18: *Leaving Earth—Our Solar System*

Ever since there have been people, I suppose they have been staring out into space at night in amazement at the endless number of heavenly lights. We can see these lights rising and falling in the sky from east to west. People who cared about these sorts of things once thought that Earth was at the center of all of these lights and that they all moved about us. This school of thought was called **geocentric**, or "Earth-centered," thinking. But from the mid 1500's those thoughts were changed to **heliocentric**, or "sun-centered," thinking, led by a Polish astronomer named Copernicus. He showed through his studies that the sun is at the center of our solar system, and that the Earth and the other planets revolve around it.

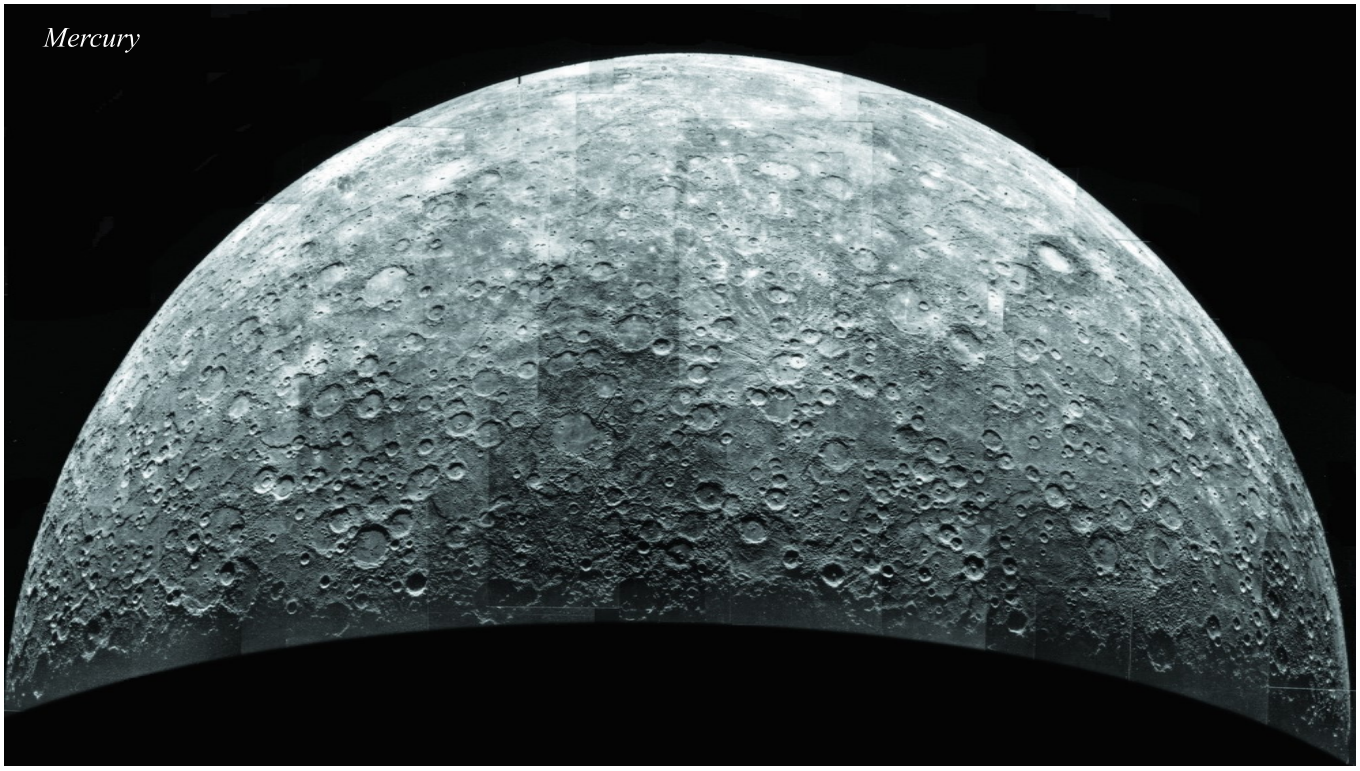
The religious people in the day of Copernicus had made a huge mistake. Many of them believed that if God made the Earth for His special purposes, and if the rest of the universe was here for the pleasure of man, then God must have put the Earth right smack in the middle of it. As you can imagine, Copernicus (as well as others who studied the "heavens") upset a lot of people with his observations. From this, we learn an important lesson. We mustn't let our personal beliefs and opinions take the place of the truth. Even today, atheists point to this example of the error of religious people who deny "the truth" in favor of religion. No person was ever made to feel ashamed for accepting God' s words, but people are often proven wrong and made to feel ashamed for using the words of God to support their own opinions.

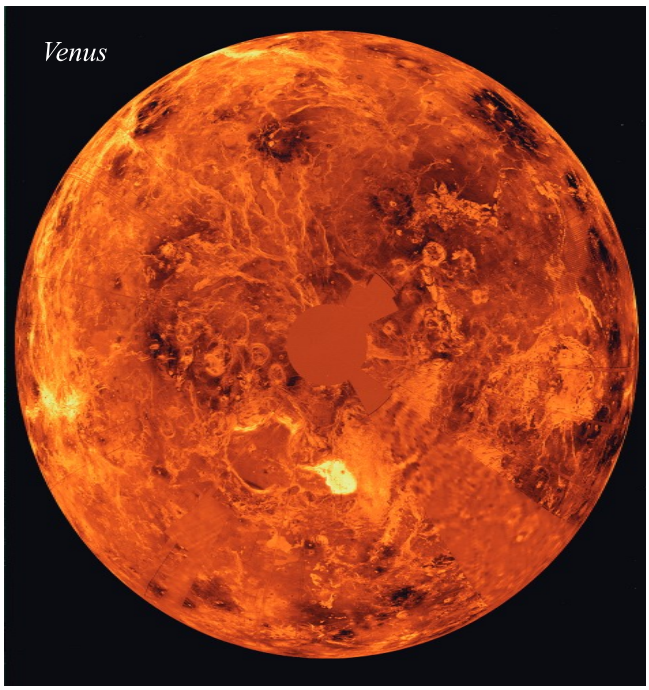
Now it is known (as well as man can know) that the sun has a system of at least nine planets that **revolve** around it. They are, in order of their distances from the sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. The first four are called the **terrestrial planets** because they are made up of mostly solid materials. They are relatively small and close to the sun. Except for Pluto, the other planets are thought to be made up of mostly hydrogen, helium, methane and ammonia. Pluto is so small and distant, we don't know a lot about it, but it is thought to be more solid than its larger neighbors. While all other planets revolve around the sun on the same plane, Pluto has a path around the sun that is tilted with respect to the others. It also has a moon that is half its own size. You could think of Pluto as two planets revolving around each other as they both revolve around the sun.

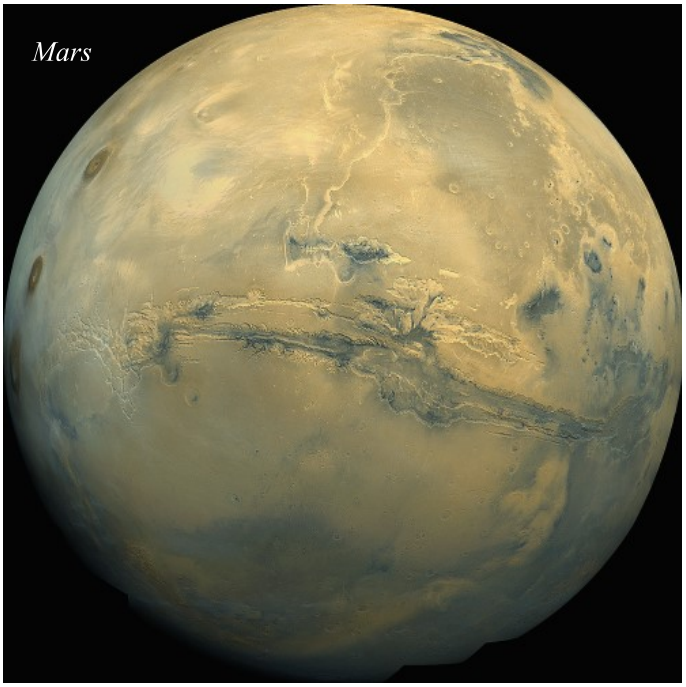
The moon is the only celestial body besides the sun close enough to see as a planet with the naked eye rather than a point of light. We can also visibly see the impact this closest neighbor has on Earth by the rising and falling tides of the oceans that are in large part caused by the gravitational attraction of the moon for the earth.

The Earth's moon

The terrestrial planets are close in size to the Earth yet nothing is believed to live on them. Is it chance that among these terrestrial planets so similar in vicinity to the sun that only one has the incredible necessities to sustain life? Although Mars is referred to as the "red planet," Venus appears reddish in the photo below due to the photography techniques used.



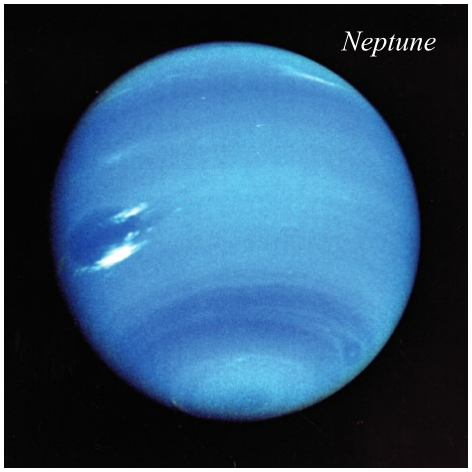




Between the terrestrial planets and the outer planets there is a ring of rock-like objects that also orbit the sun. These are called **asteroids**, and the group that they form is called the **asteroid belt**. **Meteoroids** are rocks that have different orbits from the asteroid belt and are believed to have resulted from asteroid collisions. **Meteors** are rock fragments that enter the atmosphere of a planet, especially Earth. We see them at night burning up as they enter the outer atmosphere because of friction between the atmospheric gases and the solid meteor. We call them "shooting stars" because to us they look like stars shooting across the sky. Occasionally one of these objects is massive enough to survive the intense heat of the friction and hits the Earth. Such objects are called **meteorites**. The Earth shows signs of having been hit by some pretty big meteorites. Some scientists even suggest that global changes in temperature following a large meteorite were responsible for the extinction of the dinosaurs.

It's fun to listen to scientists speculate; and it's harmless as long as we realize that it is just that—*speculation*. Scientists are just people. Occasionally people get passionate about their speculations and try to convince others that these speculations are true. Just because someone is passionate about something doesn't make it true. Be sure you test everything on the basis of its evidence and not on the basis of the beliefs or passions of others.

Comets are other objects that revolve around the sun. These are collections of dust, ice, liquids and gases. They are made up of a disk-shaped **coma** and a long **tail** of ionized gases. A comet



The outer planets are also called the Jovian planets, *named after the Roman emperor Flavius Claudius Jovianus. The temperatures on these planets' surfaces are believed to be below -100°F.*

Table: Characteristics of Planets

Planet	Diameter (km)	Relative Mass (Earth = 1)	Distance from Sun (km)	Length of Day (Earth time)	Length of Year (Earth time)	Number of Satellites
Mercury	4880	0.055	57,900,000	59 d	88 d	0
Venus	12,100	0.815	108,200,000	243 d	117 d	0
Earth	12,756	1	149,600,000	23 hr, 56 min	365 d	1
Mars	6,794	0.107	227,900,000	24 hr, 37 min	687 d	2
Jupiter	142,984	318	778,300,000	9 hr, 55 min	11.86 yr	16
Saturn	120,536	95.2	1,429,000,000	12 hr, 39 min	29.46 yr	18
Uranus	51,100	14.5	2,875,000,000	17 hr, 18 min	84 yr	15
Neptune	49,500	17.2	4,504,000,000	16 hr, 06 min	165 yr	8
Pluto	2,300	0.002	5,900,000,000	6 d, 9 hr, 18 min	248 yr	1

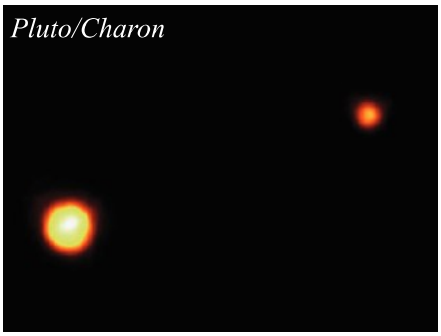
Planet	Composition	Features
Mercury	Silicates, nickel, iron	Swiftest planet; daytime 400°C, nighttime 180°C
Venus	Silicates, nickel, iron	Days longer than Earth years
Earth	Silicates, nickel, iron	Life
Mars	Silicates, iron sulfide	Red surface
Jupiter	Liquid hydrogen, molten rock	Largest planet
Saturn	Liquid hydrogen, water, ammonia, molten rock	Rings
Uranus	Liquid hydrogen, helium, ammonia, water, molten rock	Tilt is 82.1° from vertical (Earth's tilt is 23.5°)
Neptune	Liquid hydrogen, helium, ammonia, water, molten rock	Orbit's path crosses with Pluto's
Pluto	Unknown	Smallest planet; moon of comparable size

shines brightly as it approaches the sun, and the **solar wind** blows the tail away as the comet circles nearby. The comets travel long, narrow, elliptical orbits (that is, orbits that look like circles stretched out of shape). These orbits extend far beyond the planets into the galaxy. A few visit the Earth often, but most of them are on paths that will bring them back only over periods of thousands of years.

We have a **moon** that revolves around our Earth, but we are not the only planet to have one. In fact, the planet Jupiter has at least 16 moons, each of them being its own fascinating place. Two of those moons are big enough to be considered planets if they revolved around the sun instead of Jupiter. Another word for moon is **satellite**. A satellite is any object that circles (**orbits**) a planet. Humans have put artificial satellites around the Earth and other planets to help us "view" these bodies from high above their surfaces.

The **sun** is an enormous ball of hydrogen that is burning under force of a nuclear reaction where hydrogen is being fused together to form helium while giving off a tremendous amount of energy. Approximately one million Earths would fit inside the sun. The sun shines its rays on us from 93 million miles away. At the speed of light, it requires approximately eight minutes for light leaving the sun to get here.

This photo taken on the Galileo mission shows asteroid 243 Ida and its small satellite Dactyl (right). Ida is 58 KM along its long axis.



This image of Pluto and its satellite Charon were taken by the NASA Hubble Space Telescope with the Faint Object Camera.

Exercises:

1. What force keeps planets from flying out into space? (Review Red Lesson 5 if necessary.)
2. What influence keeps planets from falling into the sun under gravitation?