

Chapter 29 The Solar System

Section 29.1 "Models of the Solar System"

29.1 notes Models of the Solar System

- Geocentric: Earth-centered model of the solar system. (Everything revolves around Earth)
- Heliocentric: Sun-centered model of the solar system. (Earth and the other planets revolve around the Sun.)
- Nicolaus Copernicus, a Polish astronomer, proposed the heliocentric model in the 1500's.
- In the 1600's, **Galileo** Galilei confirmed the heliocentric model using his newly invented telescope.

29.1 notes Models of the Solar System

- Ellipse: an oval whose shape is determined by two points called foci. (Focus = singular, foci=plural)
- Perihelion: the point where an orbit is closest to the sun.
- Aphelion: the point where an orbit is farthest from the sun.

29.1 notes Models of the Solar System

- Astronomical Unit (AU): the average distance between the Sun and the Earth. 149.5 million kilometers.
- Why? Because Earth's aphelion = 152 million km, and perihelion = 147 million km. The average of these two distances = 149.5 million km.

Law of Periods

- Orbit period: the time required for the planet to make one revolution around the Sun.
- Average distance of a planet to the sun (r) measured in AU.
- Orbit period (p) measured in Earth years.
- Law of Periods: $r^3 = p^2 (r \times r \times r = p \times p)$
- Which means: the cube of the average distance of a planet from the Sun (r), is always proportional to the square of the period (p).

Sir Isaac Newton

- Inertia: the tendency for an object to move in a straight line at constant speed unless acted on by an outside force. Also, the tendency for an object at rest to remain at rest until acted on by an outside force.
- What outside force keeps the planets from spinning off into space in a straight line?





Mercury

- 0.4 AU from the Sun
- Orbital period: 88 Earth-days
- Axial rotation: 59 Earth-days
- No moons
- 1974 and 1979, Mariner 10 visited Mercury
- Heavily cratered, which suggests Mercury has changed little since the formation of the solar system.
- Thin atmosphere because the Sun heats up any gas, and Mercury is too small to have enough gravity to keep the heated gas.



Venus (Earth's evil twin)

- 0.7 AU from the Sun
- Axial rotation: 243 Earth-days
- Orbital period: 225 Earth-days
- No moons
- Similar size, mass, and density
- Much hotter than Earth because Venus is closer to the Sun and its atmosphere holds in more of the Sun's heat.
- Average surface temp. 464 Celsius.



Earth

- 1AU from the Sun
- Axial rotation: 24 hours
- Orbital period: 365 days
- Fifth largest planet
- One moon (named The Moon)
- Average surface temp. 14 Celsius
- Life on Earth is possible because of the distance from the Sun; water can exist as a liquid.



Mars (The Red Planet)

- 1.5 AU from the Sun
- Axial rotation: 24 hours 37 minutes Earth-time.
- Orbital period: 687 Earth-days
- Nearly the same axial tilt as Earth, so Mars has seasons like Earth does.
- Two moons, Phobos and Deimos.
- Surface temp is 20 Celsius at the equator, -130 Celsius during winter at the poles
- Low atmospheric pressure prevents liquid water from existing.





The Outer Planets

- Jupiter, Saturn, Uranus, and Neptune
- Called gas giants or Jovian planets (Jupiter-like).
- Largest planets in the solar system
- Although larger and more massive than the inner planets, the gas giants are less dense.
- Each has a thick atmosphere made mostly of hydrogen and helium.



Jupiter

- Largest planet in the solar system
- Jupiter's mass is twice the combined masses of all eight other planets.
- Orbits the Sun every 12 Earth-years.
- Rotates on its axis every 10 earth-hours.
- Hydrogen and helium make up 92% of Jupiter's mass.
- Great Red Spot (massive storm of gas)
- 5.2 AU from the Sun.



Saturn

- Second largest planet in the solar system.
- Average surface temp. is -176 Celsius.
- Axial rotation 10.5 Earth-hours.
- Orbital period 29.5 Earth-years.
- Least dense planet in the solar system.
- Has a complex system of rings.
- Dense atmosphere of hydrogen and helium gas.
- 9.5 AU from Sun.



Uranus

- Pronounced 'YOOR-a-nis', not 'your anus', or 'urine us'.
- Third largest planet in the solar system.
- Discovered in 1781.
- Most distinctive feature is its rotation.
- Uranus has an almost 90 degree axis of rotation, making it roll like a ball as it rotates through its orbit.

Uranus (2)

- Axial rotation of 17 Earth-hours.
- Orbital period of 84 Earth-years.
- 19.6 AU from the Sun.
- Atmosphere composed of hydrogen and helium gas.
- Possibly liquid water and methane beneath the atmosphere.
- Surface temp. -214 Celsius.



Neptune

- 30 AU from Sun.
- Orbital period of 163.7 Earth-years.
- Axial rotation of 16 hours.
- Great Dark Spot: an Earth-sized storm.
- Winds exceeding 1000 km/hr.
- Surface temp. about -225 Celsius.

Neptune (2)

- The existence of Neptune was predicted before it was discovered.
- After the discovery of Uranus, astronomers noted variations in Uranus' expected orbit.
- The only thing that could cause such variations would be a large gravity source.
- Scientists in the 1800s accurately predicted where Neptune should be.





Pluto

- No longer considered a 'classical planet'.
- Pluto was reclassified as a 'dwarf planet' on August 24, 2006.
- Smallest planet in the solar system
- Axial rotation: 6.4 Earth-days
- Orbital period: 248.6 Earth-years
- 39 AU from the Sun
- Extremely eccentric orbit
- Perihelion 4.4 billion km, aphelion 7.4 billion km



Chapter 29, Section 4

Asteroids, Comets, and Meteoroids

Asteroids

- Asteroids are fragments of rock that orbit the Sun.
- Also called minor planets.
- Largest known asteroid, Ceres, is about 1000 km in diameter.
- (Actually, Ceres has been reclassified as a dwarf planet.)
- Asteroid belt between Mars and Jupiter.

3 types of asteroids

- Carbon: made mostly of carbon materials, and have a dark color.
- Nickel / Iron: made mostly of iron and nickel, and have a shiny, metallic look.
- Rocky: made mostly of silicate minerals and look like ordinary earth rocks.
- Rocky asteroids are the most common type.





Other types of asteroids

- Trojan asteroids: concentrated in groups just ahead and just behind Jupiter.
- Earth-grazers: have long orbits that sometimes bring them very close to the Sun and the Earth.



Comets

- Made of rock, dust, methane, ammonia, and ice.
- Three main parts: nucleus, coma, and tail.
- Nucleus: between 1km and 100km diameter
- Coma: spherical cloud of gas and dust surrounding the nucleus
- Tail: gas and dust that streams away from the comet. <u>Caused by the solar wind</u>, and always points away from the Sun.
- Some comet tails more than 80 million km.

2 Types of comets

- Long-period comets: can take several thousand, to several million years to orbit the Sun.
- Short-period comets: their orbital periods are less than 100 years.
- Halley's comet has an orbital period of 76 years. (long or short period?)
- Last seen in 1986. When will we see it again?

Meteoroids

- Meteoroids: bits of rock or metal moving through the solar system.
- Meteor: meteoroids become meteors when they hit atmosphere and begin to burn.
- Meteorite: if a meteor manages to actually land on Earth, we call it a meteorite.

3 types of meteorites

- Stony: similar to Earth rocks. Most common. Some contain carbon materials.
- Iron: made of iron and have a shiny, metallic look.
- Stony-iron: contain both iron and rock. Very rare.



• The Willamette Meteorite weighs about 32,000 <u>pounds</u> or 15.5 tons. It is classified as a <u>type III</u> <u>iron meteorite</u>, being composed of over 91% <u>iron</u> and about 8% <u>nickel</u>, with traces of <u>cobalt</u> and <u>phosphorus</u>. The approximate dimensions of the meteorite are 10 feet (3.05 <u>m</u>) tall by 6.5 feet (1.98 m) wide by 4.25 feet (1.3 m) deep



Wilamette Meteorite at the American Museum of Natural History, where it is on display today. (New York)