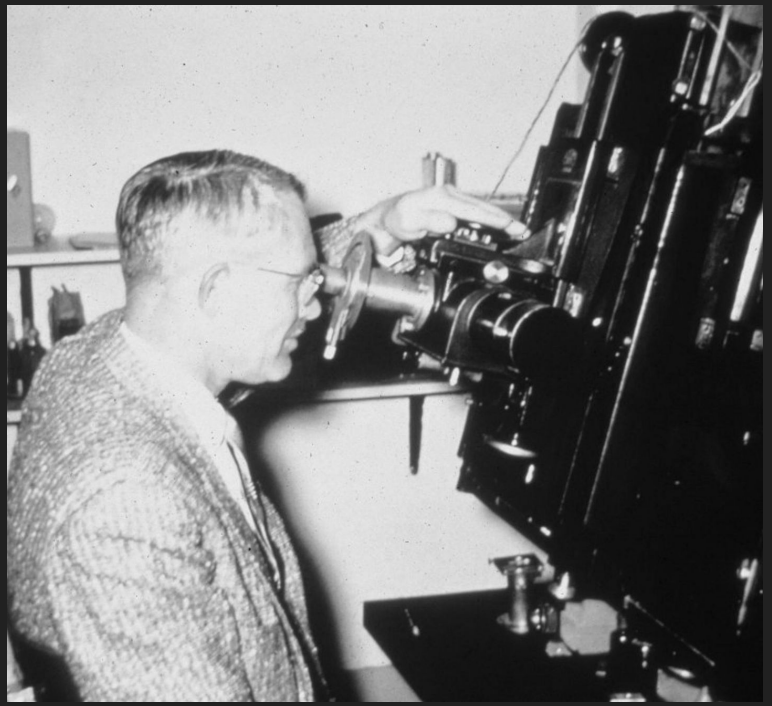


Figure 4: Tombaugh using blink comparator machine. Retrieved from https://lowell.edu/discover/history-of-pluto/

What is a Planet?

In greek, *planētēs* means “wanderer”, which is where the word *planet* comes from (Barnett, 2025).

“Planet” maintained a vague definition until 2006…

Figure 5: Greek astronomer Hipparchus using a telescope which had not yet been invented. Retrieved from https://mathigon.org/step/circles/orbits

What is a Planet?

Current definition: a celestial body that…

1. orbits a star.
2. is big enough that its own gravity forces it into a spherical shape.
   AND
3. is big enough that its gravity has cleared away any other objects of a similar size in its orbit around the Sun.

- **International Astronomical Union (IAU), 2006**

International Astronomical Union (IAU)

- Founded in 1919
- Mission: “promote and safeguard the science of astronomy”
- Comprised of professional and junior astronomers
- Current membership count: 12742 across 92 Countries

Figure 6: IAU Logo. Retrieved from https://www.iau.org/

Michael E. Brown, “The Man Who Killed Pluto”

- Planetary Astronomer at Caltech
- Discovered the dwarf planet Eris along with his team in 2005 in the Kuiper Belt
- Eris being more massive than Pluto but in the same region of space sparked a debate on the definition of a planet
- Very soon (1 year after) led to our current definition

(Everything Explained, 2025)

Figure 7: Mike Brown. Retrieved from https://globalnews.ca/wp-content/uploads/2016/02/mike-brown-pluto.jpg?quality=85&strip=all&w=720

IAU 2006 General Assembly

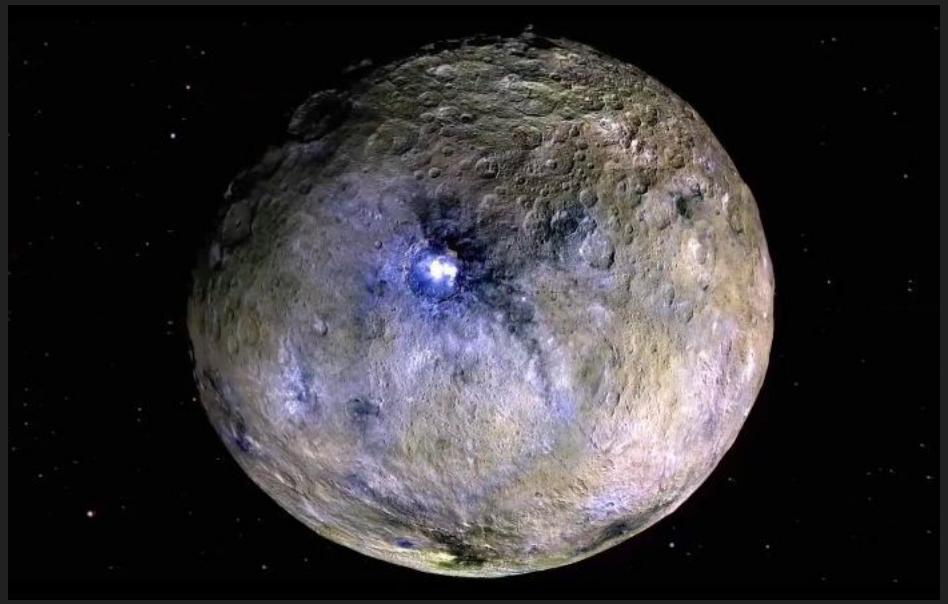
That Fateful Day…

Figure 8: August 24, 2006, IAU Vote. Retrieved from: https://www.sciencenews.org/article/pluto-planet-vote-status-definition-demotion

- IAU held 26th general assembly in August 2006
- **Resolution 5A**: changed the definition of a planet
- **Resolution 5B**: the vote for Pluto's planetary status
- Resolution 5B occurred on final day of event
- Only 424 astronomers voted out of roughly 2,700 who had attended
- 424 votes out of a total of (at the time) 10,000 IAU members world-wide: 5%

Would it have been different if there was more representation?

From *Planet* to *Dwarf Planet*



- The IAU formalized the definition of the word *planet* and introduced the new category of *dwarf planet* in 2006
- Pluto (and other celestial bodies) were **re-categorized**
  1. Orbits the Sun ✓
  2. Is round ✓
  3. Has cleared its orbit of other similar sized objects ✗

Figure 9: Enhanced-colour image of dwarf planet Ceres captured during NASA's Dawn mission in 2015. Retrieved from https://www.nasa.gov/missions/dawn/nasa-ceres-may-have-had-long-standing-energy-to-fuel-habitability/

Public Outcry

Points of Discontent:

- Necessity of rewriting science texts
- Affection towards Pluto a being the “runt” or underdog of the solar system
- Disservice toward Clyde Tombaugh’s work

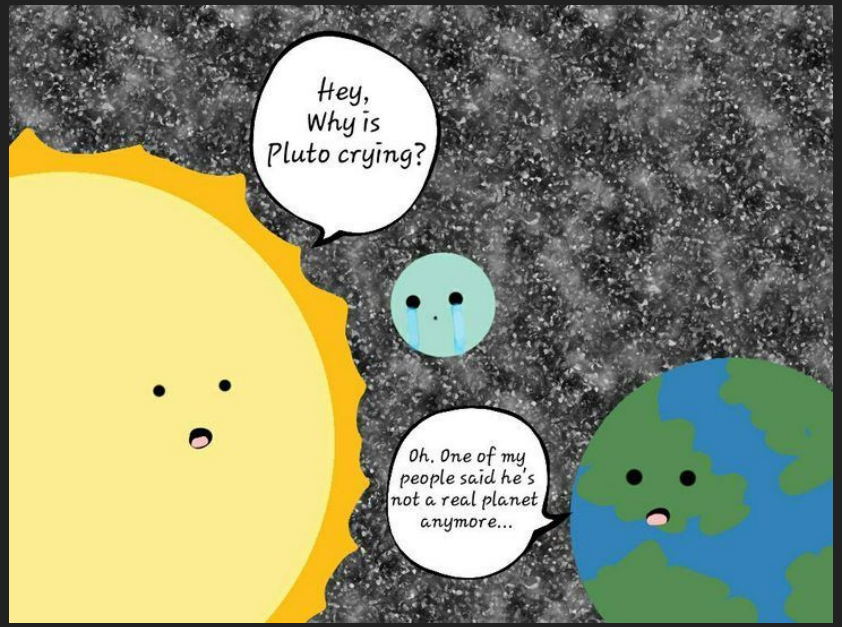


Figure 10:Justice for Pluto. Retrieved from https://imgur.com/gallery/justice-pluto-BCgzlJS

Figure 11: Clyde Tombaugh’s family joins protest. Retrieved from https://www.space.com/2848-clyde-tombaugh-family-joins-protest-pluto-downgrade.html

Pluto’s reclassification sparked strong emotional and public reactions, but understanding why the debate happened requires looking beyond opinions and toward the science. A key part of that science involves Pluto’s position in the solar system, specifically, where it orbits and what surrounds it.

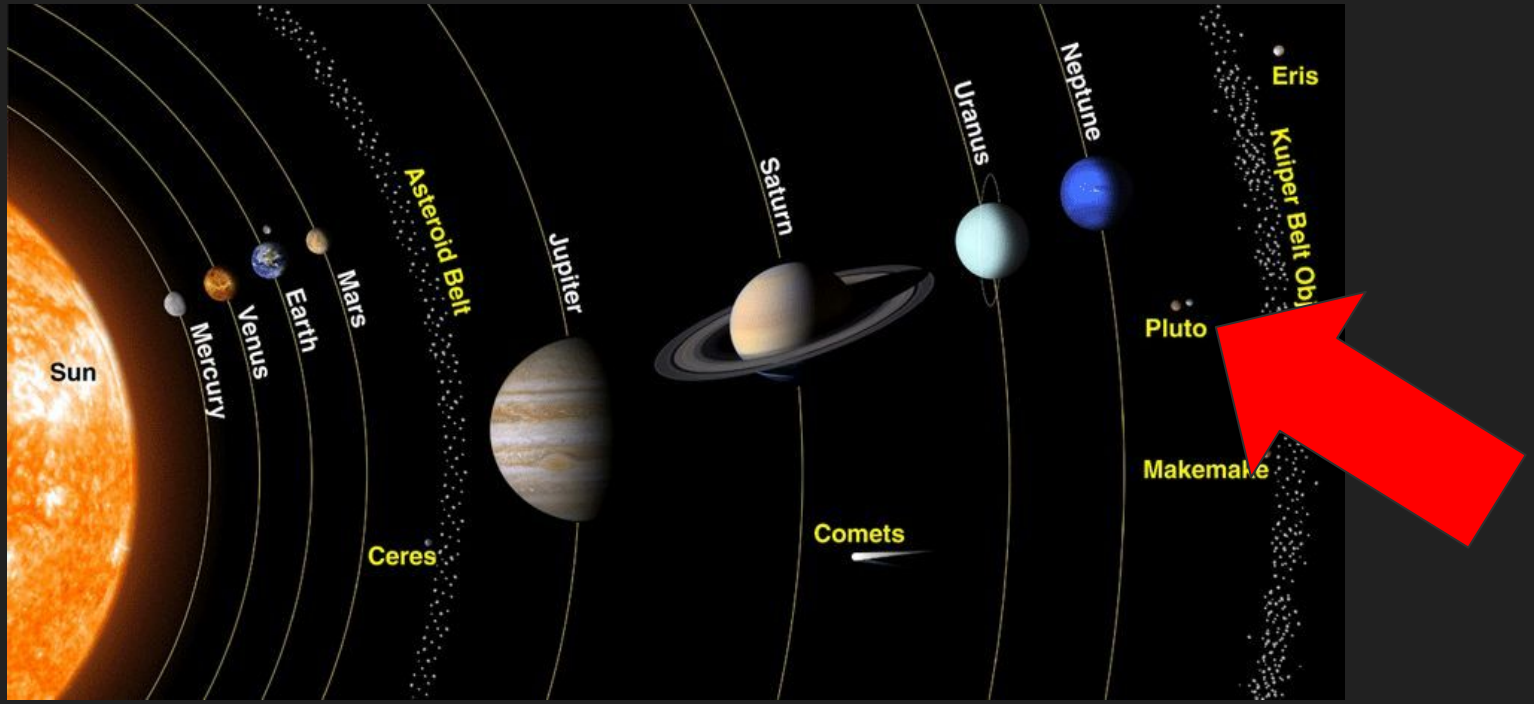
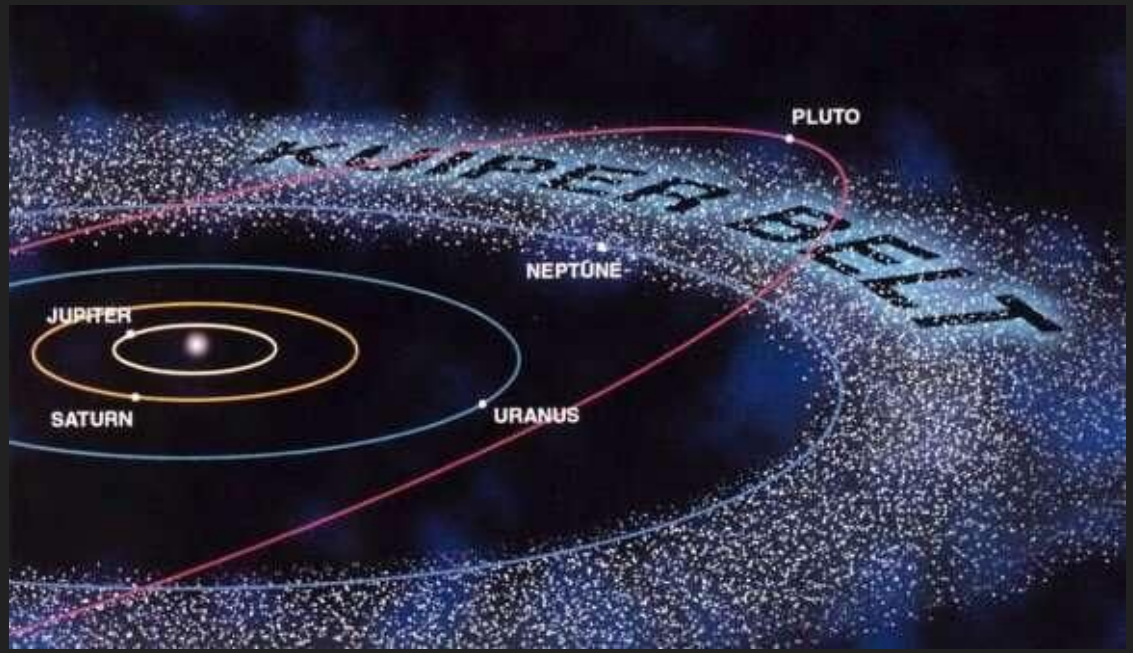


Figure 12: Pluto’s location in our solar system. Retrieved from https://www.forbes.com/sites/startswithabang/2018/05/08/you-wont-like-the-consequences-of-making-pluto-a-planet-again/

Where is Pluto?

- Located in the **trans-Neptunian** region ➡ Area of our solar system beyond the orbit of Neptune (Barnett, 2025)



- Includes the **Kuiper Belt**

Contains **<u>Plutinos:</u>**
Objects similar in size to Pluto with a particular orbit and unique resonance with Neptune. Possibly hundreds exist. (Thirouin & Sheppard, 2018)

Figure 13: Pluto's orbit in our solar system. Retrieved from https://phys.org/news/2022-04-pluto-orbit-surprisingly-unstable.html

Pluto's Orbit

Pluto's orbit is highly *elliptical* and extremely *tilted* (Hashemi, 2025)

- 0 = Perfect Circle
- 0.0167 = Earth
- 0.093 = Mars
- ***0.25 = Pluto***
- 1= Parabola (Not an orbit)

Pluto does not orbit on the same plane as the other planets

Pluto = 17.4 degrees!
Mercury = 2 degrees

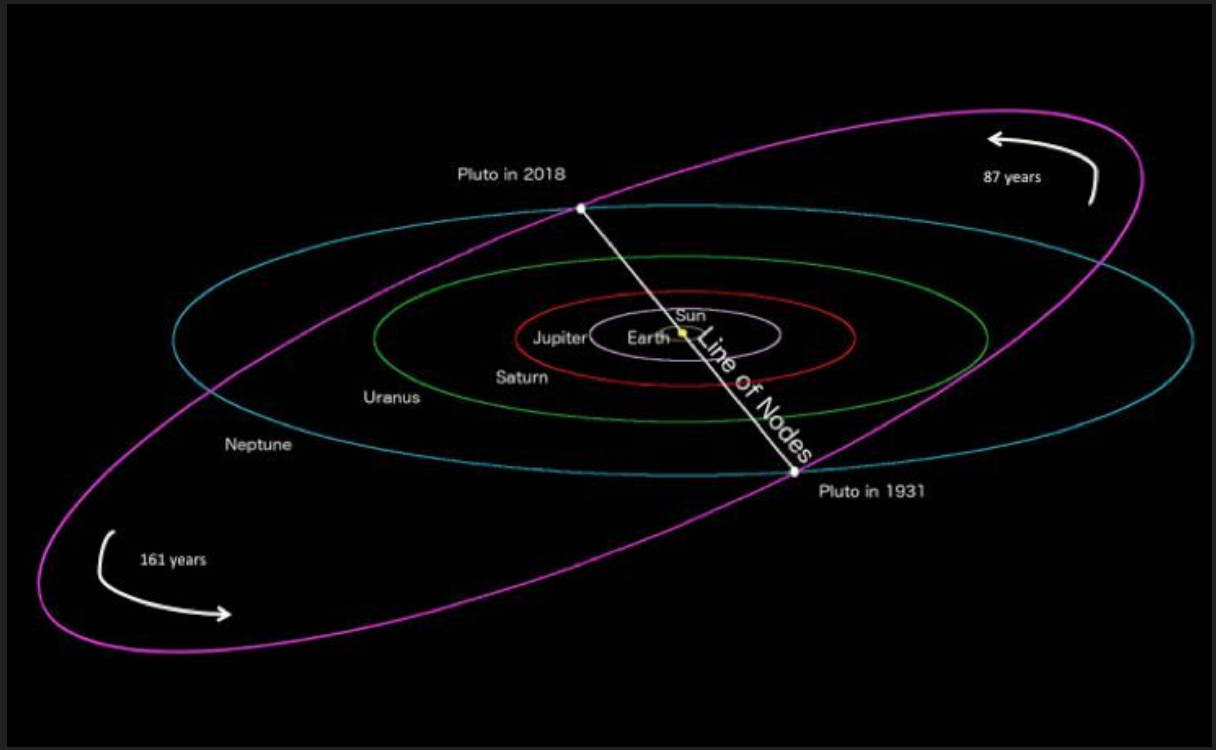
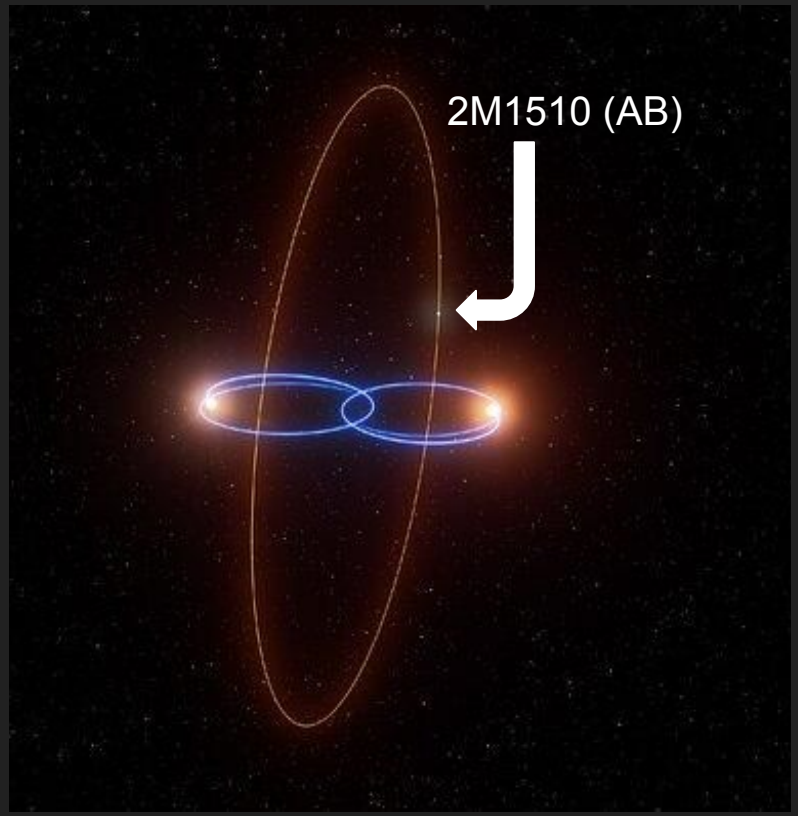


Figure 14: Pluto's orbit in our solar system. Retrieved from https://www.saao.ac.za/2018/09/05/pluto-small-distant-and-fascinating/

Irregular Orbits of Other Planets



An exo**planet** that orbits two brown dwarf stars, with its orbit tilted almost perpendicular to their rotational axes! (Ahart, 2025)

Weird doesn't mean wrong,
an orbit is still an orbit!

IAU definition of "Planet" excludes exoplanets (Margot et al. 2024)

Figure 15: The perpendicular orbit of planet 2M1510 (AB). Retrieved from https://www.eso.org/public/images/eso2508a/

Geoactivity

Mercury is a **planet** that is mostly *geologically dead.* Little to *no geoactivity* (LPI, 2025).

↳ Visible craters = No recent reshaping of surface

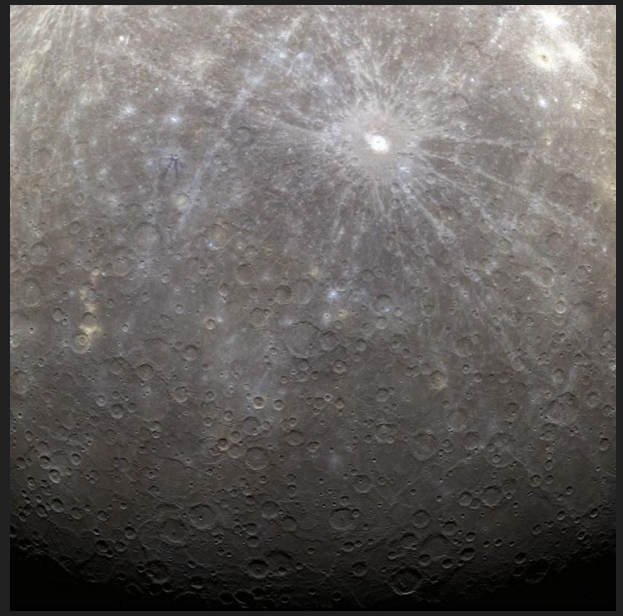


Figure 16: Crater covered Mercury. Retrieved from https://cseligman.com/text/planets/mercury.htm

Pluto on the other hand…

The **Tombaugh** Regio/Pluto's Heart

↳ A cratorless icy plain reshaping due to geologically active surface (Holtz, 2025)

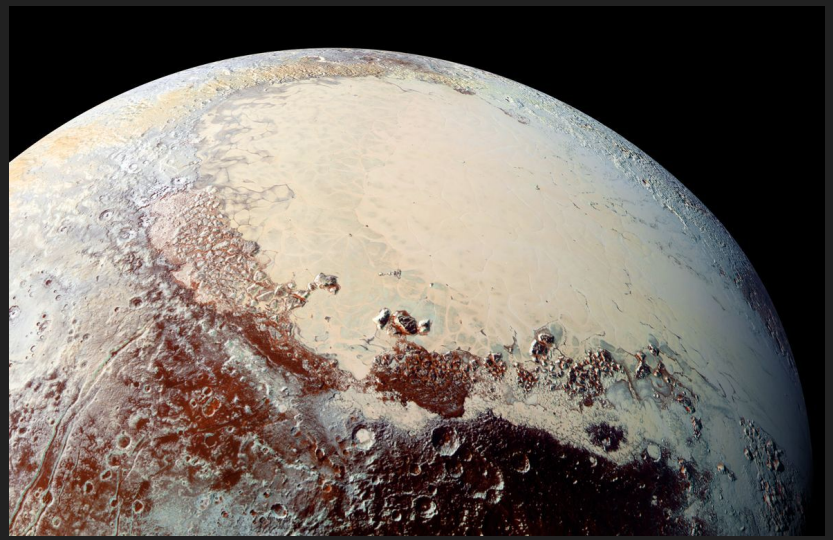


Figure 17: Glacier covered Pluto. Retrieved from https://www.forbes.com/sites/bridaineparnell/2015/10/16/first-new-horizons-study-pluto/

Geoactivity Cont.

Moons can be geoactive too!

Jupiter's moon Io

- Most geologically active object in the solar system with 400 volcanos! (Planetary Society, 2025)

Quick comparison:

	Pluto	Io
Diameter (km)	2377	3640
Gravity (m/s^2)	0.62	1.8

* (Barnett; Planetary Society)

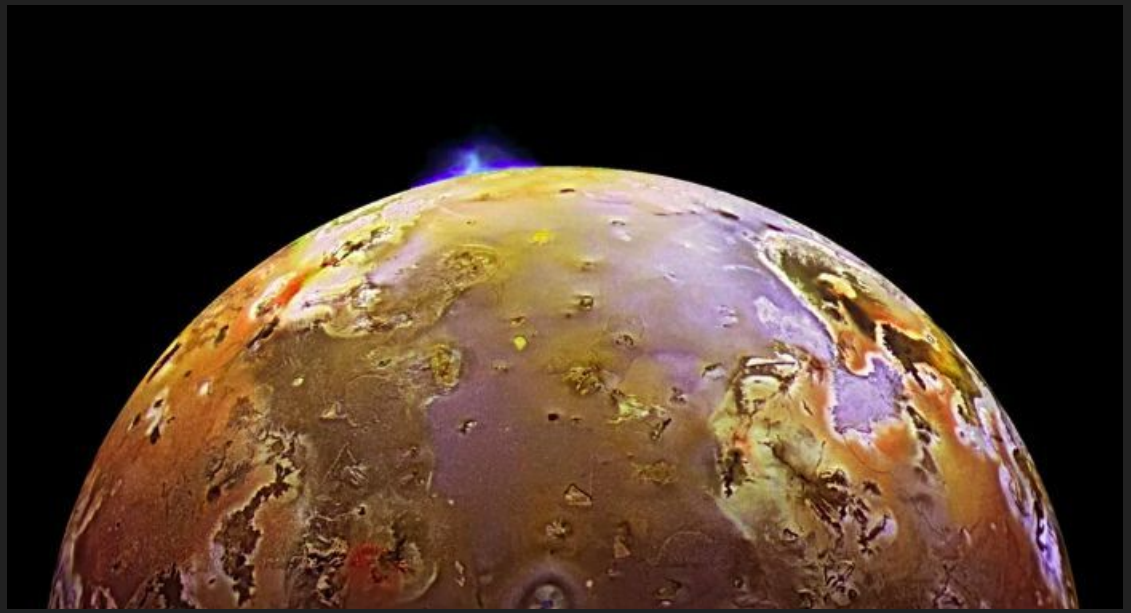


Figure 18: 1997 Galileo spacecraft captures photo of volcanic eruption on Jupiter's moon, Io. Retrieved from https://www.planetary.org/worlds/io

Moons

Pluto has moons! That's a planet thing!

- Pluto has 5 moons!

- If Pluto can sustain a system of moons, how does that not demonstrate gravitational control?

- Earth also has a moon and nearby objects, yet it is still considered dominant in its orbital region…
  so why isn't Pluto?

Figure 19: Pluto's moons to scale. Retrieved from https://science.nasa.gov/dwarf-planets/pluto/moons/facts/

Moons Cont.

- Charon is half the size of Pluto
- Largest moon-to-“planet” ratio in the entire solar system
- Charon and Pluto both orbit a common center of mass
- Pluto is ⅔ the size of Earth’s moon…

- (Barnett, 2025)

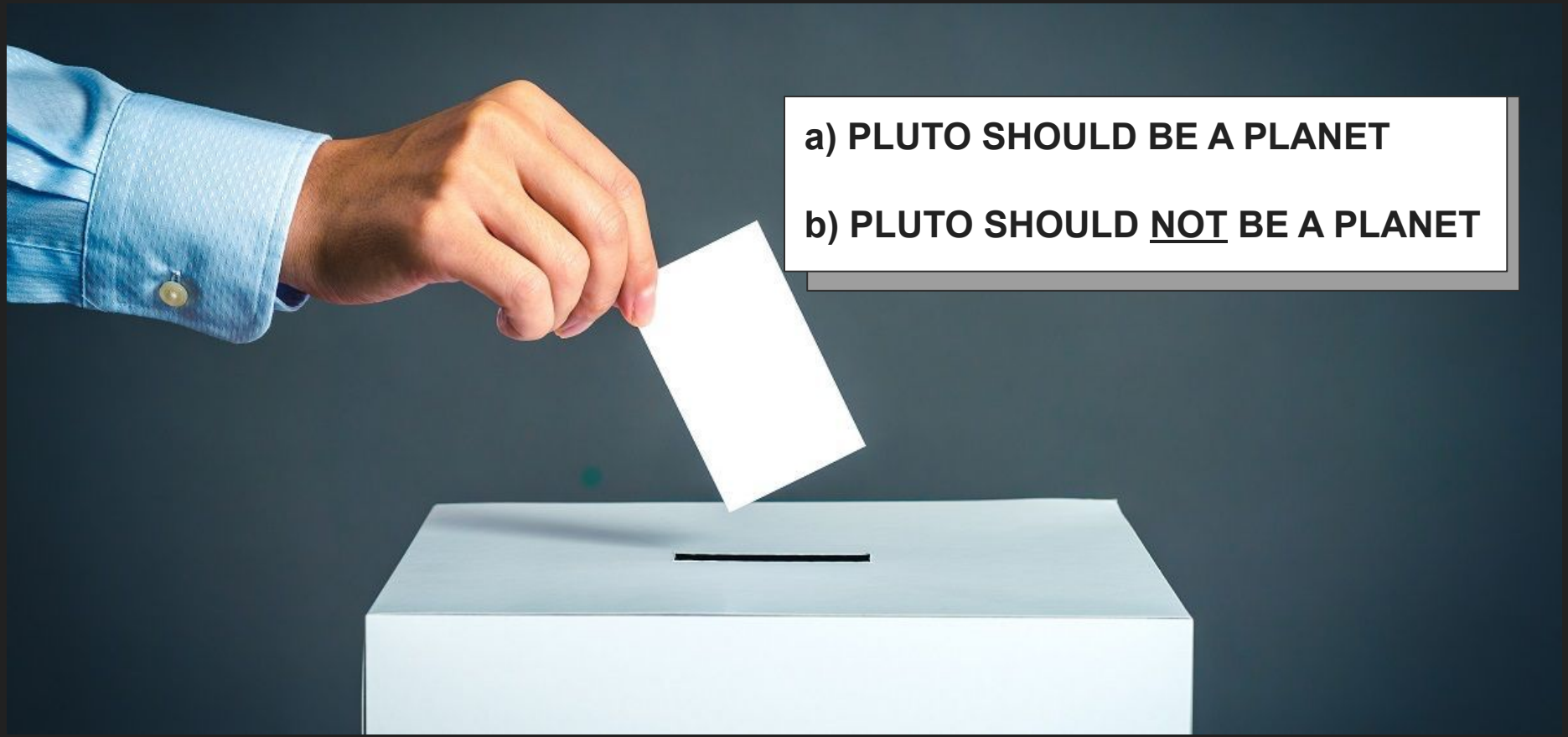
Figure 20: Size comparison of Pluto, Charon, and Earth. Retrieved from: https://sciencephotogallery.com/featured/1-pluto-and-charon-compared-to-earth-mark-garlick.html

Pluto should be considered a planet

- Tombaugh's career investment
- Met the criteria of a planet for over 76 years until the IAU changed the criteria and then immediately voted to demote Pluto
- Shares key planetary traits such as geoactivity and a system of moons (orbit clearing is more of a spectrum)
- Decision to demote was not wholly representative of IAU (only 5%)

Pluto should NOT be considered a planet

- The discovery of similar objects prompted the need for a dwarf planet category to better represent the diversity in our solar system
- Other larger icy objects have been found in its zone
- Does not dominate its region gravitationally
- Dwarf planet categorization aligns with the most recent scientific criteria based on formation, structure, and orbital behaviour


a) PLUTO SHOULD BE A PLANET
b) PLUTO SHOULD NOT BE A PLANET