

Moon Obs #1 Due!

- ◆ Moon visible: early morning through afternoon
- ◆ 6 more due June 13th
- ◆ 15 total due June 25th
- ◆ Final Report Due June 28th

Our Solar System

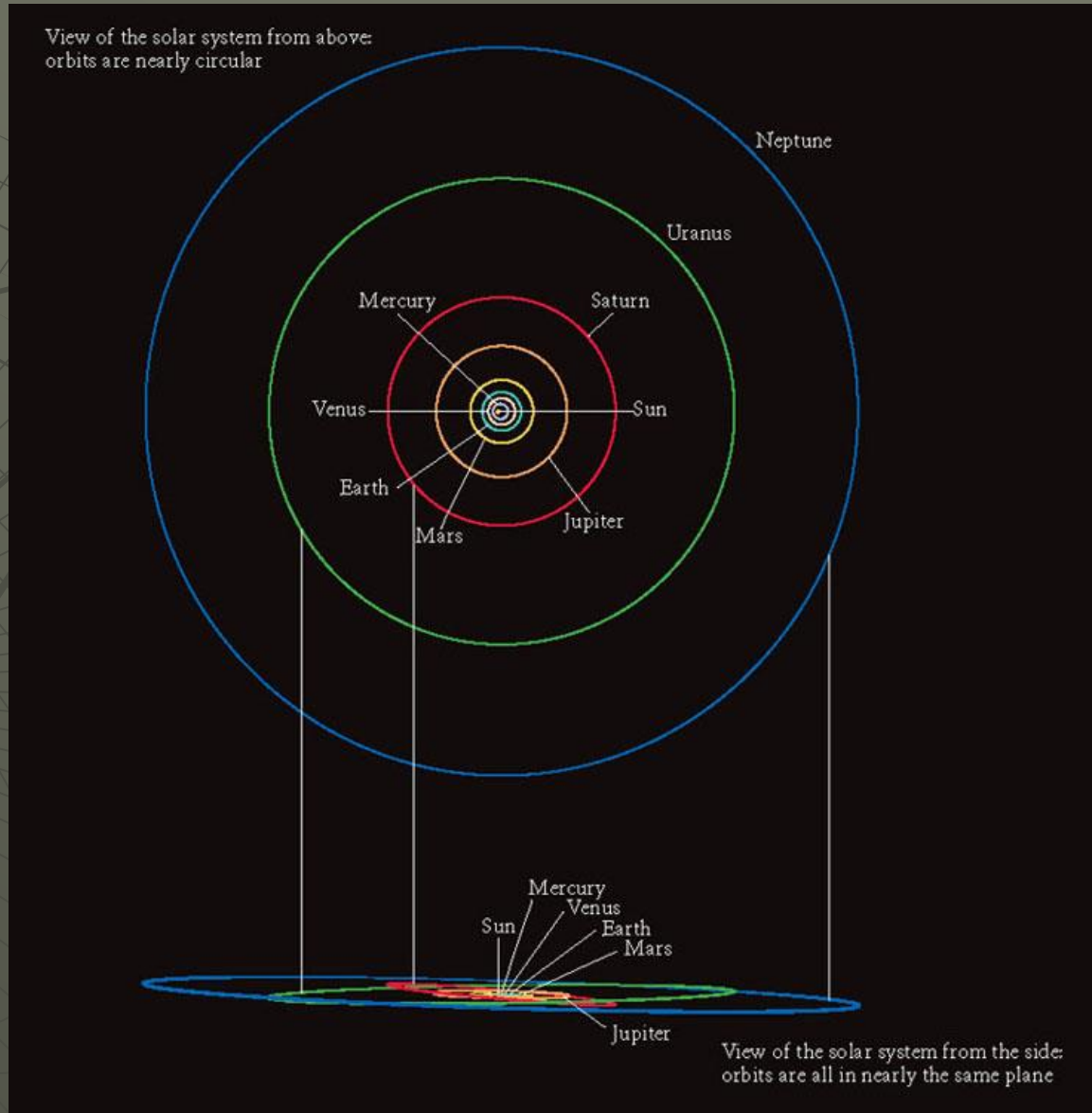
- ◆ Objectives
 - Overview of what is in our solar system
 - How was the solar system formed

Planets

- Each planet has unique characteristics
- But there are similarities- Mars, Venus, and Earth have volcanoes; Jupiter, Saturn, Neptune & Uranus have rings, etc.
- Planets are divided into **two broad categories**:
 - **Terrestrial** (*inner, rocky, Earthlike*) planets: Mercury, Venus, Earth, Mars
 - **Jovian** (*outer, Gas Giant*) planets: Jupiter, Saturn, Uranus, Neptune

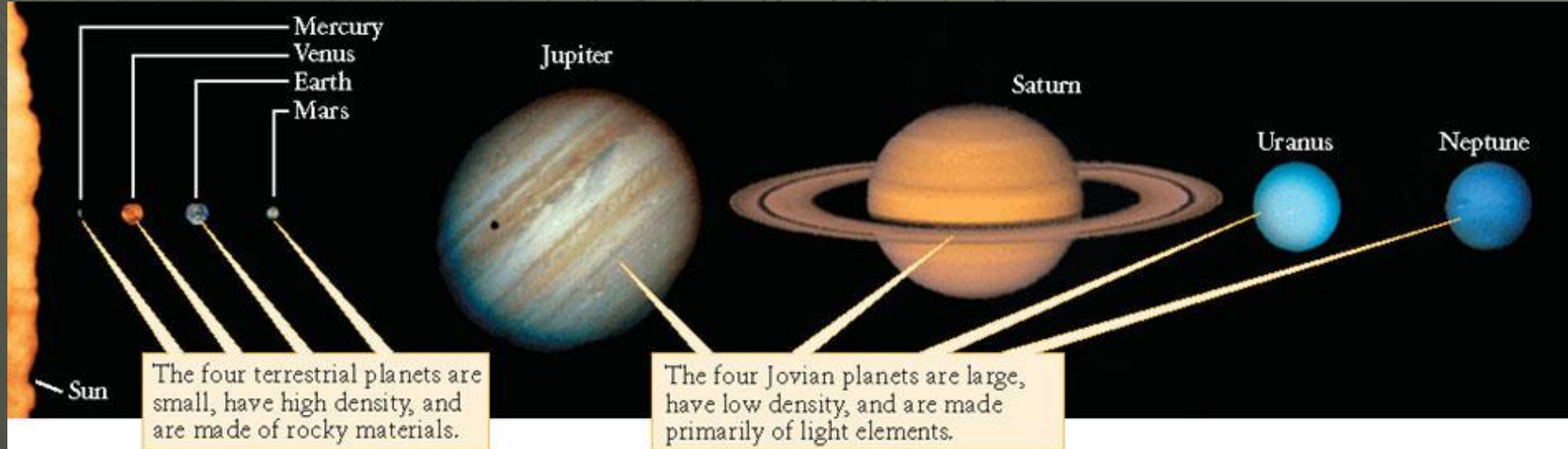
Planets-Orbits

- All orbits have low eccentricity
- All roughly in the same plane
- All orbit in the same direction (CCW seen from above).
- Why is that???



Planets-Physical Properties

- Terrestrial planets have hard, rocky surfaces you could stand on
- Jovian planets are made of mostly liquid and gas. What we see aren't hard surfaces, but cloud formations in their atmospheres
- Jovian planets are much larger than the terrestrials!

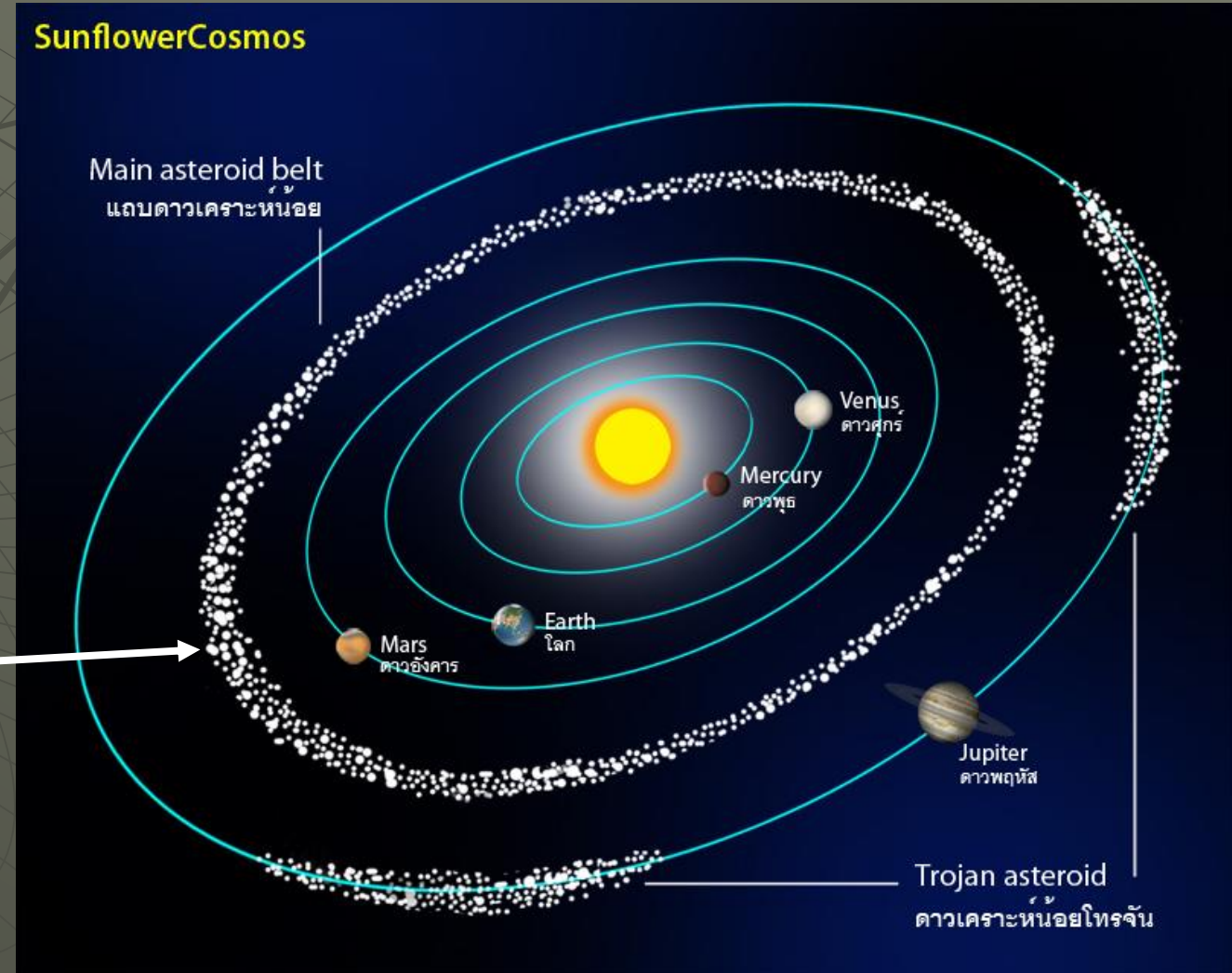
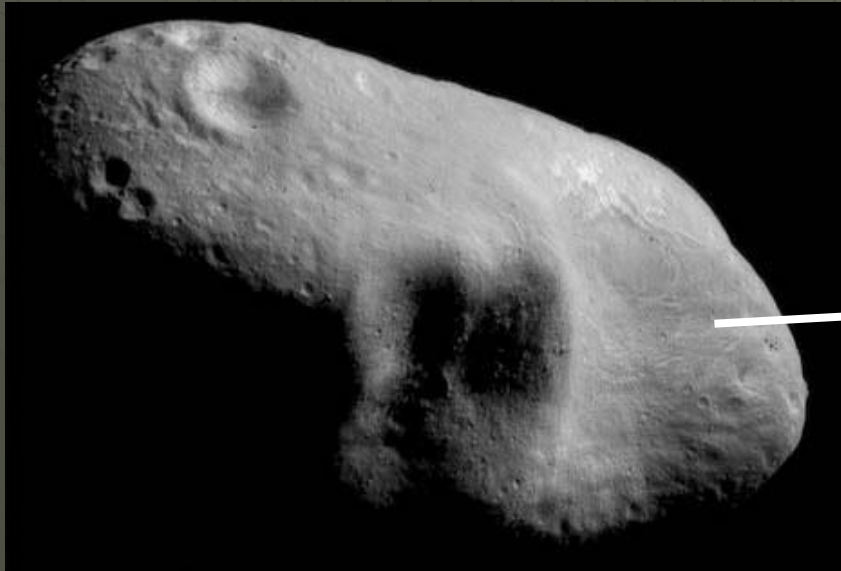


Other Satellites (Moons)

- All the other planets, except Mercury and Venus, have satellites (moons)
- More than 140 satellites in our Solar System!
- Earth has 1, Mars has 2, Jupiter has ~62, Saturn has ~43, Uranus has ~24, and Neptune has ~13
- **All are very different from each other-** not just copies of our own Moon. But they do **all have solid surfaces** (like terrestrial planets)

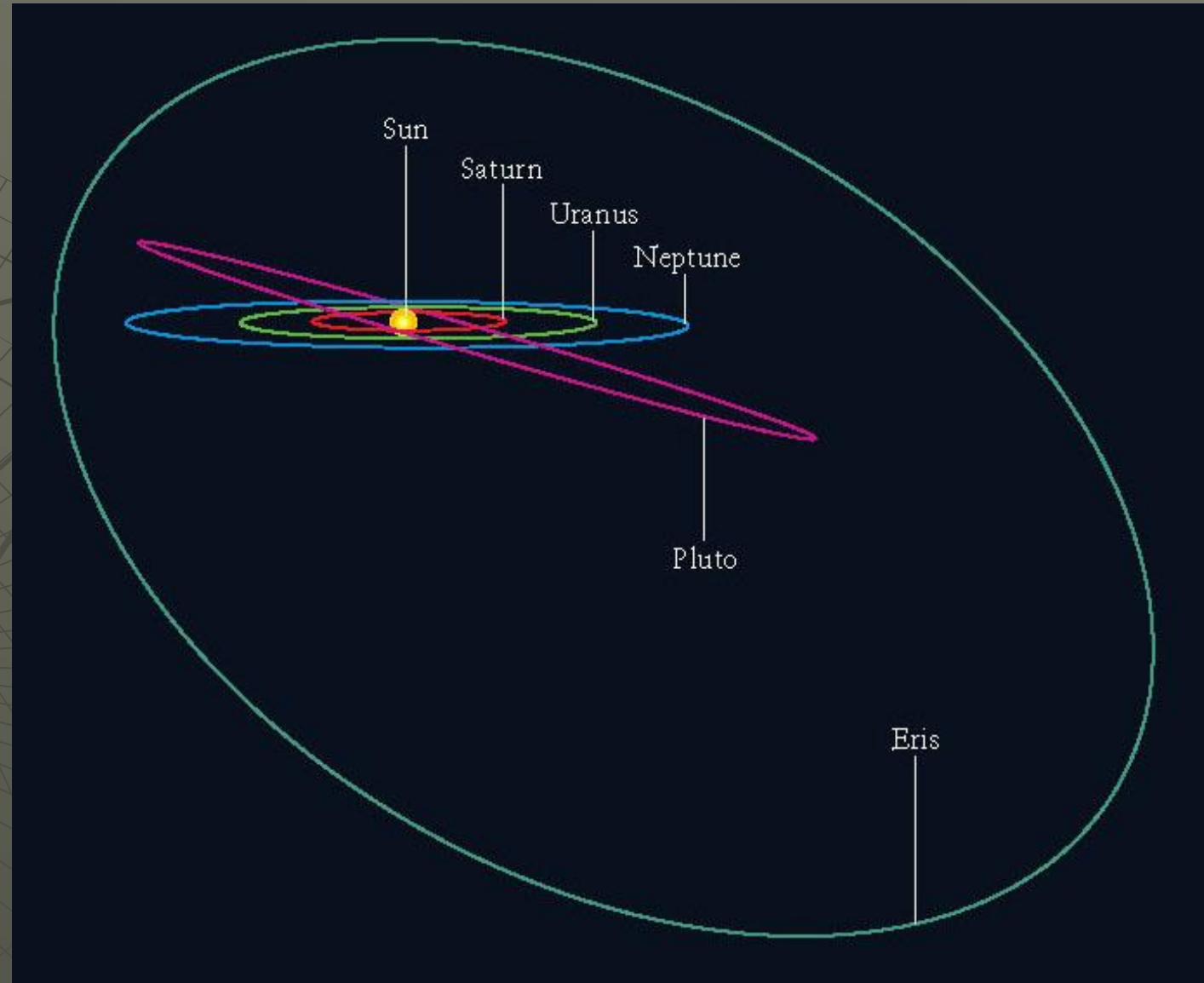
Other Objects: Asteroids

- *Asteroids (minor planets)* are found interior to Jupiter's orbit
- Small rocky objects (largest 900 km)
 - N~100,000's Big Ones
 - Many more small ones
- Most in the Asteroid Belt
- Trojan Asteroids could be Broken up moons!



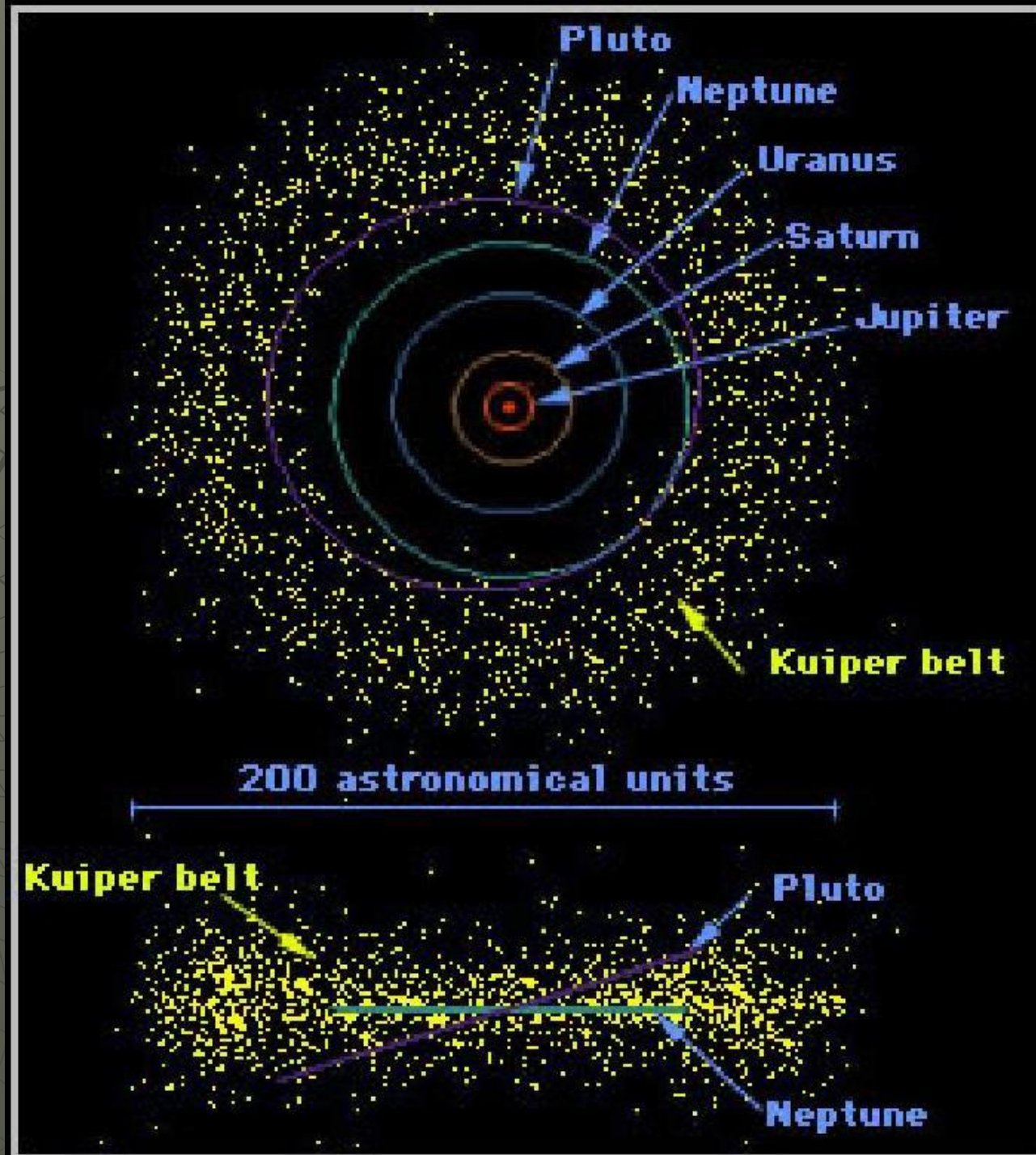
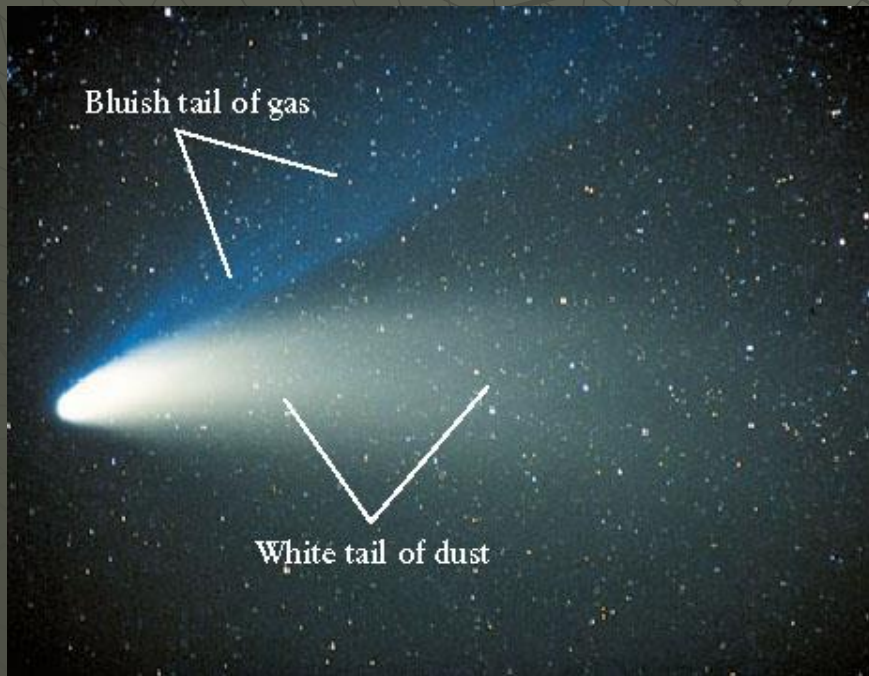
Other Objects: Trans-Neptunian

- *Trans-Neptunian Objects* are found outside the orbit of Neptune
- Pluto is now considered one of these objects
- Pluto's small size and strange orbit resulted in its recent demotion from "planet"
- Objects in the Kuiper belt and Oort cloud are trans-Neptunian objects



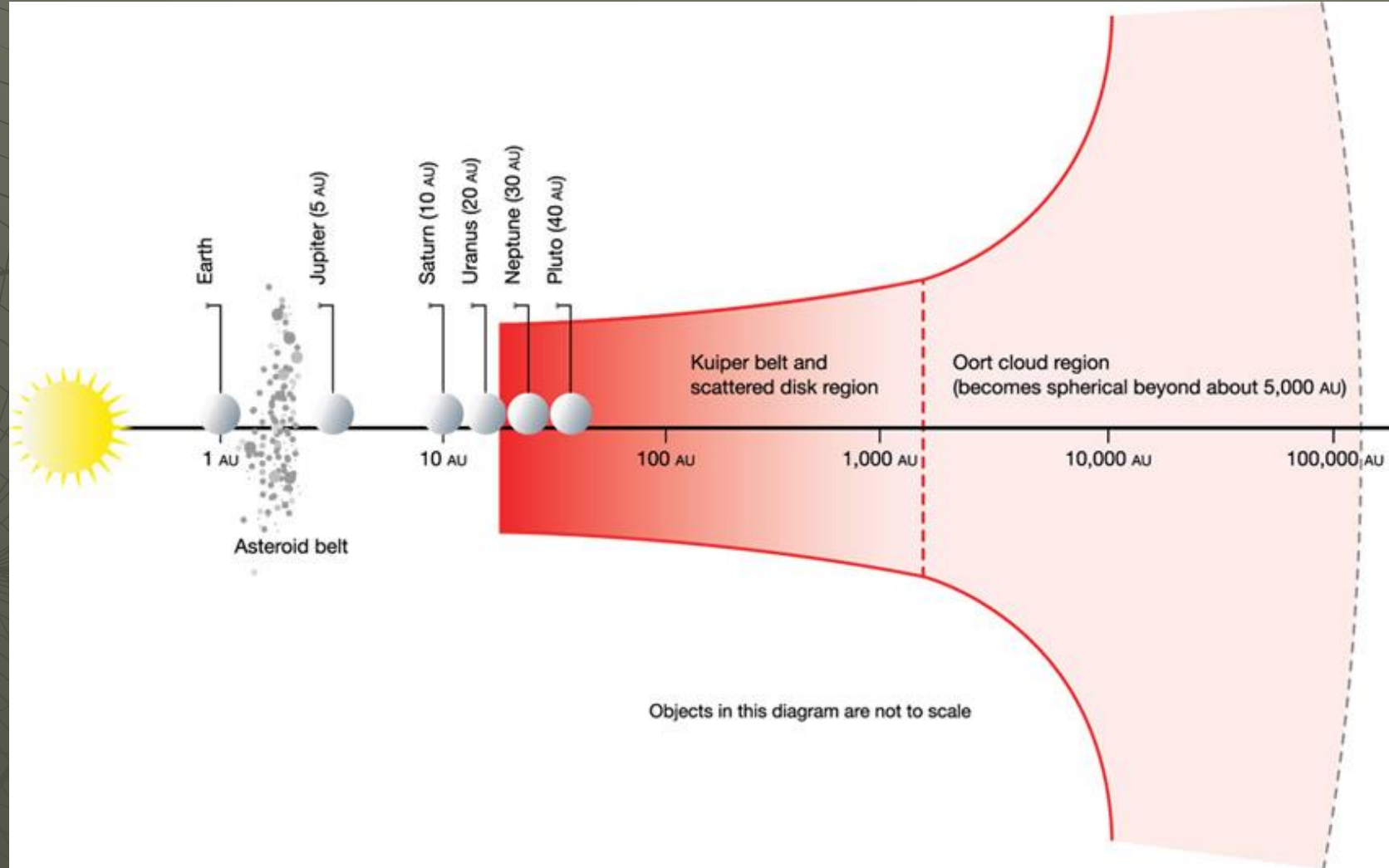
Kuiper Belt

Comets are formed when Kuiper Belt objects "bump" each other (gravitationally or physically)



Oort Cloud

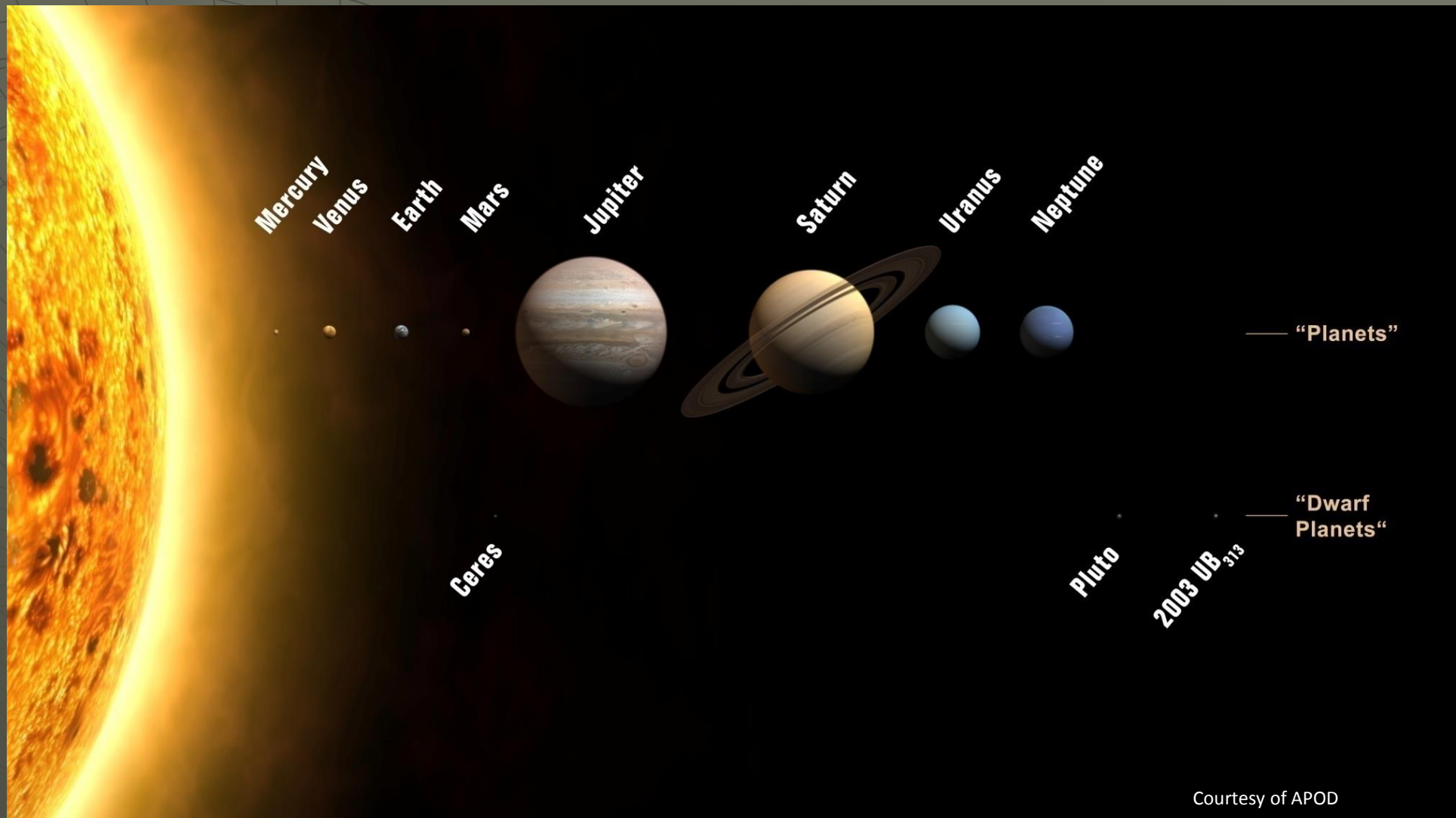
- Defines the outer boundary of our solar system and the gravitational dominance of the Sun!
- These objects are the left over material from the formation of the solar system



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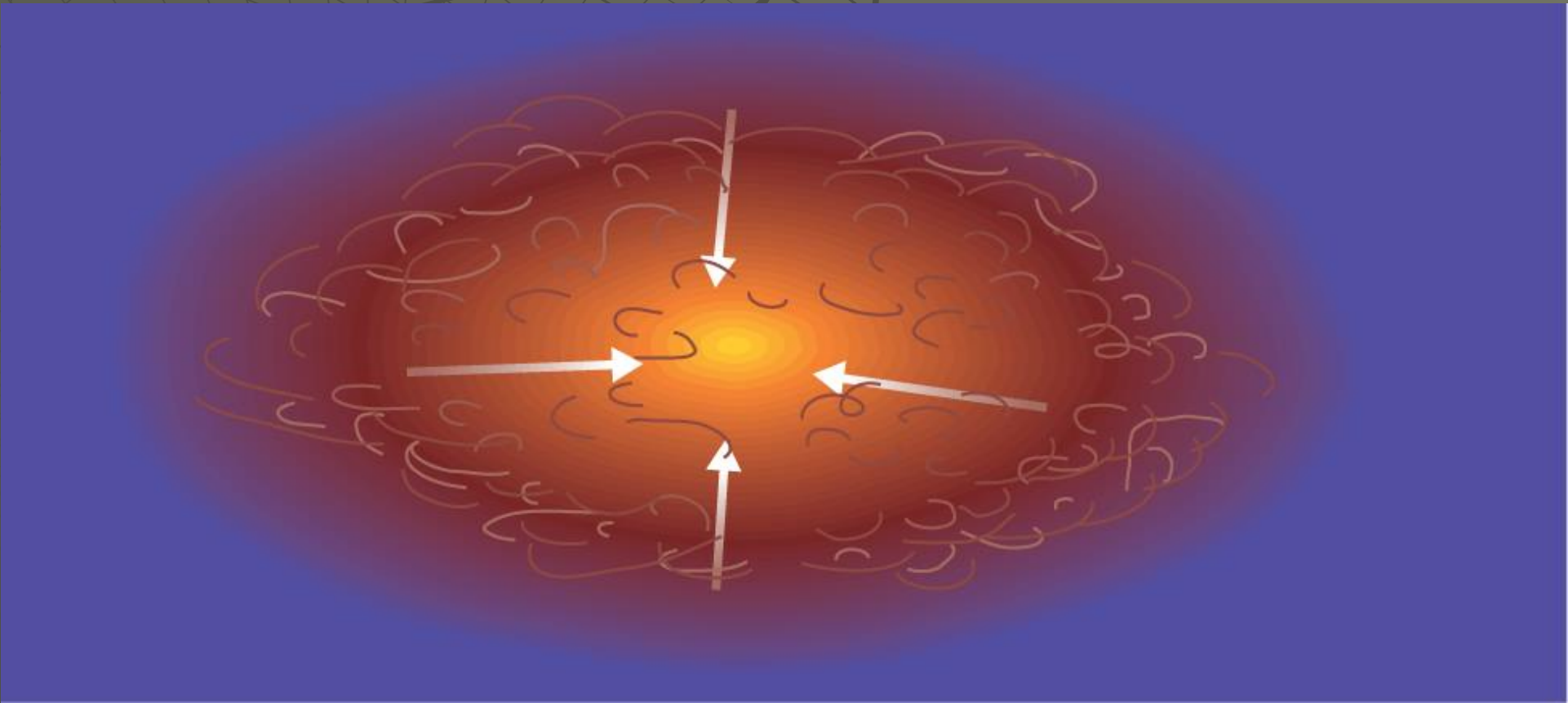
- ◆ The solar system is a large, mostly empty space
- ◆ This tutorial will give you an idea of the size of things
- ◆ Sun Size
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How did the Planets get to be this way?



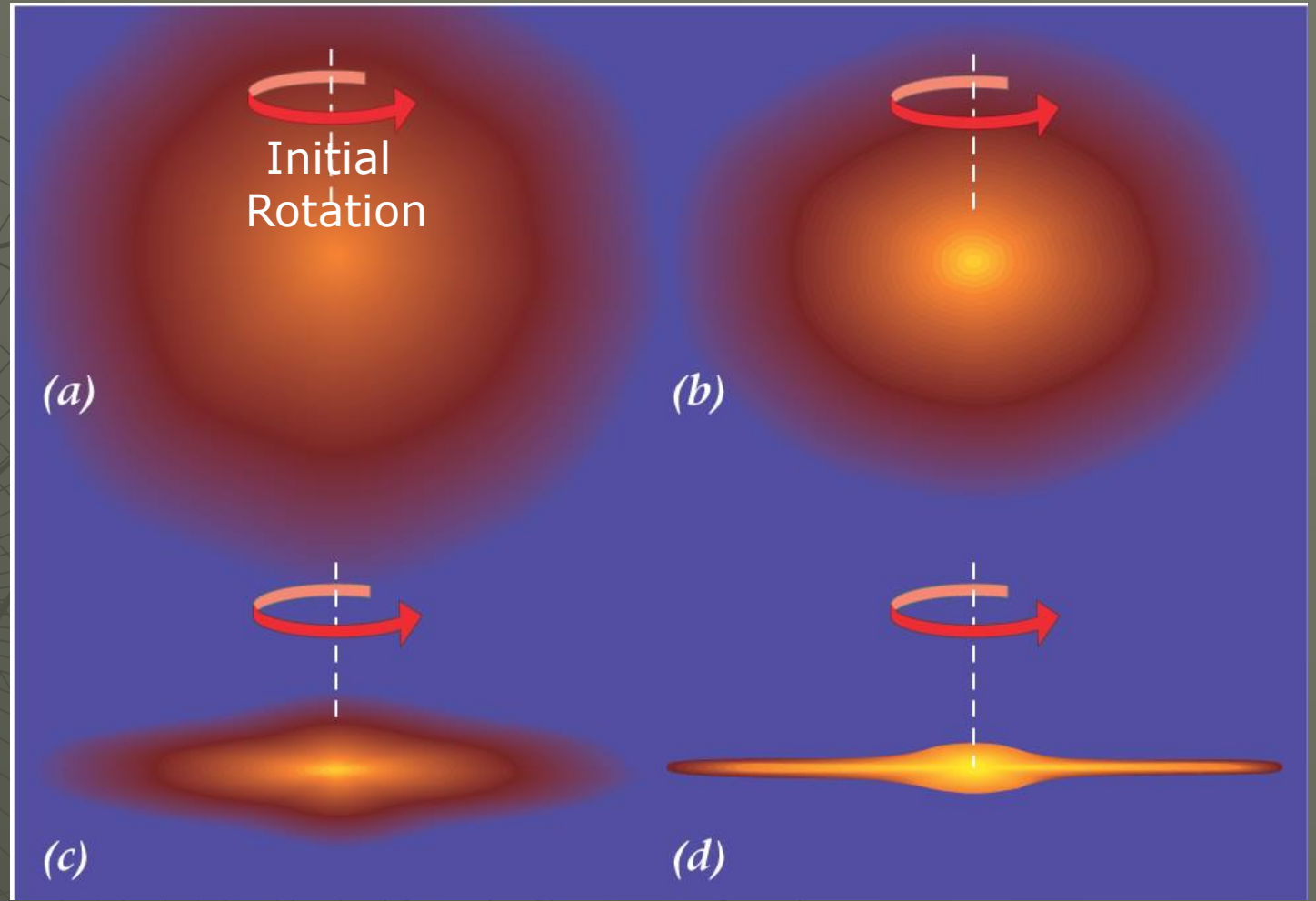
The Nebular Hypothesis

- ◆ A rotating cloud of gas and dust undergoes gravitational collapse and flattens.
 - Cloud composed of $\sim 74\%$ Hydrogen and $\sim 24\%$ Helium
 - ◆ A few trace elements (C,N,O,Be,etc)

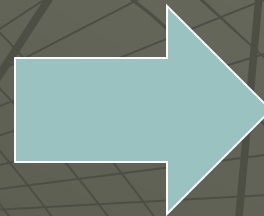


Flattening of Rotating Cloud

- ◆ Spherically collapsing due to gravity.
- ◆ The Cloud has an initial rotation
- ◆ Angular momentum (L): $L = mvr$
- ◆ Conservation:
- ◆ $L_1 = L_2$
- ◆ $m_1 v_1 r_1 = m_2 v_2 r_2$
- ◆ If r decreases \rightarrow v increases



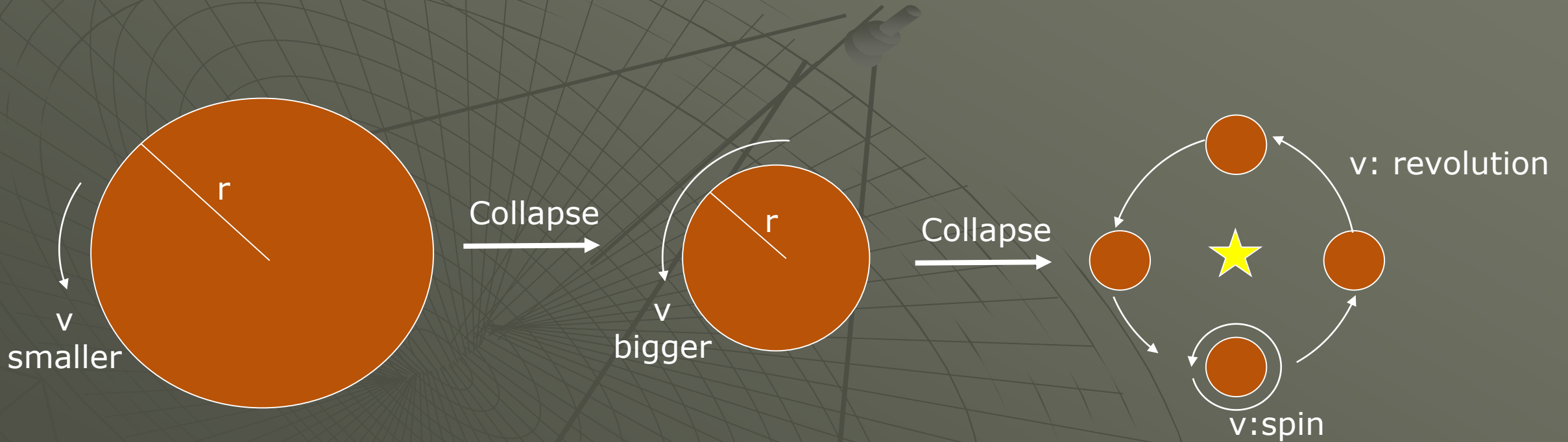
Things that spin tend to flatten out in shape



Demo

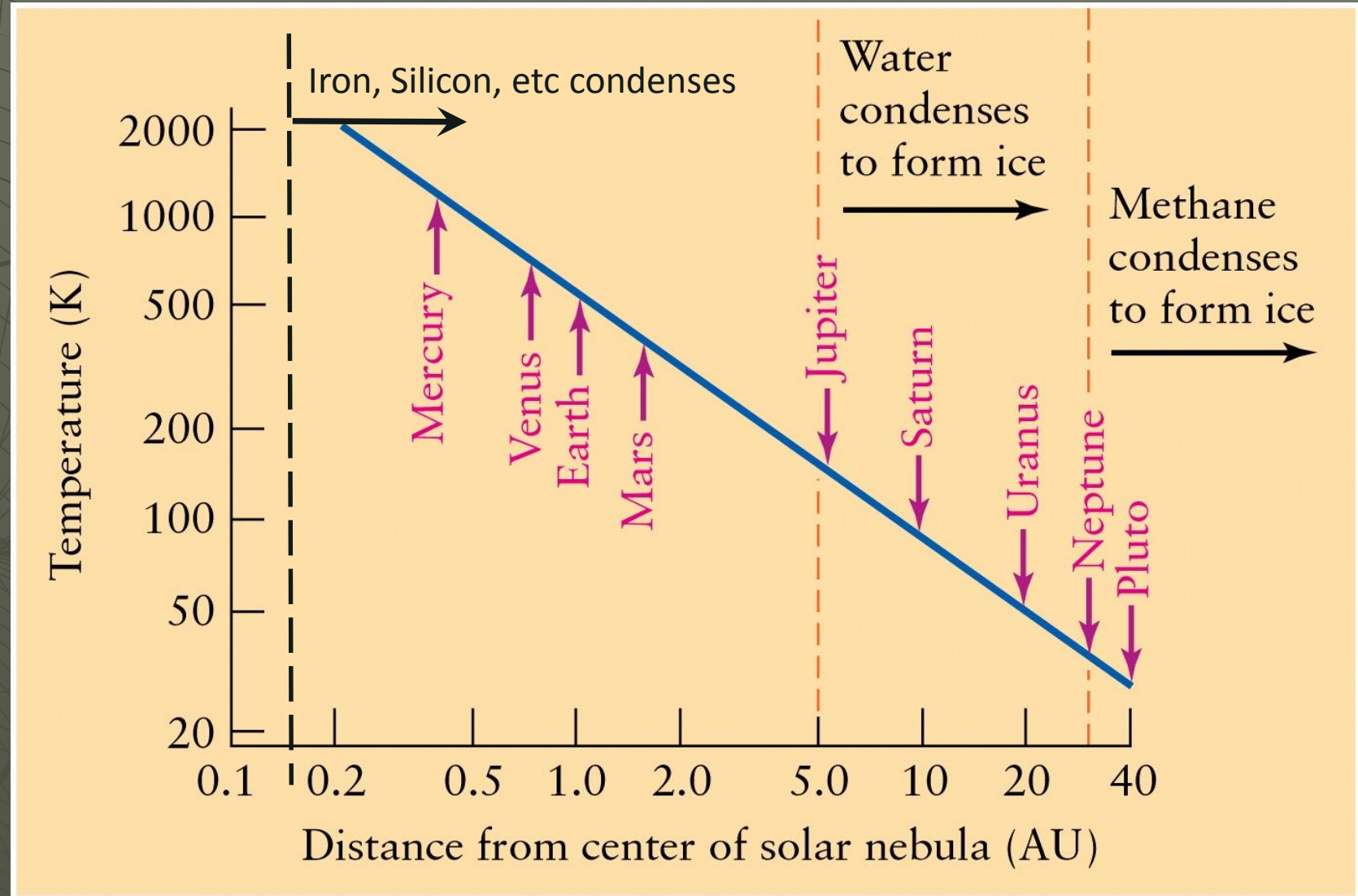


Why Does Everything Rotate and Spin in the Same Direction?

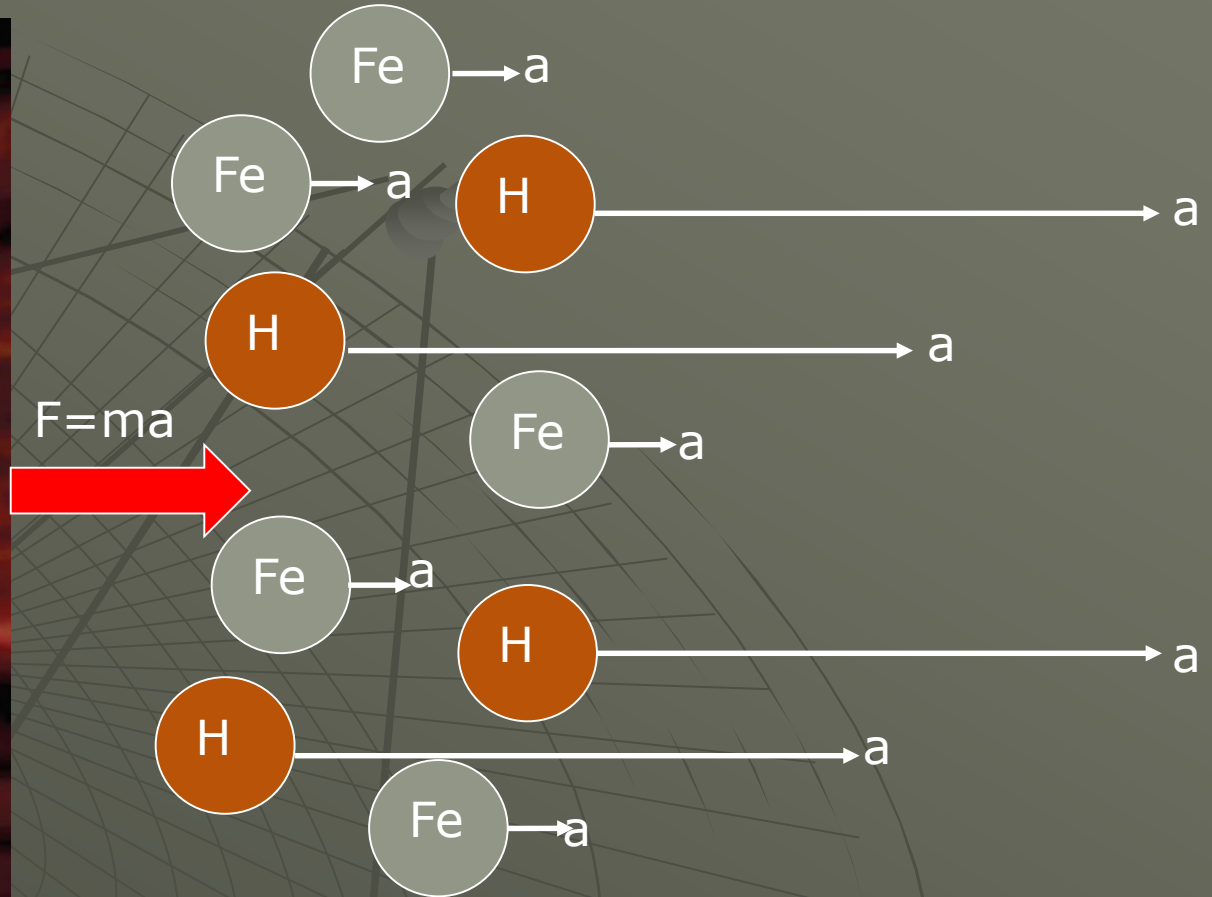
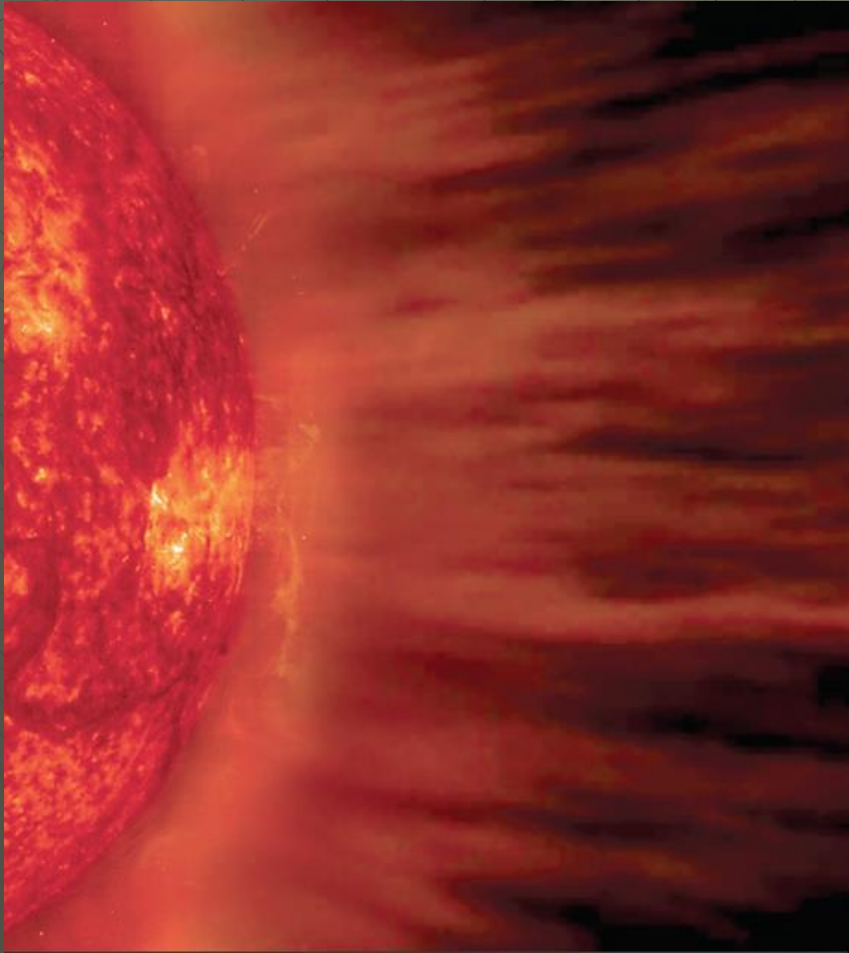


The planets formed by the accretion of *planetesimals* and the accumulation of gases in the solar nebula

- **Kelvin Temperature scale:**
 - $T(k) = T(C) + 273.15$
 - Defined absolute zero is 0°
- **Absolute zero:** temperature at which all atomic motion stops!
- **Celsius:**
 - Defined as freezing and boiling of water is 0° and 100°
- **Fahrenheit:** based off the freezing and boiling point of salt water???

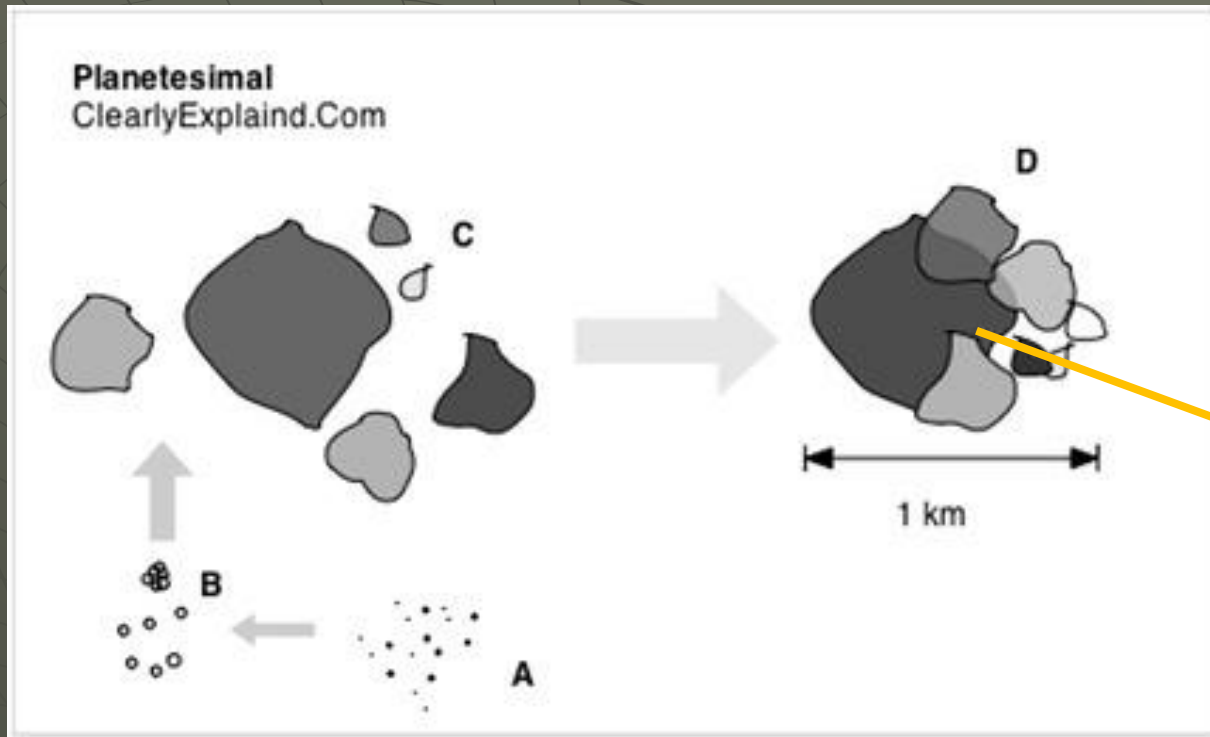


Solar Wind

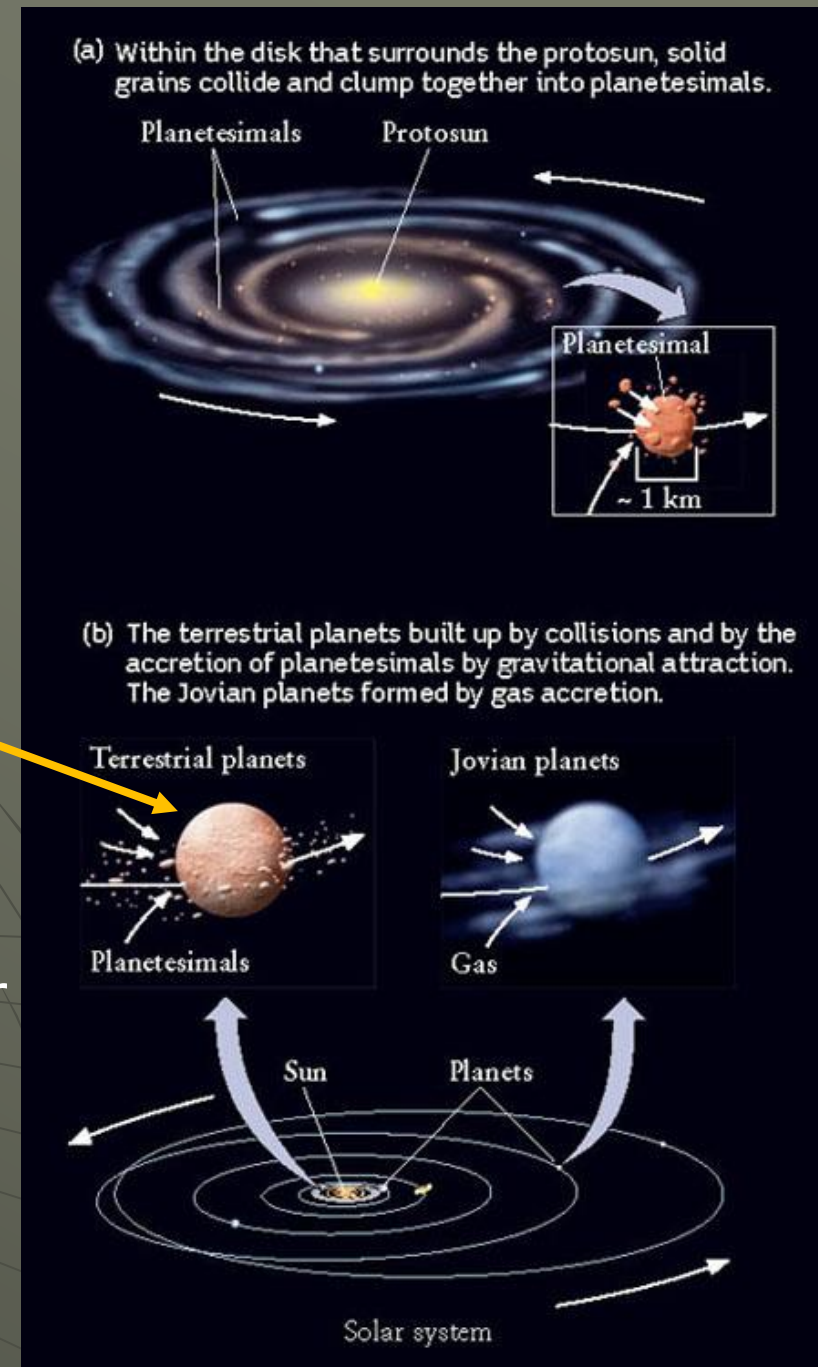


H=Hydrogen

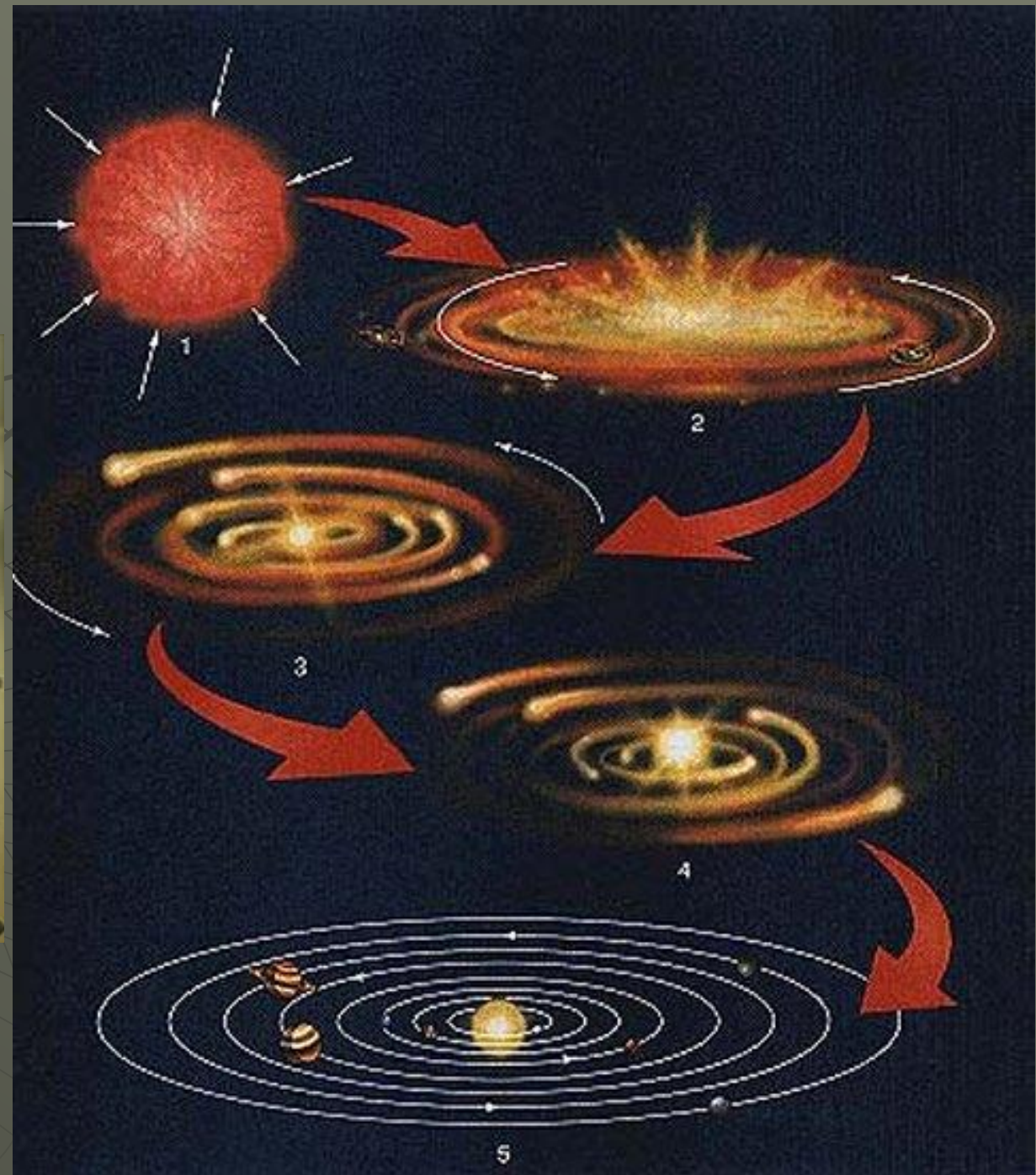
Accumulation



- Two particles are gravitationally attracted to each other
- Stick together
- Then two more, and so on...



Planetesimals Sweep Up!



So what's in the solar system?

- ◆ Defined by the sun, and anything orbiting around it:
 1. Planets (8, no Pluto for you!)
 2. Planetary moons
 3. Asteroids
 4. Comets (trans-Neptunian objects)
 5. Other debris (dust, gas, charged particles, etc.)

- ◆ Which of the following correctly lists the various regions of our solar system in increasing distance from the Sun?
 - A. Terrestrial planets, Jovian planets, asteroid belt, Oort cloud, Kuiper belt
 - B. Terrestrial planets, asteroid belt, Jovian planets, Kuiper belt, Oort cloud
 - C. Terrestrial planets, Kuiper belt, Jovian planets, asteroid belt, Oort cloud
 - D. Terrestrial planets, Jovian planets, asteroid belt, Kuiper belt, Oort cloud

- ◆ Which of the following facts CANNOT be explained by the theory that the planets formed out of a rotating flattened disk that formed from the solar nebula?
 - A. All of the planets orbit the Sun in the same direction.
 - B. The orbits of all of the planets lie near the ecliptic plane.
 - C. The outer planets have compositions similar to the Sun.
 - D. Most of the moons in our solar system belong to the Jovian planets.

- ◆ Rocky planets formed closer to the Sun because
 - A. Elements like Carbon and Silicon have low condensation temperatures
 - B. Elements like Carbon and Silicon have high condensation temperatures
 - C. H and He can't accumulate because they don't have mass
 - D. Rocky and gaseous materials don't get along

- ◆ For a planet-star system, the center of mass of the two is located
 - A. closer to the planet.
 - B. closer to the star.
 - C. directly in between the two.
 - D. at the center of the star.

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- ◆ Temp and Formation of The Solar System
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