LECTURE 1

Intro into science and earth's formation

- What is science
    - Trying to understand the world around us
    - Not the only way of viewing the world
    - Uses facts to explain the world around us
        - Principles – been proven true so many times they are now facts
- Scientific method
    - Observations
    - First real step is: Question
    - 2: Hypothesis (educated guess based on what you know going into it)
        - Testable and predictive
        - Does it pass the "if-then" test
        - Past and future events
    - 3: collect data
    - Last step 4: evaluation
        - Calculate anything necessary
        - Determine if data supports hypotheses or no
    - Can somebody else test the hypotheses and get the same results?
    - Theory: hypotheses tested several times and got the same results
    - Theory can be upgraded to a law if tested and people like it. Can be revised thought.
    - All about facts not beliefs
- What is geology?
    - Study of the earth
    - Only about 200 years old
    - Catastrophism: explain all of earths features with just a few catastrophes and those ó events created everything (rivers, mountains, ect)-noahs flood
    - History
        - James hutton (1795, Scotland)
        - Theory of the earth
        - Principle of uniformitarianism
            - Gradually happens; uniform manner over time
            - Ex: stream gradually pushing the canyon walls apart and cutting through them and eventually making the grand canyon
        - Actualism
            - Don't always happen at same rate overtime (glaciers)
            - Uniformitarianism is still right but Actualism is the upgraded version
                - 1 more component
    - Meteorites enter the earth's atmosphere at up to 40km/s
        - What's that in MPH? 1 mile=1.6km
        - 40km*1mile*3600seconds/(1.6km*1hr)=90mph
        - Unit conversion problem
- How did the earth form?
    - >6bya: no solar system, just a nebula of H atoms
    - Nebula: large cloud of gas in outer space
    - Forming the solar system
        - Nebular hypotheses (file 1b)<-animation file

- Everything form out of nebula
- Step A: Gravity
    - Gravity is everywhere. Can draw objects closer together overtime
- Step B: solar disk model
    - Flatten and rotates
- Step C: protostar (6 Ga)<-billions of years
    - Very similar to star just not fully functioning
    - Temperature increasing
    - If high enough causes fusion
- Step D: fusion
    - Weld themselves together
    - Birth of our sun

- Forming the planets
    - Planetary accretion
        - 4.5 Ga-(how long it took earth to form)
        - Atoms hit each other hard enough they stick
        - Still happens today
    - Theia impact
        - Planet on planet collision
        - Theia hit earth
        - Density (mass per unit volume)<-how heavy for its size
            - Oil and water
            - Theia aftermath
                - Everything close to surface of earth melts down
                - Liquids and gasses move freely and can separate but solids cant (low density rock moves towards surface and denser rocks move down towards center)
    - Compositional layers of earth
        - 4 layers defined by chemistry (aka composition)
            - 1-crust (8-45km)
                - Light elements (Si, Al)<- silicone and aluminum
                - Low density elements
                - Types of crust
                    - Continental crust
                    - Oceanic crust
            - 2-mantle (45-2900km)
                - denser elements (iron)
            - Core
                - 3-outer core
                    - More dense
                - 4-inner core
                    - Pure iron and nickel
                    - Most dense

- Geology in the news
    - 6.1 magnitude quake hits san Francisco bay area
        - Few people injured
        - A lot of property damage
- Physical layers of the earth

- 5 layers defined by physical(mechanical) strength
    - Lithosphere
        - Upper 100km
        - Thicker than crust
        - Includes crust plus other materials under
        - Brittle layer. Little force = no change. A lot of force=shatter into fragments. (frozen candy bar)
    - Asthenosphere
        - Rock behaves in a ductile (plastic) behavior
            - Little force=gives easily
            - Flow rather than shatter
            - Melted candy bar or thick peanut butter
    - Lower mantle (mesosphere)
        - Chemical
        - More brittle than ductile behavior
        - Temperature not the only thing effecting rocks but also pressure
        - Pressure is great enough to be brittle in this layer
    - Core
        - Outer core
            - Very ductile
            - Consistency of ketchup
        - Inner core
            - More brittle
            - Solid ball of iron
            - Temperature is higher here but has more pressure

- What's down there?
    - How do we know the layers have different densities, compositions, and strengths?
        - Don't have sample from deep in the earth
        - Can't get to mantle
        - Rely on other factors
            - Volcanoes
                - Composition in lava
            - Earthquakes
                - Generates seismic waves
                - Speeds of waves helps learns densities of layers
- Meteorites
    - Earth is made of meteorites so study them to see what earth is made of