HYDROLOGY

GEOLOGY IN THE NEWS: California has just declared mandatory water restrictions; they are in the middle of their worst multi-year drought; trying to cut water use by 25%; California just discovered that Nestle has been withdrawing from a state park to sell as bottled water, their permit expired in 1988.

Q: Why should we care?

A: main water reservoirs: oceans, glaciers, lakes, rivers, groundwater, etc.

I. GROUNDWATER

- Hydrologic Cycle- basically the flow of water from the ground to the sky and so on
- Runoff- water flowing across surface of Earth into lakes etc.
- Infiltration- water going into the soil
- Infiltration properties
    - Porosity- % of an area that is open space that can be filled w/ water; 3 main types
        - Intergranular pores- empty spaces in between grains; most important type of porosity, usually where most of the empty space will be
        - Fractures- breaks or cracks in rock; water can flow along fractures & fill them up; vary a lot; where they are present they are important but they're not always present
        - Vugs- formed by dissolution (an opening in an underwater rock turns into a large cave or cavern); where they are present they are important but they're not always present
    - Controls on Porosity
        - Determined by sediment/rock properties: well sorted gravel = high porosity; poorly sorted gravel, sand, clay = low porosity; mostly cemented sediment = low porosity

    - Permeability- how well connected the pore spaces are; need them connected for water to flow through ground
- Need high porosity & permeability for water to flow
- Water Table- line between zone of aeration & zone of saturation
    - Beneath it: pores are filled w/ water
- Groundwater Supply
    - Aquifer- goal; layer that contains a useable amount of water; high porosity & permeability
    - Types of aquifers
        - Unconfined aquifer- no layer above aquifer to restrict water movement
        - Aquitard- layer restricting water movement
        - Confined aquifer- aquifer between 2 aquitards; aquitard becomes a problem here because water can't get back into the ground so the aquifer can run dry over time
            - Artesian well- easy to operate; high water pressure at bottom of a hill, well is drilled & high pressure allows water to come up w/o pumping or drilling
        - Perched aquifer (aka perched water table)- small water table building up on top of an aquitard in the middle of a hill
- Water Supply
    - Recharge- amount of water going in
    - Discharge- amount of water coming out
    - If recharge > discharge, water table rises (sometimes good, sometimes bad)
    - If recharge < discharge, you're overdrafting
- Effects of Overdrafting
    - Cone of depression- water table lower around well; if it continues, the well can't pump anymore water out
    - Subsidence- ground level sinking; when you pump all the underground water out, upper sediment is going to fill it in & ground is going to sink; impossible to fix

    - Salinity contamination- saltwater goes into aquifer when near the coast
    - Desalinization- extracting the salt & making the water fresh again; problem: very expensive
- Groundwater Movement
    - Typically moves very slow
        - Good: water can't flow out of the aquifer quickly
        - Bad: contaminants in soil/water are going to be there for a pretty long time
    - Erodes even at slow speeds
    - Groundwater carries dissolved substances
        - CO_2 & SO_2
        - Dissolve carbonate rocks
    - Bad at the surface: not a lot of structural support; sinkholes
- Case Study: Groundwater Contamination
    - Love Canal, Niagara Falls, NY
    - Abandoned canal was turned into a chemical waste dump in 1940s
    - Property was bought for development
    - Construction broke contaminant seals, chemicals reached water table by 1970s
    - Increased cases of illness
        - Asthma, infection, epilepsy, cancer
        - Birth defect rate 56% by mid-70s
    - 1978: Local homeowners learn there are 21,000 tons of chemical waste underground
    - Who's responsible?
    - August 7, 1978: President Carter declares a federal emergency, evacuates some areas
    - 1980: "Superfund Act"- federal government gives money to help people clean up contaminated areas
    - Chemical company found negligent in 1994
    - 2008: survey of 4 states found 500,000 kids in schools <1/2 mile from waste dumps, including one on top of a PCB dump