

## Ch 23 - The Planets & Solar System

### Lesson I - The Inner Planets

Our solar system has nine planets that orbit the sun.

The planets are grouped by position as \_\_\_\_\_ (four closest to the sun) or \_\_\_\_\_ (five farthest from the sun). \_\_\_\_\_ orbit between Mars and Jupiter divide the two groups.

The planets are also grouped by properties as \_\_\_\_\_ (earthlike) or \_\_\_\_\_ (Jupiterlike). The earthlike planets are \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. All are similar in size, all are much more dense than water, and all are thought to have similar inner structures (rocky crusts with denser mantles and cores).

\_\_\_\_\_, a dwarf planet, is not dense enough to be considered terrestrial nor large enough to be Jovian.

\_\_\_\_\_ - terrestrial planet nearest the sun. Smallest of the four terrestrial planets (1/3 the diameter of Earth). \_\_\_\_\_, the result of huge rocks striking the planet's surface, cover 75% of its surface. The planet has almost no atmosphere.

\_\_\_\_\_ - Considered Earth's twin due to their proximity to one another and the similarity in size, mass, and gravity. Unlike Earth, Venus rotates east to west. The dense atmosphere of Venus is mostly carbon dioxide, which prevents much of the heat from escaping the planet. This trapping of heat is called the \_\_\_\_\_ effect.

Venus and Mercury are seen only at sunrise or sunset due to the fact that their orbits are nearer the sun than Earth's. When seen near sunset the planets are called \_\_\_\_\_ stars. When seen before sunrise they are called \_\_\_\_\_. Other planets can be seen all night.

\_\_\_\_\_ - Third rock (terrestrial planet) from the sun. Geologically active due to the movement of tectonic plates; oceans cover more than 70% of its surface; atmosphere contains 78% free \_\_\_\_\_, 21% free \_\_\_\_\_; its axial tilt of 23.5° results in four seasons for its northern and southern hemispheres; only planet known to support life. The Earth is about \_\_\_\_\_ km from the sun and its period of revolution takes 365.25 days.

\_\_\_\_\_ - Fourth planet from the sun. Its diameter is about one half that of Earth. Mars' axis is tilted at almost the same angle and in the same direction as Earth. Mars has four seasons that are about twice as long as Earth's due to its 687 (Earth) day period of revolution. Mars' thin atmosphere is 95% \_\_\_\_\_ and 5% nitrogen. Mars' polar ice caps are carbon dioxide and water. Great dust storms periodically blanket the planet. The largest known volcano in the solar system, \_\_\_\_\_, and a canyon system nearly as long as the U.S., Valles Marineris, are significant surface features.

### Lesson II - The Outer Planets

The Jovian planets are \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. All are large, all are less dense than terrestrial planets, and all have similar structures, such as a liquid mantle and gaseous outer layer. The Jovian planets are composed mainly of the light elements \_\_\_\_\_ and \_\_\_\_\_, while terrestrial planets are made of iron, \_\_\_\_\_, \_\_\_\_\_, and other heavy elements. Jovian planets also have features such as \_\_\_\_\_ systems, with many particles in orbit over the planets' equators. They also have numerous moons.

\_\_\_\_\_ - Largest planet in the solar system with almost twice as much mass as all other planets combined; yet, it rotates faster than any other planet – once every 10 hours. Jupiter's gaseous surface consists of alternating light- and dark-colored bands that run parallel to its equator. The dark bands are areas of sinking gases while the light bands are areas of rising gases. There are 5 or 6 bands in each hemisphere. The \_\_\_\_\_ is a striking feature of Jupiter's surface; one of several spots that appear and disappear at varying intervals. Jupiter has the strongest known magnetic field. The three rings of Jupiter are made of fine bits of dark rock.

\_\_\_\_\_ - Takes 30 years to orbit the sun, yet rotates on its axis once every 10.7 hours. Saturn has colored bands of rising and sinking gases, such as Jupiter, though the number of bands are fewer. Saturn, like Jupiter, radiates more heat than it receives from the sun. Unlike Jupiter, it has a weak magnetic field. The spectacular \_\_\_\_\_ of Saturn are made of billions of "snowballs" of ice and ice-covered rock.

\_\_\_\_\_ - This planet has a number of unusual features. It has the slowest rate of rotation for any Jovian planet and its \_\_\_\_\_ is tipped almost completely over so that it orbits the sun on its side. Also unusual, the planet's \_\_\_\_\_ is nearly upright, meaning its magnetic field and axis of rotation differ by 60 degrees. This made it possible to more accurately calculate its rate of rotation. Surprisingly, the temperature is nearly the same over the entire surface of the planet.

\_\_\_\_\_ - Most distant Jovian planet. It rotates in 16.1 hours & takes 165 years to orbit the sun. Neptune's magnetic field is tipped 47° in relation to its axis of rotation and is offset from the center of the planet. Wind speeds up to 2200 km/hr have been recorded on the planet. Neptune gives off 2.7 times more energy than it receives from the sun.

\_\_\_\_\_ - once considered the smallest, coldest and most distant planet. Most of its atmosphere of methane and helium is frozen solid on the surface. Pluto seems to be made of water, ice, and rocks. It has a highly elliptical orbit that is inclined 17 degrees in relation to the orbits of the other planets. For a time, during its 248 year orbit, Pluto comes closer to the sun than Neptune.

### **Lesson III - Planetary Satellites**

A **planetary satellite** or \_\_\_\_\_ is a smaller body that revolves around a planet. Except for Venus and Mercury, each planet has at least one satellite. Many satellites have unusual features. Earth has one moon that is about 1/4 Earth's diameter (slightly smaller than the planet Mercury) and orbits at ~386,000 km. It circles Earth every \_\_\_\_\_ days.

Mars has two moons, \_\_\_\_\_ and \_\_\_\_\_. Both are irregular and marked with impact craters. \_\_\_\_\_, the larger of the two moons is only 27 km across and circles Mars three times a day.

Jupiter's Moons - There are \_\_\_\_\_ known moons. The four largest - \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ - are known as the Galilean satellites.

Saturn's Moons - NASA reports at least \_\_\_\_\_ moons orbit Saturn; the largest is \_\_\_\_\_. It is the second largest moon in the solar system.

Moons of Uranus - NASA now reports \_\_\_\_\_ moons orbit Uranus. The five largest are \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. All are dark, lack atmospheres, and have many impact craters on their surfaces.

Neptune's Moons - There are \_\_\_\_\_ moons orbiting Neptune. \_\_\_\_\_, the largest of these is 4/5 the size of Earth's moon. It has a very thin atmosphere.

Pluto's moon - There are \_\_\_\_\_ known moons. \_\_\_\_\_ is the largest and best known of these moons. Its diameter is about half that of Pluto's. Hydra & Nix were discovered in 2005.

### **Lesson IV - Comets, Asteroids, and Meteoroids**

A **comet** has a \_\_\_\_\_ of ice and debris, a \_\_\_\_\_ of gas surrounding the nucleus, a bright \_\_\_\_\_ caused by solar wind, and a large, elongated orbit. The head, or nucleus of the comet glows by reflected sunlight. Most comets spend much of the time out beyond the orbit of Pluto. The closest comet, Encke's comet, returns every 3.3 years. The famous Halley's Comet, returns every 76 years. Some comets only come near the sun once in thousands of years. The nucleus of a comet has been described as a "dirty snowdrift." The nucleus of Comet Halley contained carbon, nitrogen, oxygen, sulfur, and magnesium - elements common throughout the solar system.

\_\_\_\_\_ are small, planetlike bodies. Most orbit the sun between Mars and Jupiter. \_\_\_\_\_ is the largest of thousands of asteroids (and now considered a dwarf planet - 2007). Asteroids are solid, rocklike masses, most have irregular shapes. Most asteroids are less than 1 km long. Asteroids revolve around the sun in the same direction as the planets and most asteroid orbits are nearly circular and lie between Mars and Jupiter. A few, however, have loopy oval orbits; some come close to Mercury at perihelion. Asteroids may be left overs from the solar system's formation or possibly extinct or inactive comets.

A \_\_\_\_\_ is a rock or icy fragment in space. They may be as large as boulders or as small as sand grains. A \_\_\_\_\_ is a meteoroid glowing as it enters Earth's atmosphere. The light is caused by \_\_\_\_\_ between the rapidly moving meteoroid and the atmosphere. Scientists estimate 100 million meteoroids enter the atmosphere daily – most vaporize in the air. However, the dust and gases from the meteoroids add a few metric tons to Earth each day. \_\_\_\_\_ are regular events that occur when Earth's orbit crosses the orbit of a meteoroid swarm. The meteors of a particular shower appear to come from the same constellation and are named for that constellation.

A \_\_\_\_\_ is part of a large meteoroid that has reached Earth's surface. There are three basic types of meteorites: most are \_\_\_\_\_, resembling Earth's dark igneous rocks (primarily silicates and 10-15% iron); \_\_\_\_\_ are meteorites containing 85-95% iron, the rest is generally nickel (because they are made of iron and nickel, they are much heavier than stony meteorites); \_\_\_\_\_ are rare and consist of a mixture of stone and iron. The most abundant source of meteorites on Earth is the \_\_\_\_\_ ice cap. (Deserts provide another location to search for meteorites)

Meteorite craters (also known as \_\_\_\_\_ craters) are common to some planets and most moons in the solar system. They are rarely seen on Earth (~140 known impact craters have been identified). Many of these craters have been located only recently with the use of \_\_\_\_\_ **remote sensing** \_\_\_\_\_ (above the Earth) instruments. Meteor Crater, also called \_\_\_\_\_ Crater, was first recognized as a terrestrial impact crater in 1920. The cause of impact craters (collision of \_\_\_\_\_ **asteroids** \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ **comets** \_\_\_\_\_) are now thought to have had significant effects on the environment and biology of Earth. Evidence of impact craters on Earth are often difficult to discern due to Earth's \_\_\_\_\_ (earthquakes and volcanoes) activity, \_\_\_\_\_ and weathering. \_\_\_\_\_ and \_\_\_\_\_ also help to conceal the presence of impact craters on Earth.

### **Recent Discoveries (not in the book)**

Orbiting in a disc-like zone beyond Neptune are objects of the \_\_\_\_\_ **Kuiper** Belt. The region (out to 50 AU) consists of thousands of miniature icy worlds. Several recent KBO discoveries including \_\_\_\_\_ **Quaoar** (2002 LM60), \_\_\_\_\_ **Orcus** (2004 DW), and \_\_\_\_\_ **Eris** (2003 UB313). 2002 LM60's orbit is about 1 billion miles beyond that of Pluto (~42 AU), and it's size is about half that of Pluto. 2004 DW is larger and orbits at a distance of ~45 AU.

The discovery of 2003 UB313 was announced in 2005. With an estimated diameter of 3,000 km, it is ~700 km larger than Pluto. It is now the largest KBO in the Solar System and is the largest object found in orbit around the sun since the discovery of Neptune and its moon Triton in 1846. It is the third, and largest, "dwarf planet". It is also the most distant object ever seen in orbit around the sun.

\_\_\_\_\_ **Sedna** (2003 VB12) is a \_\_\_\_\_ **planetoid** (planet-like object) that was discovered in 2004. It's about one-quarter the size of Pluto, but it's long elliptical orbit takes it as far as 86 AU from the sun. 2003 VB12 has been described as an inner \_\_\_\_\_ **Oort** Cloud object, since it never comes closer to the sun than 76 AU.

The \_\_\_\_\_ **Oort** cloud is made up of billions of icy bodies in solar orbit make up this spherical cloud surrounding the solar system. It is the source of \_\_\_\_\_ **long** - period comets, which take more than 200 years to orbit the sun.

\_\_\_\_\_ **Dwarf** planets have the following characteristics: (a) orbit the sun (b) have a spherical shape (c) have not cleared the neighborhood around its orbit (d) not a satellite. Current examples: Pluto, \_\_\_\_\_ **Eris** (2003 UB313), \_\_\_\_\_ **MakeMake** (2005 FY9), Ceres (in asteroid belt).

\_\_\_\_\_ **Plutoids** is the name give to trans-neptunian dwarf planets similar to Pluto. All plutoids are dwarf planets, but not all dwarf planets are plutoids (Ceres, for example). Three named plutoids are: Plut, Eris, MakeMake.