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EARTH SCIENCE – UNIT 6 – CHAPTER 24 NOTES

THE SOLAR SYSTEM

24.1 Sun-Centered Model

- first supported by Copernicus and Galileo (in the 1500's)
- 9 planets orbit the sun (although in 2006, scientists removed Pluto\* from the list)
- sun = central object in the solar system, contains 98% of the mass of the entire solar system
- solar system is divided into 2 parts: inner planets and outer planets
- inner planets = Mercury, Venus, Earth, Mars
- outer planets = Jupiter, Saturn, Uranus, Neptune, Pluto\*

24.1 Formation of the Solar System

1. A large cloud of gas, ice, and dust once occupied our place in space.
2. Gravity pulled matter inward, causing the cloud to begin to spin.
3. The dense center grew to be very hot.
4. Gas and dust particles in the outer rim began to clump together.
5. The clumps grew into larger objects.
6. The clumps became the 9\* planets, and the core grew denser and hotter.
7. Nuclear fusion began in the core, creating a star (the sun).
8. The smaller objects became the moons and their rings.

24.1 Terms Used to Identify Planets

1. type of planet (inner planet or outer planet, large or small, rocky or gaseous)
2. size (based on diameter and mass)
3. density (whether the planet is “heavy” or “light”)
4. distance to the sun (based on average distance and period/time of revolution)
5. eccentricity (high eccentricity = elliptical, low eccentricity = circular)
6. orbital speed (how fast the planet spins on its axis)
7. satellites (moons) or rings
8. atmosphere (how thick or thin the atmosphere is affects the temperature of the planet)

| Table 1 Planetary Data |                           |                |                      |                       |                                                 |               |                           |                                      |                             |
|------------------------|---------------------------|----------------|----------------------|-----------------------|-------------------------------------------------|---------------|---------------------------|--------------------------------------|-----------------------------|
| Planet                 | Average Distance from Sun |                | Period of Revolution | Orbital Velocity km/s | Period of Rotation                              | Diameter (km) | Relative Mass (Earth = 1) | Average Density (g/cm <sup>3</sup> ) | Number of Known Satellites* |
|                        | AU                        | Millions of km |                      |                       |                                                 |               |                           |                                      |                             |
| Mercury                | 0.39                      | 58             | 88 <sup>d</sup>      | 47.5                  | 59 <sup>d</sup>                                 | 4878          | 0.06                      | 5.4                                  | 0                           |
| Venus                  | 0.72                      | 108            | 225 <sup>d</sup>     | 35.0                  | 244 <sup>d</sup>                                | 12,104        | 0.82                      | 5.2                                  | 0                           |
| Earth                  | 1.00                      | 150            | 365.25 <sup>d</sup>  | 29.8                  | 23 <sup>h</sup> 56 <sup>m</sup> 04 <sup>s</sup> | 12,756        | 1.00                      | 5.5                                  | 1                           |
| Mars                   | 1.52                      | 228            | 687 <sup>d</sup>     | 24.1                  | 24 <sup>h</sup> 37 <sup>m</sup> 23 <sup>s</sup> | 6794          | 0.11                      | 3.9                                  | 2                           |
| Jupiter                | 5.20                      | 778            | 12 <sup>yr</sup>     | 13.1                  | 9 <sup>h</sup> 50 <sup>m</sup>                  | 143,884       | 317.87                    | 1.3                                  | 63                          |
| Saturn                 | 9.54                      | 1427           | 29.5 <sup>yr</sup>   | 9.6                   | 10 <sup>h</sup> 14 <sup>m</sup>                 | 120,536       | 95.14                     | 0.7                                  | 31                          |
| Uranus                 | 19.18                     | 2870           | 84 <sup>yr</sup>     | 6.8                   | 17 <sup>h</sup> 14 <sup>m</sup>                 | 51,118        | 14.56                     | 1.2                                  | 25                          |
| Neptune                | 30.06                     | 4497           | 165 <sup>yr</sup>    | 5.3                   | 16 <sup>h</sup> 03 <sup>m</sup>                 | 50,530        | 17.21                     | 1.7                                  | 13                          |
| Pluto                  | 39.44                     | 5900           | 248 <sup>yr</sup>    | 4.7                   | 6.4 <sup>d</sup>                                | approx. 2300  | 0.002                     | 1.8                                  | 1                           |

\*Includes all satellites discovered as of March 2004.

NOTES: “Period of Revolution” = how long one year is on a planet  
 “Period of Rotation” = how long a combined day and night is on a planet

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#### 24.2 Planet # 1 – Mercury

1. small, rocky, inner planet
2. 2<sup>nd</sup> smallest planet based on diameter and mass
3. 2<sup>nd</sup> most dense planet
4. closest planet to the sun based on average distance and period (time) of revolution
5. 2<sup>nd</sup> highest eccentricity of orbit (highly elliptical orbital path around the sun)
6. highest orbital speed (spins very quickly on its axis)
7. no satellites (moons), no rings
8. very thin atmosphere – low gravitational pull allows gases to escape into the atmosphere, causes temperature extremes between day (450°C) and night (-170°C)

#### 24.2 Planet # 2 – Venus

1. large, rocky, inner planet
2. 4<sup>th</sup> smallest planet based on diameter and mass (just slightly smaller than Earth)
3. 3<sup>rd</sup> most dense planet
4. 2<sup>nd</sup> closest planet to the sun based on average distance and period (time) of revolution
5. very low eccentricity of orbit (orbital path around the sun is nearly a perfect circle)
6. 2<sup>nd</sup> highest orbital speed (spins very quickly on its axis)
7. no satellites (moons), no rings
8. very dense atmosphere – lots of carbon dioxide, traps heat (like an extreme type of greenhouse effect), extremely high temperatures (470°C) that are fairly constant between day and night

#### 24.2 Planet # 3 – Earth

1. large, rocky, inner planet
2. middle-sized planet based on diameter and mass (4 are larger and 4 are smaller)
3. most dense planet
4. 3<sup>rd</sup> closest planet to the sun based on average distance and period (time) of revolution
5. very low eccentricity of orbit (orbital path around the sun is nearly a perfect circle)
6. 3<sup>rd</sup> highest orbital speed (spins very quickly on its axis – every 23 hours, 56 minutes)
7. 1 satellite (the moon), no rings
8. atmosphere – allows light to pass through, while reflecting most ultraviolet (UV) rays, also prevents temperature extremes, which allows living things to be able to survive

#### 24.2 Planet # 4 – Mars

1. small, rocky, inner planet
2. 3<sup>rd</sup> smallest planet based on diameter and mass
3. 4<sup>th</sup> most dense planet
4. 4<sup>th</sup> closest planet to the sun based on average distance and period (time) of revolution
5. medium eccentricity of orbit (orbital path around the sun is somewhat elliptical)
6. 4<sup>th</sup> highest orbital speed (spins on its axis at a medium speed)
7. 2 satellites (2 very small moons), no rings
8. very thin atmosphere – somewhat large temperature fluctuations between day (35°C) and night (-170°C), similar to Mercury in that way (but a little less extreme)

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24.3 Planet # 5 – Jupiter

1. large, gaseous, outer planet (gas giant)
2. largest planet based on diameter and mass
3. 3<sup>rd</sup> least dense planet
4. 5<sup>th</sup> (middle) planet from the sun based on average distance and period (time) of revolution
5. medium eccentricity of orbit (orbital path around the sun is somewhat elliptical)
6. middle orbital speed (4 planets spin faster on its axis, 4 planets spin slower on its axis)
7. 16 satellites (moons), 1 ring of dust  
4 moons are listed below:
  - a. Io = most volcanically active object in the solar system; red color (lots of sulfur)
  - b. Europa = has rocky interior, has a crust of ice, has many visible cracks
  - c. Ganymede = the largest satellite (moon) in the solar system
  - d. Callisto = has a rocky interior, has a crust of ice, has many visible craters
8. atmosphere – mostly contains hydrogen and helium gases
  - planet has a solid, rocky core and a large outer area of liquid hydrogen and helium
  - Great Red Spot = a large storm in Jupiter's atmosphere

24.3 Planet # 6 – Saturn

1. large, gaseous, outer planet (gas giant)
2. 2<sup>nd</sup> largest planet based on diameter and mass
3. least dense planet
4. 6<sup>th</sup> planet from the sun based on average distance and period (time) of revolution
5. medium eccentricity of orbit (orbital path around the sun is somewhat elliptical)
6. 4<sup>th</sup> lowest orbital speed (spins on its axis at a medium speed)
7. 18 satellites (moons), 1000's of rings of ice, rocks, and dust  
1 moon is listed below:
  - a. Titan = largest moon of Saturn (larger than Mercury), has thick clouds of smog
8. atmosphere – mostly contains hydrogen and helium gases
  - planet has a solid, rocky core and a large outer area of liquid hydrogen and helium

24.3 Planet # 7 – Uranus

1. large, gaseous, outer planet (gas giant)
2. 3<sup>rd</sup> largest planet based on diameter and mass
3. 2<sup>nd</sup> least dense planet
4. 7<sup>th</sup> planet from the sun based on average distance and period (time) of revolution
5. medium eccentricity of orbit (orbital path around the sun is somewhat elliptical)
6. 3<sup>rd</sup> lowest orbital speed (spins on its axis at a slow speed)
  - the axis of rotation is tilted on its side
  - Uranus rotates perpendicular to the plane of its orbit
7. 15 satellites (moons), 11 rings that are thin and dark
8. atmosphere – mostly contains hydrogen, helium, and methane gases
  - the methane gas in the atmosphere gives Uranus a blue-green color
  - planet has a solid, rocky core and a large outer area of liquid H<sub>2</sub>O, methane, & ammonia

24.3 Planet # 8 – Neptune

1. large, gaseous, outer planet (gas giant)
2. 4<sup>th</sup> largest planet based on diameter and mass
3. 4<sup>th</sup> least dense planet
4. 8<sup>th</sup> planet from the sun based on average distance and period (time) of revolution
  - Sometimes Neptune is the 9<sup>th</sup> planet from the sun. It occasionally crosses Pluto's path.

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24.3 Planet # 8 – Neptune (continued)

5. very low eccentricity of orbit (orbital path around the sun is nearly a perfect circle)
6. 2<sup>nd</sup> lowest orbital speed (spins on its axis at a slow speed)
7. 8 satellites (moons), 4 rings of various thicknesses  
1 moon is listed below:
  - a. Triton = largest moon of Neptune, has an atmosphere of nitrogen and methane
8. atmosphere – mostly contains hydrogen, helium, and methane gases
  - the methane gas in the atmosphere gives Neptune a blue-green color
  - planet has a solid, rocky core and a large outer area of liquid H<sub>2</sub>O, methane, & ammonia

24.3 Planet # 9 – Pluto\*

1. small, rocky, outer planet\* (NOT CONSIDERED A PLANET ANYMORE)
2. smallest planet\* based on diameter and mass
3. 5<sup>th</sup> most dense planet\* (middle planet\* based on density)
4. 9<sup>th</sup> planet\* from the sun based on average distance and period (time) of revolution
  - Sometimes Pluto\* is the 8<sup>th</sup> planet\* from the sun. It occasionally crosses Neptune's path.
5. high eccentricity of orbit (highly elliptical orbital path around the sun)
6. lowest orbital speed (spins on its axis at a very slow speed)
7. 1 significant satellite (moon), no rings  
Pluto's largest moon is listed below:
  - a. Charon = moon that is half the diameter of Pluto, called a "double planet\*\*"
8. very thin atmosphere
  - planet\* has a solid, icy-rock surface
  - scientists are not sure how Pluto and Charon originated – possibly from the Kuiper belt of comets or as moons that escaped from other planets

24.4 Other Objects in the Solar System

1. Comets
    - Comets are composed of dust, rocks, ice, and gases.
    - Comets develop a bright tail as they pass by the sun.
    - Solar winds push away small particles from the nucleus of the comet, forming a tail.
    - After a comet has orbited the sun many times, only a few solid particles are left.
    - The remaining small pieces of rock are called meteoroids.
- \*\*SHOW DIAGRAM OF A COMET & LABEL THE NUCLEUS, COMA, AND TAIL\*\***
2. Meteoroids
    - Meteoroids are small pieces of rock that move through space.
    - Meteoroids formed when the solar wind reduced a comet to a few small rocks (what was originally in its nucleus)
  3. Meteors
    - Meteors are simply meteoroids that have burned up in Earth's atmosphere.
    - They burn up because they fall onto Earth at such a fast speed.
    - Meteors do NOT hit the ground if they completely burn up.
  4. Meteorites
    - Meteorites are meteors that didn't completely burn up in Earth's atmosphere.
    - Meteorites hit the ground, leaving a crater.
  5. Asteroids
    - Asteroids are pieces of rock that orbit the sun.
    - Asteroids are similar in structure to the rocky planets, but are smaller.
    - Asteroids can be large rocks or small rocks.
    - Most asteroids are found in the "Asteroid Belt" between Mars and Jupiter.
    - The "Asteroid Belt" could have been a planet that never quite formed.