Jovian Planets

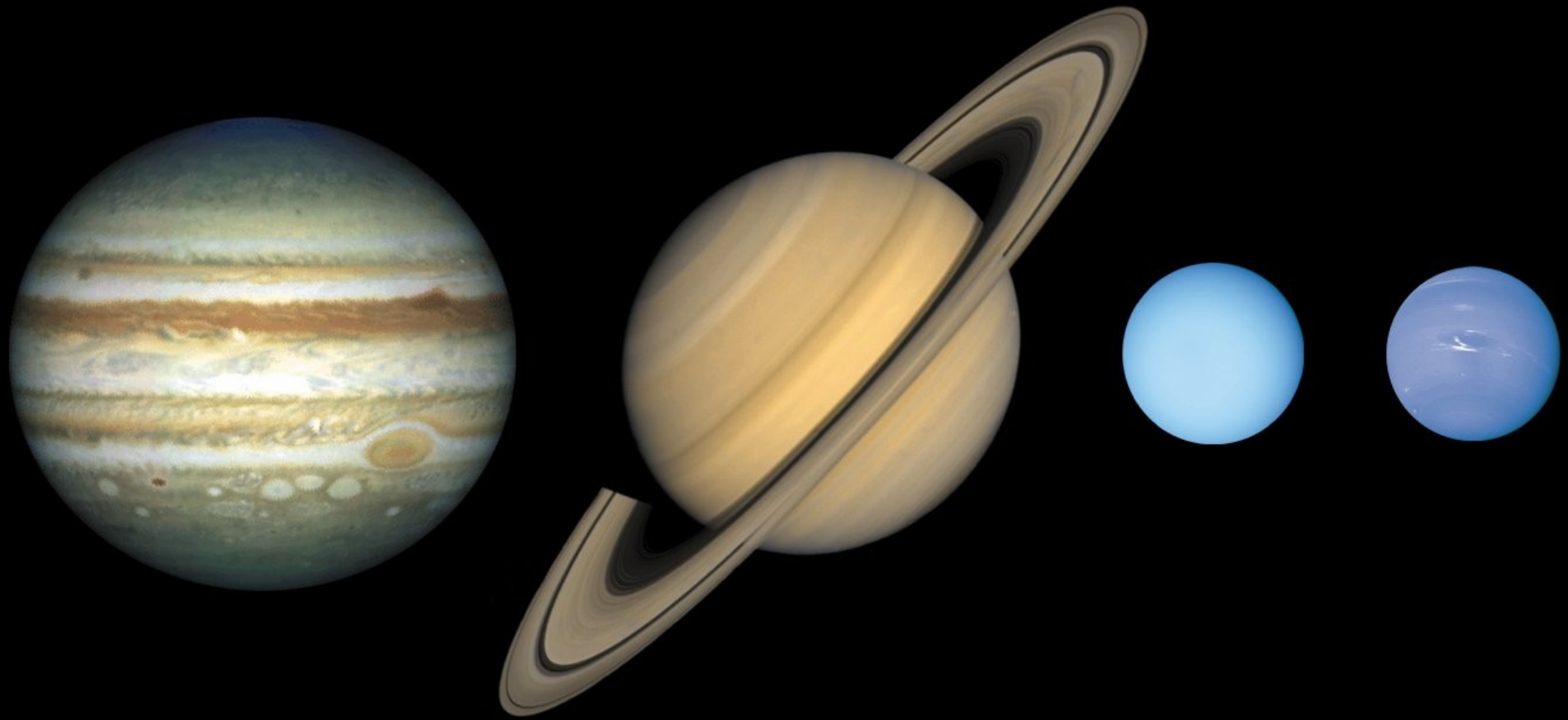
11/18/2009

Opening Discussion

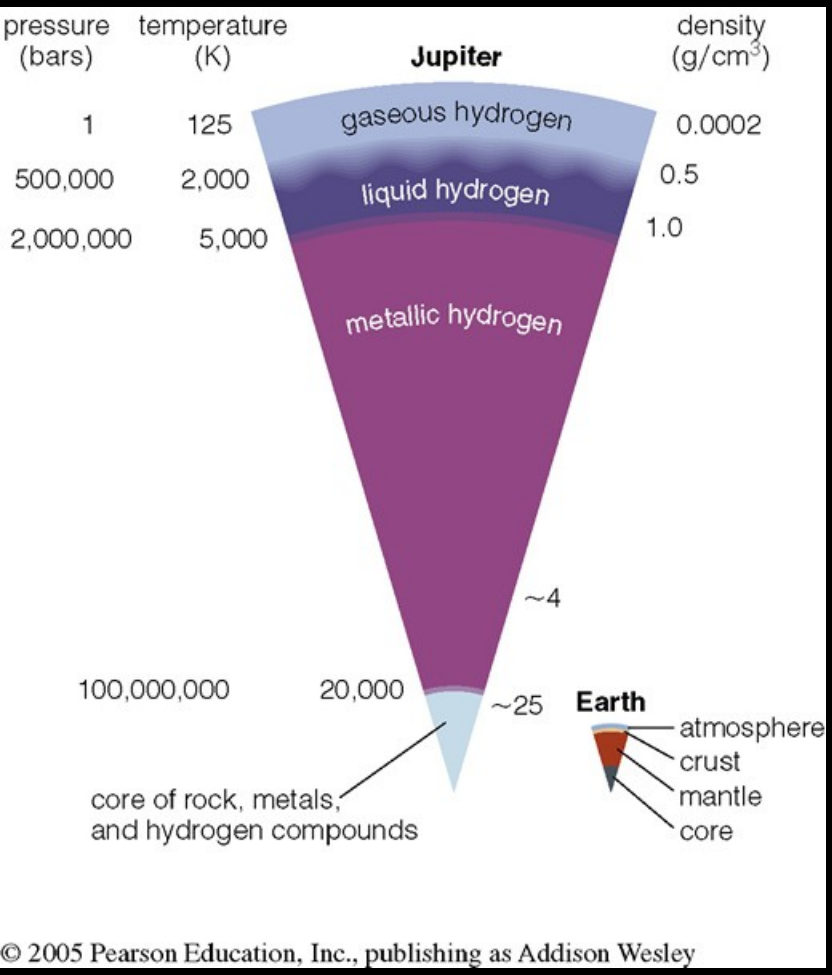
- http://www.youtube.com/watch?v=XGK84Poeynk
- Have you seen anything interesting in the news recently?
- What did we talk about last class?
- Minute Essays
  - Science vs. policy
  - How do people who don't believe global warming defend themselves?
  - When to expect effects and length of time line.
  - Day before Thanksgiving.

Jovian Planet Basics

- Jovian planets are all giant balls of gas. They are extremely different from the terrestrial worlds. They are low density and rotate quickly causing some oblateness. They have numerous moons and rings.



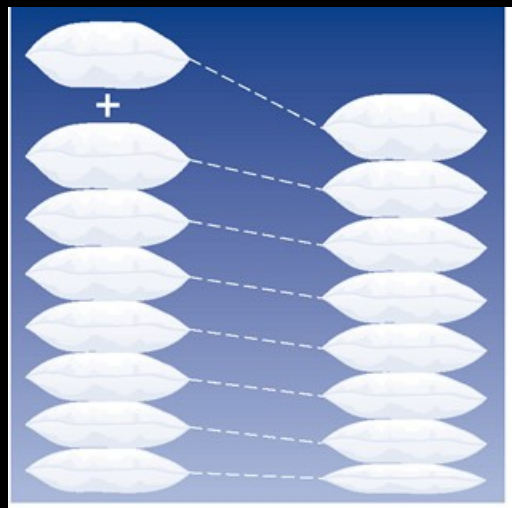
Jovian Planet Interiors

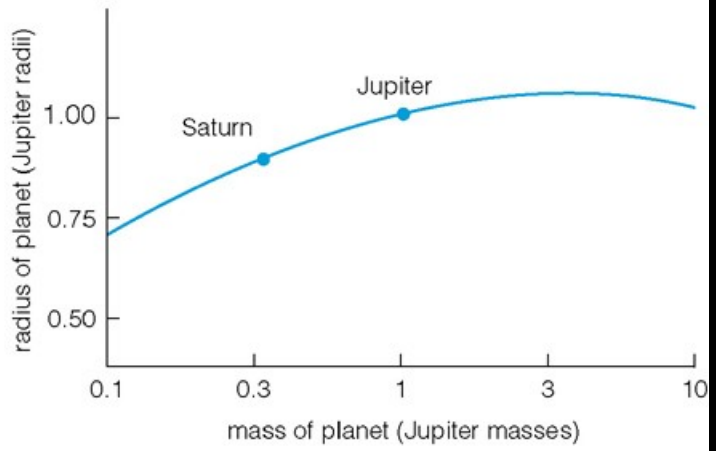


- This figure shows the internal structure of Jupiter. The cloud tops that we see have pressures similar to the Earth and are quite cold.
- As you drop into the planet, the pressures and temperatures rise significantly. At these pressures and temperatures, matter behaves in ways that are very different than what we are used to. For this reason Jupiter has layers of liquid hydrogen and metallic hydrogen around a rather small core.

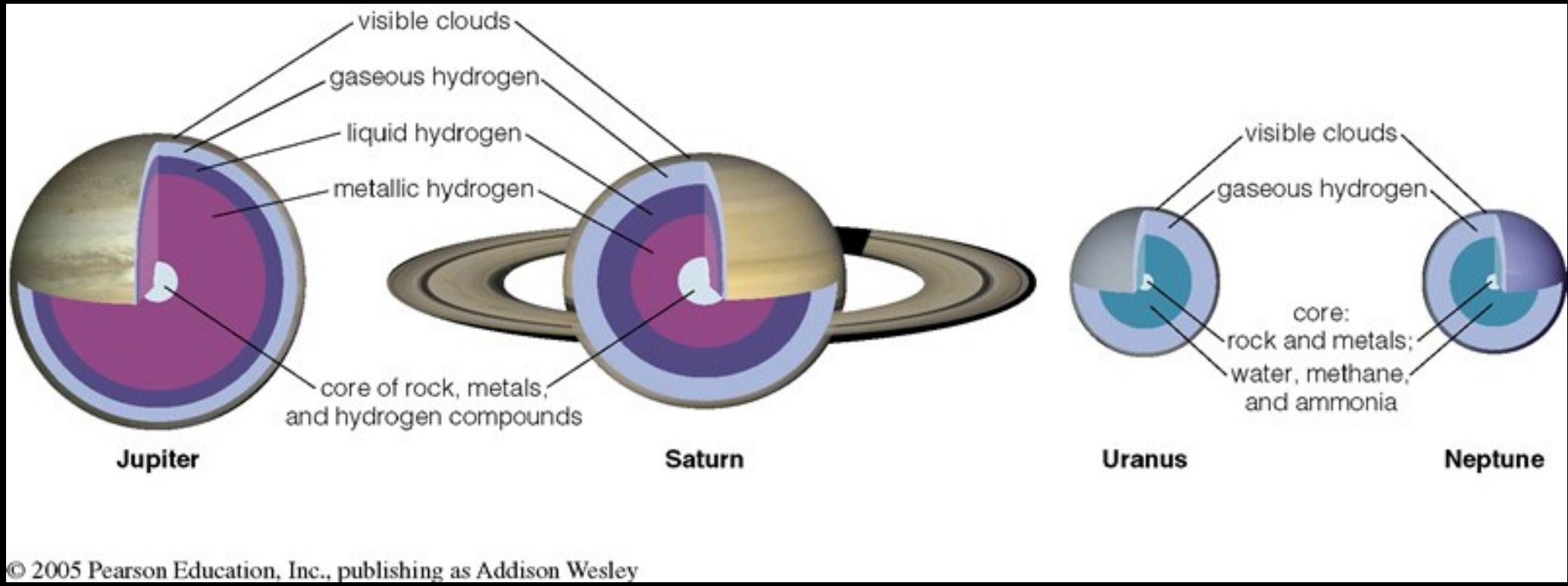
Compression

- The size of the planets does not vary with mass as one might expect. For Jupiter and Saturn this is because more mass compresses the material. At 80 Jupiter masses the object would sustain fusion and become a star.
- Uranus and Neptune have less H and He.





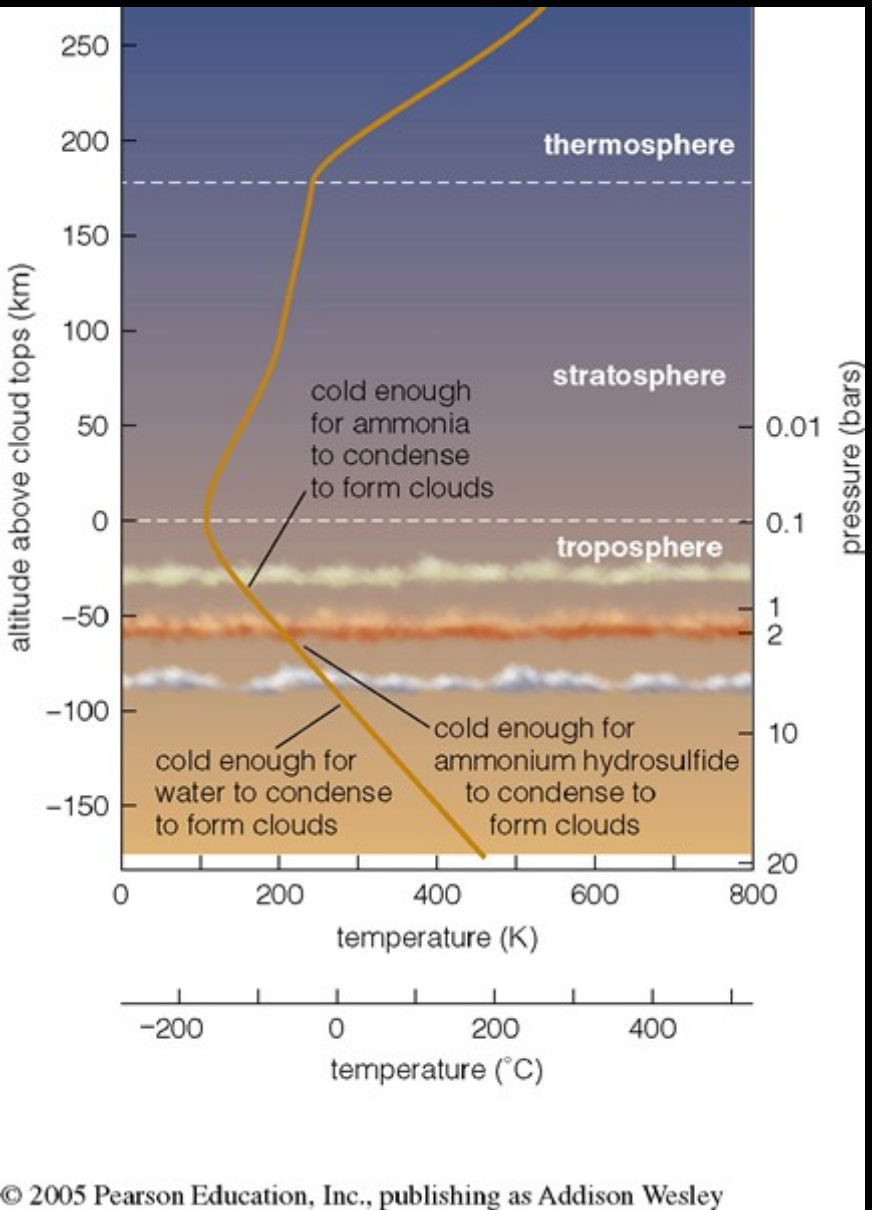
Comparison of Jovian Planets

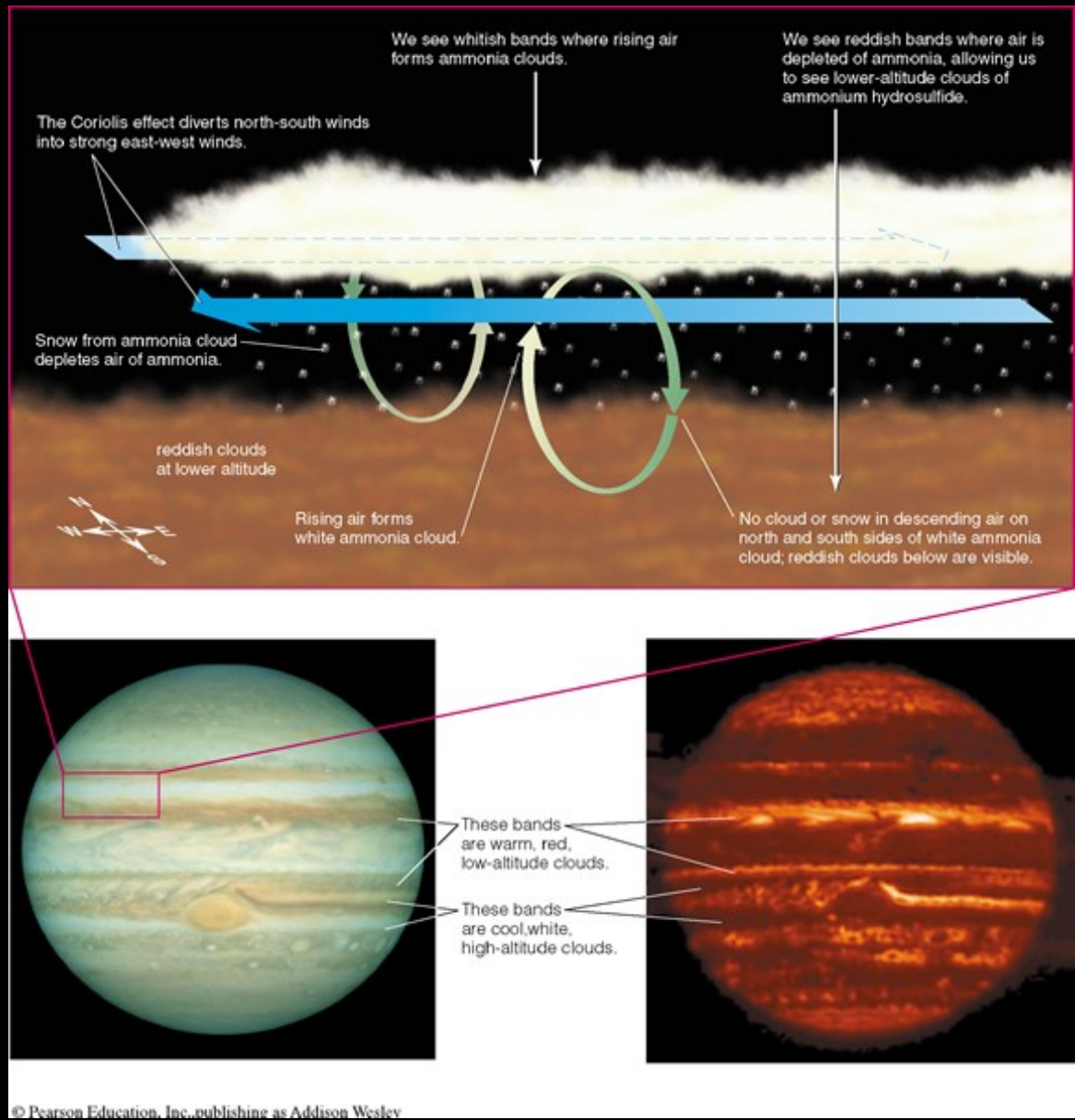


Internal Heat of Jovian Planets

- Jupiter, Saturn, and Neptune all emit roughly twice as much thermal radiation as they are hit with from the Sun.
- Jupiter's heat most likely comes from continued contraction of the planet.
- Saturn's heat appears to come from helium rain out where helium higher up condenses to a liquid and sinks.
- Neptune's extra heat energy isn't well explained. The only decent option would be continued contraction, but it isn't clear why that should be.

Jupiter's Atmosphere

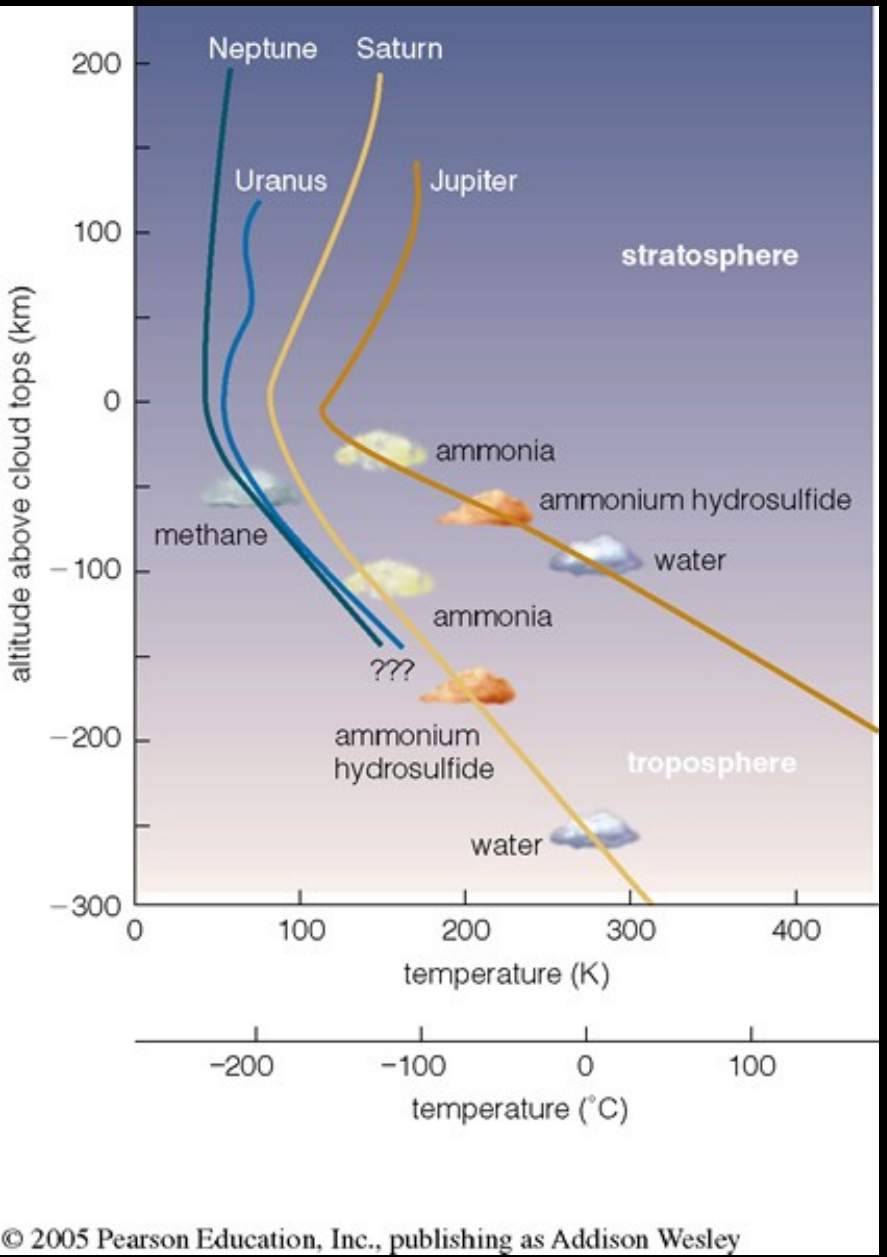




Storms and Winds

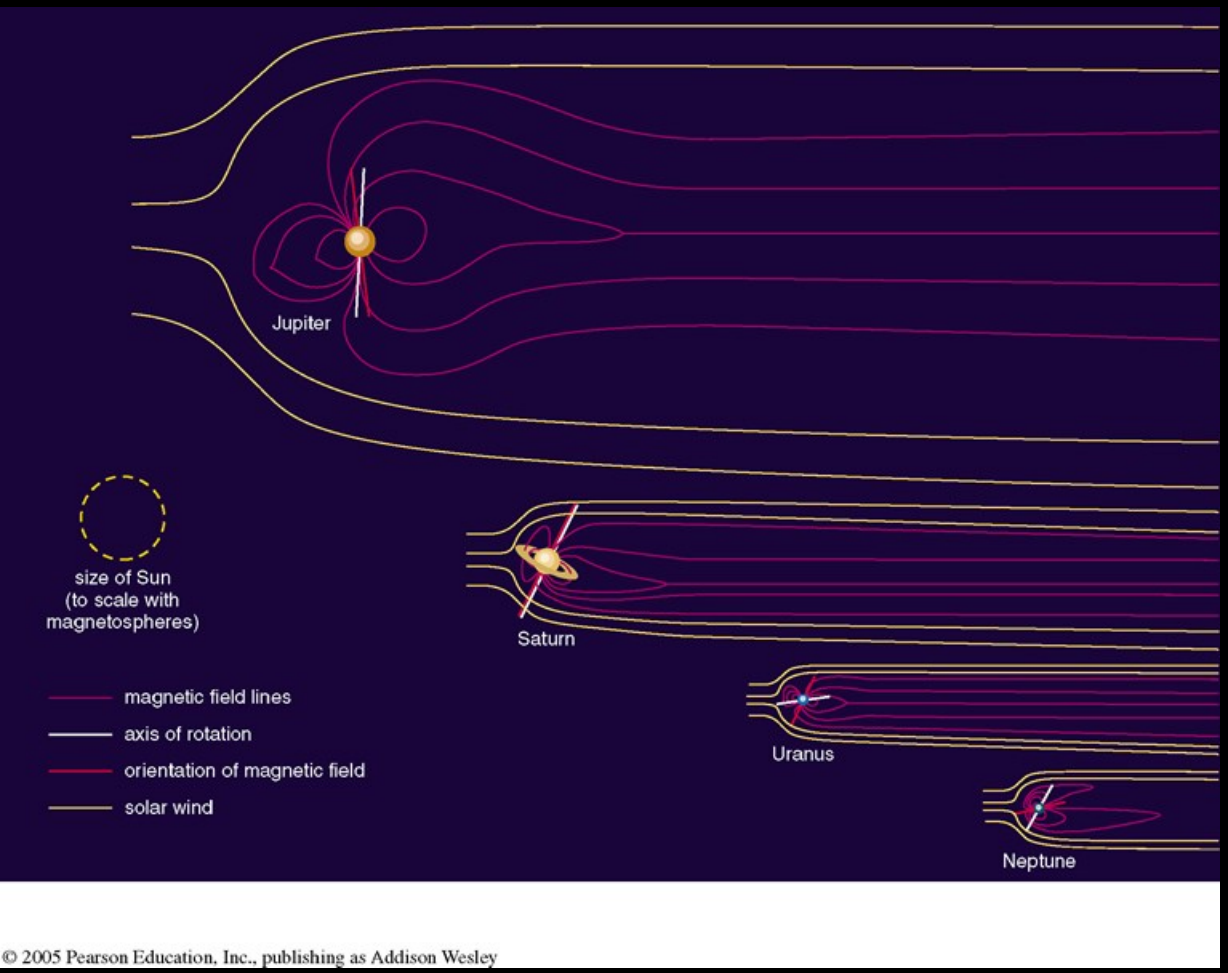
- Strong Coriolis forces produce remarkably strong winds on Jupiter and Saturn just in the bands, you don't have to be in the many storms on the planets.
- The storms that form are impressive in their own right. The Great Red Spot is a high pressure region that rotates counterclockwise. It is two Earth radii across and has been there for over 300 years.
- The chemistry of the brown and red colored clouds on Jupiter has not been well explained.

Comparing Atmospheric Structure



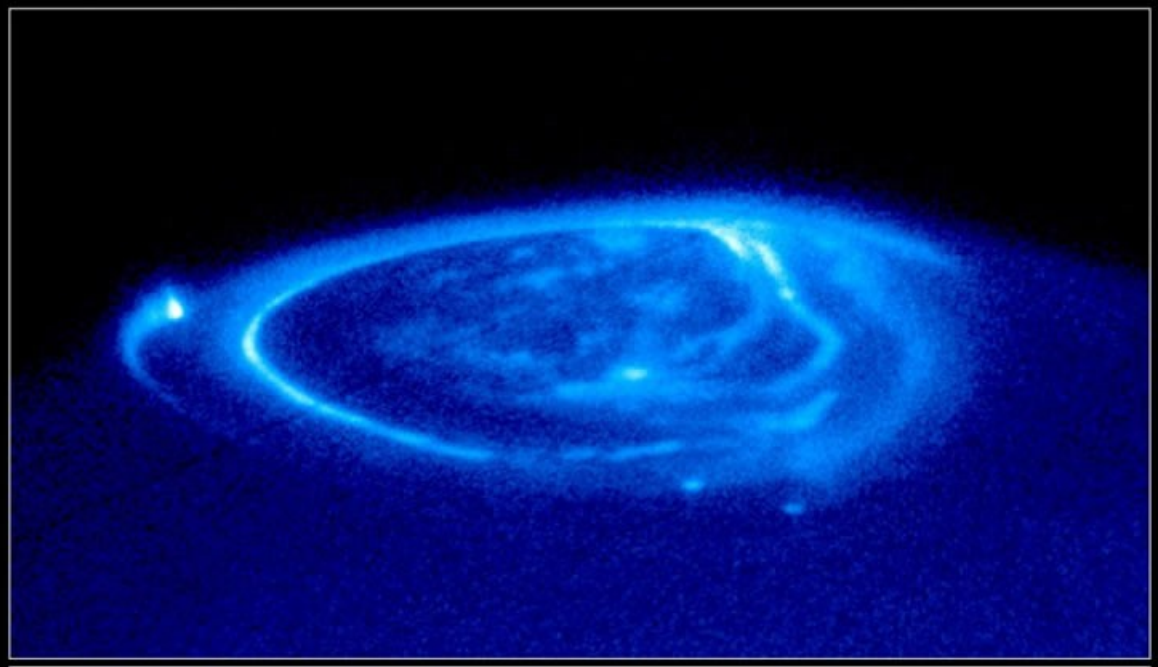
- The structure of the Jovian atmospheres differs as a result of distance from the Sun and mass.
- Hazes obscure things on Saturn and Uranus. Saturn has the fastest winds.
- When Voyager 2 went by Uranus there was virtually no weather seen. Now we can see significant weather in Hubble images.
- Methane clouds are the reason by Uranus and Neptune appear blue.

Jovian Magnetospheres



- All four of the Jovian planets have magnetic fields that produce magnetospheres. The magnet field and magnetosphere of Jupiter are the largest. Jupiter's magnetic field is 20,000 times as strong as that of the Earth.

Jovian Aurora



Jupiter Aurora
Hubble Space Telescope • STIS

NASA and J. Clarke (University of Michigan) • STScI-PRC00-38

- The strong magnetic fields mean these planets have aurora like on the Earth.
- The aurora are Jupiter are particularly impressive because the moon Io provides a large population of charged particles.

Minute Essay

- Why do Jupiter and Saturn have numerous colored bands? Why are they different colors?