PLATE TECTONICS

I. WHAT IS PLATE TECTONICS?

- Why do we care about plate tectonics?
  - Almost all earth processes relate back to plate tectonics (climate, flora & fauna, volcanoes, earthquakes, rock & mineral distribution, fossil fuel deposits)
  - Ex: Antarctica is now at the South Pole surrounded by cold, oceanic current, 90 mil years ago it had a climate similar to Canada's; plate tectonics changed its location & affected climate, etc.
- Lithosphere is divided into several pieces (plates) that move around Earth's surface; plates are often described as floating on the asthenosphere
- Plate boundaries DO NOT correspond to continent & ocean boundaries
- Some plates contain just oceanic crust, some contain just continental crust, & some contain both

II. DISCOVERING PLATE TECTONICS

- Early cartographers noticed that the continents looked like puzzle pieces that could fit together
- Early 20th century: Alfred Wegener developed the Continental Drift Hypothesis- continents moved over time
  - Evidence: continental boundaries fit together, some fossil species were found on opposite sides of the ocean (Mesosaur fossils in Africa & South America)
- Continental Drift Hypothesis did not get much support until 1940s because Wegener could not explain HOW continents moved
- In the 1940s there was lots of submarine warfare (WWII) so detailed maps of the ocean floor were needed
- Scientists already knew there was a Mid-Ocean Ridge (MOR)- long mountain chain running through the oceans

- Seafloor anomalies- scientists found some unusual features on the seafloor while mapping it in 1940s-1960s
    - Found magnetic anomalies in seafloor rocks
    - Rocks close to MOR record normal magnetic polarity (magnetic mineral grains point north), while rocks further away begin alternating between normal & reverse polarity
    - This meant Earth's magnetic field changed through time & seafloor rocks were not all the same age (rocks closest to rift are youngest, rocks farthest away are youngest); seafloor rock dating confirmed this
- Explaining the anomalies
    - Magnetic & age anomalies produce mirror images to the east & west of the MOR
    - Seafloor spreading hypothesis- lava rises to the surface at the MOR, cools to form new rocks, rocks get pushed aside as more lava comes to the surface
    - Seafloor spreading revived Wegener's Continental Drift Hypothesis & provided the mechanism for making continents move
- Plates move partly because of convection- hot, low-density material moves upward displacing cooler, high-density material
- Convection within the ductile asthenosphere helps move the brittle lithospheric plates
- We now know convection is only one process that makes plates move
- New hypotheses:
    - Ridge Push Model- buoyant material near the MOR pushes the plates apart & they slide downhill away from MOR
    - Slab Pull Model- as one end of the plate sinks, it pulls the rest of the plate down behind it
    - Slab Suction Model- the descending plate sucks down some asthenosphere, helping stir the convection cell
- Fast-moving plates might move 10 cm per year

- Q: If Los Ang & San Fran are 300 miles apart & moving toward each other at 10 cm per year, how many years until they're side by side?
    - A: ~4.75 million years

III. PLATE BOUNDARIES

- No gaps between plates
- When a plate moves it affect the plates around it
    - Pull away from each other (diverge)
    - Run into each other (converge)
    - Slide past each other (transform)
- Divergent Margins- 2 plates moving away from each other
    - Seafloor spreading- occurs when a divergent boundary exists between 2 plates with oceanic crust; characterized by undersea volcanic activity
    - Rift valleys- form when a divergent boundary starts forming in continental crust
        - Ex: East Africa Rift Valley
    - Triple junction- often get a Y-shaped split
    - 1 arm may become an active plate boundary, other 2 arms become "failed rift"
- Convergent Margins- 2 plates collide head-on
    - Subduction zone- 1 plate contains oceanic crust, other contains continental crust (sometimes both have oceanic crust)
        - Plate with oceanic crust is forced down (subducted) because it has a higher density
        - Characterized by volcanic activity & big earthquakes
    - Collision zone- both plates contain continental crust, low density makes it hard to subduct (like trying to keep a cork underwater)
        - Rocks are pushed up & form mountain belts