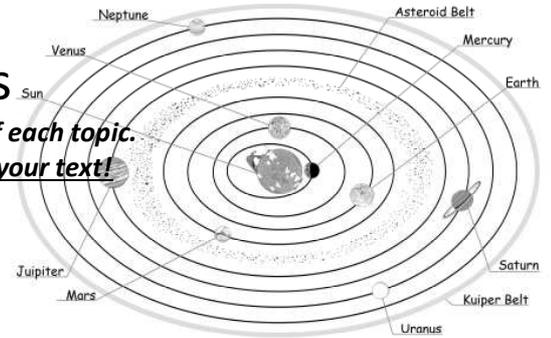


Chapter Outlines

NOTE: This is intended to help students 'organize' their understanding of each topic. It is not a comprehensive study guide for quizzes or midterms, i.e. study your text!



Our Solar System

Steps in the nebula hypothesis

Overview of the Planets

According to the **Nebula Hypothesis**, our solar system formed from a cloud of interstellar dust and gas approximately 4.5 billion years ago

- Under its own early gravitational force this cloud began to contract and slowly spin, forming a flattened disk
- Most of the mass gathered near the center to form the hot 'protosun'
- Other bits of debris slowly clumped together forming larger and larger 'planetesimals' until there were eight distinct planets, and leftover debris

○ The planets can be divided into two groups

▪ Terrestrial planets (*Mercury, Venus, Earth, Mars*)

- The four nearest the Sun
- All are smaller
- Are rocky and denser than the outer planets (*as high as 5.5 gms/cm³*)
- All have either no atmosphere or meager atmospheres

▪ Jovian planets (*Jupiter, Saturn, Uranus, Neptune*)

- The four furthest from the Sun
- Are all much larger, less dense (*as low as 0.9 gms/cm³*), and contain large amount of gases
- All have multiple moons
- All have thick atmospheres of hydrogen, helium, methane, and ammonia
- The thicker atmosphere of the Jovian planets is a result of cooler temperature (*distance from the Sun*) and the greater gravity of the Jovian planets

Earth's Moon

- Our Moon likely formed as a result of the youthful semi-molten Earth colliding with another smaller planet
- The Moon's surface remains essentially unchanged over time due to the near non-existence of any weathering processes
- Moon's exterior has two distinct surfaces:

▪ Seas (*maria*)...

- are lower areas formed from large outpourings of basaltic lava which were likely the result of meteor impacts
- are younger surfaces with only more recent impact craters

▪ Highlands (*terrae*)...

- are higher in elevation
- are heavily cratered from ancient meteor impacts and largely unchanged since Moon's early days

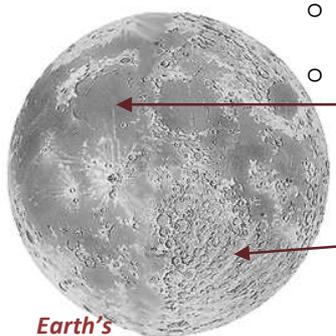
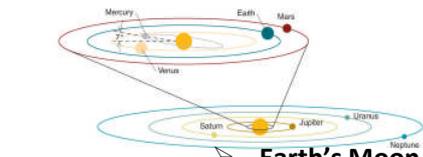
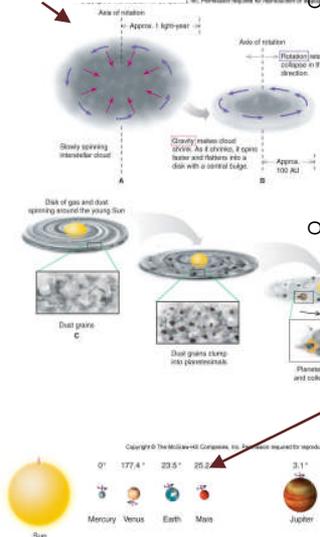
➤ Tour of the Planets (*in order from the Sun*)

○ Mercury

- Very hot and difficult to see due to being very close to the Sun
- Mercury has a large iron core, is heavily cratered from its early days, and has essentially no atmosphere

○ Venus

- The hottest planet with temperatures of 480°C in the day (*basalt rock will melt at approximately 1,000°C*)
- We can't see the surface due to permanent thick cloud cover (*mostly carbon dioxide*)



Earth's moon

- There appears to be slow convection within the mantle but no plate tectonics...the planet's interior is likely similar to Earth's but is not well understood
- The surface has been mapped by satellites using radar; there appear to be thousands of volcanoes and many lava flows

○ **Earth** (*discussed in other chapters*)

○ **Mars** – 2 moons

- Mars' surface is normally clearly visible by telescope
- There is evidence that during the first billion years of Mars history there was flowing water including ancient river beds, erosional features, and sedimentary rock. There is only a small amount of frozen water now. Highlands are heavily cratered, lowlands have volcanic features
- The thin Martian atmosphere is mainly carbon dioxide, dust storms are common
- Mars' early molten iron core is no longer liquid, due to cooling

○ **Jupiter** – 63 moons (*'gas giant'*)

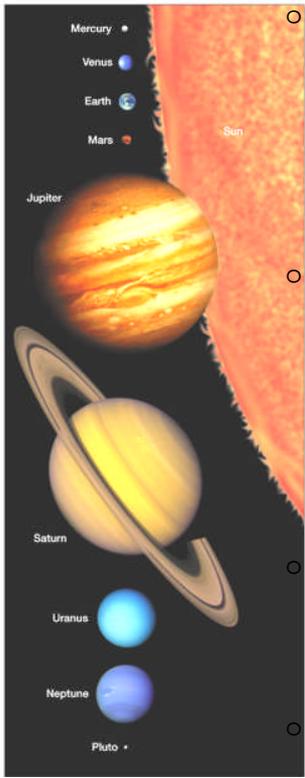
- The largest planet, nearly large enough to have become a second sun
- Its magnetic field is a result of a liquid iron core
- Continually covered by clouds and belts of strong winds, which are driven by internal heat. It has a well known 'Giant Red Spot' which is a non-ending storm.
- The dense atmosphere is mainly hydrogen and helium, and Jupiter's surface is likely liquid hydrogen
- Jupiter's many moons have fascinating geologic activity, including the possibility of liquid water beneath a frozen surface

○ **Saturn** – 56 moons (*'gas giant'*)

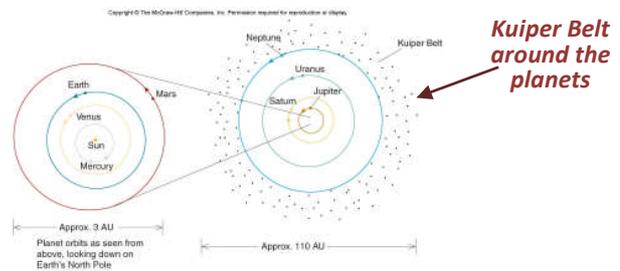
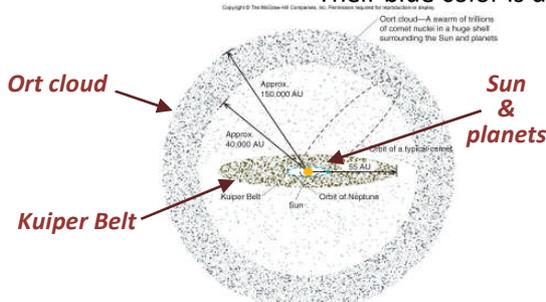
- Its magnetic field is a result of a liquid iron core
- It has the most distinctive rings
- Continually covered by clouds and belts of strong winds, which are driven by internal heat

○ **Uranus** – 27 moons; **Neptune** – 13 moons

- Their magnetic fields are both a result of a liquid iron cores
- Continually covered by clouds and belts of strong winds, which are driven by internal heat... known as 'ice giants'
- Their blue color is due to methane in their atmospheres



Relative order & sizes of the planets



➤ **Minor Solar System Members** - In addition to the Sun and the planets, our solar system has many other smaller bodies that have been studied

○ **Asteroids** – clumps of rubble left over from the solar system formation. 100,000 are known, all smaller than 940 km in diameter, and most are very small.

○ **Comets** – bodies of frozen water, ammonia, methane, carbon dioxide, and carbon monoxide, along with small pieces of rock and metal. They are left over from the solar system formation. Their elliptical orbits occasionally take them close to the Sun where the tail and coma become visible, but normally they exist in one of the following locations:

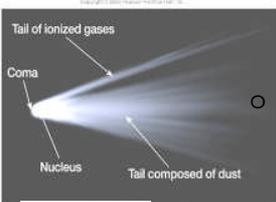
- **The Kuiper belt** (*see diagram above right*) – a belt of debris just beyond Neptune
- **The Oort cloud** (*see diagram above left*) – a spherical shell around the solar system that contains millions of comets

○ **Meteoroids** – are a name for solar system debris from old comets, the asteroid belt, or elsewhere, that might fall to Earth. Small meteoroids may harmlessly burn up in Earth's atmosphere, larger meteoroids can impact Earth causing catastrophic damage. Two general categories: stony and iron

○ **Dwarf planets** – Small round objects such as Pluto that orbit beyond Neptune in the Kuiper belt



Asteroid



Comet