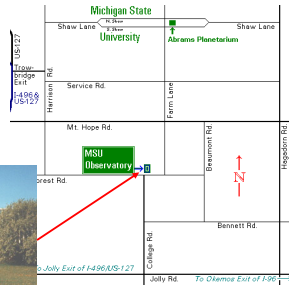


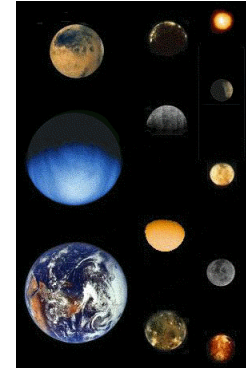
The Earth–February 7

- New policy on absences
 - You may miss classes for a university sanctioned event if you bring me a letter from your sponsor.
 - You may miss class if you are really sick if you bring me a note from your doctor.
 - If you miss class for either of these two reasons, you will not be penalized for missing clicker questions.
 - Of course you will need to learn the material that you missed.
- Processes that shape earth
 - Plate tectonics
 - Volcanism
 - Energy trapping: Greenhouse effect
 - Carbon dioxide cycle
 - Erosion (you already know this)
 - Loss of gases (for Wed)
- Public viewing sessions at MSU campus observatory.
 - Fri & Sat, 9-11pm, if it is not cloudy.
 - Mar 18 & 19
 - Apr 15 & 16
 - May 13 & 14
 - 24-inch telescope in dome
 - small telescopes outside



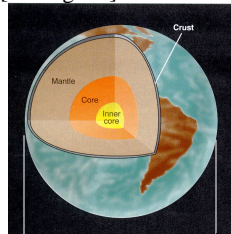
Why does Earth support life? Why do Venus and Mars not support life?

1. A possible reason why the surface of Venus does not support water-based life is
 - a. The temperature is too cold.
 - b. The temperature is too hot.
 - c. The pressure is too high.
 - d. The pressure is too low.
2. Same question for Mars.
 - Earth, Venus, and Mars formed in similar ways. What processes caused them to become so different?



The Interior of the Earth

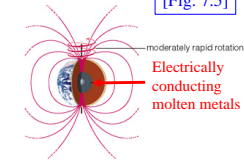
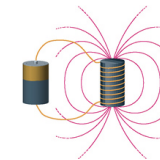
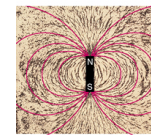
[see Fig 7.2]



- Crust
 - ~6 km thick under oceans.
 - 20-70 km thick under continents.
 - Rocks composed of silicon, oxygen, etc.
 - 0.3% of mass.
- Mantle
 - Slowly flowing semi-solid rock.
- Core
 - 7000 km diameter.
 - Metallic (iron, nickel, sulfur)
 - Outer core is liquid.
 - Inner core probably solid.

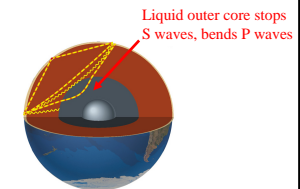
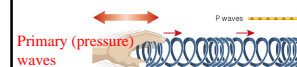
Measuring the Earth's Interior

- Magnetic field ←→ molten core



[Fig. 7.5]

- Seismic waves [pg. 173]

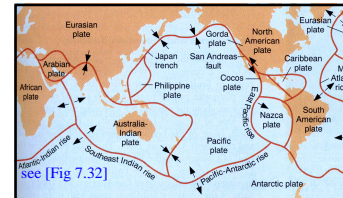


Differentiation

- Heavy stuff sinks to center of planets
- Giant planets
 - total mass, density → small solid cores
 - (~10x mass of Earth).
- Terrestrial planets
 - cores contain iron, nickel, etc.
 - lighter silicates make up crust.
 - This separation must have occurred when planets were hot & liquid.

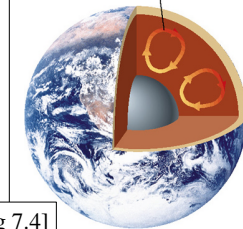
Plate Tectonics

- Crust split into huge *plates* drifting around on top of the mantle.
- Driven by *convection* (same as bubbles in boiling water).
- Convection time is 200Myears.



- Plates pushed apart in *rift zones*
 - Mid-Atlantic Ridge
- Plates bash together in *subduction zones*.
 - e.g. “Rim of Fire” around Pacific Ocean.
- Plates can slide at the boundaries
 - San Andreas Fault in California

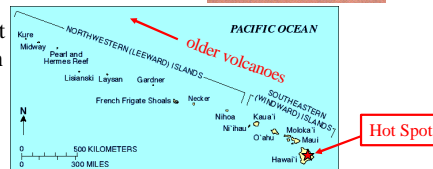
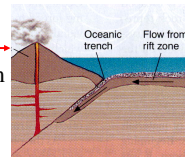
Mantle convection: hot rock rises and cooler rock falls.



[Fig 7.4]

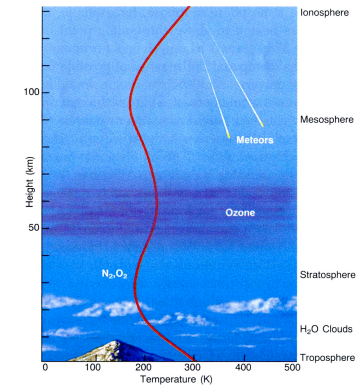
Geological Activity on Earth

- Plate collisions → Mountain building
 - Light continental plate collides with light continental plate
 - Himalayas
 - Heavy oceanic plate collides with light continental plate
 - Andes
- Volcanoes
 - *Magma* (molten rock) forced upwards from
 - Along mid-ocean ridges (rift zones).
 - Around subduction zones (Rim of Fire)
- Plate drifts over a hot spot
 - Hawaiian Island chain



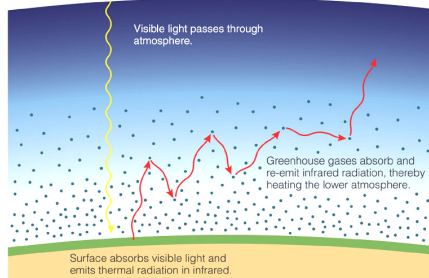
The Earth's Atmosphere [7.5]

- Weighs 13.6 pounds per square inch
 - 10^{-6} of total mass of Earth.
- 78% nitrogen, 21% oxygen, + argon, H_2O , CO_2 , etc.
- Ozone (O_3) is critical for life
 - blocks Sun's ultraviolet radiation
 - *Ozone hole*: over Antarctica, where ozone destroyed by man-made pollutants.



The Greenhouse Effect

- Incoming sunlight passes through atmosphere.
 - Absorbed by ground.
 - Re-emitted as infra-red radiation.
 - CO₂ gas causes atmosphere to be opaque to infra-red light.
 - Infrared light is trapped, so heats surface.
- **Global Warming [7.5]**
 - Temperature is going up.
 - Human activity causing huge rise in CO₂, other gasses.
 - What will the consequences be????

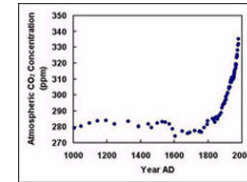


[Fig 7.14]

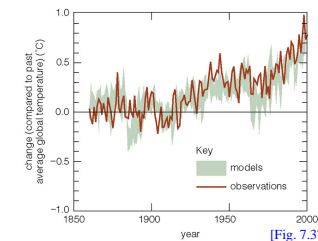
applet

Lots of scientific debate about the details....

- **Is the CO₂ increase really causing the temperature increase?**
 - Man-made greenhouse effect likely driving up the temperatures.
 - But other gasses have bigger effect per molecule than does CO₂.
- **How hot will it get?**
 - Predictions uncertain - very complicated interactions between atmosphere and ground.
 - 3° C (5° F) increase by 2030 is typical prediction.



CO₂ concentration, from Antarctic ice cores.



[Fig. 7.37]

For more info:

<http://www.pa.msu.edu/courses/isp205/sec-3/links.htm>

applet

Carbon Dioxide Cycle

- Removal of CO₂ from atmosphere
 - Rain dissolves CO₂
 - Rivers carry CO₂ into the oceans
 - Carbonate rocks lock up carbon
- Introduction of CO₂ into the atmosphere
 - Subduction of oceanic plate carries carbonate rocks underneath continent
 - Volcanoes release CO₂
- Q2: Which is the main reason Venus so hot?
 - a. CO₂ traps heat
 - b. It is close to the sun
 - c. Its atmosphere has so much CO₂
 - d. Its atmosphere has so much water.
- Assignment for Wed: What went wrong on Venus?

