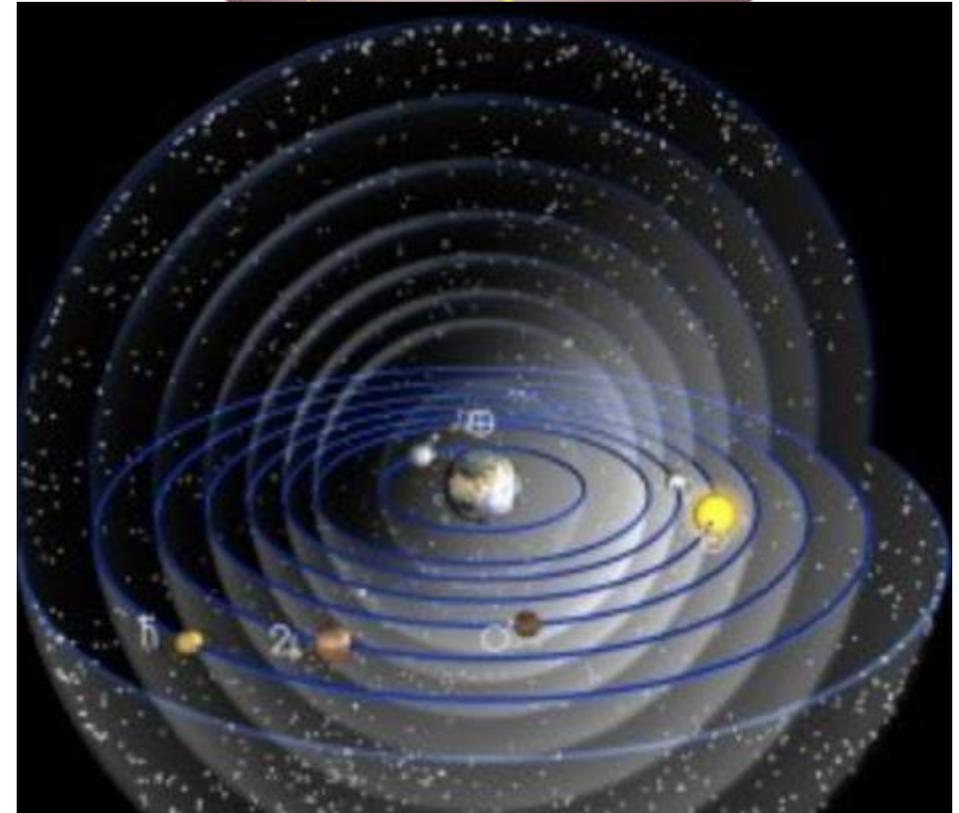
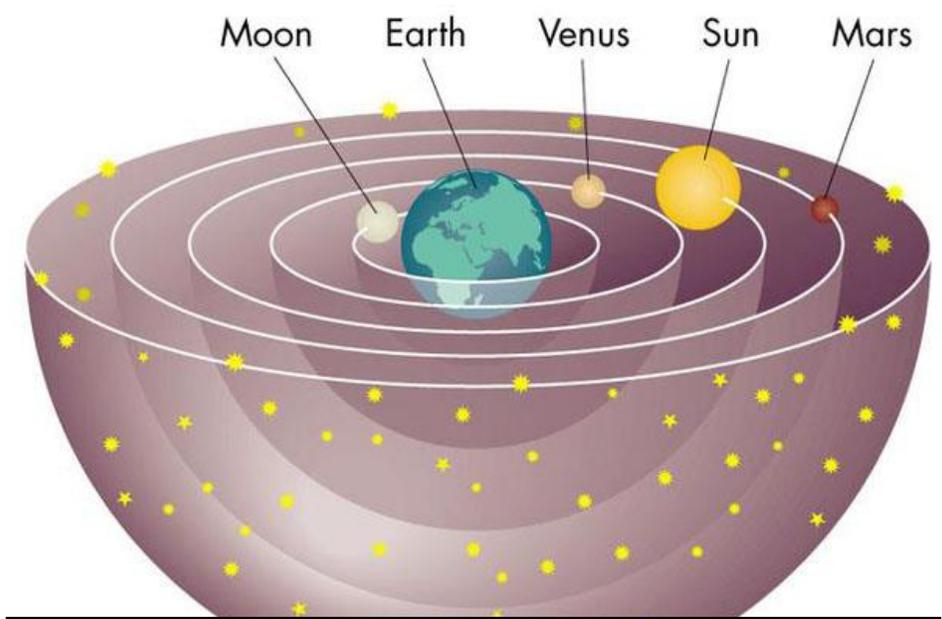
A detailed illustration of the solar system. At the center is a bright yellow sun. Several planets are shown on elliptical orbits around it. In the foreground, a large ringed planet (Saturn) is visible. The background is a dark space filled with stars and a nebula-like glow.

The Solar System

Chapter 2

Geocentric Model

- **Prior to Copernicus, observers incorrectly (but reasonably) thought that other celestial objects revolved around Earth, an idea called the **GEOCENTRIC MODEL** (“Earth-centered”)**



Heliocentric Model

- **The idea that the Earth and other planets revolve around the Sun, which is at the center of the system, is referred to as a HELIOCENTRIC MODEL (“Sun-centered”)**
 - **While this seems like common sense to us, this idea has only been around since Copernicus in the 1500’s**
 - **It was supported by observations made by Galileo in the early 1600’s**

How did the Solar System Form?

• NEBULAR THEORY

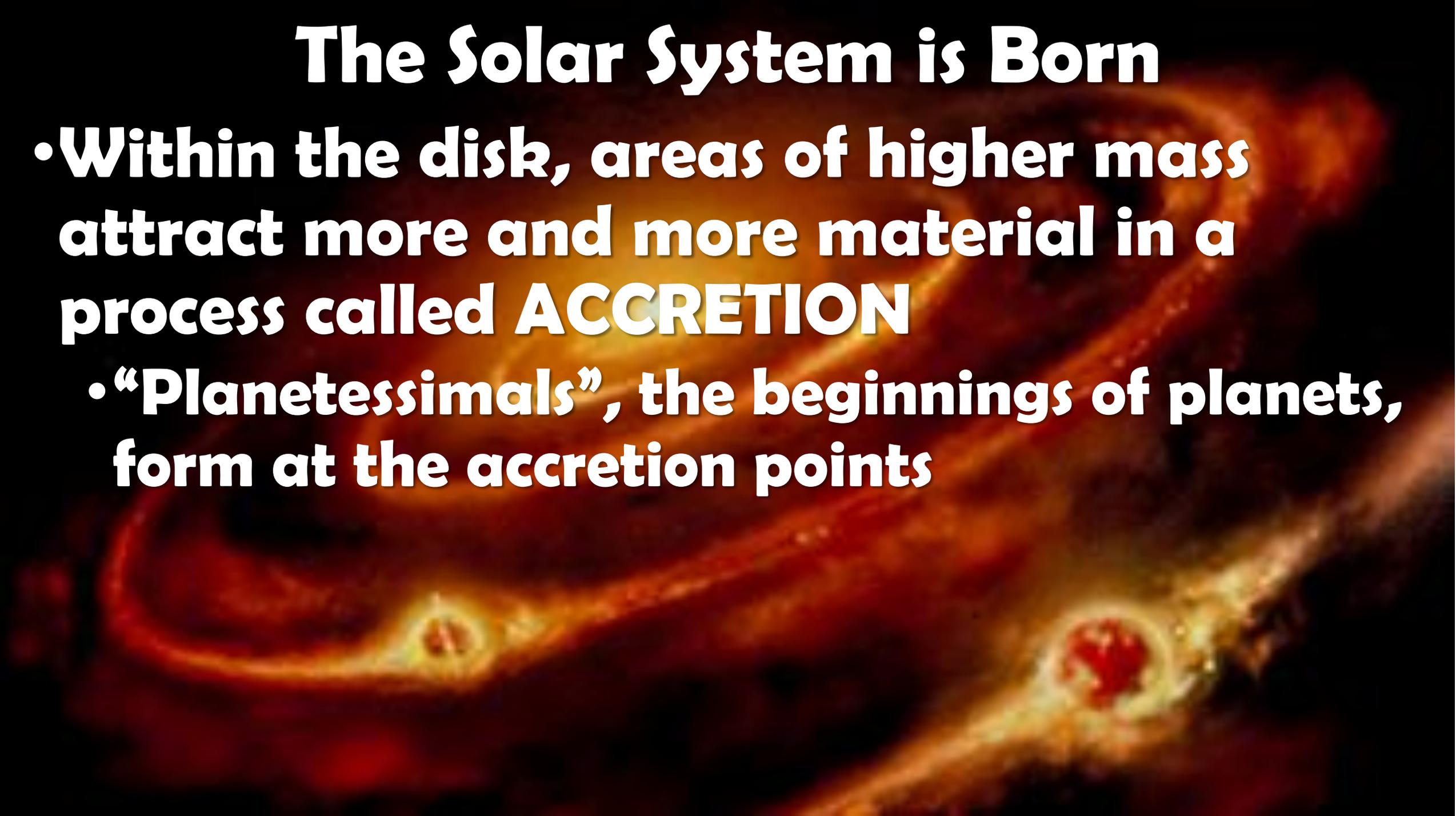
- Nebula – extremely large cloud of dust/gas
- Uneven distribution of matter causes the nebula to collapse around different regions of higher mass
- These points where the matter collects become stars
 - Nebulae are often called “stellar nurseries”

The Solar System is Born

- **Matter collects unevenly around a central point and begins spinning, forming a PROTOPLANETARY DISK**
 - **99% of mass collects in the center forming a star**
 - **The remaining 1% of mass flattens into a spinning disk of dust and gas around the star**

The Solar System is Born

- **Within the disk, areas of higher mass attract more and more material in a process called ACCRETION**
 - **“Planetessimals”, the beginnings of planets, form at the accretion points**



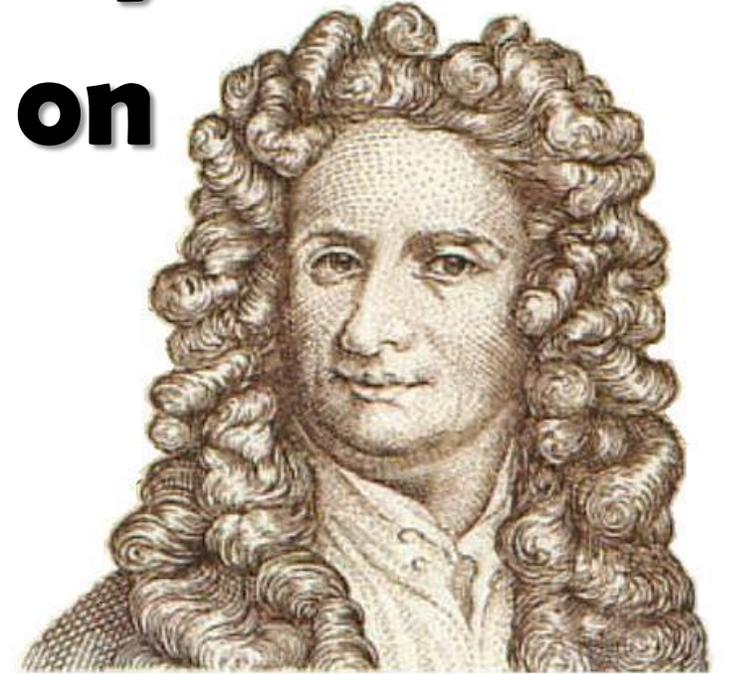
The Solar System is Born

- **When the process of accretion is complete, the result is a collection of planets orbiting the star in the center of the system**
- **SOLAR (star) SYSTEM**



The Role of Gravity

- **Gravitational force depends on**
 - **Masses of the objects**
 - **Distance between the objects**
- **Holds planets in elliptical orbits around Sun**
- **Shapes planets into spherical objects**

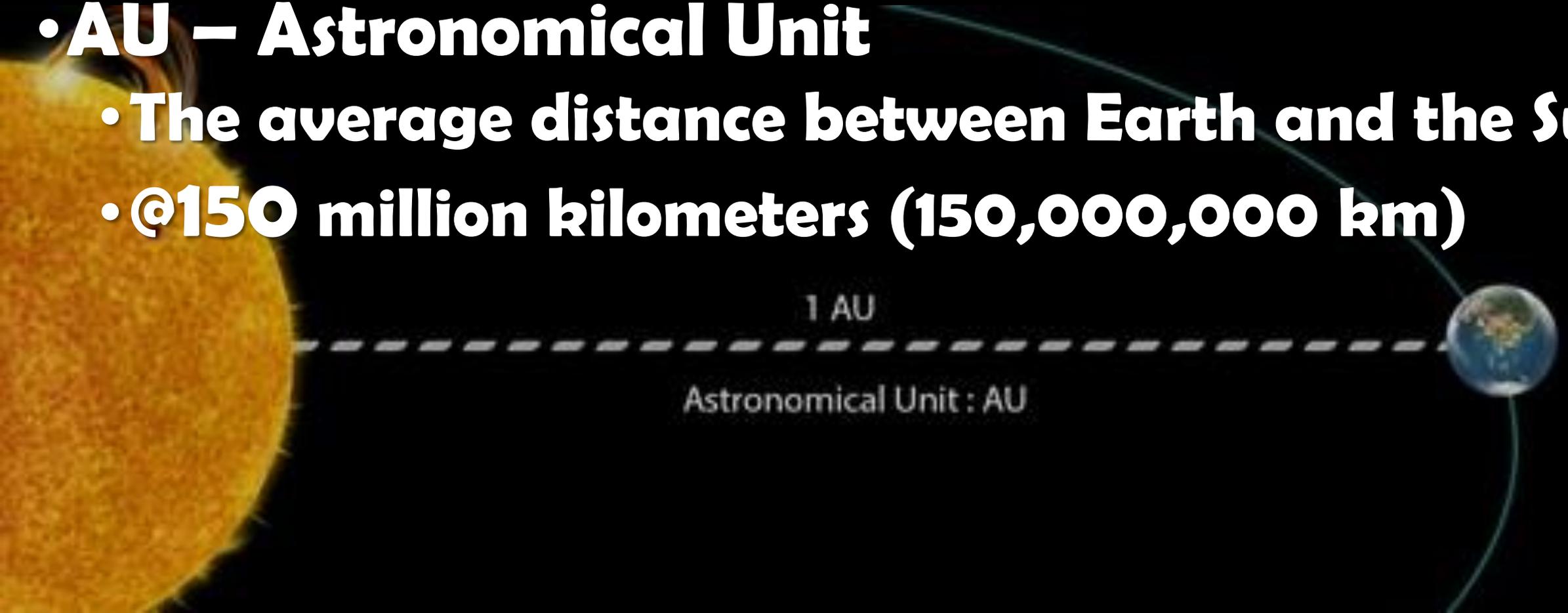


Gravity.

It's not just a good idea.
It's the Law.

Distances Within the Solar System

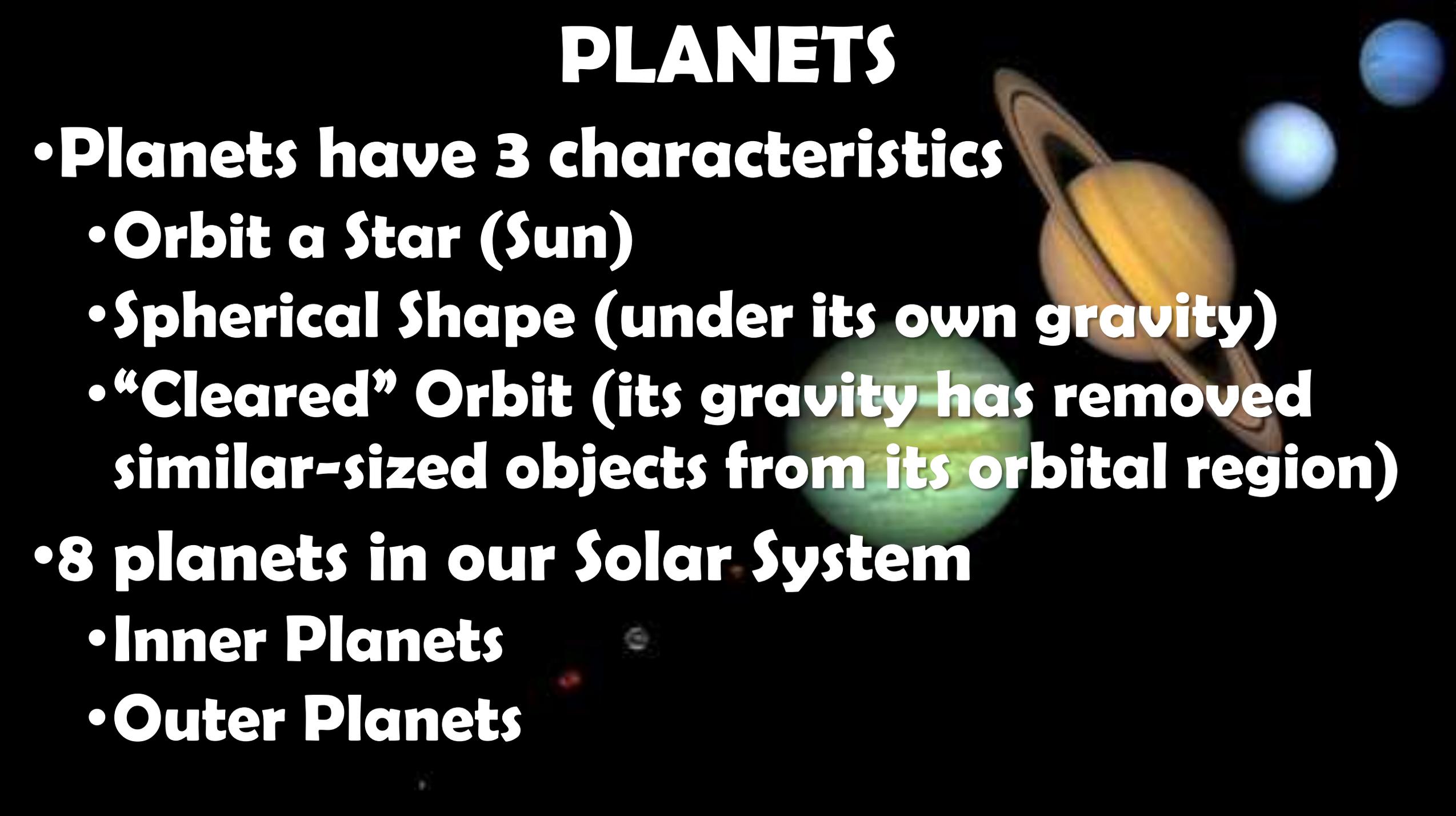
- Because distances between objects in our Solar System are so large, we use a unique unit...
- **AU – Astronomical Unit**
 - The average distance between Earth and the Sun
 - @150 million kilometers (150,000,000 km)



THE SUN

- **The star at the center of our Solar System**
 - **92.1% Hydrogen, 7.8% Helium**
 - **Nuclear Fusion produces radiant and thermal energy**
 - **5,500°C (9,900°F)**
 - **@1,300,000 Earths could fit inside the Sun**

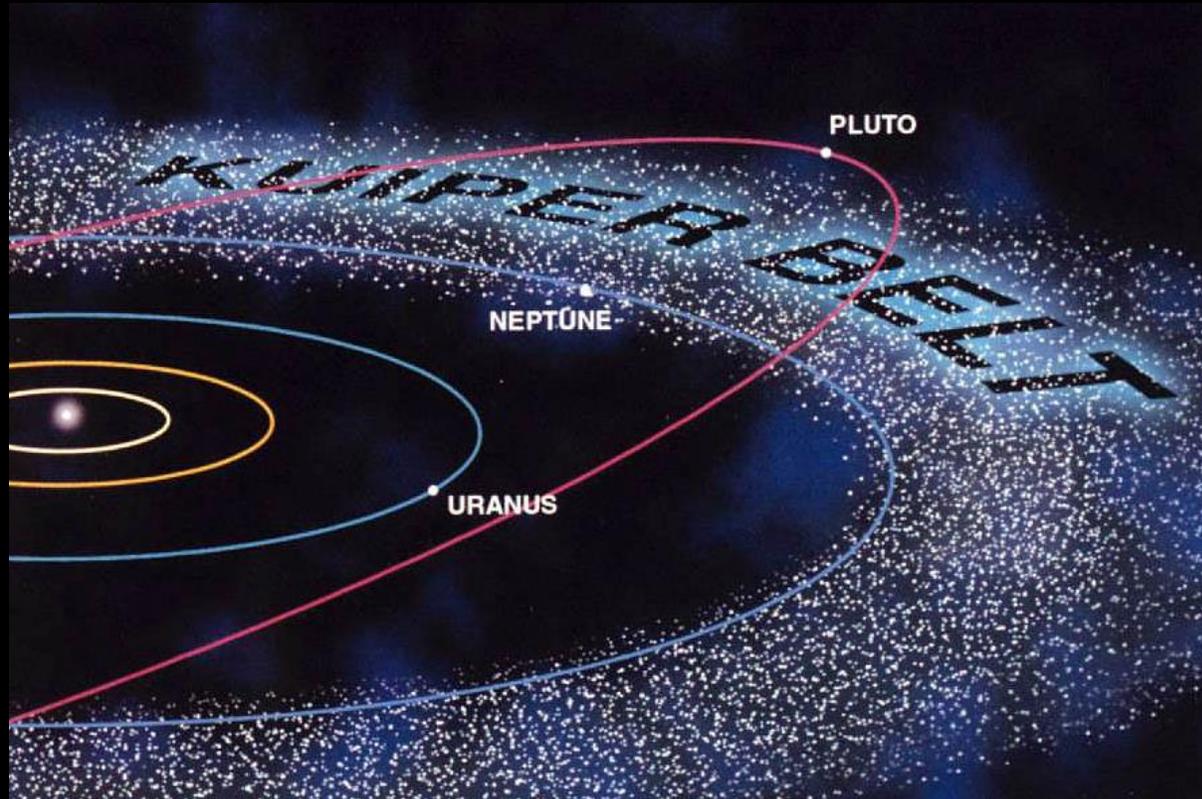
PLANETS



- **Planets have 3 characteristics**
 - **Orbit a Star (Sun)**
 - **Spherical Shape (under its own gravity)**
 - **“Cleared” Orbit (its gravity has removed similar-sized objects from its orbital region)**
- **8 planets in our Solar System**
 - **Inner Planets**
 - **Outer Planets**

DWARF PLANETS

- Dwarf Planets orbit the Sun and have a spherical shape, but orbit near other large objects (asteroids)



INNER PLANETS

- **Four planets closest to the Sun**
 - **Inside the Asteroid Belt**
 - **Much smaller than the Outer Planets**
 - **Few Moons**
 - **Warmer Temps**
 - **Faster Orbits**
- **Often called, “Terrestrial Planets”, due to their rocky surfaces**



Mercury

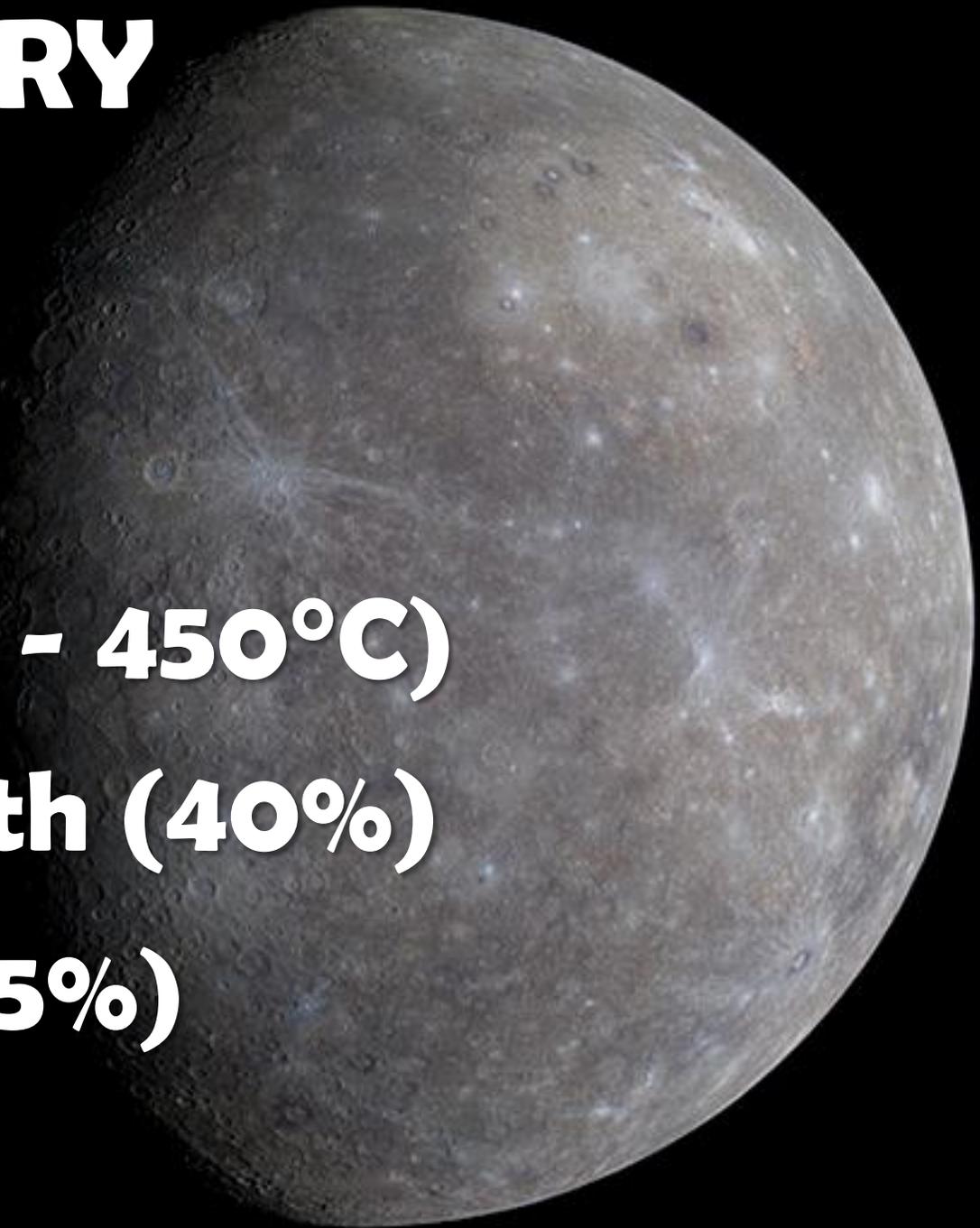
Venus

Earth

Mars

MERCURY

- **Smallest Planet**
- **No Atmosphere**
 - **Cratered surface**
- **Extreme Temps (-170°C - 450°C)**
- **$\frac{2}{5}$ the diameter of Earth (40%)**
- **$\frac{1}{20}$ the mass of Earth (5%)**



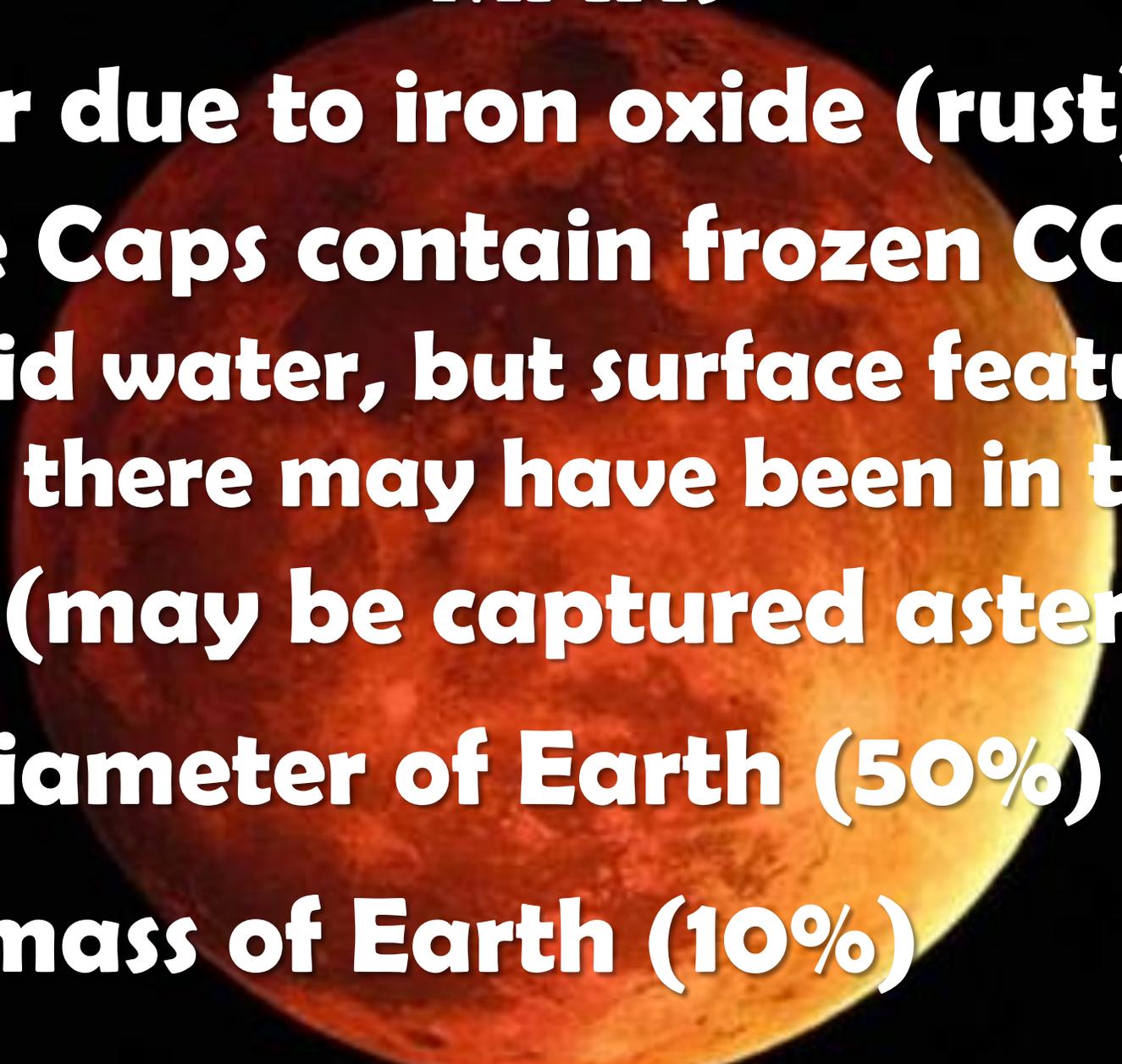
VENUS

- **Similar size to Earth**
- **VERY** slow rotation
 - longer to rotate than revolve...like a day that lasts longer than a year
- **VERY** dense atmosphere
 - **HOTTEST** planet (460°C)
- $\frac{19}{20}$ the diameter of Earth (95%)
- $\frac{4}{5}$ the mass of Earth (80%)

EARTH

- **Distance from Sun is perfect for:**
 - **Moderate temperatures**
 - **Important for life & liquid water unique to this planet**
- **Atmosphere**
 - **Absorbs much of the Sun's radiation**
- **150 million km from Sun (1 AU)**
- **Rotates every 24 hrs (day)**
- **Revolves every 365 days (year)**

MARS

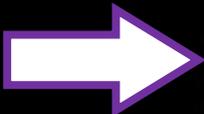


- **Red color due to iron oxide (rust)**
- **Polar Ice Caps contain frozen CO_2 & H_2O**
 - **No liquid water, but surface features suggest there may have been in the past**
- **2 Moons (may be captured asteroids)**
- **$\frac{1}{2}$ the diameter of Earth (50%)**
- **$\frac{1}{10}$ the mass of Earth (10%)**

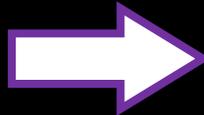
ASTEROID BELT

- **Region beyond Mars' orbit where hundreds of thousands of asteroids orbit the Sun**
 - **Remnants of protoplanets that never formed due to Jupiter's gravity and collisions with other objects**
- **Objects range in size from a Dwarf Planet, Ceres, down to as small as a single dust particle**

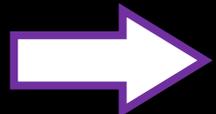
Moon



Earth

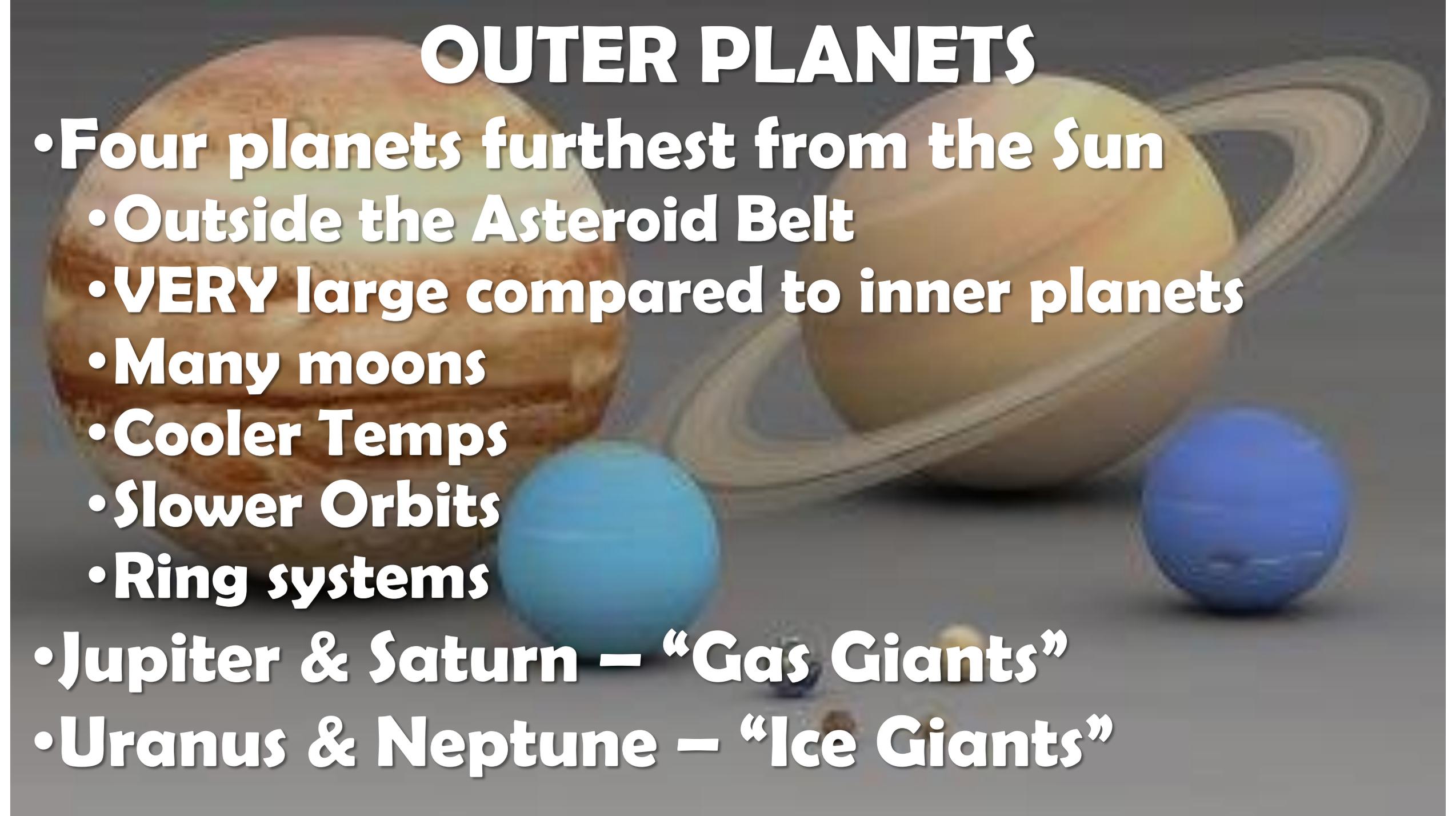


Ceres



Size Comparison

OUTER PLANETS



- **Four planets furthest from the Sun**
 - **Outside the Asteroid Belt**
 - **VERY large compared to inner planets**
 - **Many moons**
 - **Cooler Temps**
 - **Slower Orbits**
 - **Ring systems**
- **Jupiter & Saturn – “Gas Giants”**
- **Uranus & Neptune – “Ice Giants”**

JUPITER

- **Largest planet in the Solar System**
 - Mass is more than 2x the mass of the other planets combined
- **Thick Atmosphere (Hydrogen & Helium)**
 - Storms (Great Red Spot)
- **Faint Ring-System**
- **79 moons (4 largest are “Galilean Moons”)**
- **11x the diameter of Earth**
- **318x the mass of Earth**



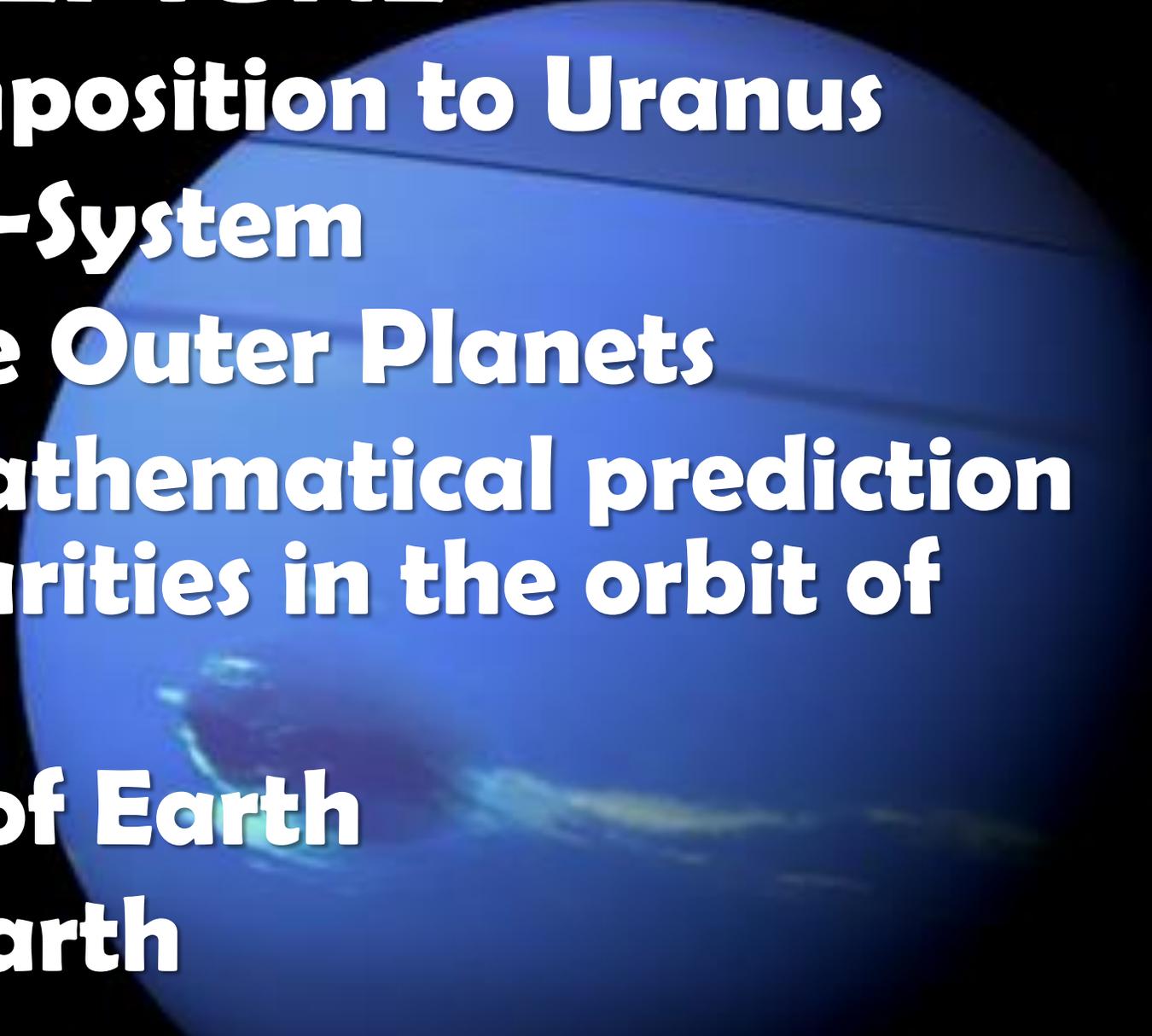
SATURN

- **2nd Largest but Least Dense planet**
- **Large & Complex Ring System**
 - **icy particles; possibly a shattered moon?**
- **62 moons (*53 confirmed & named*)**
 - **Titan – largest moon, larger than Mercury with a dense atmosphere**
- **9x the diameter of Earth**
- **95x the mass of Earth**

URANUS

- **Thick Atmosphere covers icy slush containing water, ammonia, & methane**
 - **Blue tint from methane gas in atmosphere**
- **Axis of Rotation is tilted nearly sideways**
 - **Collision with large planet-sized object?**
- **Dark & Narrow Ring System**
- **4x the diameter of Earth**
- **14.5x the mass of Earth**

NEPTUNE

- **Very Similar Composition to Uranus**
 - **Faint, Dark Ring-System**
 - **Most Dense of the Outer Planets**
 - **Discovered by mathematical prediction based on irregularities in the orbit of Uranus**
 - **4x the diameter of Earth**
 - **17x the mass of Earth**
- 

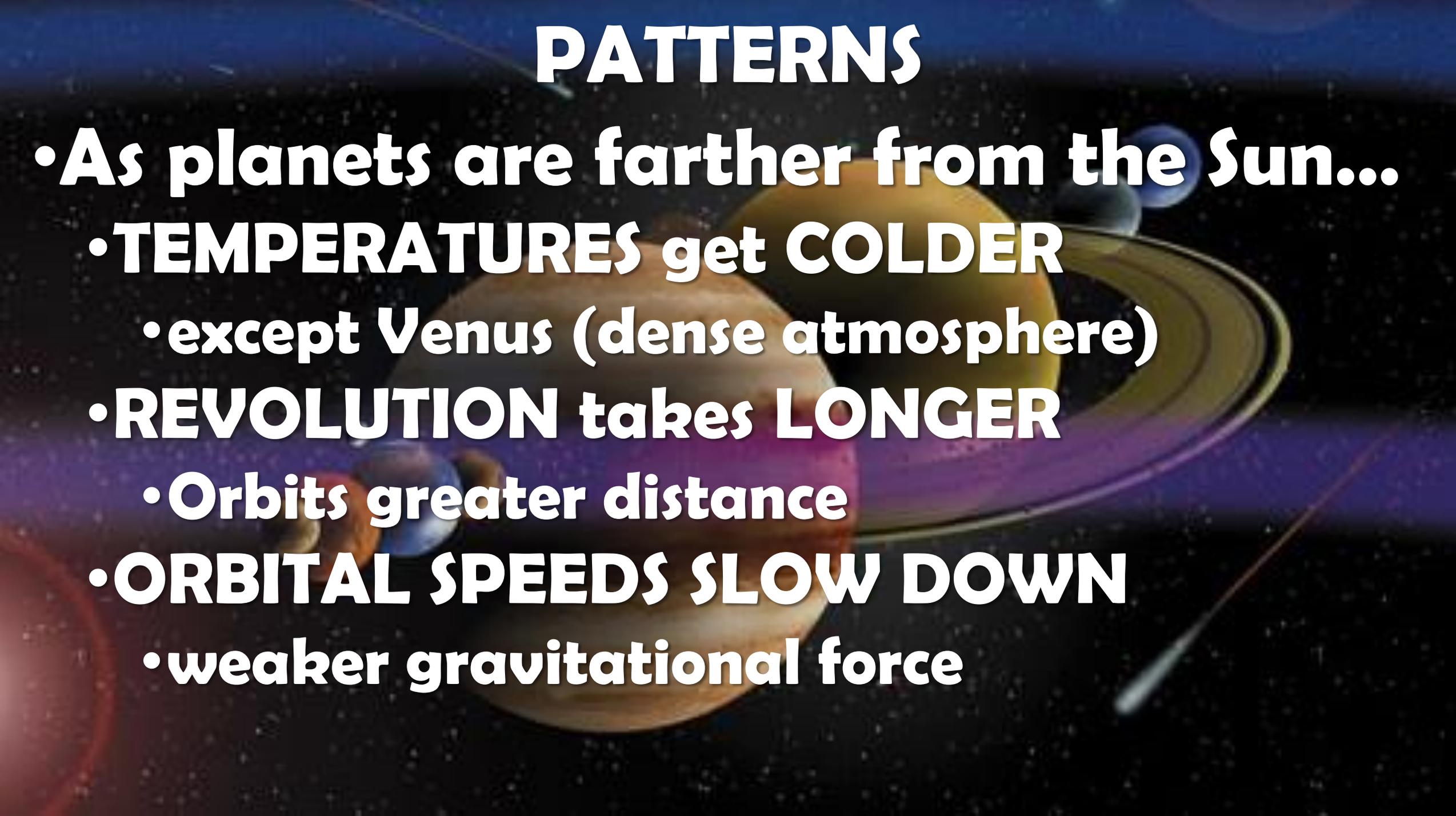
KUIPER BELT & SCATTERED DISC

- **Regions beyond the orbit of Neptune consisting of dwarf planets, small icy asteroids, & comets**
 - **Similar to the Asteroid Belt but Far Larger**
 - **Remnants of the Formation of the Solar System**
- **Home to several Dwarf Planets**
 - **Pluto, Haumea, Makemake, Eris**

COMETS

- **Relatively small ball of dust, ice, and gas**
 - **Orbit the Sun**
 - **Usually an EXTREMELY ELLIPTICAL orbit**
 - **Come from edges of the Solar System in the Scattered Disc Region**
 - **Sometimes called “shooting stars”**
 - **NOT actually stars!**
- 

PATTERNS



- **As planets are farther from the Sun...**
 - **TEMPERATURES** get **COLDER**
 - **except Venus (dense atmosphere)**
 - **REVOLUTION** takes **LONGER**
 - **Orbits greater distance**
 - **ORBITAL SPEEDS SLOW DOWN**
 - **weaker gravitational force**

PATTERNS

- **Inner Planets**

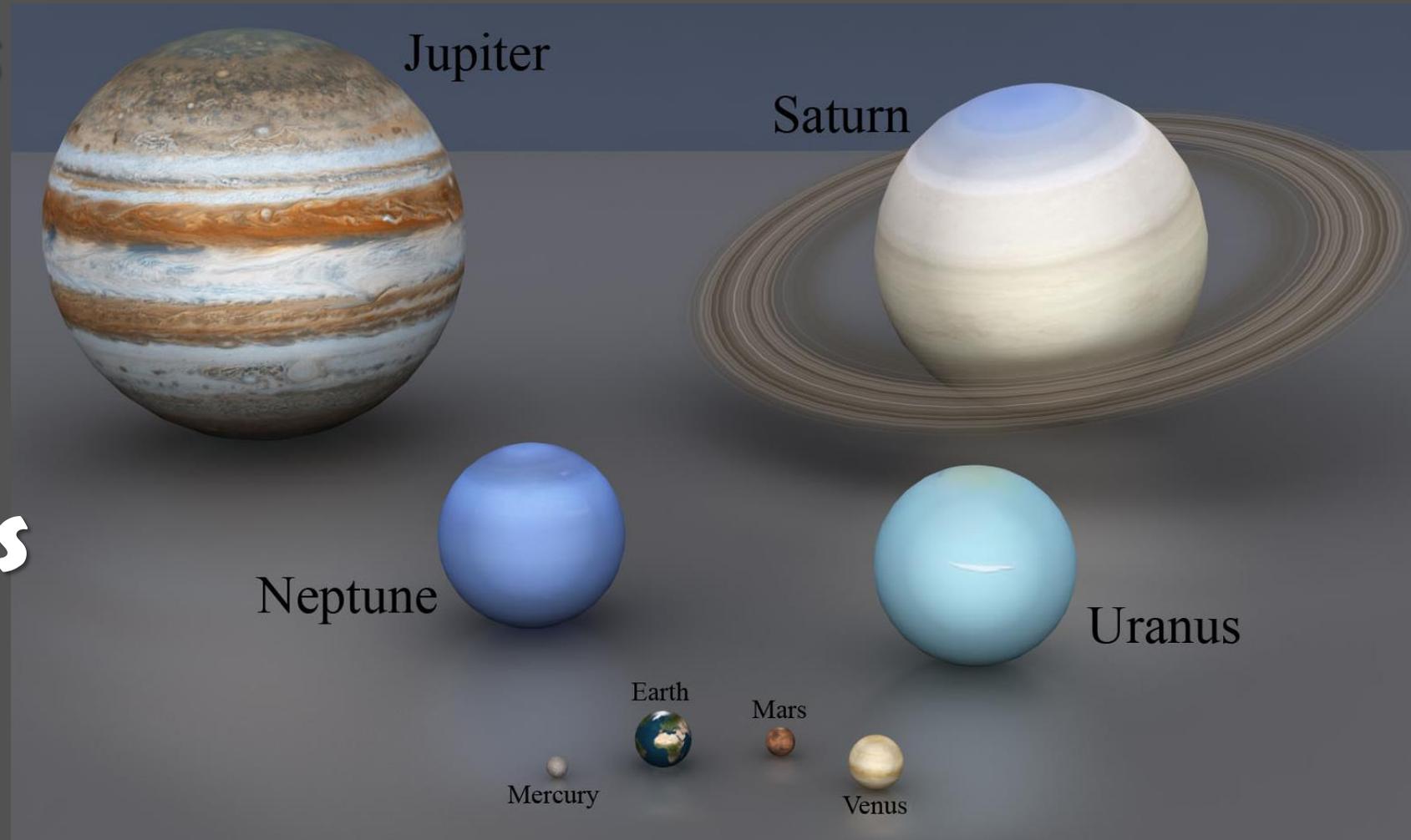
- **Terrestrial**

- **Small**

- **Outer Planets**

- **Gaseous**

- **Giant**



PLANET PAIRS

- **Earth & Venus**

- Similar size; thick atmosphere; terrestrial

- **Jupiter & Saturn**

- Largest size; rings; rotate fast; “Gas Giants”

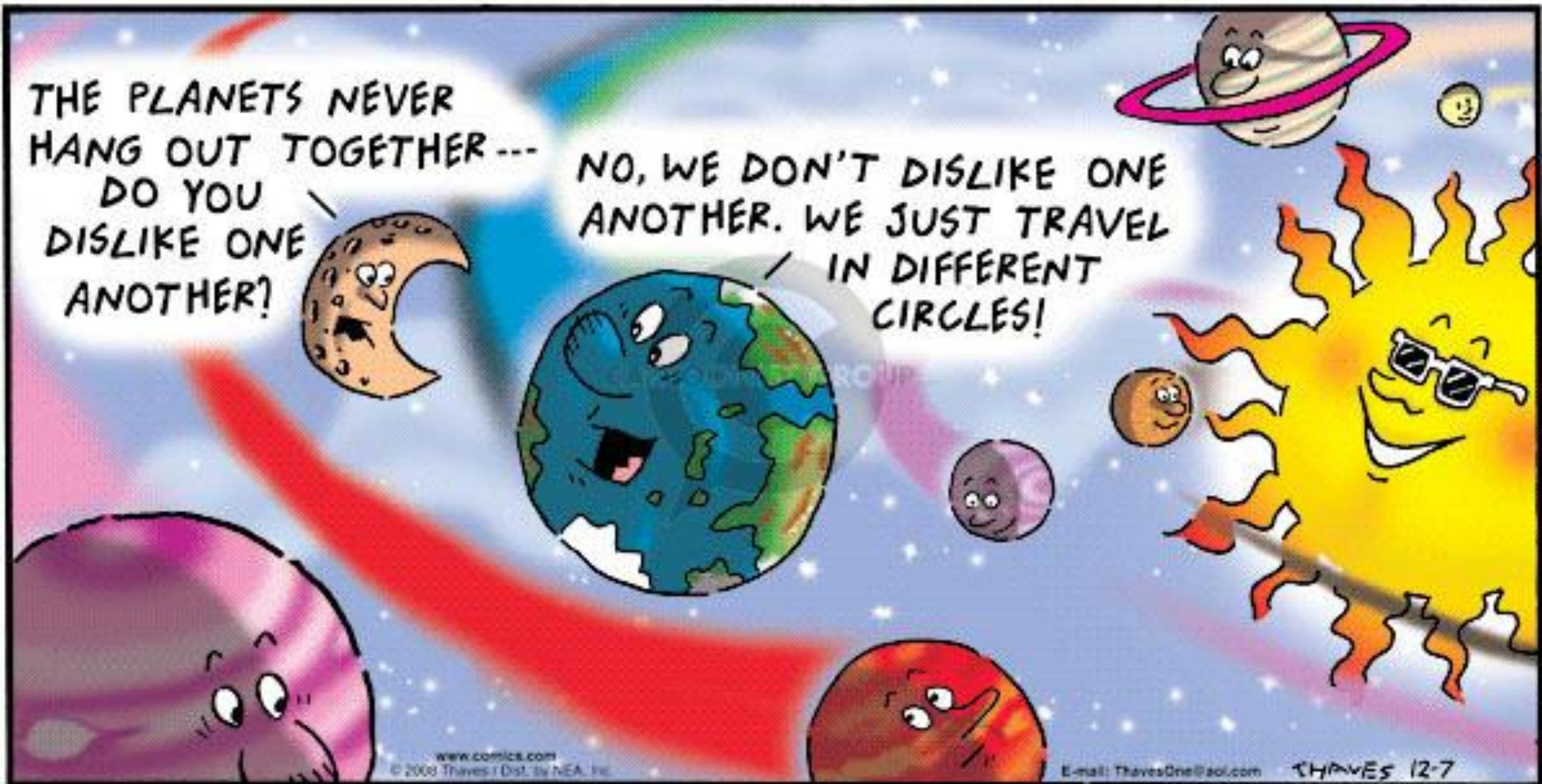
- **Uranus & Neptune**

- Similar size; rings; “Ice Giants”



THE PLANETS NEVER
HANG OUT TOGETHER ---
DO YOU
DISLIKE ONE
ANOTHER?

NO, WE DON'T DISLIKE ONE
ANOTHER. WE JUST TRAVEL
IN DIFFERENT
CIRCLES!



Not everything we do
revolves around you!

Actually...

