The Solar System

- Formation
  - Nebular Hypothesis
    - The leading hypothesis for the formation of the solar system suggests that the solar system formed from a nebula
  - Nebula: Large, shapeless cloud of gas and dust

Nebular Hypothesis

- Over time, the particles of the nebula were drawn together (gravity) and began to accrete
- The nebula began to contract and rotate, eventually forming a shape similar to a spinning disk

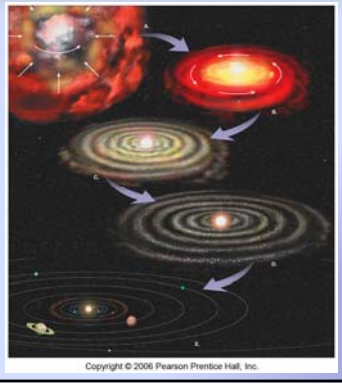
Nebular Hypothesis

- Most of the material was concentrated in the center, forming a large, very hot mass
- Eddies in the outer rim formed and smaller amounts of material began to accrete, eventually forming protoplanets

Nebular Hypothesis

- The intense heat in the center of the rotating disk eventually ignited to form a newborn sun
- The sudden release of energy from the new sun blew extra dust and gas away, leaving a central star and a number of bodies orbiting it

Nebular Hypothesis



Nebular Hypothesis

Types of Planets

- Terrestrial
  - Closest to the sun
  - Small
  - Mostly rock
  - Dense
  - Little atmosphere
  - *Mercury, Venus, Earth, Mars*

Types of Planets

- Jovian
  - Far from sun
  - Large
  - Mostly gaseous
  - Small, rocky core
  - Mostly gaseous
  - *Jupiter, Saturn, Uranus, Neptune*

Pluto?

- Recent discussions amongst scientists have concluded that Pluto is no longer considered a planet
- Instead, it is the charter member of a new class of planetary body: dwarf planet
- The aspects of Pluto and other dwarf planets will be reviewed shortly

http://www.nmsu.edu/~ucomm/Releases/2006/september/pluto_protest.jpg

The Moon

- Formation: Great Impact Theory
  - Suggests a Mars-sized object collided with the early Earth
  - Sent a huge mass of material in the upper atmosphere that began orbiting the Earth
  - Eventually accreted to form the moon

The Moon

- Composition
  - Mafic-type rock
- Highlands (light-colored areas) and lowlands (dark-colored areas)
- Numerous craters
  - Testament to the violent history of the solar system

The Moon

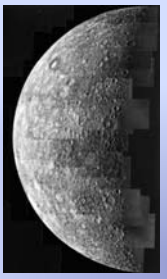
- Practically no atmosphere
  - Craters are more common since there is no atmosphere within which meteors can disintegrate through friction
  - No atmosphere and no water suggest no erosive processes at work
    - All surface features that have formed on the moon remain there (including the footprints of the astronauts that have visited the moon!)

The Moon

http://www.solarviews.com/eng/moon.htm

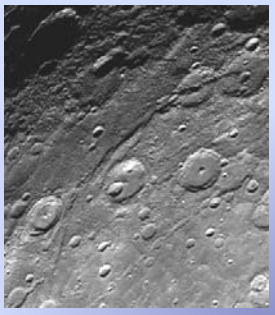
Mercury

- Reflects small amount of solar radiation
- Practically no atmosphere
  - Traces of hydrogen and helium
- Cratered highlands and smooth lowlands
- Very similar to the Earth's moon



Mercury

- Revolves very quickly but rotates very slowly
- Insignificant atmosphere does not efficiently allow the transfer of radiation from day side of planet to the night side
  - Day temps: ~800° F
  - Night temps:~-240° F



Venus

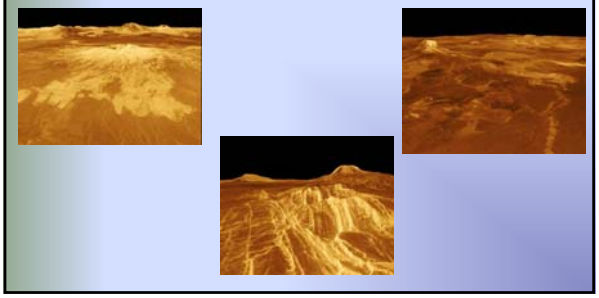
- Similar to Earth in size, mass, and density
- Many shield volcanoes
- Evidence of tectonic activity
- Mostly low-lying areas of basaltic lava flows

Venus

- Atmosphere ~95% CO_2
- Surface temperatures can reach ~900° F
- Atmospheric pressure ~90 times that of Earth
- Opaque cloud cover from surface to ~25 km

Venus

- Due to its heavy cloud cover, the surface of Venus can only be visualized through radar mapping



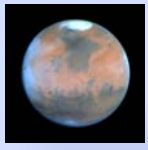
Mars

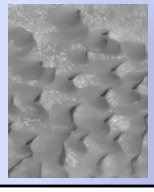
- Slightly smaller than the Earth
- Red color derived from oxidation of surface elements (oxidation)
- Low density atmosphere of carbon dioxide and water vapor

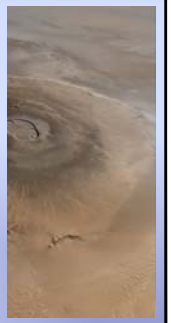
http://www.nwrc.usgs.gov/world/images/mars.jpg

Mars

- Mar exhibits many Earth-like features, including:
- Polar ice caps
  - Composed mostly of carbon dioxide and water vapor
- Shield volcanoes
- Dune seas
- Sandstorms



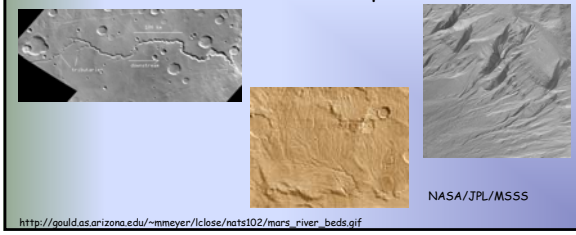




NASA/JPL/MSSS

Mars

- One of the more striking features on Mars are the occurrence of river channels that are believed to have held liquid water



NASA/JPL/MSSS

http://gould.as.arizona.edu/~mmeyer/lclose/nats102/mars_river_beds.gif

Jupiter

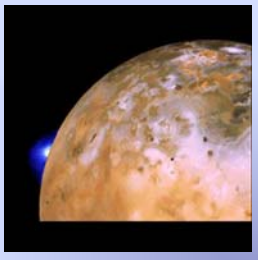
- Largest planet in solar system
- Very fast rotation
- Surface appears as alternating bands of light and dark colored gases
- Alternating colors believed to indicate a convection cell within the atmosphere
- Atmosphere composed of hydrogen, helium, with methane, ammonia, water, and some sulfur

Jupiter

- Great Red Spot is believed to be a giant storm (atmospheric disturbance)
- Has rings believed to be made predominantly of sulfur
- Enormous in size as well as mass
- Hypothesized that if Jupiter formed with ~80x more mass, it would have become a second sun

Moons of Jupiter: Io

- Io is one of the innermost moon of Jupiter
- Composed of sulfur-rich compounds
  - Giving Io its distinct yellowish-white appearance
- Tidal forces from Jupiter and Ganymede acting on Io generate heat within the moon
- This heat leads to volcanic eruptions from the surface



http://pds.jpl.nasa.gov/planets/captions/jupiter/loki.htm

Moons of Jupiter: Europa

- Io is one of the innermost moon of Jupiter
- Ice-covered, frozen moon
- Distinctive linear fractures found on the ice
- Recent models suggest a liquid water ocean may be found beneath the ice

http://www.solarviews.com/raw/jup/europa1.gif

Saturn

- Atmosphere, composition, and internal structure similar to Jupiter
- Winds up to 930 mph
- Large storms identified on surface
  - similar to Jupiter's Red Spot but smaller

Saturn

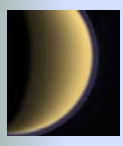
- Most notable feature are rings
- Rings are thousands of miles in width but less than one mile in thickness
- Composed mostly of rock fragments and ices
- Ring system not composed of a couple of rings but thousands

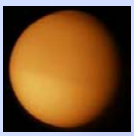
Moons of Saturn: Titan

- Second largest moon in the solar system
  - Second to Jupiter's Ganymede
- Only moon to have a significant atmosphere
- Atmospheric pressure is 60% greater than Earth's
- Atmosphere composed of nitrogen with some argon and methane
- Atmosphere also has traces of some organic compounds (ethane, hydrogen cyanide)

http://www.solarviews.com/cap/sat/titan1.htm

Moons of Saturn: Titan





http://www.solarviews.com/eng/titan.htm

http://www.esa.int/SPECIALS/Cassini-Huygens/SEM15Y71Y3E_1.html

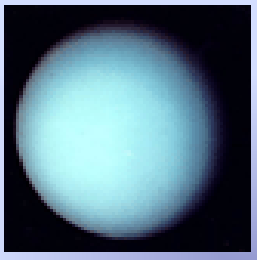
Moons of Saturn: Enceladus

- Frozen moon of Saturn
- Evidence suggests geyser-like activity on the surface

http://www.solarviews.com/eng/enceladu.htm

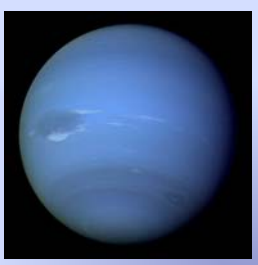
Uranus

- Atmospheric composition of hydrogen, helium, methane, and ammonia
- Distinct blue color (likely due to an abundance of methane)
- Eleven rings
- Rotates on it's side
  - Tilt of axis ~81°



Neptune

- Distinct blue color with white clouds
- Hydrogen, helium, methane, and ammonia atmosphere
- Great dark spot (similar to great red spot) believed to be a giant storm
- Great dark spot no longer seen
- Extremely fast wind speeds
- Six rings were found



Moon of Neptune: Triton

- Ice-covered, frozen body
- The observation of black streaks across it's surface led to the discovery of geyser-like activity on its surface
- Material ejected probably includes liquid nitrogen, methane, and dust
- One of the coldest object s in the solar system (~-400° F)

http://www.solarviews.com/raw/nep/triton5.gif

Dwarf Planets

- In 2006, the International Astronomical Union (IAU) declared that a number of objects in our solar system, that do not exhibit the characteristics of planets, be reclassified as dwarf planets
- The characteristics of a dwarf planet
  - is in orbit around the Sun
  - has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape
  - has not cleared the neighborhood around its orbit,
  - is not a satellite

Dwarf Planets

- Many dwarf planets are believed to reside in a vast debris field outside the orbit of Neptune known as the Kuiper Belt
- Newly named dwarf planets include
  - Pluto
  - Ceres (also known as an asteroid)
  - Eris (formerly UB313)
  - Sedna

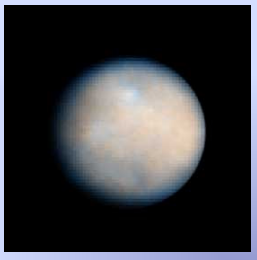
Pluto

- Very eccentric elliptical orbit
- Lies outside the orbital plane of the other planets
- Largest moon: Charon
- Also has two smaller moons: Nix and Hydra

http://upload.wikimedia.org/wikipedia/commons/a/ae/Pluto_system_2006.jpg

Ceres

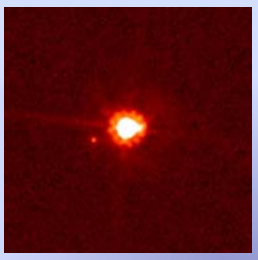
- Only dwarf planet located within the asteroid belt
- Contains one-third of the mass of the asteroid belt
- Has a roughly spherical shape, unlike many other objects in the asteroid belt



http://upload.wikimedia.org/wikipedia/commons/f/fc/Ceres_optimized.jpg

Eris

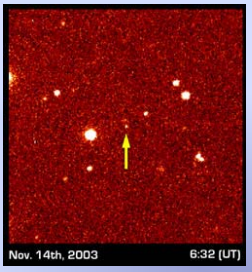
- Largest known dwarf planet
- Approximately 1600 miles in diameter
- 27% more massive than Pluto
- Largest, most distant object from the sun
- Highly eccentric orbit



http://upload.wikimedia.org/wikipedia/en/5/5b/Eris_and_dysnomia2.jpg

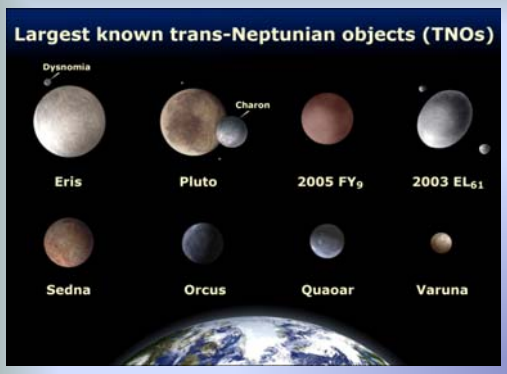
Sedna

- Approximately 1000 miles in diameter
- Temperature approximately –400° F
- Highly eccentric orbit
- Distinct red color



http://media.skytonight.com/images/Sedna-discovery-pix_m.jpg

Dwarf Planets



http://en.wikipedia.org/wiki/Image:EightTNOs.png