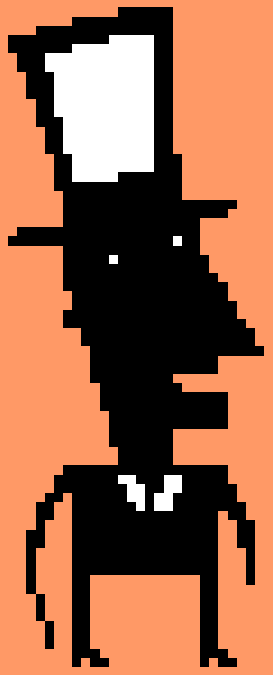
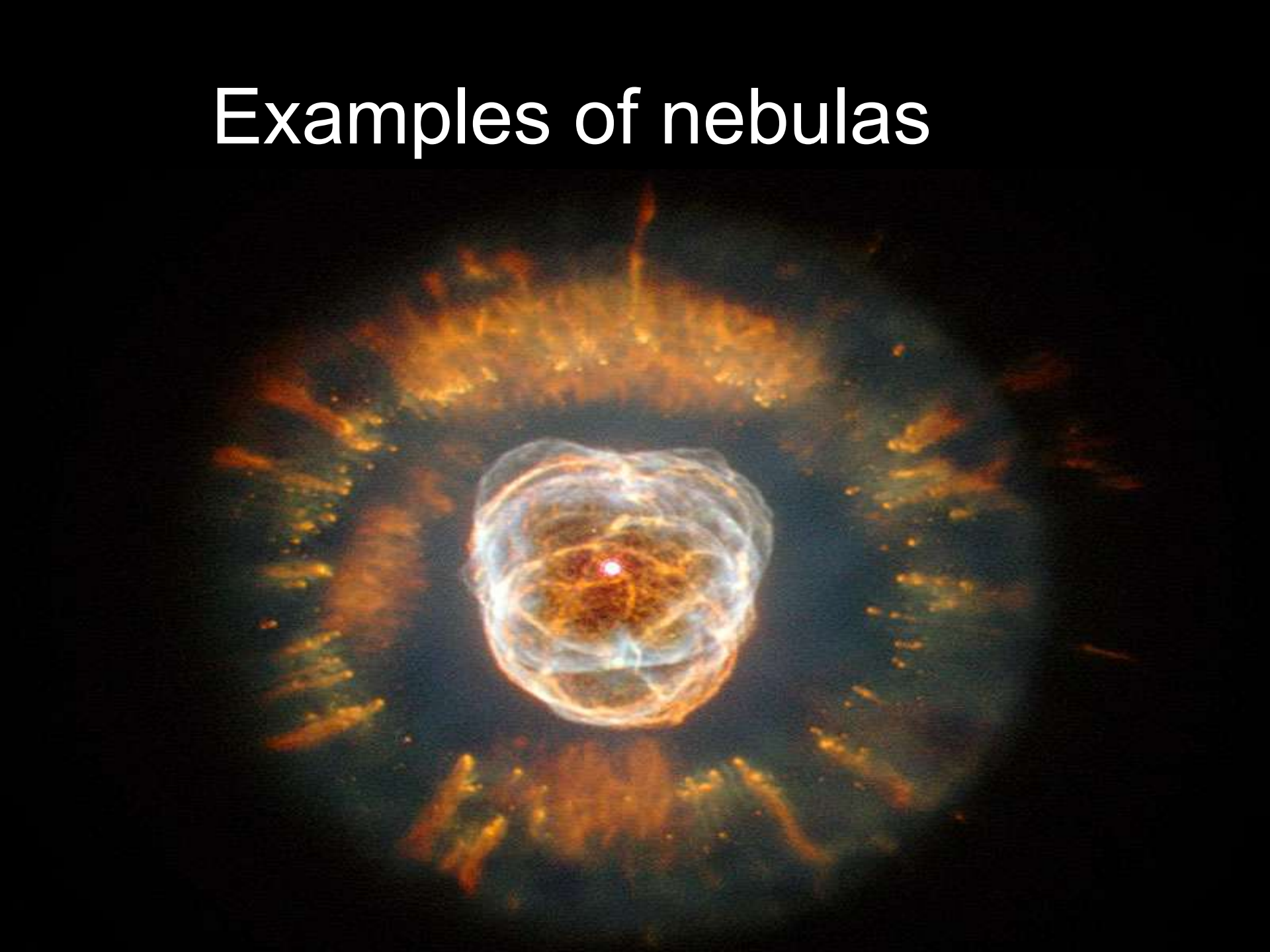
How did our solar system get here?

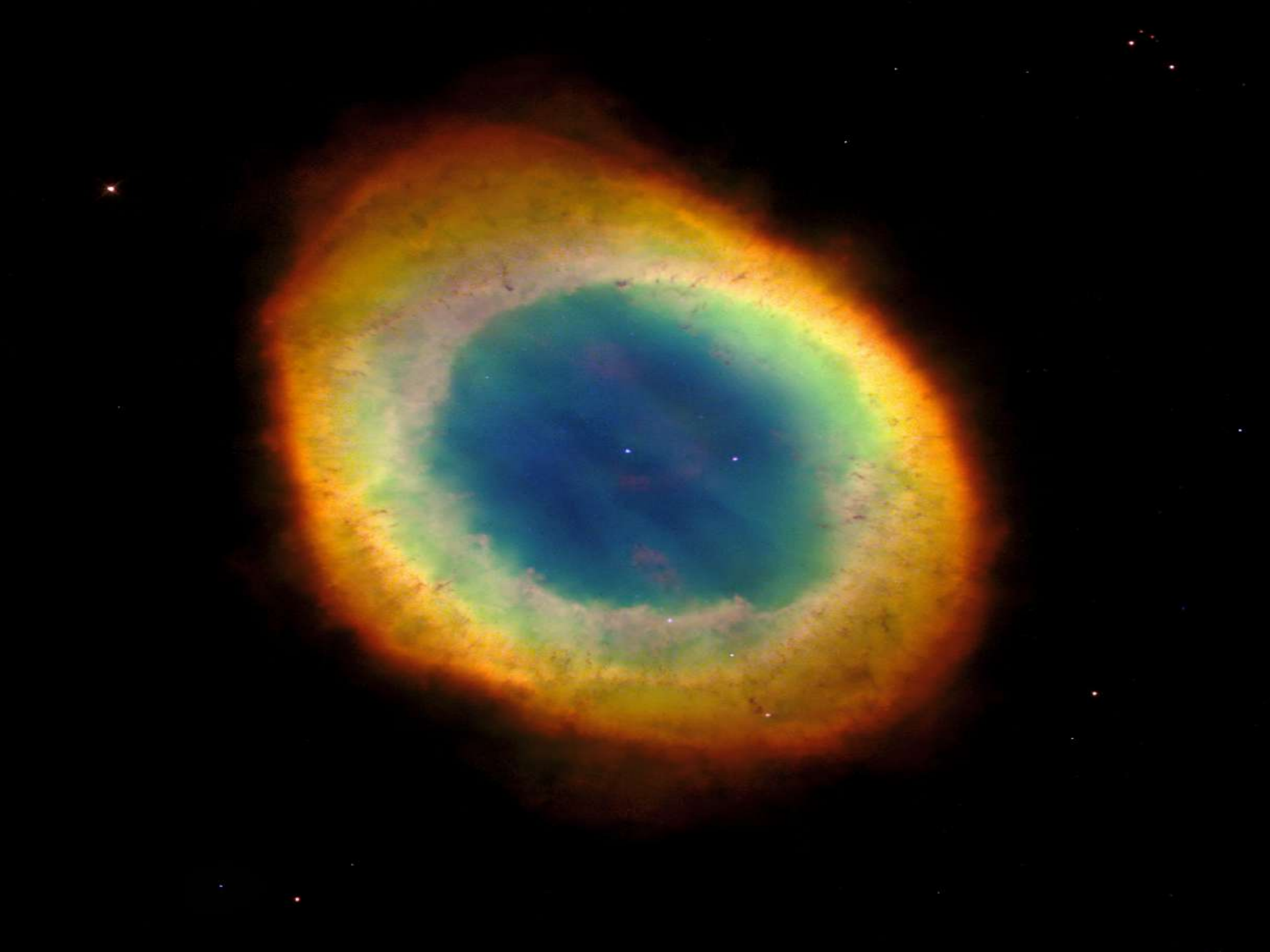


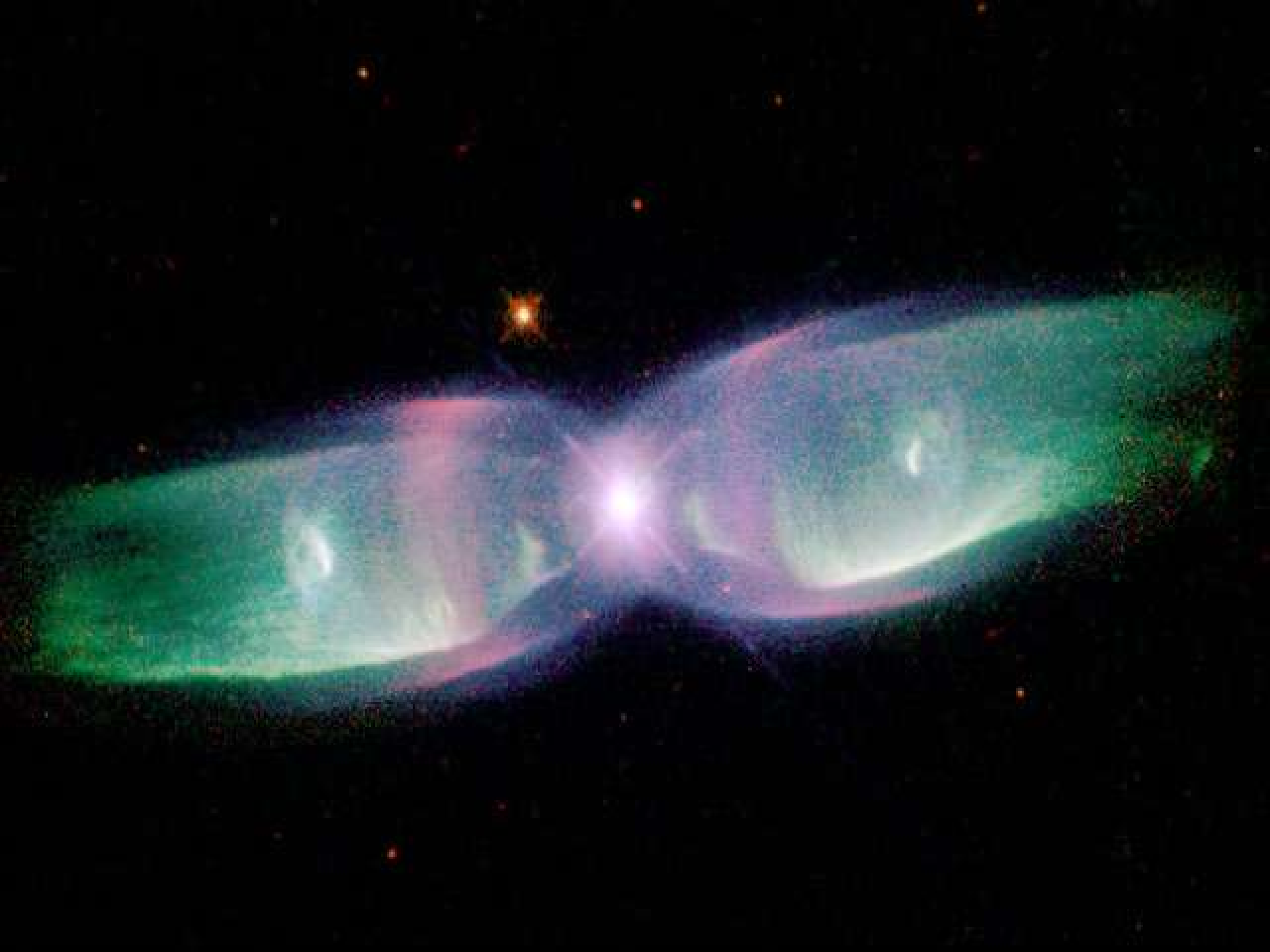
Scientists theorize…

- The solar system formed from part of a nebula of gas, ice, and dust.
- What is a ***nebula?***
- It is a large cloud of gas and dust that contracts under gravitational forces and breaks apart into smaller pieces, each of which will collapse and form a star and planets.

Examples of nebulas







Our Solar System

- Was thought to have formed 4.6 billion years ago.
- The nebula started to spin and contract; possibly because a nearby star exploded setting this into action.
- As it contracted, the density grew immensely. What is ***density?***
- Density is a physical property of matter that is determined by dividing an objects mass by its volume.

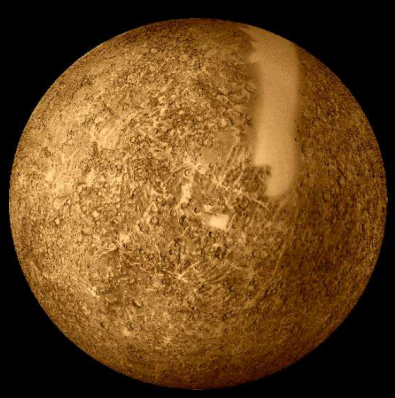
Back to how are solar system formed…

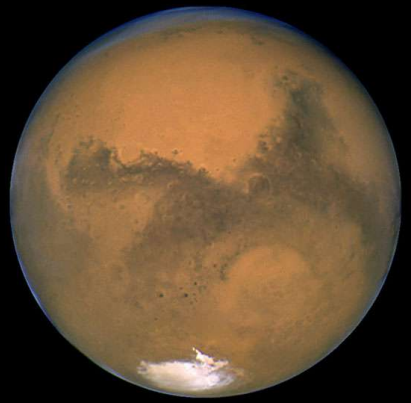
- So the nebula contracted, and the density grew. This caused the gravity to pull more and more dust into the spinning gas cloud causing it to flatten and have a very dense center.
- Because it was compacting so much, the temperature raised to about 10,000,000 degrees Celsius, and **POOF!** Our sun was born. Not everything turned into the sun, and the matter outside became the planets, moons, asteroids, and comets.

Now we know how the sun and the planets came to be, lets talk about the planets

The inner planets

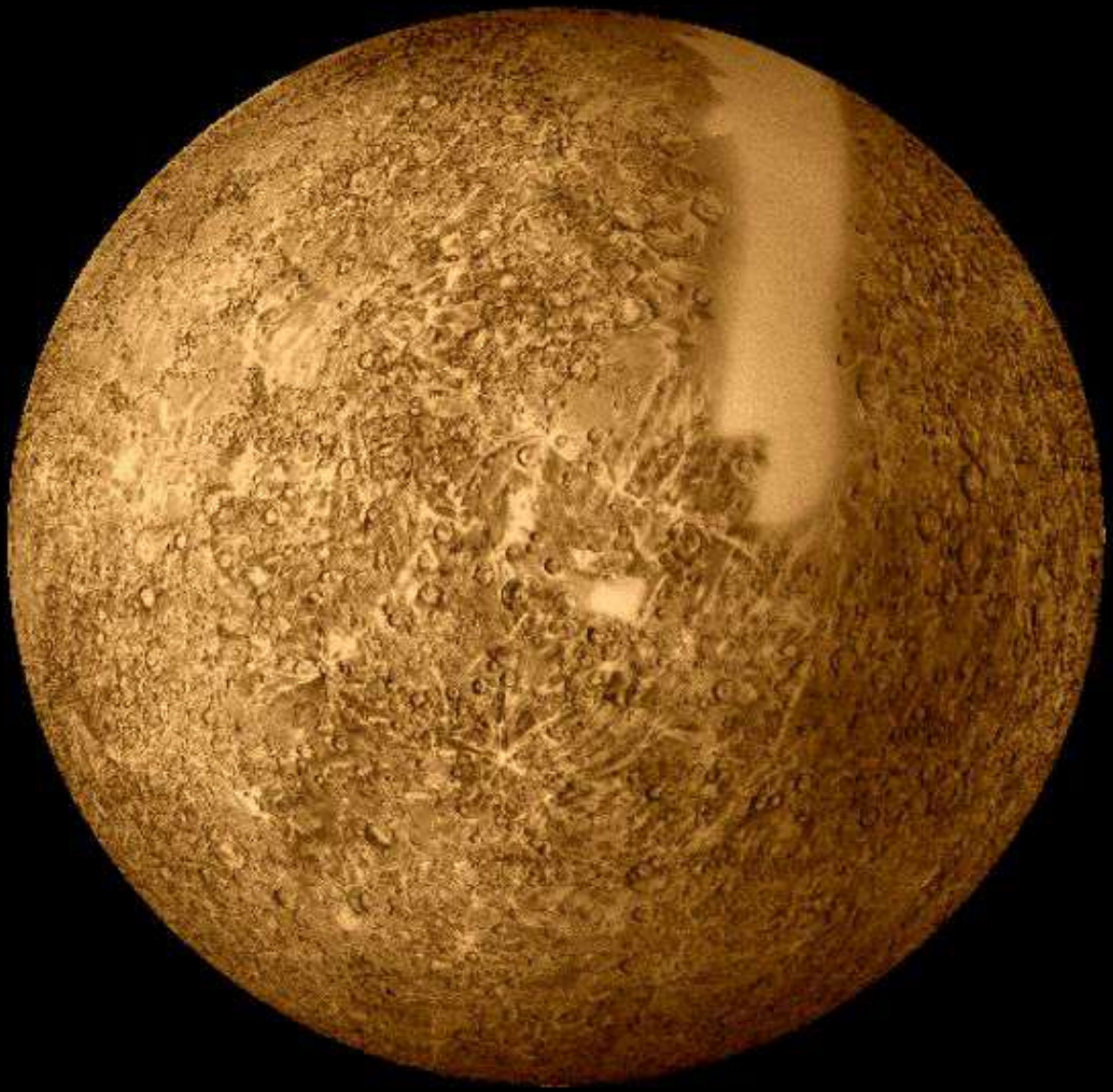
- The inner planets consist of Mercury, Venus, Earth, and Mars.
- These inner planets are also called the ***terrestrial*** planets. It comes from the Latin word *terra meaning Earth.*



All four of the inner (terrestrial) planets are small, and have rocky surfaces.

Mercury



Closest planet to the Sun.

- Average distance from Sun is 57.9 million km
- Completes one revolution (orbit) around sun in 88 days and completes only three rotations (spins) every two orbits. **What does this mean?**
- Smallest planet in our solar system and has a rocky, crater-filled surface like our moon.

Mercury cont.

- Believed to have little to no atmosphere. **What is an atmosphere?**
- A protective layer of gasses, solids, and liquids around a planet
- Because it is so close to the Sun, and has nearly no atmosphere, temperatures have an enormous span.
- Temperatures range from -183 degrees Celsius to 467 degrees Celsius.

More on Mercury

- Has a diameter of 4879 km, (a little more than 1/3 of the Earth's)
- It's mass is 0.06 of Earth's.
- Gravity is 0.38 of Earth's
- Average temperature is 167 degrees Celsius
- Evidence of Oxygen, Sodium, and Helium around planet, but thought to have mostly come from the sun.
- Has no moons or rings.

VENUS

Second planet from the Sun

- Average distance from the Sun is 108.2 million km.
- Orbits the Sun every 225 earth days, and rotates on its axis once every 243 earth days. Its day is longer than its year!!
- Has a retrograde (backward) rotation, spinning in the opposite direction of its orbit around the Sun.

Venus cont.

- Nearly the same size as the Earth, and the surface has many craters, cracks, and volcanoes.

- The volcanoes do not appear to be active, but the planet has numerous lava flows.

Venus cont.

- Has a very thick atmosphere. Because of this atmosphere, it reflects most of the sunlight, and is one of the brightest planets viewed.
- This thick atmosphere allows the Sun's heat in, but doesn't let it escape. This is an intense "greenhouse" effect. As a result, the temperatures are more than 450 degrees Celsius.
- Also, the thick atmosphere causes extreme pressure on the planet; nearly 90 times the pressure on Earth.
- In the upper layers of the atmosphere, the sulfuric acid clouds move faster than hurricane winds on Earth.

More on Venus

- Diameter is 12,100 km
- Mass is 0.82 of Earth's
- Gravity is 0.91 of Earth's
- Average temperature is 457 degrees Celsius
- Has no moons or rings

Earth

Third planet from the Sun

- Average distance from the Sun is 149,597,890 km (we call this 1 astronomical unit, or AU).
- Orbits the Sun in 365.26 days, and rotates one full turn on its axis in 23 hours 56 minutes.
- The Earth is the 5^{th} largest planet in our solar system, and is only slightly larger than Venus.

Earth cont.

- Earth is the only planet we know of so far to be able to support life; life that is very diverse.
- It can have water in all three known stages—solid, liquid, and gas—and liquid can only exist in the narrow temperature range of 0 degrees Celsius to 100 degrees Celsius.
- Earth is a very active planet, and is constantly changing and recycling itself.

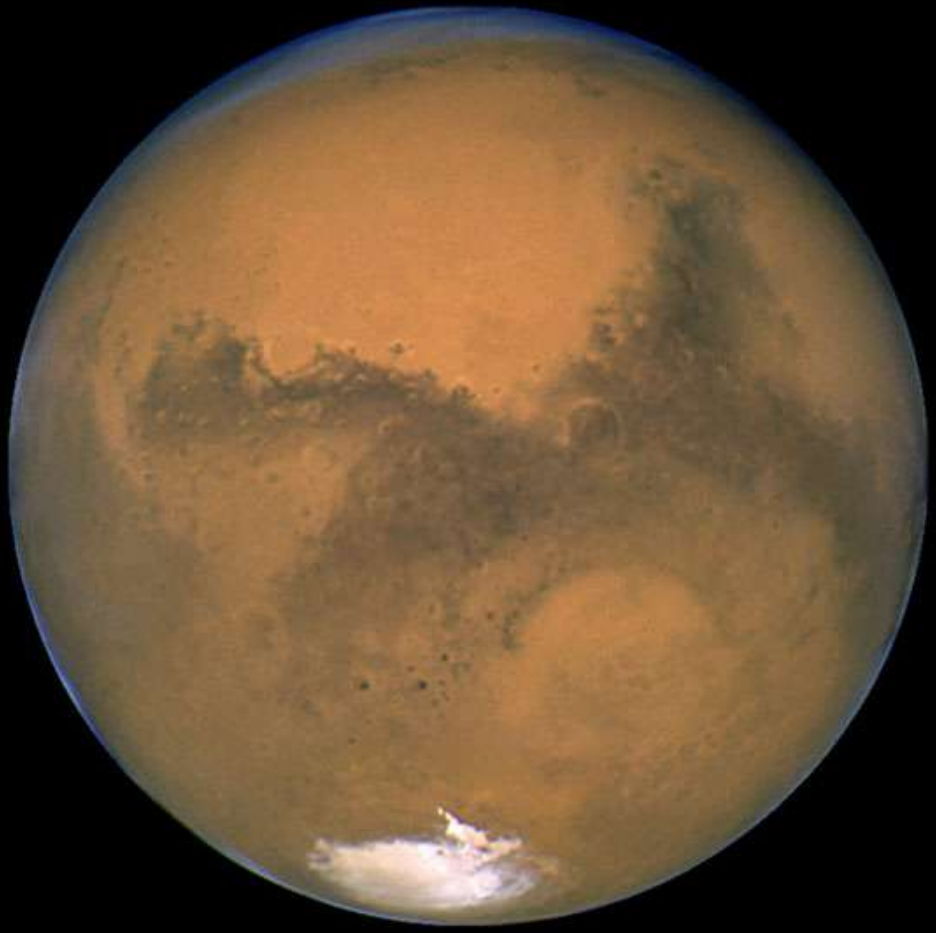
Earth cont.

- Our atmosphere is divided into 5 layers, and is responsible for allowing life to exist, keeping a long term climate, and changing weather system.
- Our atmosphere helps prevent meteor from reaching our surface by causing them to burn up, as well as protect us from harmful radiation from the Sun.
- The atmosphere is made up of 78% nitrogen, 21% oxygen, and 1% “other.”

More on Earth

- Diameter is 12,756 km
- Gravity is 980 cm/s2
- Average temperature is 15 degrees Celsius
- Has 1 moon and no rings

Mars



Fourth planet from the Sun

- Average distance from the Sun is 227,936,640 km.
- Orbits the Sun in 1.88 years, and makes one full rotation in 24 hours 37 minutes—very similar to the Earth's rotation.
- Slightly more than ½ the size of the Earth
- Has a small rocky body with large amounts of iron oxide in it's surface giving it the reddish-yellow color.

Mars cont.

- While we have not found life on Mars, there are polar ice caps, and evidence that implies water in large quantities may have been on the planet. We have not ruled out the possibilities that there may have been or might still be some form of life on Mars—technology and science is the key.
- Mars is tilted on it's axis about 25 degrees (close to Earth's 23.5 degrees), so it experiences seasons like Earth does.

Mars cont.

- Mars has the largest volcanic mountain in the solar system called Olympus Mons—27 km high, and 600 km across. It is believed this volcano is extinct.
- Mars also has a huge rift valley on it's equator called the Valles Marineris.It stretches a distance equal to the distance from New York to Los Angeles.

Mars cont.

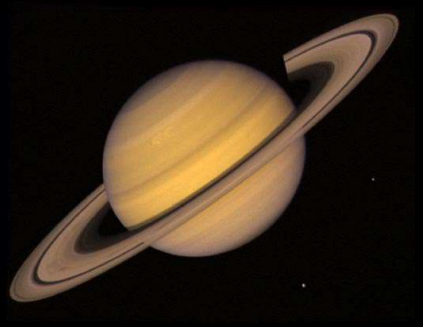
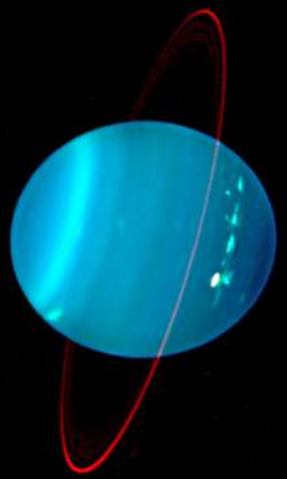
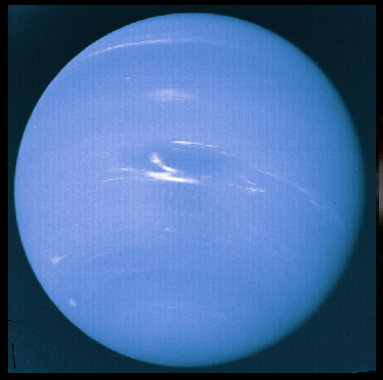
- Mars has an atmosphere that is much thinner than Earth's. It is composed mostly of carbon dioxide, with some nitrogen an argon.
- The temperature ranges from -143 degrees Celsius to 35 degrees Celsius.

More on Mars

- Diameter is 6,794 km
- Gravity is 0.38 of Earths
- Average temperature is -65 degrees Celsius
- Has 2 moons: inner moon is called Phobos, and outer moon is called Deimos.
- Mars has no rings.

The outer planets

- The outer planets consist of Jupiter, Saturn, Uranus, Neptune, and Pluto.
- Jupiter, Saturn, Uranus, and Neptune are also considered “gas giants,” or “Jovian planets.” Pluto’s surface is made mostly of ice, so it is not considered terrestrial or a gas giant.

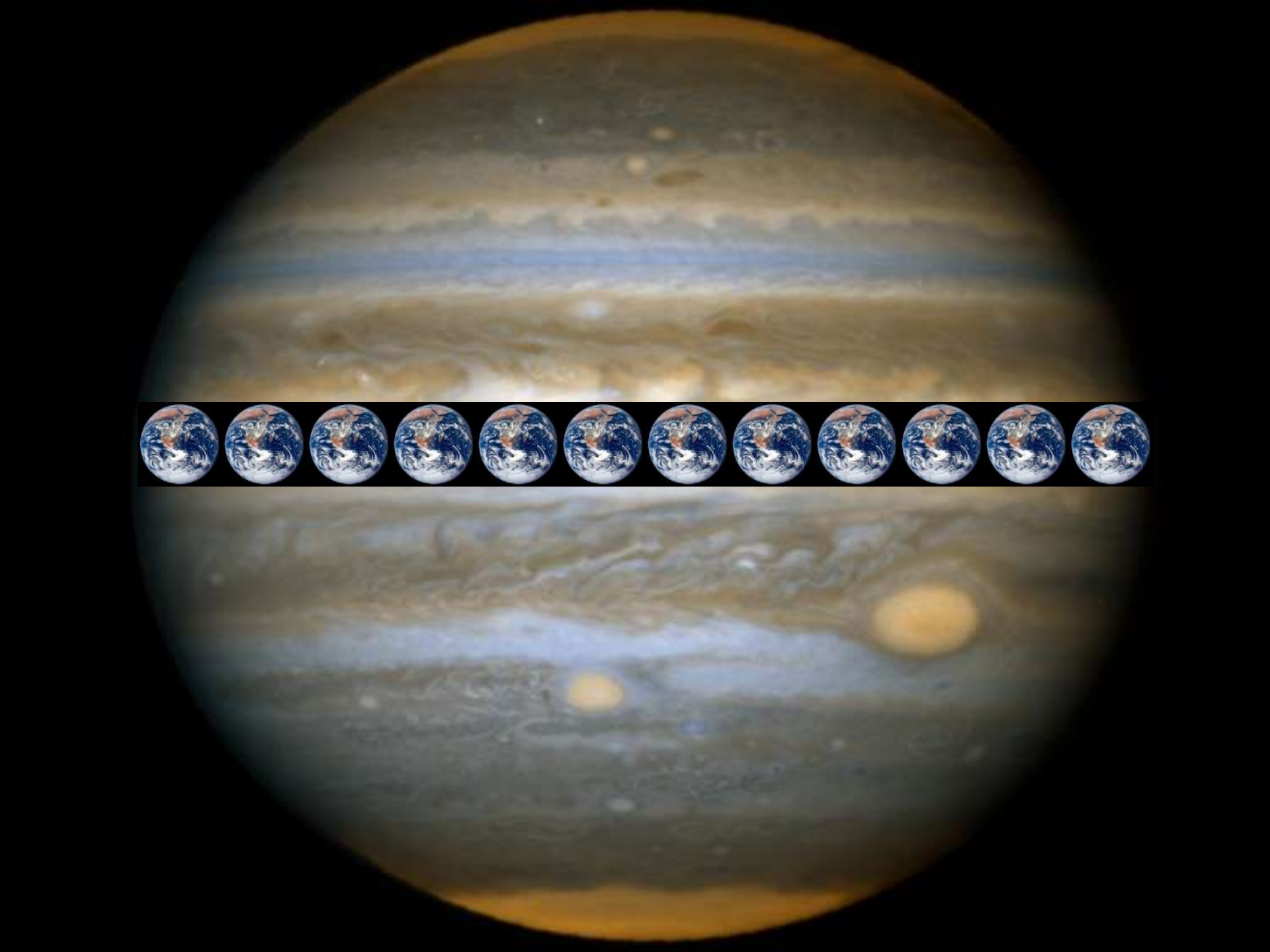






The gas giants are named this because they are mostly composed of gasses.

Jupiter

Fifth Planet from the Sun

- Average distance from the Sun is 778.4 million km.
- Orbits the Sun in 11.86 years, and makes one full rotation in 9 hours 55 minutes.
- Jupiter's diameter is nearly 12 times the Earth's. It is the **largest** planet in our solar system. It has more mass than all the other planets combined. Just to get an idea, you could fit well over 1000 Earths inside Jupiter!

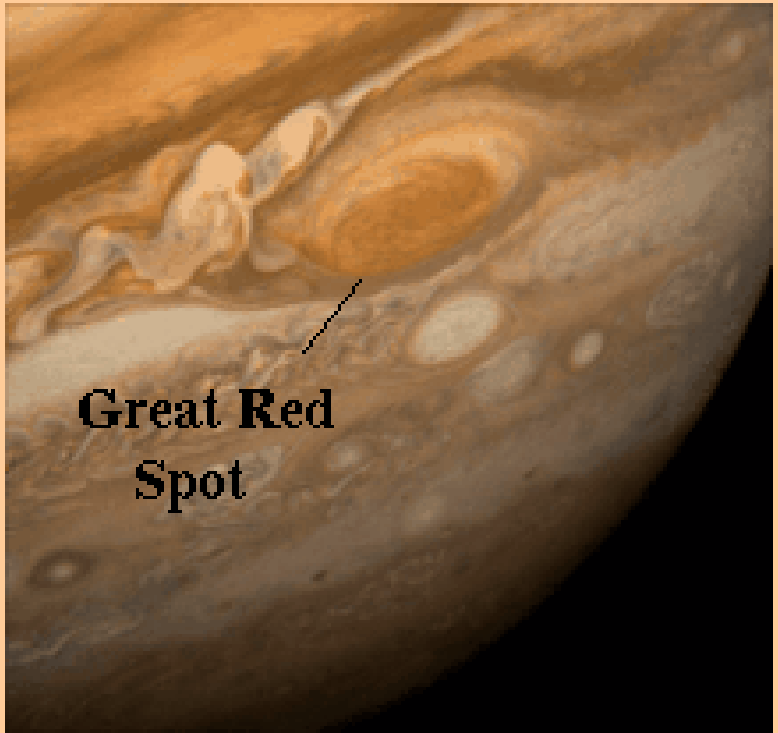


Jupiter cont.

- Being a gas giant, Jupiter's atmosphere, as well as the make up of the planet itself is mostly hydrogen and helium, with some ammonia, methane, and water vapor.
- Scientists are not fully sure of the core, but it can either be a very thick liquid, or a rocky type that would be different than anything we know of on Earth. This would be because of the extreme pressure and temperature.

Jupiter cont.

- Many continuous swirling gas storms have been observed on Jupiter, with the most famous one being labeled "**The Great Red Spot.**"



Jupiter cont.

- The Great Red Spot storm has existed at least 100 years, but may have been there as long as 400 years. Galileo reported seeing a similar storm 400 years ago.
- Three Earths could fit across the Great Red Spot.

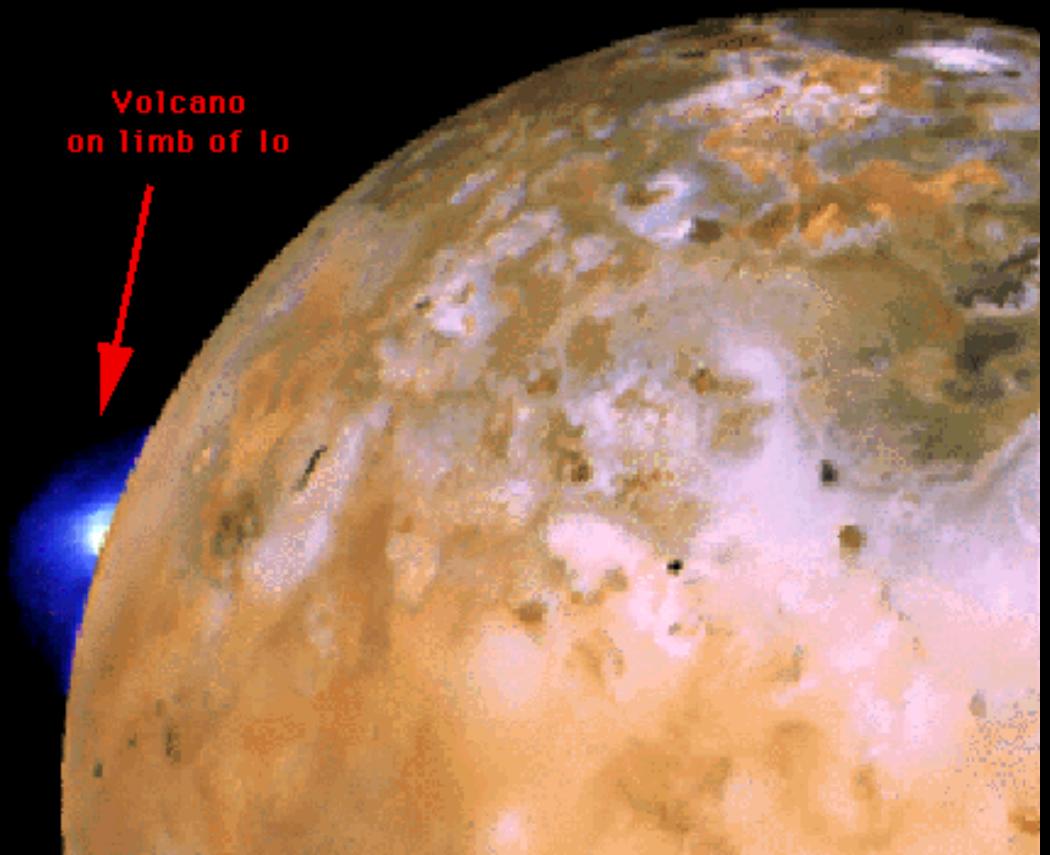
Jupiter's moons

- Jupiter is known to have at least 60 moons, but the four largest are pictured below.

IO Europa Ganymede Callisto

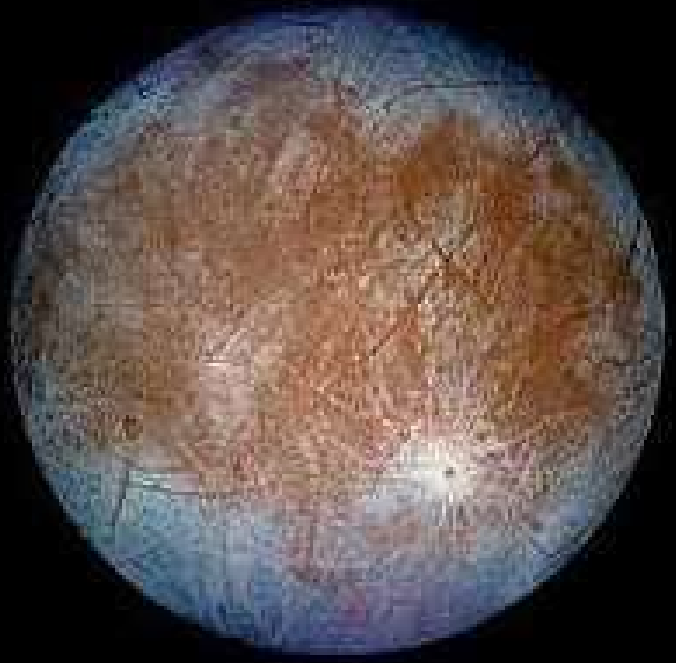
IO

- The Moon IO (pronounced “I OH”) is the closest moon to Jupiter. It is the **most volcanically active** object in the solar system. It has a thin atmosphere of oxygen, sulfur, and sulfur dioxide.



Europa

- Europa is the next moon over, and is covered by 100 km thick crust of ice.
- It has a rocky interior, and an ocean is thought to exist under the ice crust
- It has a thin oxygen atmosphere.



Ganymede

- Next is Ganymede. It is the largest moon in the solar system. It is larger than both Mercury and Pluto.
- It has a crust of ice 100 km thick as Europa does, and also has the possibility of an ocean or slushy ice under crust. The core is rocky, and the atmosphere is a thin layer of oxygen

Callisto

- The fourth closest moon to Jupiter has a heavily cratered crust of ice and rock several hundred km thick. The crust might surround a salty ocean around a rock core. It also has a thin atmosphere of carbon dioxide.

Back to Jupiter

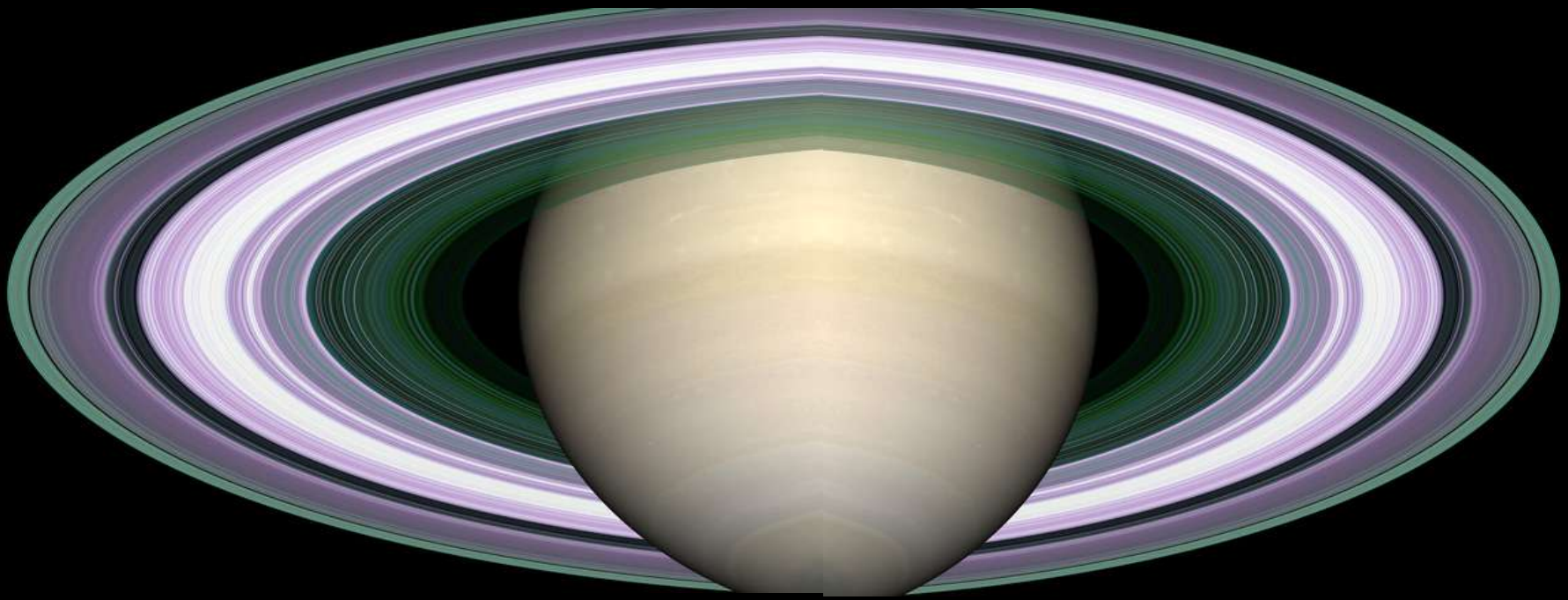
- Diameter is 142,984 km (more than 11 times the Earth's).
- Gravity is 2.36 of Earth's
- Average temperature is -110 degrees Celsius
- At least 60 moons, with four main large ones.
- Has 1 four part ring made of dust and rock.

Saturn

Sixth Planet from the Sun

- Average distance from Sun is 1.427 billion km
- Orbits the Sun in 29.42 years, and makes one full rotation in 10 hours 39 minutes.
- Second largest planet in our solar system, but has the lowest density. The density is so low that the planet would float in water!! While not as large as Jupiter, you could still fit about 750 Earth's inside Saturn.
- Saturn's atmosphere is made up of mostly hydrogen and helium, with some ammonia, methane, and water vapor.

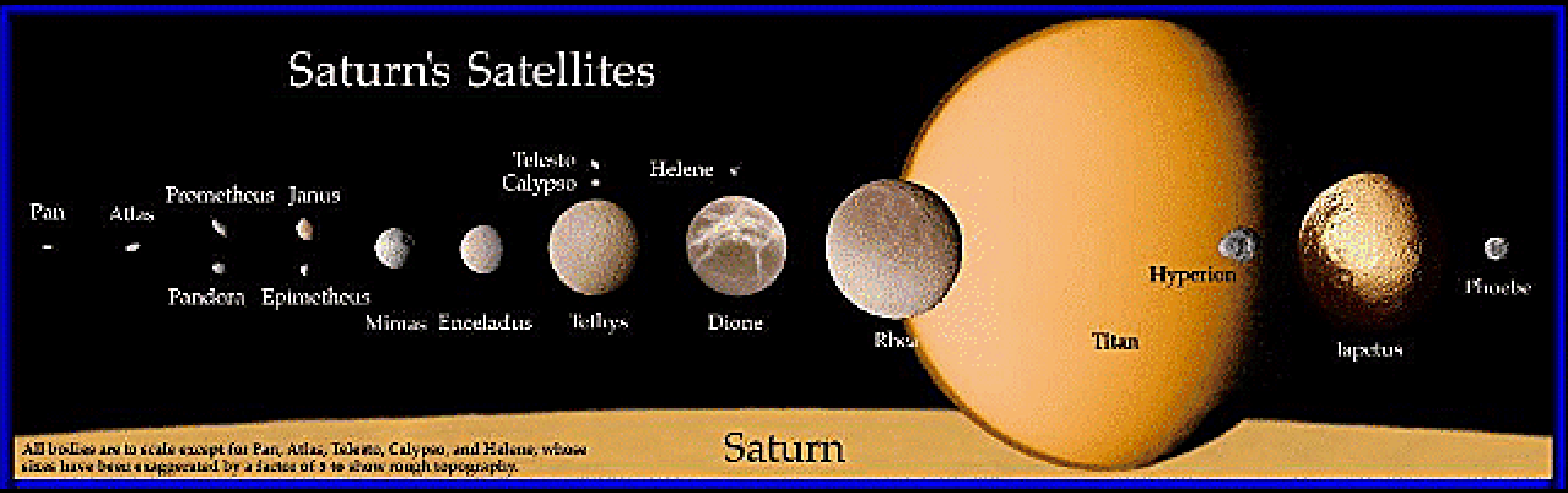
Saturn’s Rings



Saturn's Rings

- Most prominent feature about Saturn are it's famous rings. The ring system is the most complex in the solar system. The rings extend out hundreds of thousands of kilometers, and would barely fit between the Earth and our moon.
- The rings are made of pieces of rock and ice ranging from the size of a speck to tens of meters across. The rings are broken down into 7 major rings, but in actuality, there are thousands of ringlets within the major rings.

Saturn’s moons



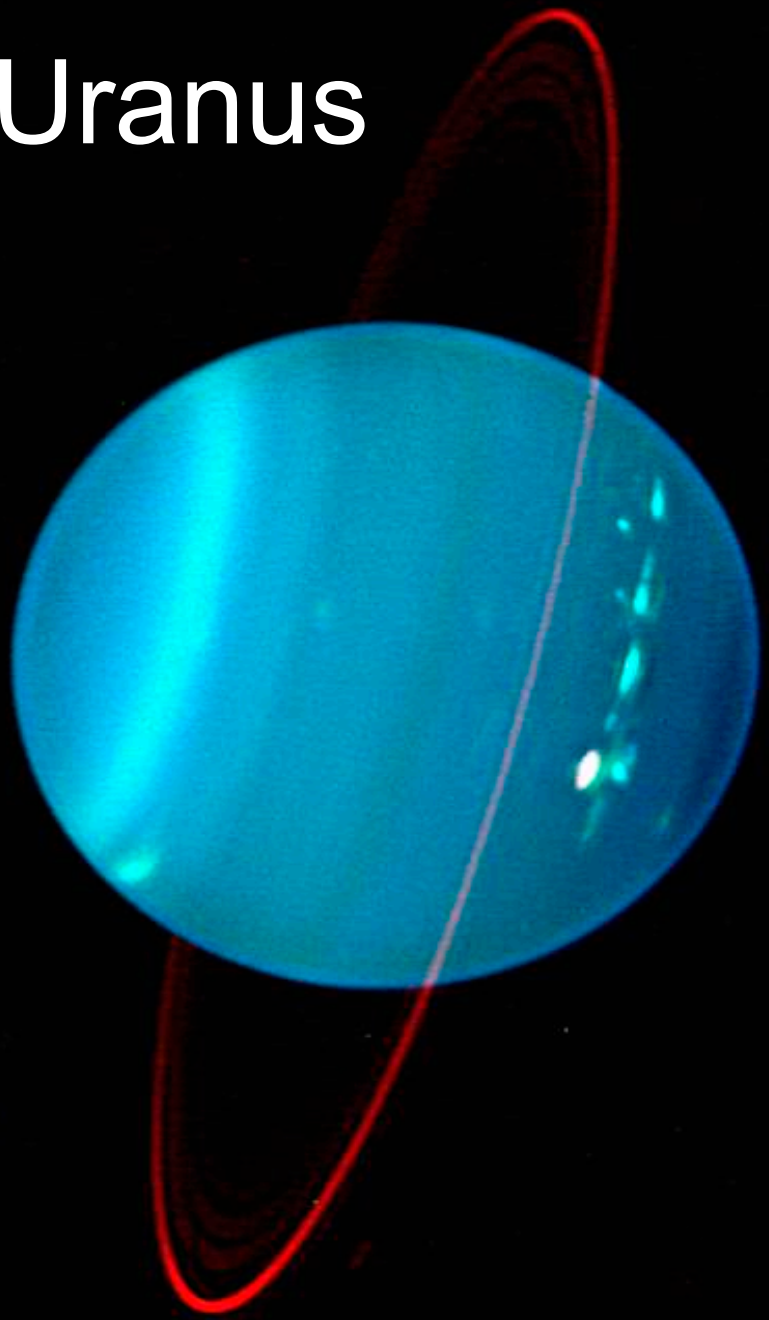
Saturn has at least 60 moons…

- The largest moon is named Titan.
- Titan is bigger than the planet Mercury and Dwarf planet Pluto (but still smaller than Jupiter's moon Ganymede).
- Titan has an atmosphere of nitrogen, argon, and methane. Thick clouds around the moon prevent scientists from seeing the surface of Titan.

More on Saturn

- Diameter is 120,536km (nearly 10 times the Earth's.
- Gravity is 0.91 of Earth's
- Average temperature is -140 degrees Celsius
- At least 60 moons, with largest being Titan
- Has 7 major rings with thousands of ringlets made of ice dust and rock.

Uranus

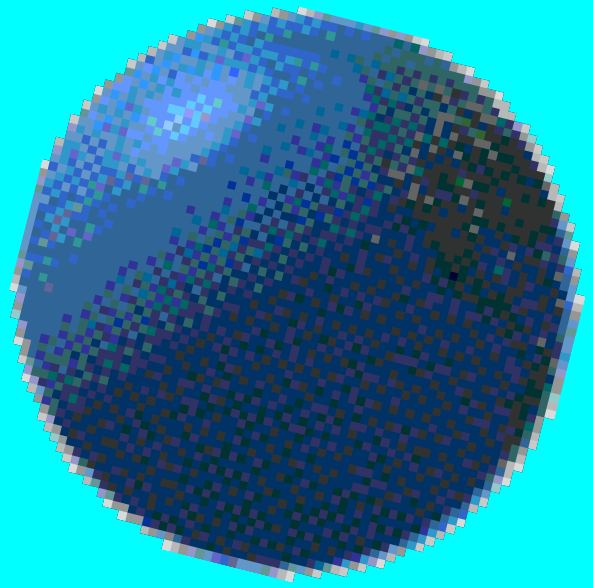


Seventh Planet from the Sun

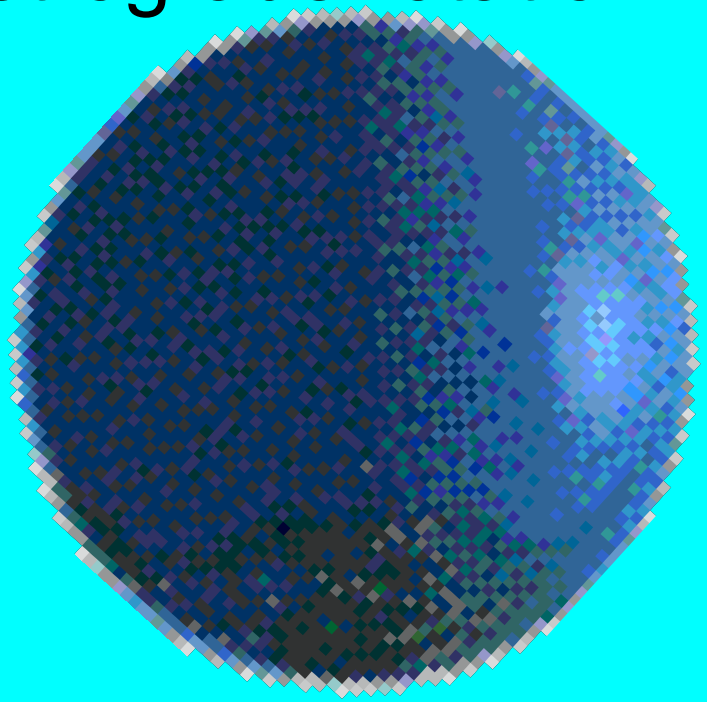
- Average distance from Sun is 2.871 billion km
- Orbits the Sun in 83.75 years, and makes one full rotation in 17 hours 14 minutes.
- Third largest planet in our solar system. It is about four times the diameter of Earth.
- Uranus's atmosphere is made up of mostly hydrogen, helium, and methane. The methane causes the planet to have a bluish green appearance. The planet is also a gas giant so it has no solid surface. Under the atmosphere is thought to be a mantle of liquid and solid water, methane, and ammonia surrounding a rocky core

Uranus's most interesting feature is…

- Its axis of rotation is nearly parallel to its orbital path. It also has retrograde rotation.



Normal rotation:
Near Perpendicular to orbit



Uranus's rotation:
Parallel to orbit

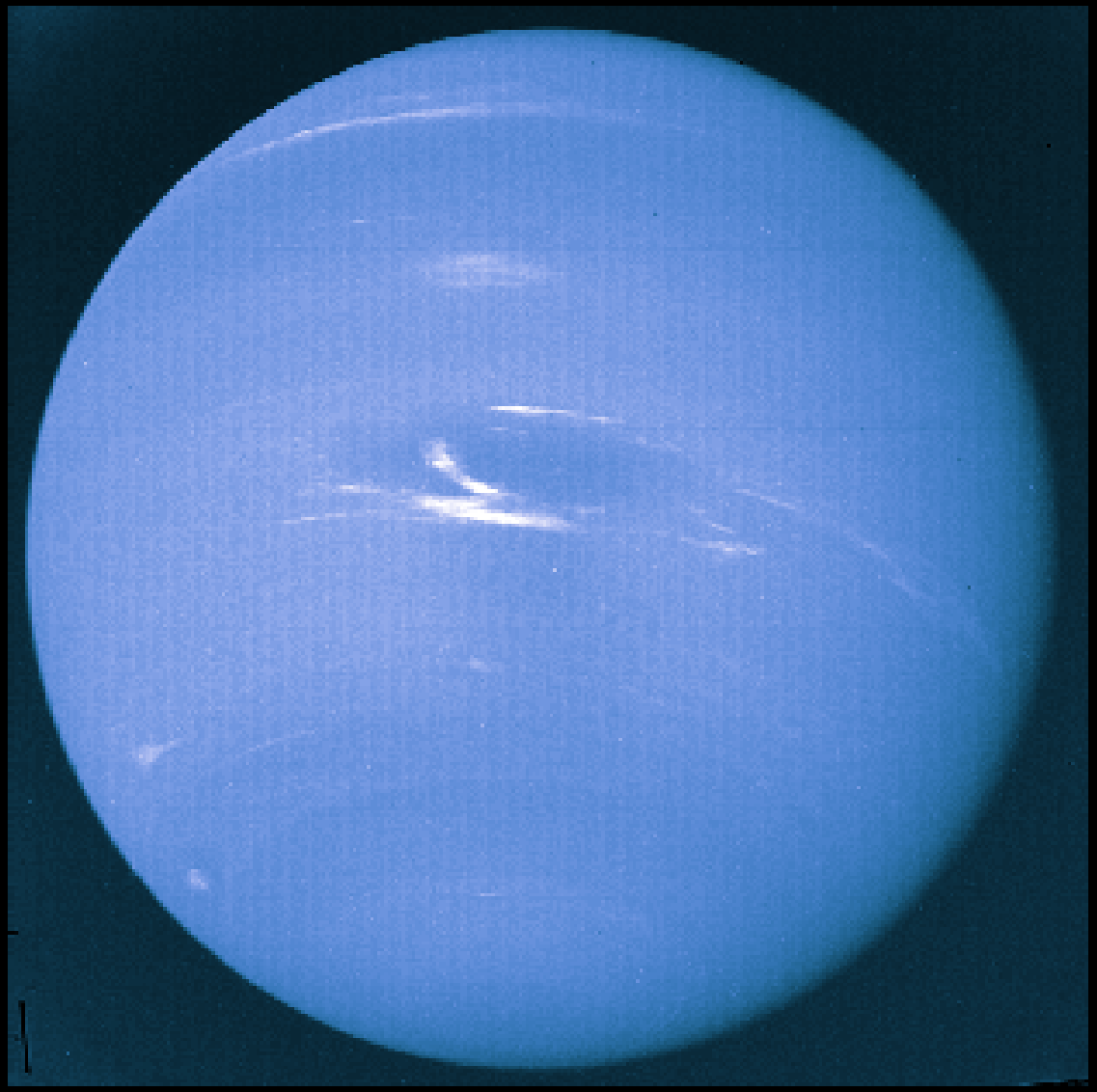
Uranus Cont.

- Some scientists think its axis of rotation is due to a collision with another planet.
- While this incredible axis causes very long “seasons” (over 20 years long), the temperatures do not vary much because of its distance from the Sun. The temperature near the cloud-tops is about -215 degrees Celsius.

More on Uranus

- Diameter is 51,118 (nearly 4 times the Earth's.
- Gravity is 0.889 of Earth's
- Average temperature is -195 degrees Celsius
- Has 21 moons, and 11 rings. These rings are different than Jupiter's and Saturn's; they consist of a fine dust.

Neptune



Eighth planet from the Sun

- Average distance from Sun is 4.498 billion km
- Orbits the Sun in 164.79 years, and makes one full rotation in 16 hours 7minutes. It has recently made its first orbit around the Sun since it was discovered in 1846.
- What year will Neptune have completed one full orbit?
- 2011
- While it is considered the eighth planet, it is actually farther from the sun than Pluto for a 20 year period out of every 248 earth years.
- Smallest of the Jovian or Gas Giants, but the fourth largest planet in our solar system. It is about three and three-quarters times the diameter of Earth.
- Neptune's atmosphere is made up of mostly hydrogen, helium, and methane. Very similar to Uranus and also giving it a bluish green appearance because it absorbs red and yellow light.

Neptune cont.

- Under the atmosphere and gaseous surface is thought to be a layer of liquid water, methane, and ammonia that might change to solid ice. It probably has a rocky core.
- Similar to Jupiter, a major storm was discovered in 1989 and was named “The Great Dark Spot,” but in 1997, it could not be seen again. This leads us to believe that the atmosphere is active and changes rapidly.

More on Neptune

- Diameter is 49,528 (nearly 3.75 times the Earth's.
- Gravity is 1.12 of Earth's
- Average temperature is -200 degrees Celsius
- Has 13 moons, with Triton being the largest and has a thin atmosphere composed of mostly nitrogen. It also has four rings

Pluto

The Dwarf Planet

- Average distance from Sun is 6 billion km
- Orbits the Sun in 248 years, and makes one full rotation in 6 hours 7minutes. Also has not made it fully around the Sun since it was discovered in 1930.
- Between 1979 and 1999, Pluto was closer to the Sun than Neptune; this gave us a good opportunity for study this planet and it's moon.
- Not considered a Gas Giant even though it is an outer planet. It's surface appears to be a frozen layer of methane, nitrogen and carbon monoxide. It is believed that it has a rocky core.
- When closest to sun, these ices thaw causing a thin atmosphere.

Pluto continued

- Pluto's diameter is about one-fifth of the Earth's, and about two-thirds of the Earth's moon.
- No spacecraft have ever been to Pluto. Since it is so far away and so small, it is hard to make good observations even with our technology today.
- Pluto has one moon called "Charon," and it is nearly half the size of Pluto. Because of the closeness of the size of it's moon, some scientists used to consider Pluto and Charon a double planet.

More on Pluto

- Diameter is 2,390 (only about 1/5 of the Earth's).
- Gravity is 0.08 of Earth's
- Average temperature is -225 degrees Celsius
- Has 1 moon- Charon, and has no known rings