Mountain Building - Orogenesis

1. Archimedes' principle
    a. The mass of the water displaced by the block of material equals the mass of the whole block
    b. Thus for a given material, the proportion of material above the water surface is constant
    c. For example wood (density 0.8 gm/cm) will have 20% of its mass above water (density of 1.0 gm/cm). Thus for a 1 m block 0.2 m will be above water and 0.8 m below, but for a 2 m block .4 m will be above water and 1.6 m below
2. Isostasy
    a. Less dense material "floats" on top of the denser material
    b. Buoyancy forces pushing the block up are balanced against the gravitational forces pulling the block down
    c. When weight is added to the crust, the crust will subside (sink)
    d. When weight is removed, the crust will rebound (uplift)
    e. Essentially, isostasy is the balance between topography of Earth's surface and the thickness and density of the underlying rock
3. Mountain Roots
    a. Continental Crust has "roots"
    b. As a result of isostasy, the thicker the surface exposure of rock, the thicker the crustal "roots"
    c. As continental crust is compressed it shortens and thickens
    d. Avg. continental crust is 35-40 km thick, under deformed crust avg. is 50-70 km, with the majority of the difference in the "roots"
4. Mountain-Types
    a. Fault-Block Mountains
        i. Formed from tensional stress
        ii. Normal Faulting
        iii. Example: Basin and Range Provinces SW USA
    b. Upwarped Mountains
        i. Formed from compressional stress
        ii. Broad arching of the crust or great vertical displacement along faults
        iii. Example: Black Hills SD
    c. Folded Mountains
        i. Formed from compressional stress
        ii. Reverse Faulting and Folding – highly deformed rocks
        iii. Will have highly metamorphosed rocks
        iv. Example: Appalachians, Himalayas
    d. Volcanic Mountains
        i. Formed volcanic activity
        ii. Associated with plate boundaries or hot spots
        iii. Example: Cascade Mts. Or mountains within Japan
5. Mountain Building (Orogenesis) Zones
    a. Convergence Zones

i. Oceanic-Continental
    1. Folded Mt. Belts
    2. Thrust Faults
    3. Volcanic Chains
    4. Accreted Terranes
        a. As exotic blocks collide with continents they become sutured to the continent.
        b. The blocks are referred to accreted terranes
        c. Accreted Terranes are island arcs, portions of ocean floor, fragments of continental crust
    5. Example: Andes Mountains, Cascades
ii. Oceanic-Oceanic
    1. Volcanic Chains
    2. Examples: Japan, Philippines

b. Collision Zones
    i. Folded Mt. Belts
    ii. Thrust Faults
    iii. Remnants of Volcanic Chains
    iv. Examples: Alps, Himalayas
c. Continental Rifting
    i. Fault-block mountains

6. Mountain Building – Multiple Events
7. Why does the Earth have mountains of various height?
    a. Erosion attacks mountains – remember Earth wants to be flat
    b. Orogenic collapse.
8. Mountain Building, Rock Cycle and Plate Tectonics