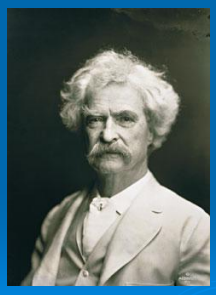
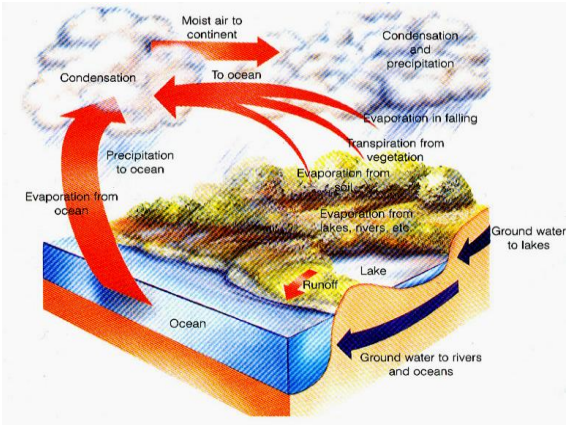
Water



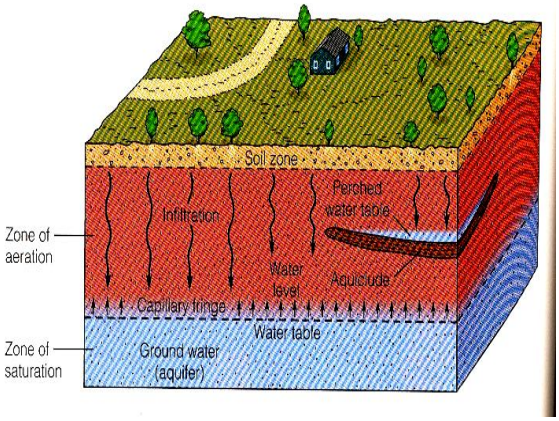
- Whiskey is for drinking and *water* is for fighting!

Groundwater



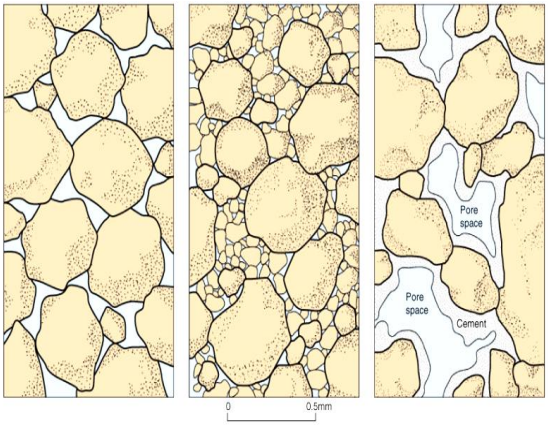
So Where is the Groundwater?

- New terms
  - Infiltration
  - Zone of aeration
    The Water Table
  - Zone of saturation

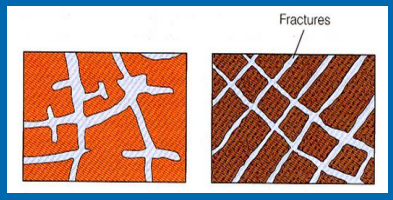


Porosity Vs. Permeability

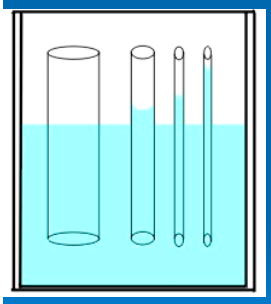
- Porosity
- Permeability
- Size, shape, and density of the rock or soil.



Fractures



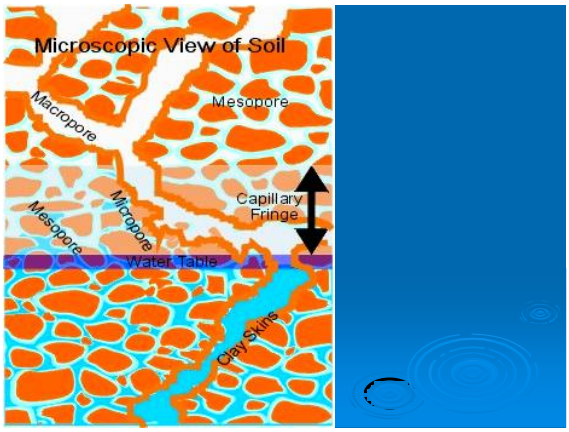
Capillary rise



Why?

- Adhesion, water first adheres (fixes itself) to a surface

- Cohesion, Water molecules are attracted, creating a cohesive strength



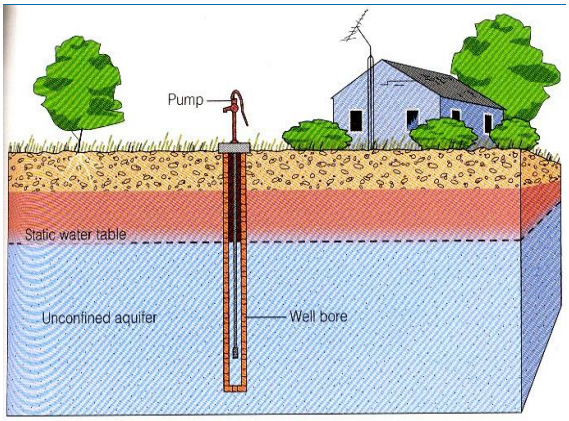
What is an Aquifer, anyway?

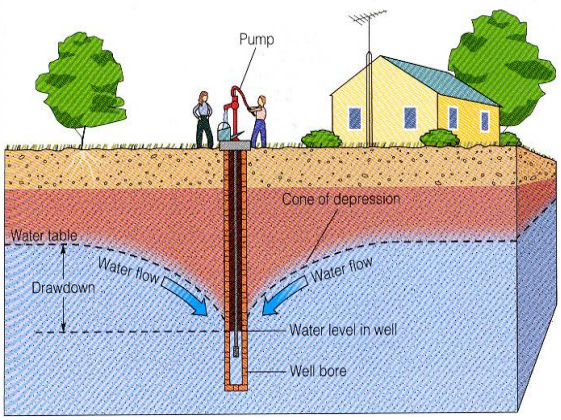
- An Aquifer is,
  - A water saturated geologic formation whose porosity and permeability are sufficient to produce water in the form of natural springs and human made wells.

Aquifer types

1. Unconfined aquifers
   - Are contained within geologic formations that are exposed to atmospheric pressure changes and are capable of providing water by pumping.

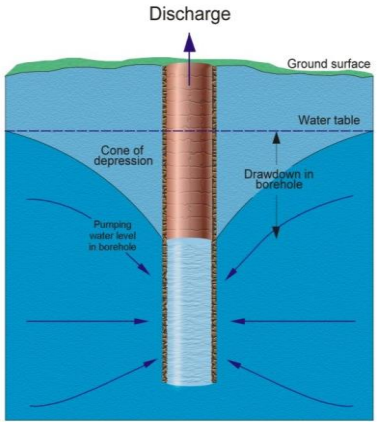
Drilling for the water table





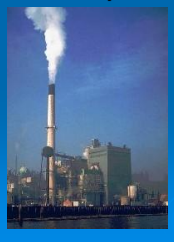
Be careful!

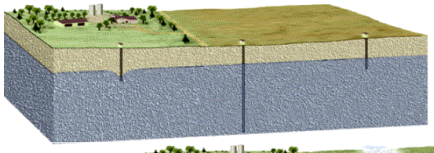
Discharge
vs.
Permeability



Be kind to your neighbors, but also watchful!

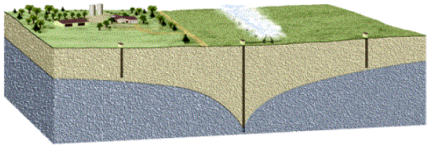
- Agriculture (irrigation) and industries use a lot of water, so much that it can leave your well high and dry!





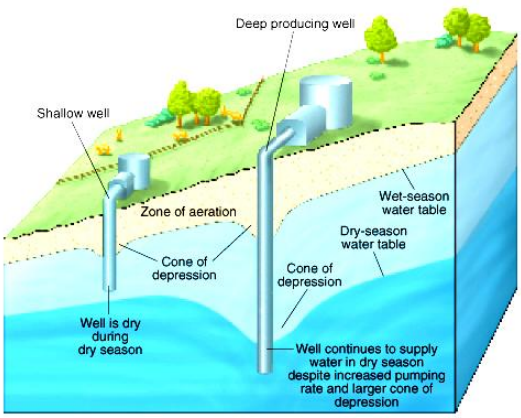
All is well.

All is not well!



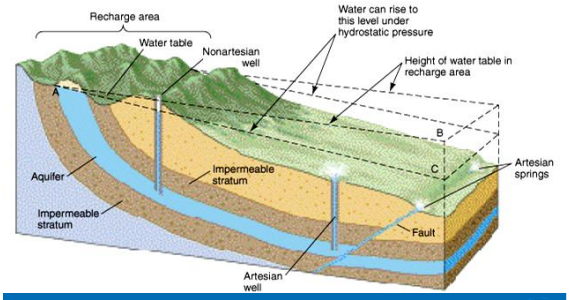
Seasonal Change

- The water table is generally lower in late summer and higher during the Fall or Spring



Aquifer types

2. Confined aquifers
   - Are pressurized systems that occur where water-saturated permeable layers are enclosed between to aquicludes.
   - Also called artesian wells



Ground-water Mining

Exists when the amount of water withdrawn from an aquifer exceeds the aquifers sustained yield = an overdraft.

California

- California and groundwater mining
  - San Joaquin Valley, has subsided (sank) approximately 9 meters (29 ft.) from 50 years of heavy irrigation.

Groundwater contamination

Vocabulary term

- Residence Time
  - The average time a given substance will stay in a system (E.g. an Aquifer)

Common sources of ground water contamination

1. Agriculture
2. Commerce
3. Industry
4. Our homes
5. Waste management

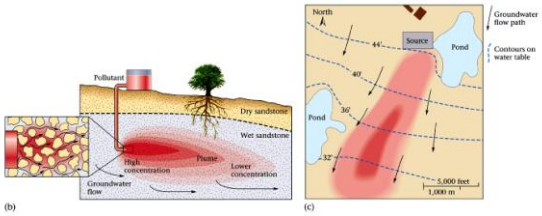


FIGURE 19.23

Common Pollutants

- Hydrocarbons
- Solvents (benzene, toluene, and xylene)
- Fertilizers
- Pesticides
- Manure

Remediation (clean-up)

1. Problem identification
2. Remove the contaminate source
3. Isolate the contaminate
4. Determine the possible effects of the contamination

5. Determine the best way to remove the remaining contaminants
   1. Bioremediation (microbes)
   2. Pumping (Extraction and Injection wells)
   3. Filtration

IGWA
IOWA GROUNDWATER ASSOCIATION

Website

http://www.igwa.org/

Iowa's groundwater resources by region.

Geologic Work by Underground water

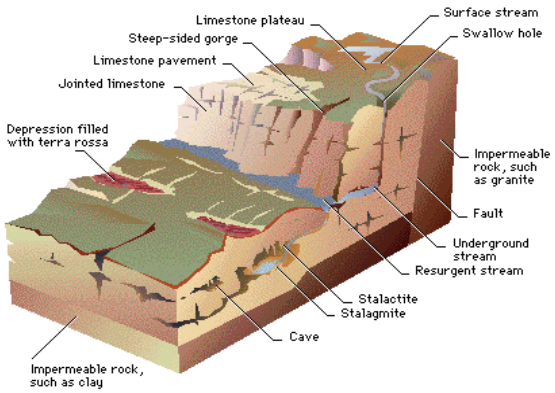
Karst topography

Factors in developing a Karst system

- A product of chemical weathering, (solution weathering) of carbonate rock by carbonic acid (H_2CO_3)
- Soluble rock (E.g. limestone)
- Areas of moderate rainfall
- Valleys

Karst features

1. Pitted grooves in surface rocks
2. Dolines (sink holes)
3. Karst Plain
   - Few streams
   - Shallow holes in the ground (good places to hide
4. Caves
   - Caverns
   - Speleothems (flowstone, dripstone)



Why should you care?

- Caving is fun!
- You should think twice before building or buying a home in an carbonate rock rich area.