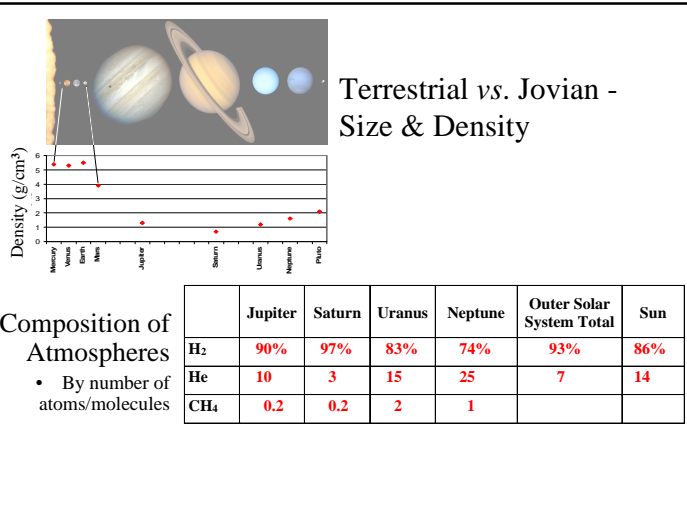
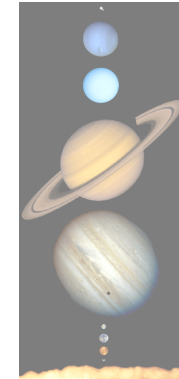


## Jupiter–February 16

- Homework 2 is ready on Angel
  - It will close at 3am on 22 Feb. (Finish before you sleep Monday night.)
- Jupiter
- Internal structure
- Formation
- Heat source
- Atmosphere
- Winds

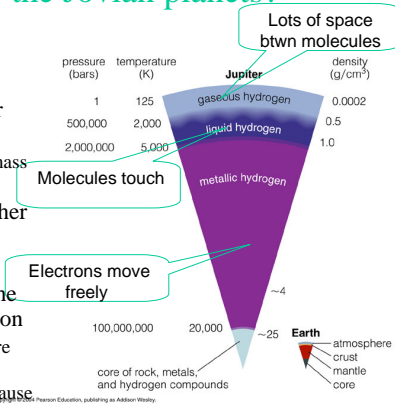
## Jovian (Jupiter-like) Planets

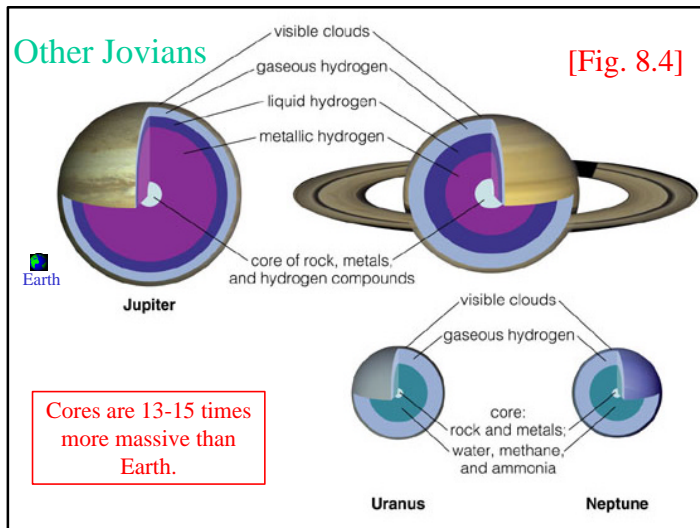
- Jupiter & Saturn are often the brightest objects in the sky.
- Telescopes from Earth give good views.
- Space probes provide most detailed information [Don't copy these down.]
  - Pioneer 10, 11 (1973,74)
  - Voyager 1,2 Grand Tours (1977...)
  - Galileo (Jupiter orbiter + atmospheric probe. 1995-2003)
  - Cassini-Huygens (orbiter/probe, arrived at Saturn 2004)



## What is inside the Jovian planets?

- Structure of Jupiter
- Why is pressure higher nearer the center?
  - Pressure supports the mass above.
- Why is the density higher nearer the center?
  - Pressure
- Why is Jupiter hot in the center? 2x solar radiation
  - Hot means the atoms are moving faster
  - Atoms gain energy because they are falling over time





## How did Jovians form?

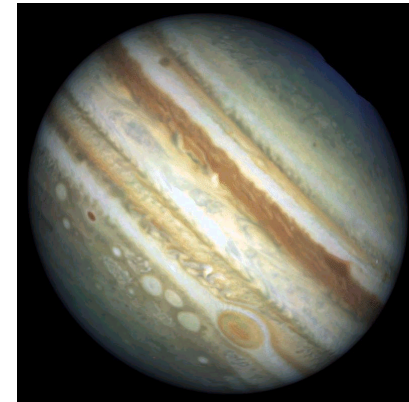
- In nascent solar system, most of material contracted to form sun. Left-overs became planets, asteroids, comets, & dust.
- Solid particles collided with others to form bigger ones. Solid means metal, rock, hydrogen compounds (ice H<sub>2</sub>O, methane CH<sub>4</sub>, ammonia NH<sub>3</sub>).
- Dust size > pebble size > Lansing sized > Planetesimals > Cores of Jovian planets
- Cores collected surrounding hydrogen and helium.

## Jupiter's heat sources

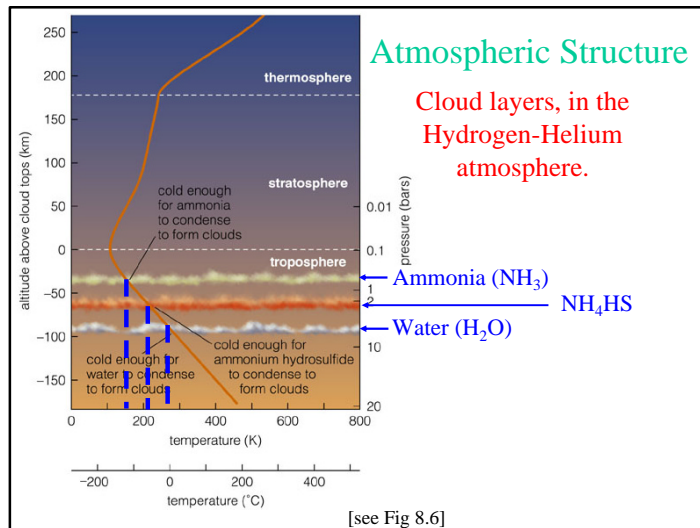
- 50% is from solar energy
- But other 50% comes from internal heating
  - This is gravitational energy released when Jupiter formed.
  - Currently stored in interior as heat energy.
  - Slowly being radiated away.
  - Plus maybe some continuing energy release from contraction.
- Similar effect in Saturn
  - But additional effect of same magnitude from ongoing differentiation.
    - Separation of H from He.

## Jupiter

- Main constituents of gaseous atmosphere:
  - Hydrogen: 90%
  - Helium: 10%
  - Methane (CH<sub>4</sub>): 0.2%
  - Ammonia (NH<sub>3</sub>): 0.02%
- Clouds
  - Frozen ammonia (white)
  - Frozen ammonium hydrosulfide (brown & red)



Rotating Jupiter



1. Which is the principal reason the interior of Jupiter is hot?
  - a. Material falls from 100km to 90km
  - b. Uranium decays
  - c. The sun heats it
  - d. There is a lot of methane
2. What is the difference between liquid and metallic hydrogen?
  - a. Metallic is less dense
  - b. Metallic has more electrons
  - c. Electrons are free in metallic hydrogen
  - d. Liquid hydrogen is hotter.