

Our Solar System

And the Spacecraft Sent to Explore It

Types of Planets

- The four innermost planets are known as *terrestrial* planets, since they are similar to the Earth in structure.
- The next four planets, the gas giants, are known as *jovian* planets, since they are similar to Jupiter in structure.
- The last planet, Pluto, is neither a jovian or a terrestrial planet. It is considered by some not to be a planet at all.

Terrestrial Planets

- Terrestrial planets possess the following properties:
 - Small in size
 - Rocky and dense
 - Low mass
 - Few if any moons
 - Thin atmospheres

Jovian Planets

- Jovian planets possess the following properties:
 - Large in size
 - Gaseous and low in density
 - High mass
 - Many moons
 - Thick atmospheres
 - Planetary rings

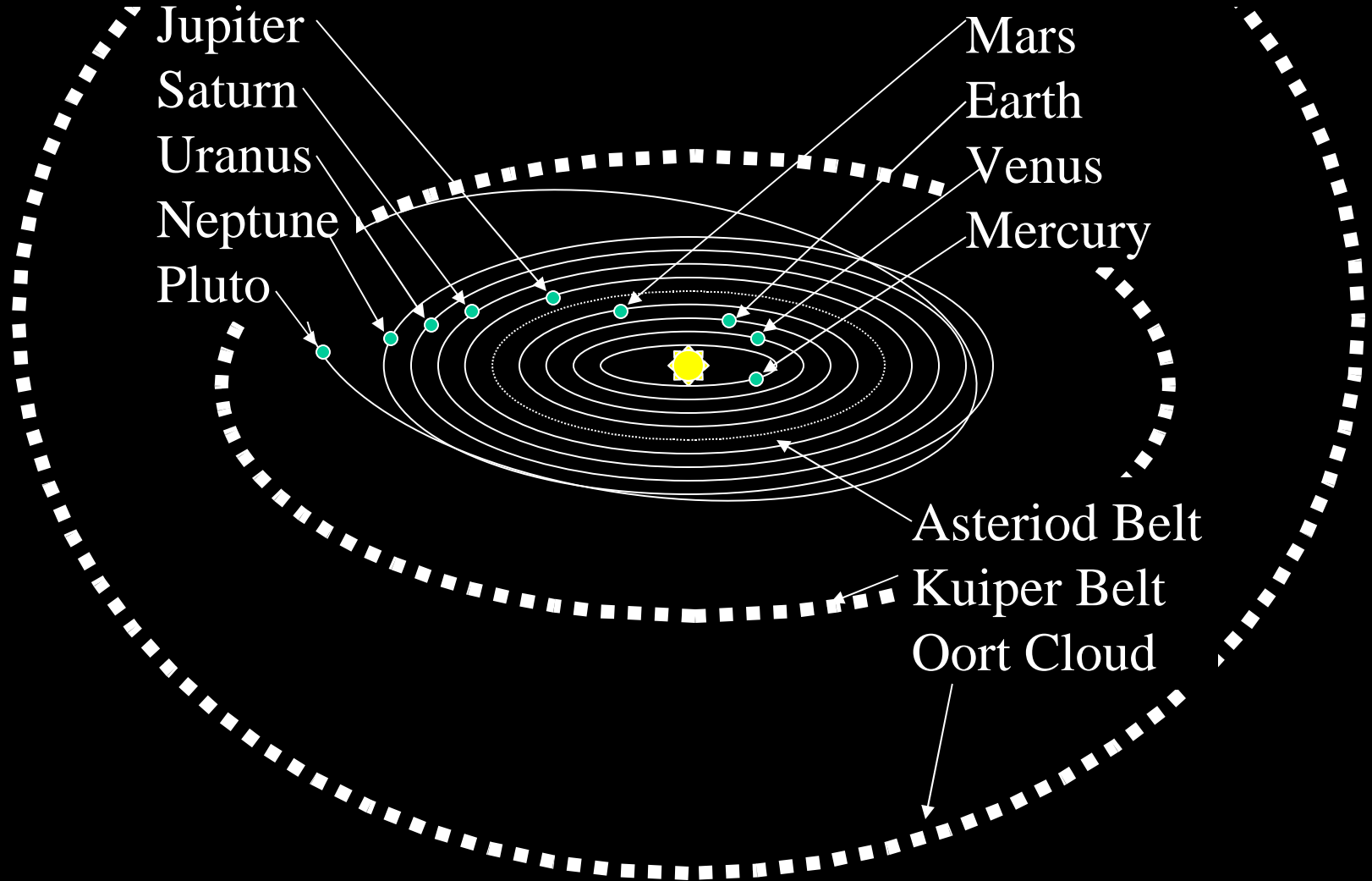
The Reason for the Differences

- Terrestrial and jovian planets are different in structure because of the different temperatures at which they formed.
- Terrestrial planets formed close to the Sun where the temperatures were high and the only solid materials around were rocks and metals.
- Jovian planets formed further away from the Sun where the temperatures were cool enough to allow for the solidification of lighter compounds such as water, ammonia, and methane.

Other Solar System Inhabitants

- Other than planets, our solar system is also populated by asteroids, comets, and other Pluto-like object.
- Asteroids are large chunks of rock and metal that are typically found in a belt between the orbits of Mars and Jupiter.
- Comets are large chunks of ice that are typically found in the Oort Cloud about 50,000 AU from the Sun, but occasionally will drift into the inner solar system.
- There are many other objects like Pluto in what is called the Kuiper belt which begins at a distance of 50 AU.

Schematic of Our Solar System



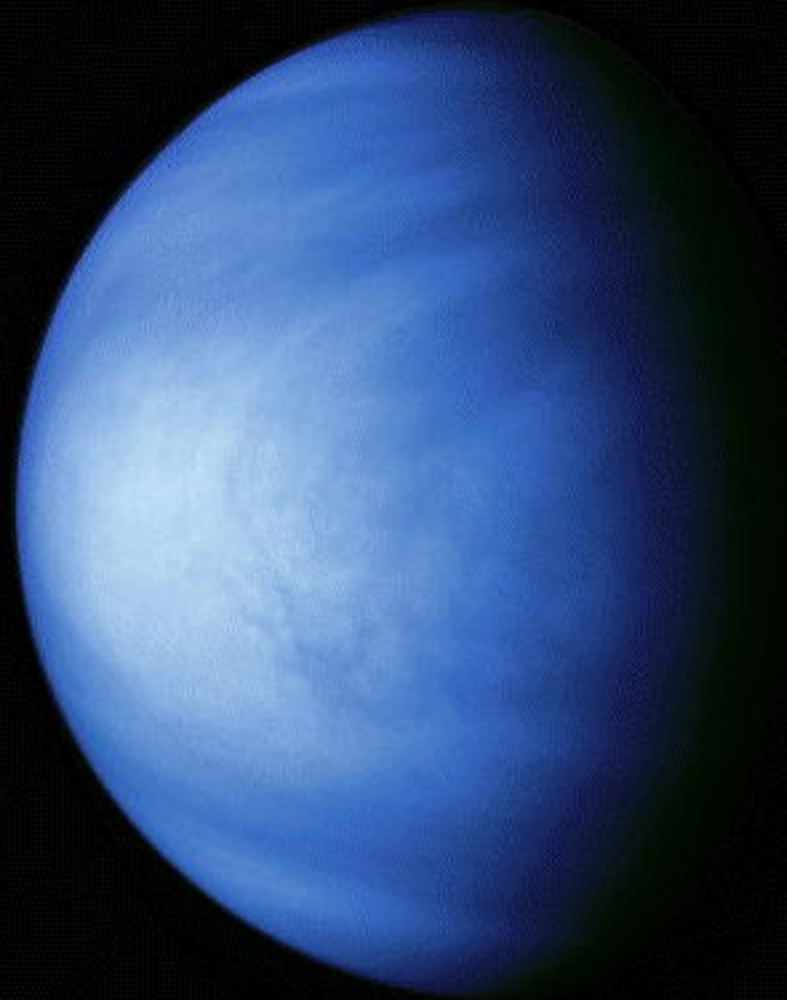


Mercury

- Closest to the Sun
- Largest temperature difference: 100 K - 700 K
- Surface of Mercury and the surface of our Moon bear the closest resemblance share by any other two bodies in the Solar System.
- Visited by Mariner 10 and 11

Venus

- Highest surface temperature: ~ 725 K.
- Atmosphere is VERY thick for a terrestrial planet and is 96% carbon dioxide.
- Visited by Magellan, and Venera 9 and 10, and many others.



Earth

- Most dense planet.
- Only planet with a significant amount of liquid surface water.
- Only planet known to support life.



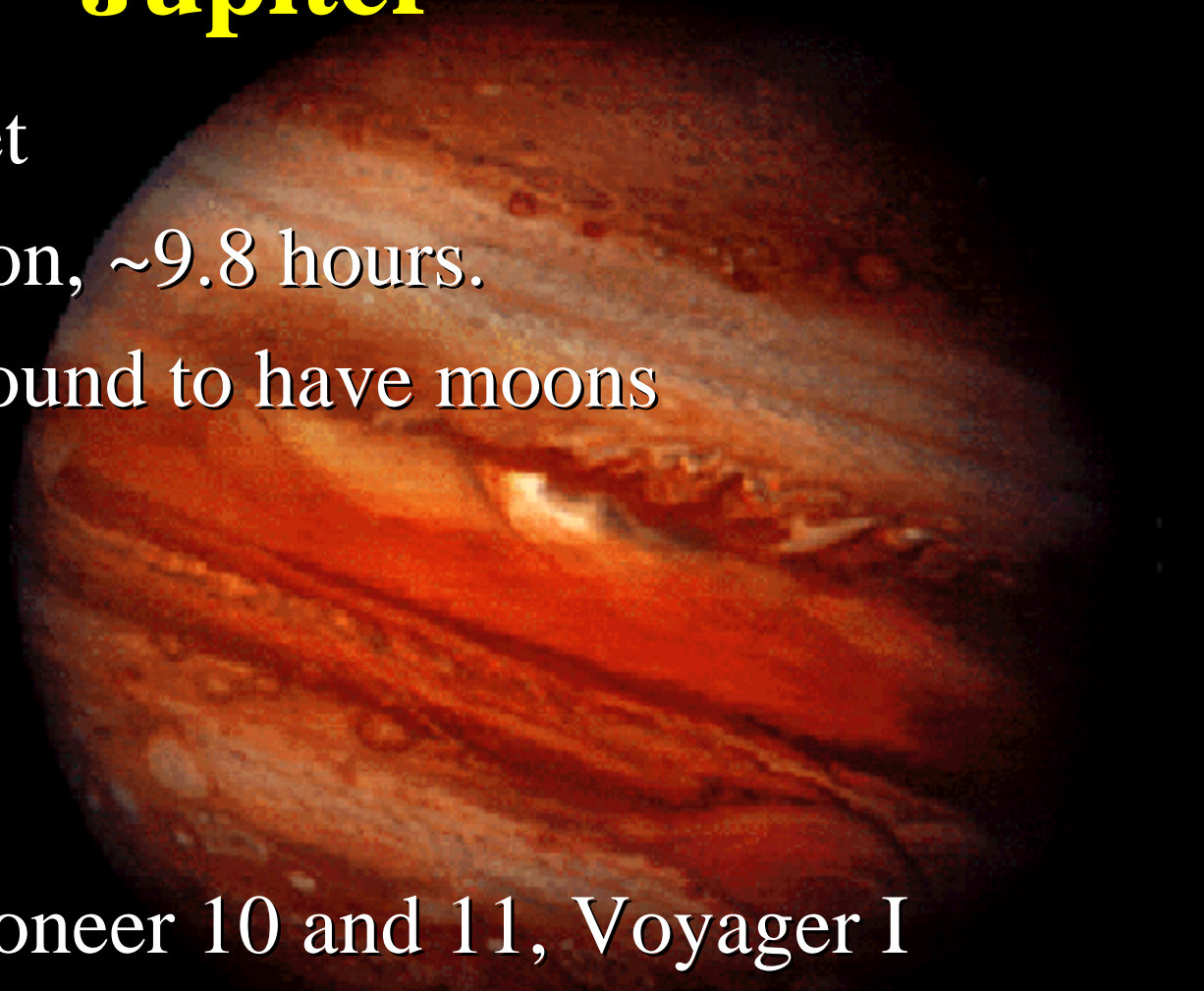


Mars

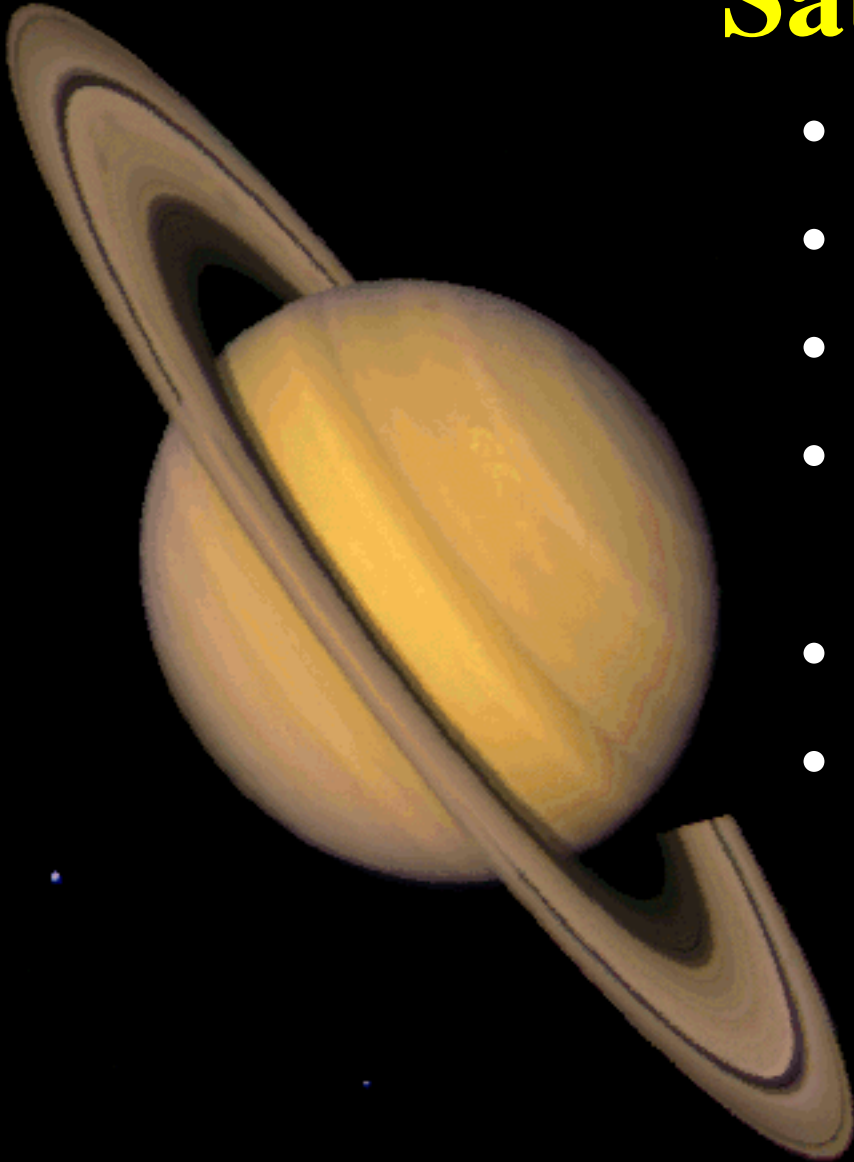
- **Red in color due to large amounts of iron oxide (rust) in the soil.**
- **Has about the same rate of rotation and axial tilt as the Earth.**
- **Visited by Viking I and II, Pathfinder, Mars Global Surveyor, and many others.**

Jupiter

- Largest planet
- Fastest rotation, ~9.8 hours.
- First planet found to have moons
 - Io
 - Europa
 - Ganymede
 - Callisto
- Visited by Pioneer 10 and 11, Voyager I and II, Galileo and Cassini



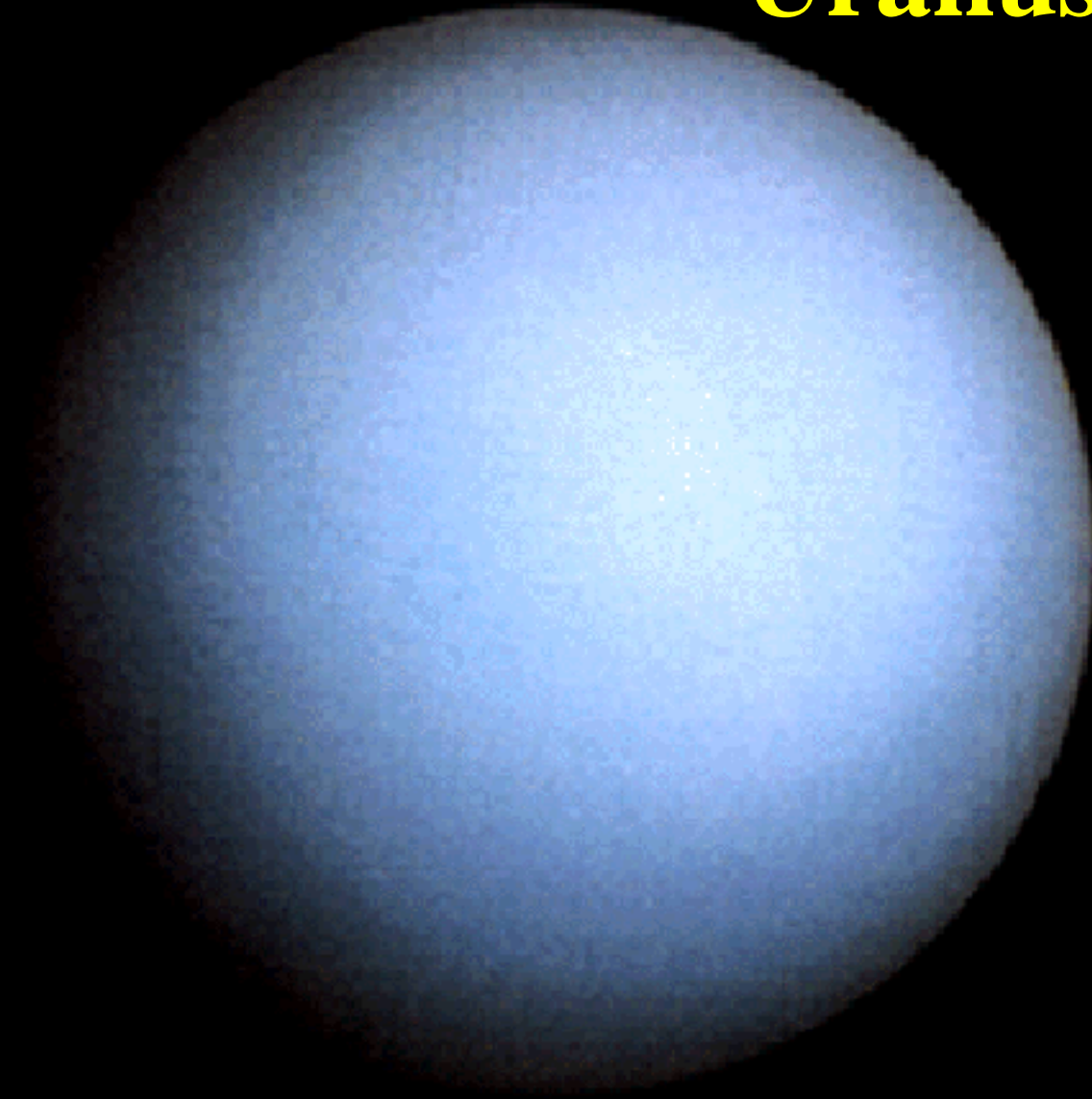
Saturn



- Most elaborate ring system.
- Most oblate shape.
- Fastest measured winds.
- Has the only moon with an atmosphere: Titan
- Visited by Voyager I and II.
- Soon to be visited by Cassini.

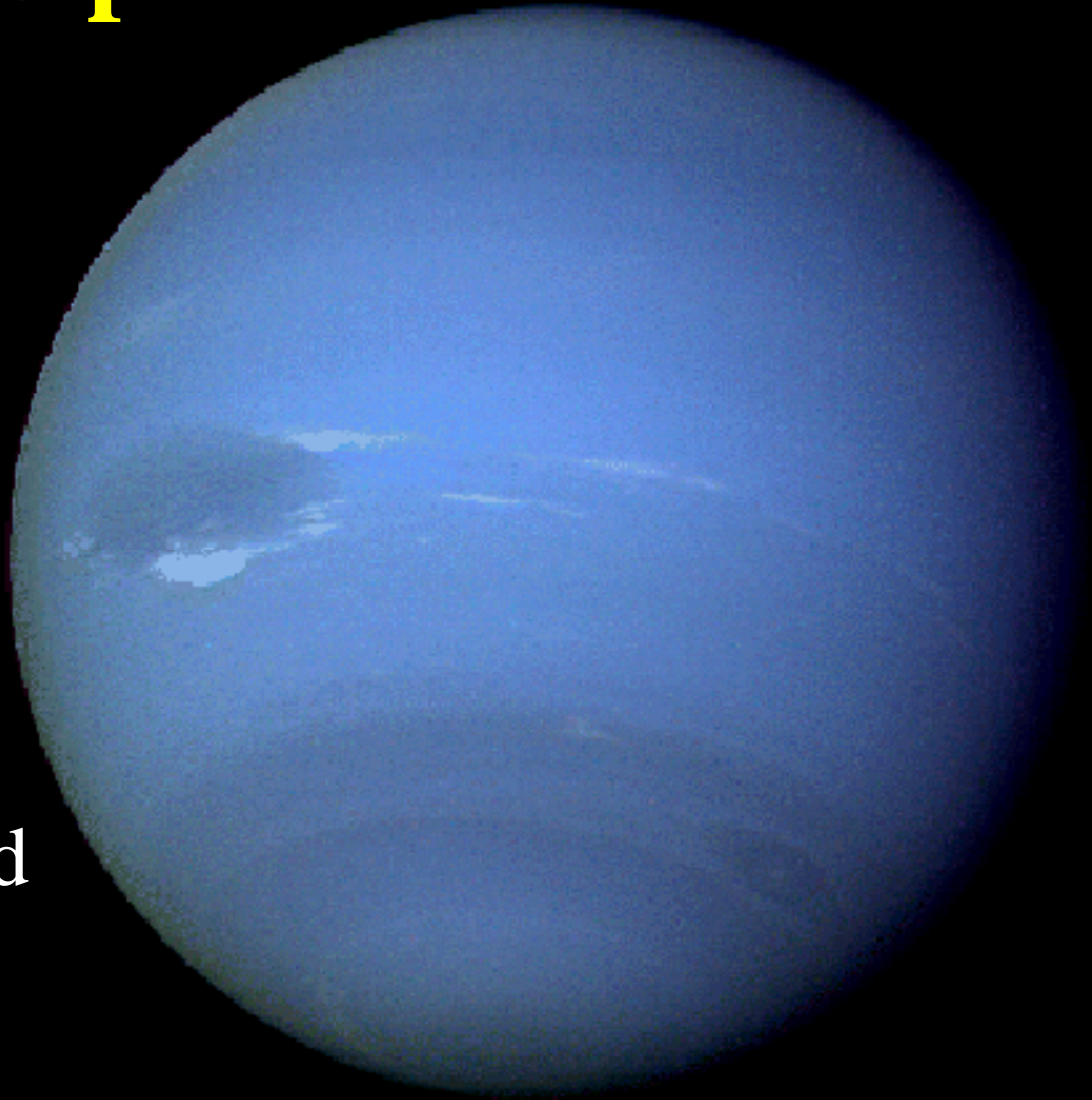
Uranus

- Largest axial tilt: 98 degrees.
- First planet to be discovered telescopically.
- Visited only by Voyager II.

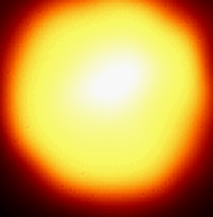


Neptune

- Only planet to be discovered mathematically.
- Visited only by Voyager II
- One of its moons, Triton has volcanoes of liquid nitrogen.



Pluto

- Smallest planet.
 - Its moon Charon is almost as large as Pluto.
 - Discovered by Kansas native, Clyde Tombaugh.
 - Never visited by any spacecraft.
- 

Asteroids, Comets, and Kuiper Belt Objects

- Asteroids
 - Rock crust with metal core
 - Mainly found in the asteroid belt
- Comets
 - All ice with dust coating
 - Mainly found in the Oort Cloud
- Kuiper Belt Objects
 - Ice crust with rock core
 - Very similar to Pluto in structure



Our Robotic Explorers

- Most of our information about the objects in our solar system is obtained by robotic probes.
- All of the planets have been visited by spacecraft except for Pluto.
- Even asteroids and comets have been observed by probes.

The image shows the Mariner 10 spacecraft, a small probe with a central body and two large, rectangular solar panels extending outwards. The spacecraft is positioned in the upper left quadrant of the frame. The background is a dark, starry space.

Mariner 10

- **Made three successful flybys of Mercury.**
- **Main objective was to photograph the surface of Mercury and search for an atmosphere and magnetic field.**
- **Mariner did find a very thin helium atmosphere, but only an extremely weak magnetic field.**
- **Mariner also made gravitation probes of Venus on one of its flybys of the planet.**

Magellan

- Magellan used radar to penetrate the opaque cloud deck and map the surface.
- The Magellan data were far better than any other mapping data previously taken.
- The results of the Magellan data made it necessary to significantly modify, or in some cases abandon, models of planetary surface modification.

Viking I & II, and Pathfinder

- The Viking and Pathfinder probes were both landers.
- Viking I and II were fixed landers. That is they were immobile once they landed.
- Pathfinder was composed to two parts, a base lander which was fixed in position and a remote controlled rover which could roam around the surface nearby the base.
- All of these probes were designed to record weather conditions and take soil samples.



Mars Global Surveyor

- MGS is a currently ongoing mission to map the surface of Mars.
- Unlike Magellan, MGS uses optical wavelengths for its mapping.
- So far, many unexpected surface features have been found.
 - Sandstorms and dust devils
 - Signs of recent mudslides

Voyager I and II

- These twins were designed to photograph the outer planets and measure the plasma environment.
- Voyager I ended its mission with a close flyby of Saturn's moon, Titan.
- Voyager II is the only probe to visit Uranus and Neptune.
- Voyager II is still functioning and sending data back on the environment past Pluto at a distance of ~ 85 AU.



Galileo



- Galileo was designed to orbit Jupiter and study the plasma environment and Jupiter's four Galilean moons.
- Galileo also released a probe into the Jupiter's atmosphere to determine the composition and structure of the atmosphere.
- Galileo's repeated visits to the four Galilean moons have revealed much about their structure.
- One of the most significant findings was the presence of a salt water ocean under the surfaces of both Europa and Ganymede.
- Galileo also found that Ganymede may be the only moon in the solar system to have its own magnetic field

Cassini

The background of the slide is a digital illustration of the Cassini spacecraft in orbit around Saturn. The spacecraft is shown in the center-left, with its complex structure and antennas visible. Saturn's large, orange-brown globe is on the right side, partially cut off by the edge of the frame. The planet's rings are visible as a series of grey and white bands. The background is a dark blue space filled with small white stars.

- **The objectives of the Cassini mission are similar to those of the Galileo mission except that Cassini is destined for Saturn.**
- **The Cassini spacecraft released a probe, called the Huygens Probe, into the atmosphere of Titan to determine its composition, and to take aerial imagery of the surface.**

Giotto

- First spacecraft to visit a comet.
- Rendezvoused with Halley's Comet in 1986.
- Giotto gave scientists their first close-up look at a comet's nucleus.
- Also took samples of the material surrounding the comet to determine the comet's composition.

NEAR

- **NEAR was the first probe to enter an orbit around an asteroid.**
- **NEAR has approached as close as 50 km to the asteroid Eros.**
- **In addition to some fantastic photographs, NEAR is also probing the gravitational and magnetic fields of Eros and using remote techniques to determine the composition of the asteroid.**



**Near Earth
Asteroid Rendezvous**

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ACE and Ulysses



- ACE and Ulysses have similar instrument packages designed for investigating the Sun and the solar wind.
- ACE is in a fixed orbit around the L1 point between the Earth and Sun.
- Ulysses is the only spacecraft ever to be in a heliopolar orbit.
- Ulysses has given us the only view of the Sun's poles that scientists have.