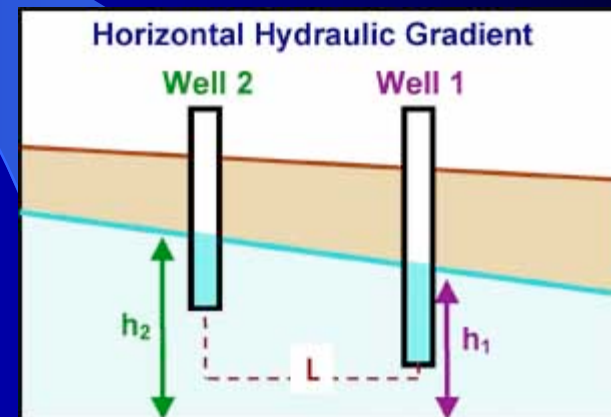
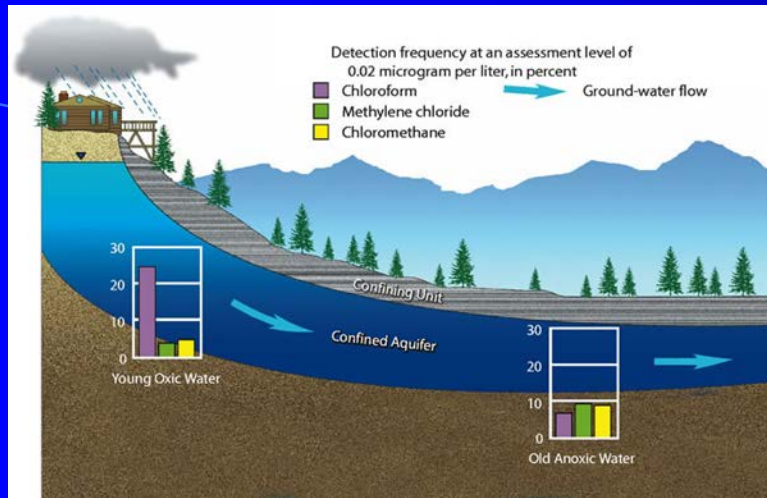
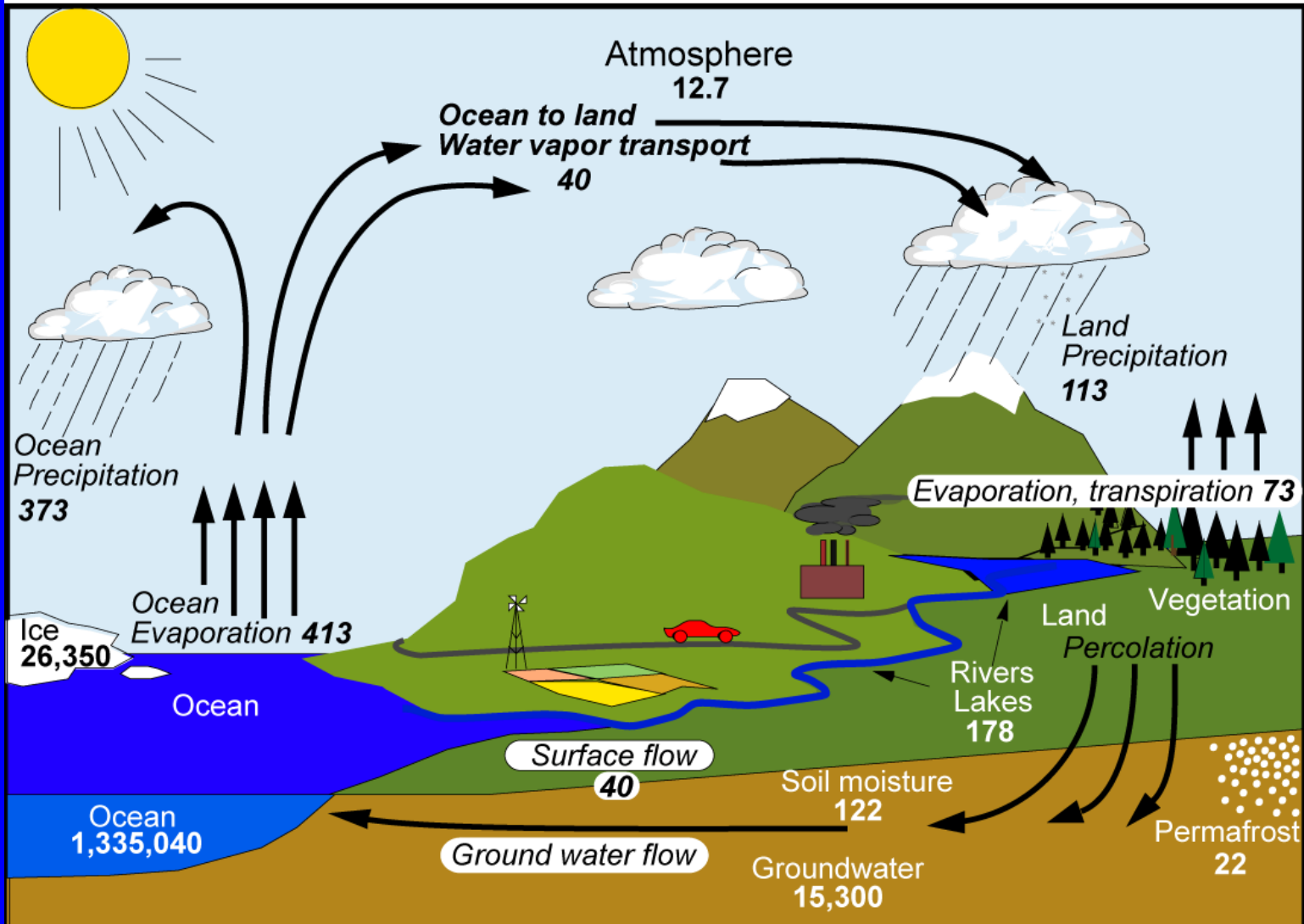


89.325 – Geology for Engineers

Groundwater



Hydrological Cycle



Units: Thousand cubic km for storage, and *thousand cubic km/yr* for exchanges

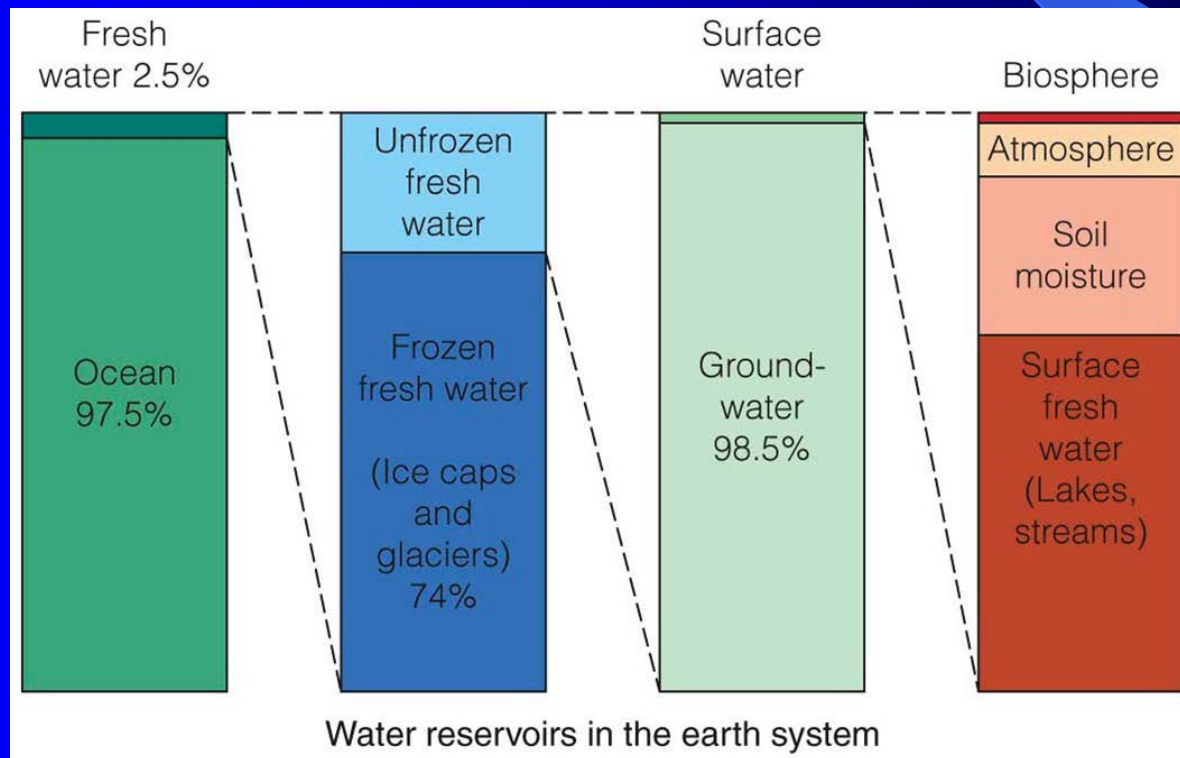
The largest reservoir in the hydrologic cycle is the ocean

- Contains more than 97.5% of Earth's water
- Most of the water in the hydrologic cycle is saline, and not usable by humans

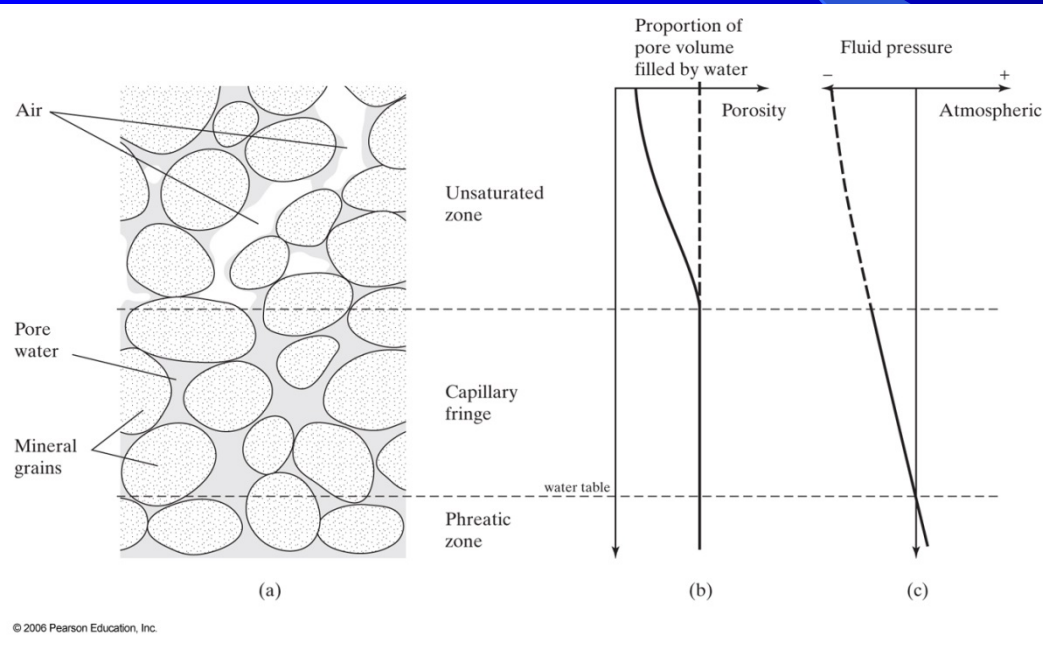
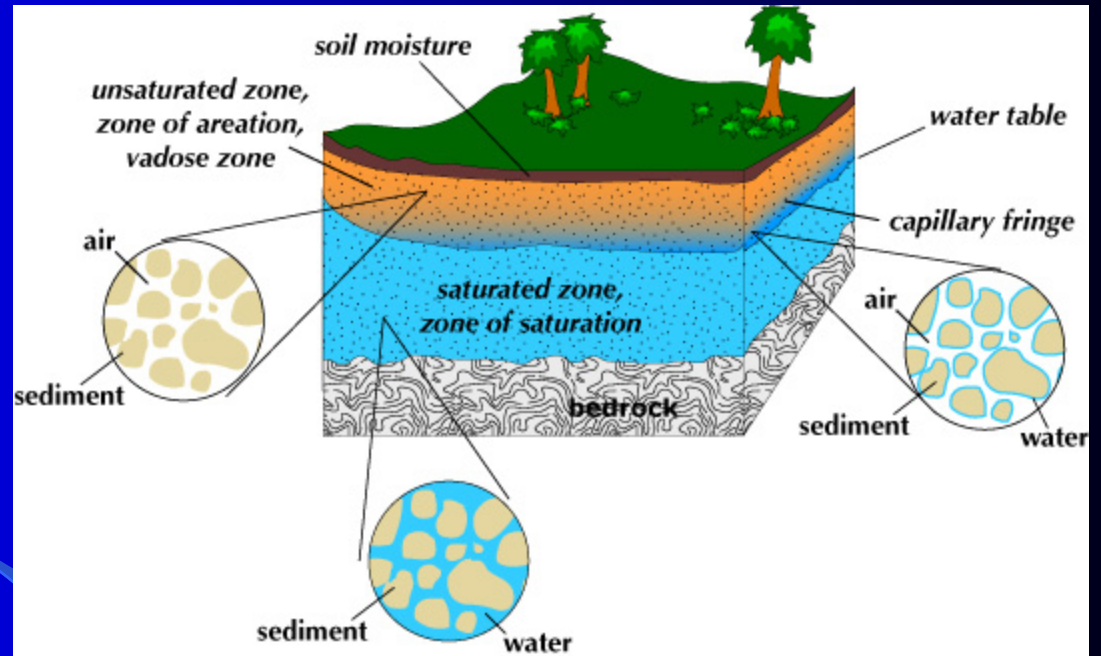
The largest reservoir of fresh water is the polar ice sheets

- Contain 74% of the Earth's fresh water

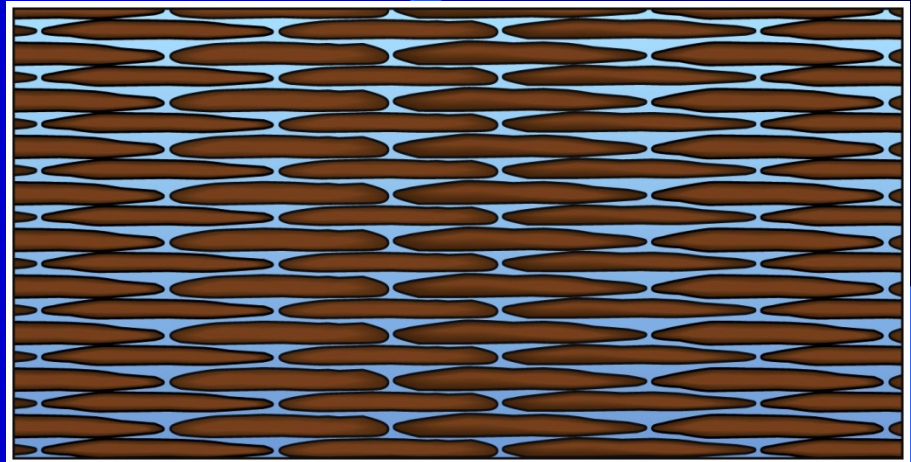
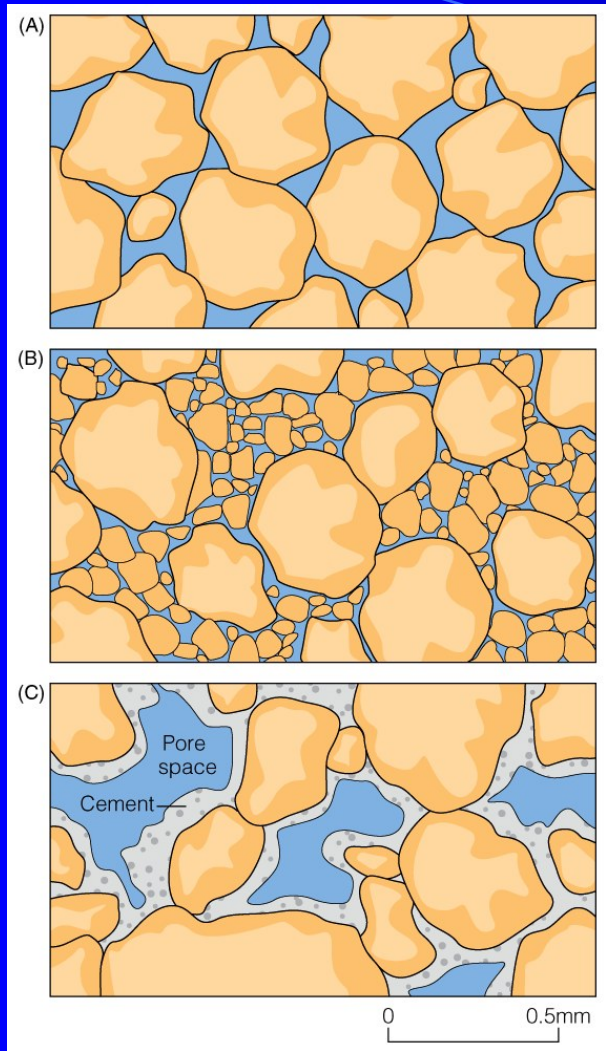
The largest reservoir of unfrozen fresh water is groundwater



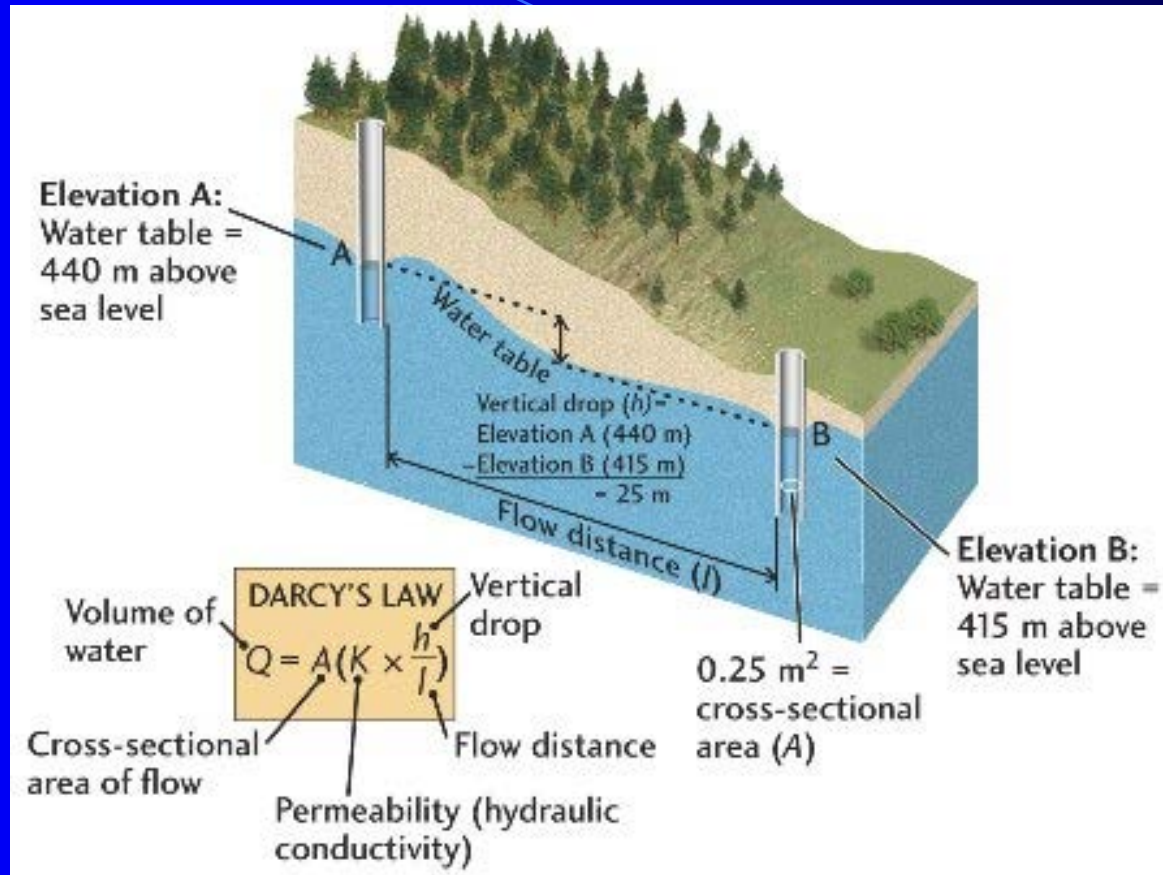
The Water Table

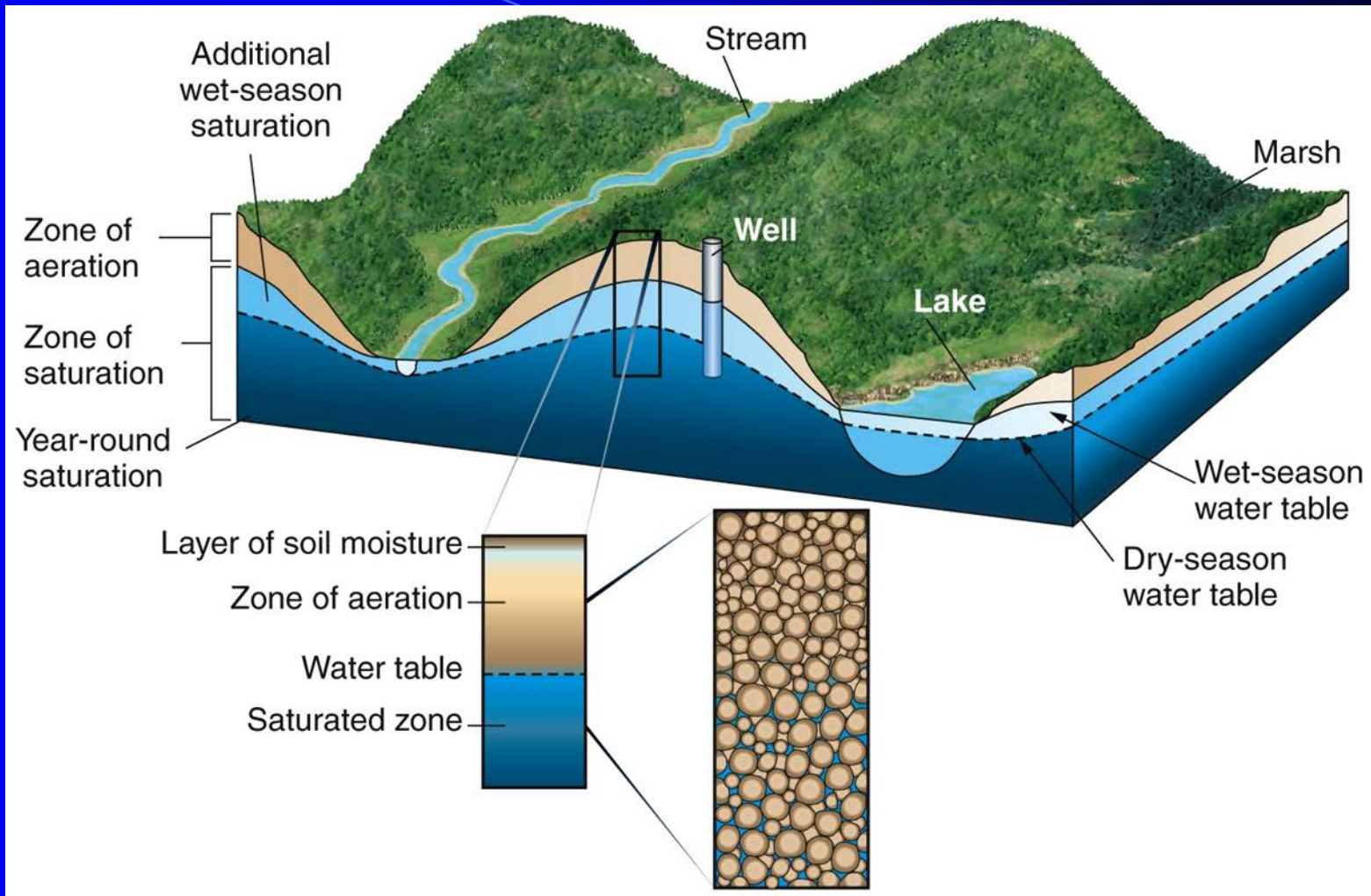


Porosity and permeability

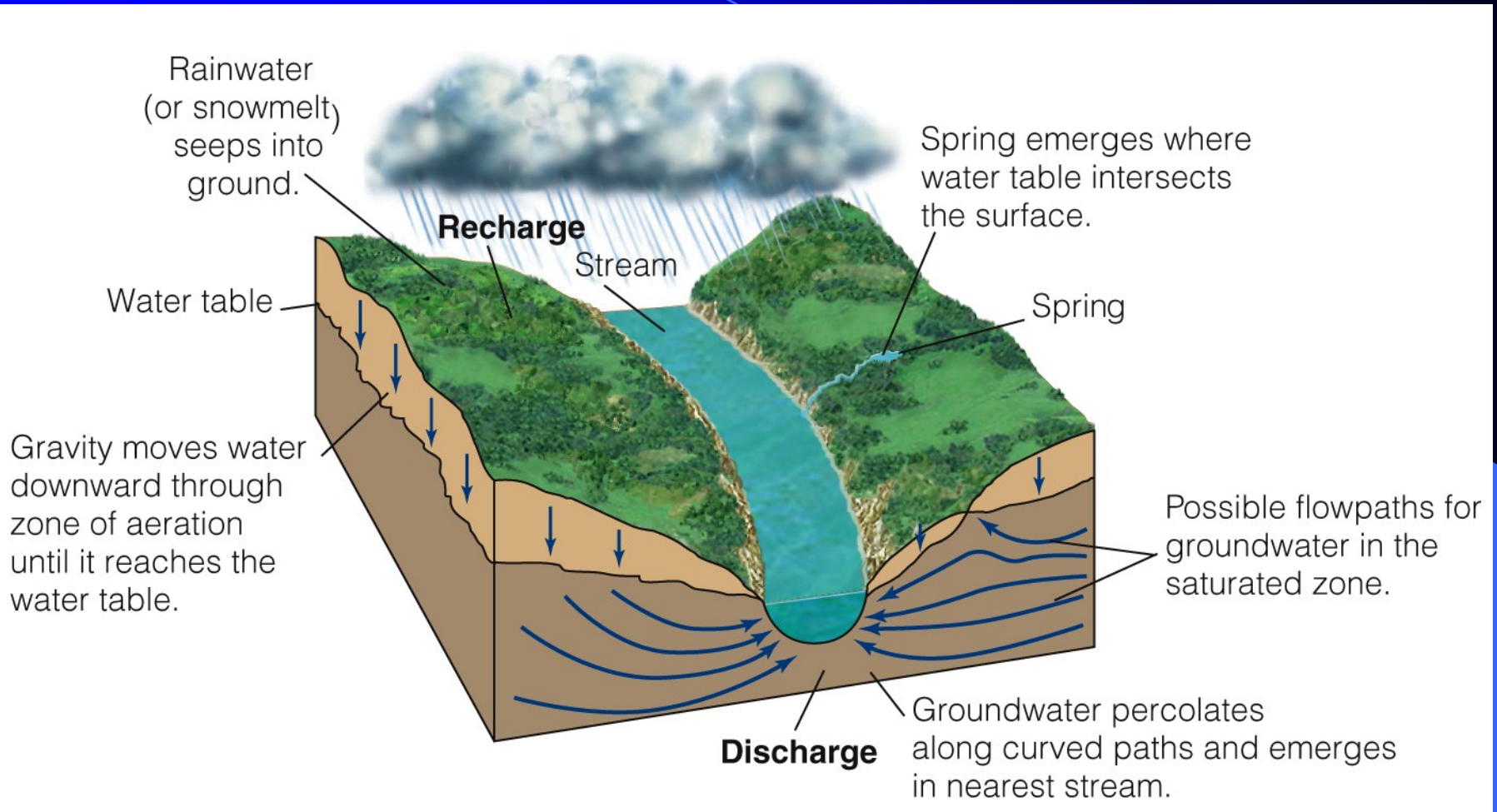


Darcy's Law

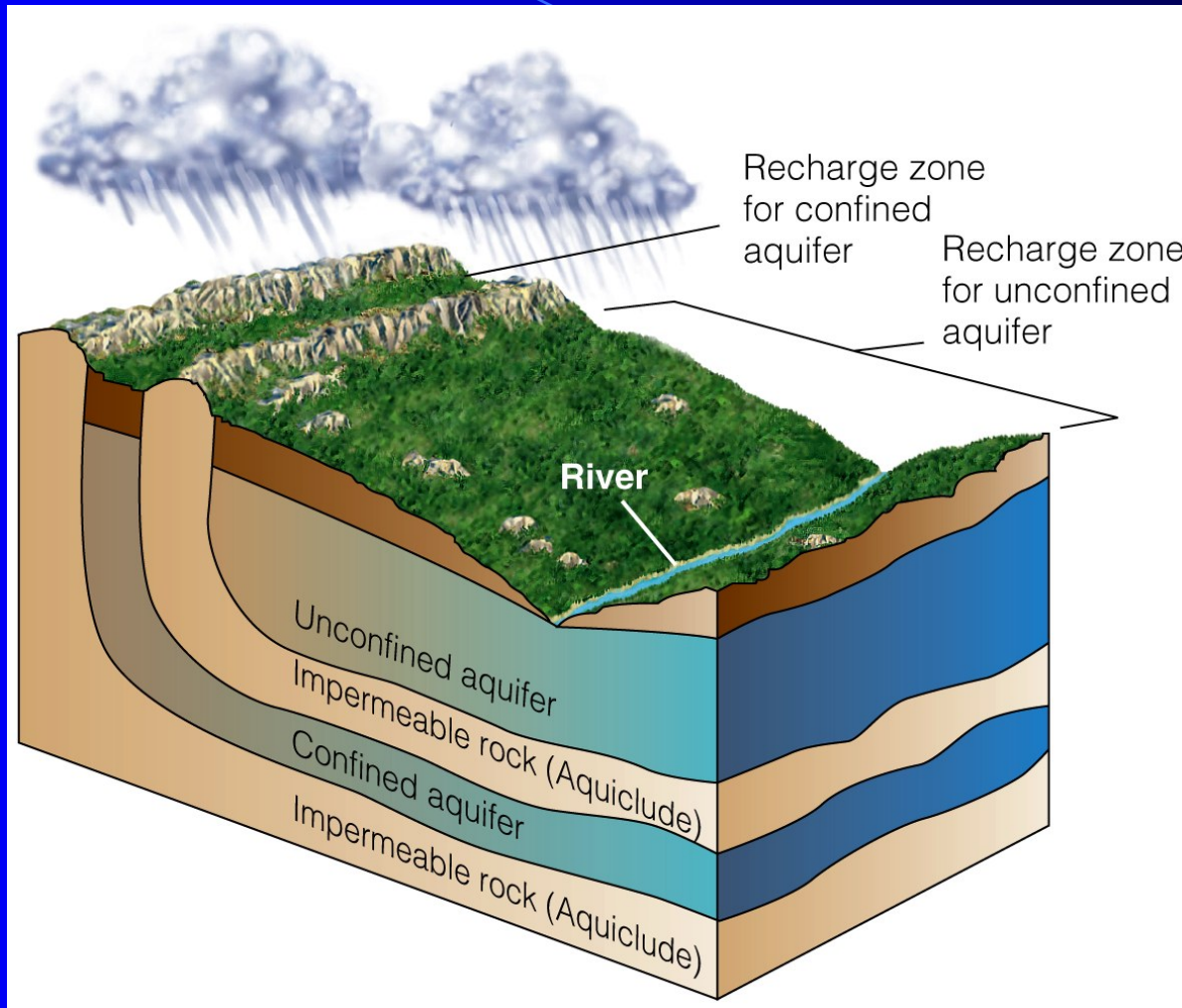




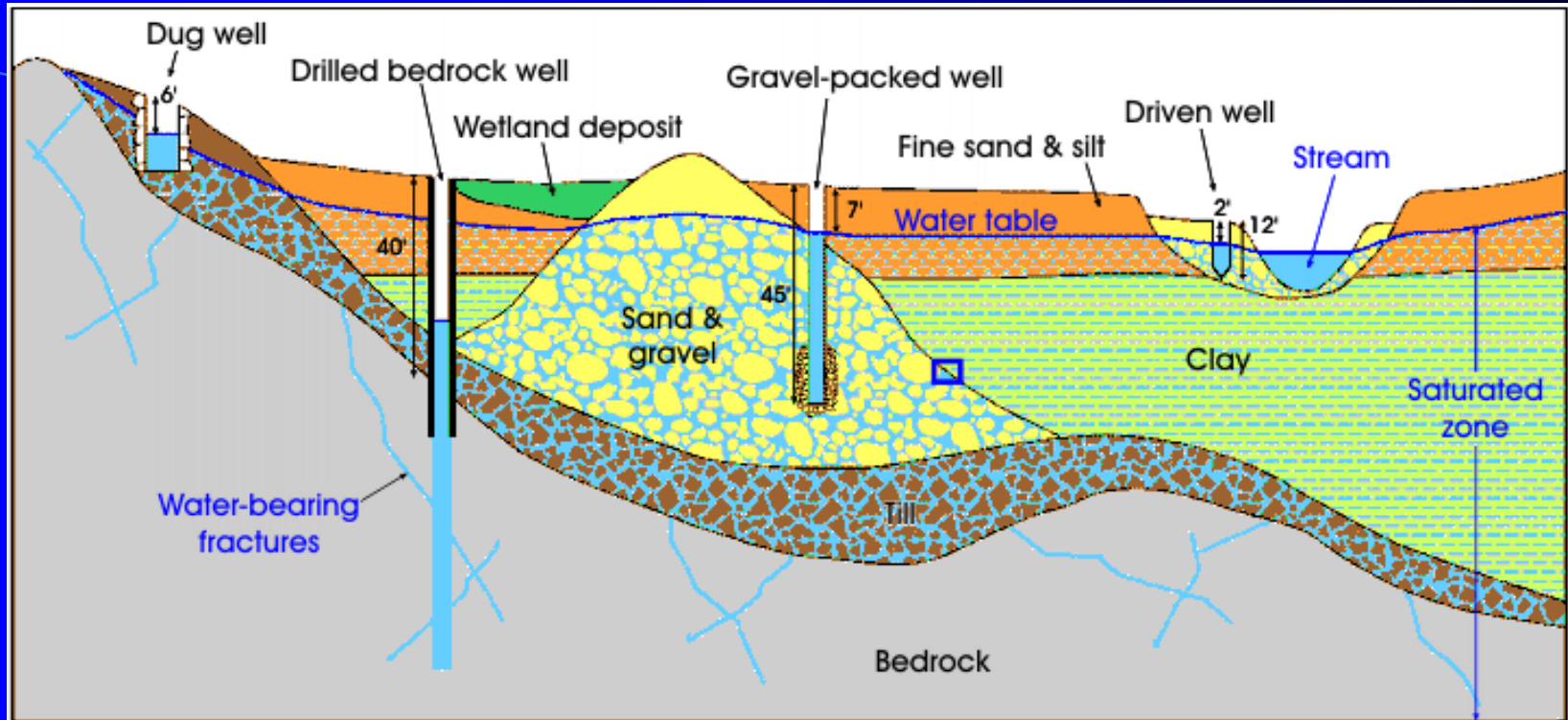
Groundwater Recharge



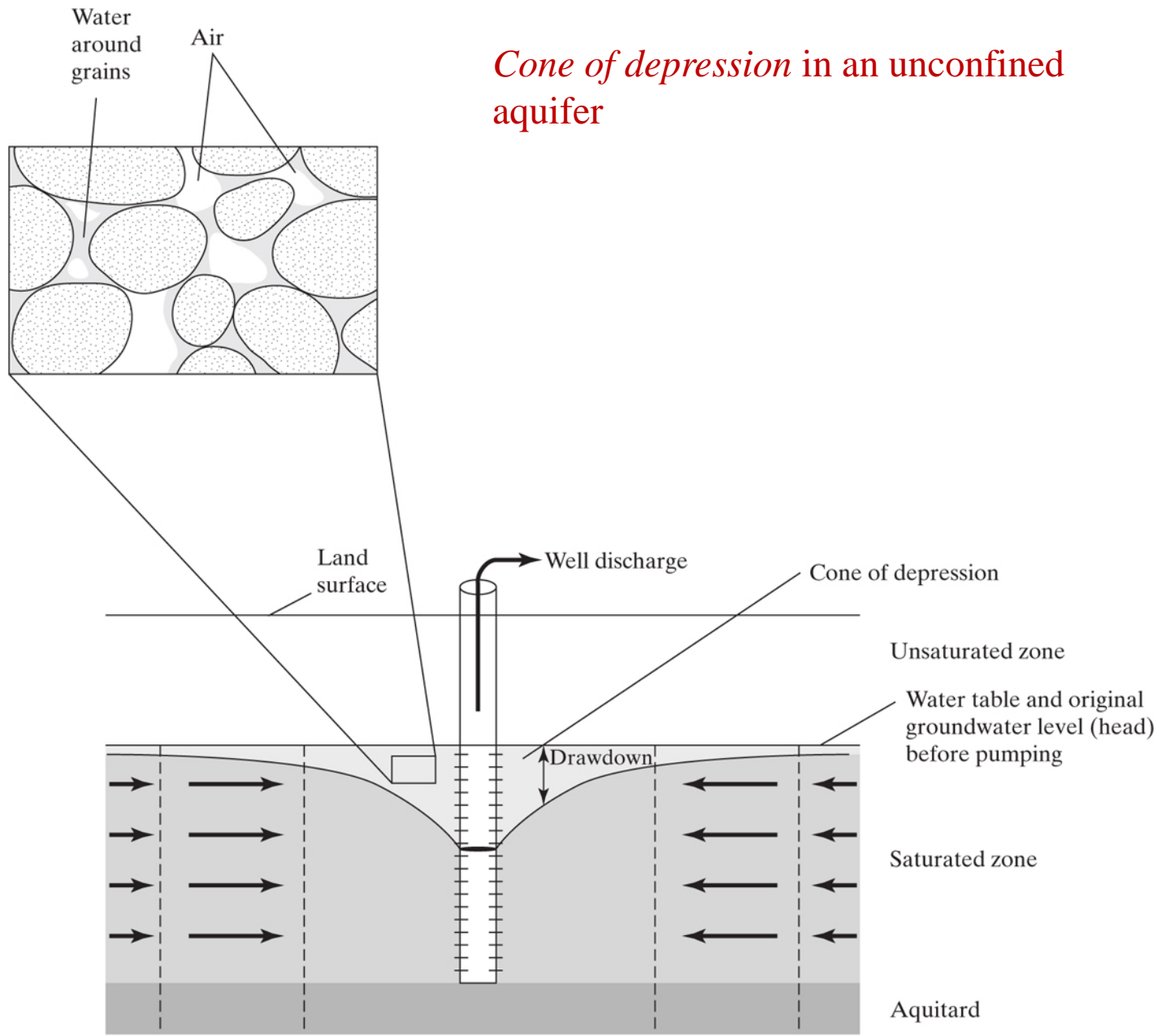
Artesian Aquifer



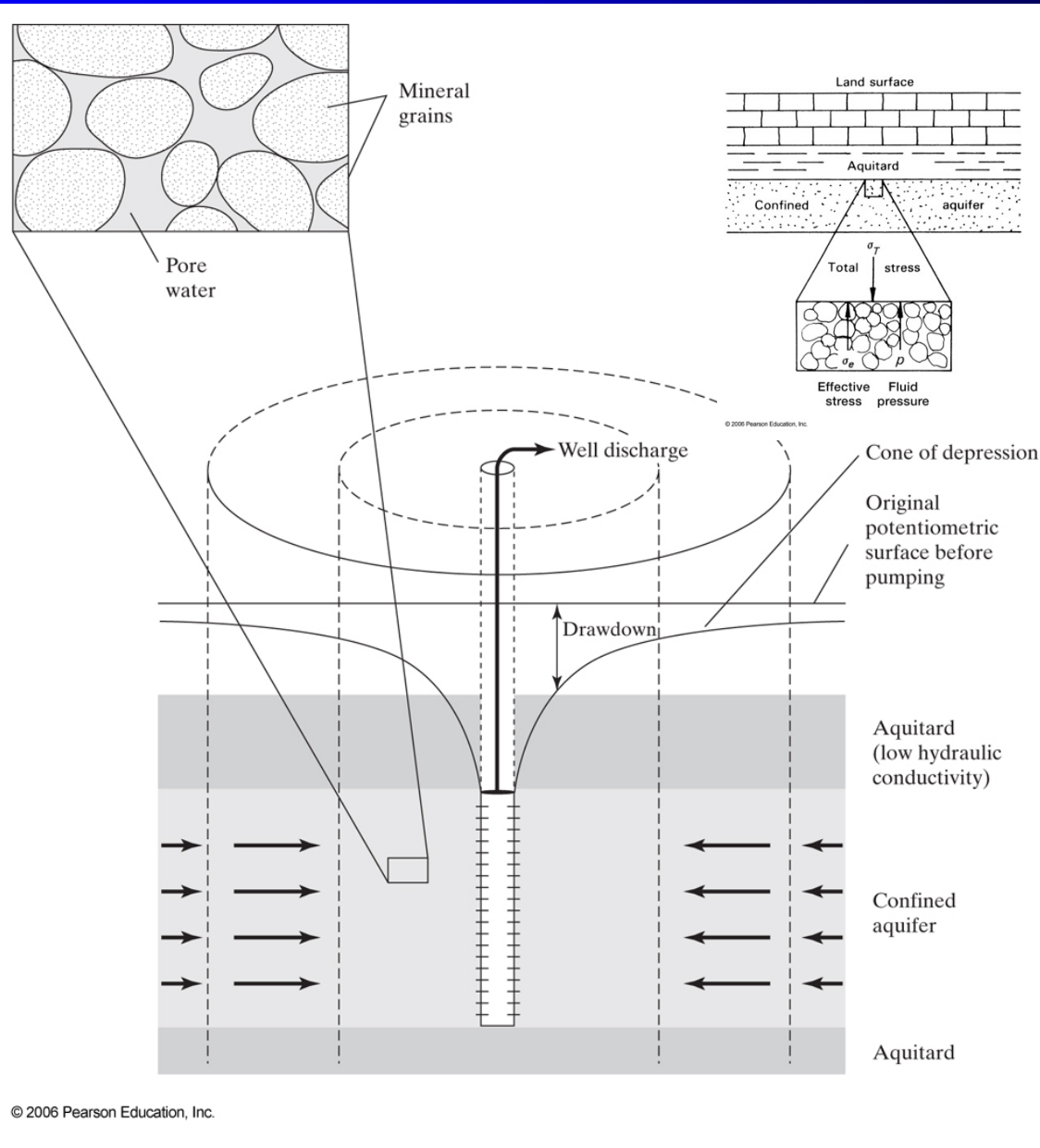
Typical New England Aquifer



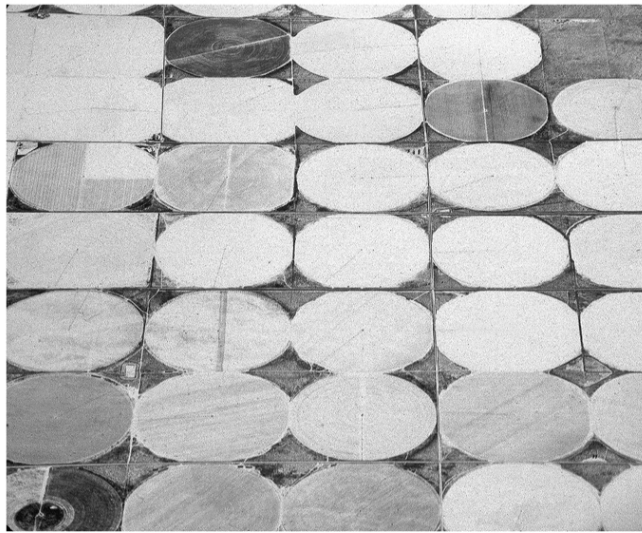
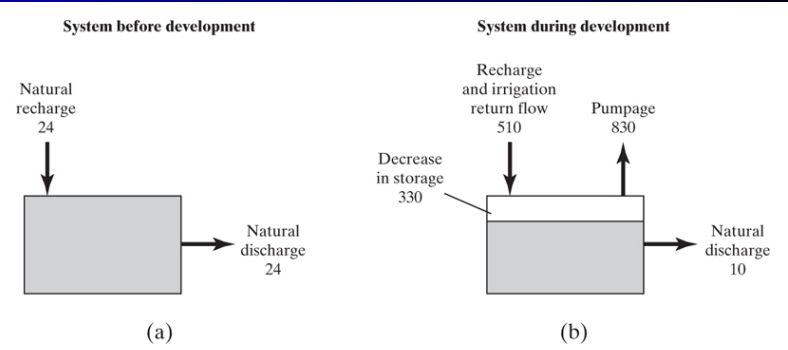
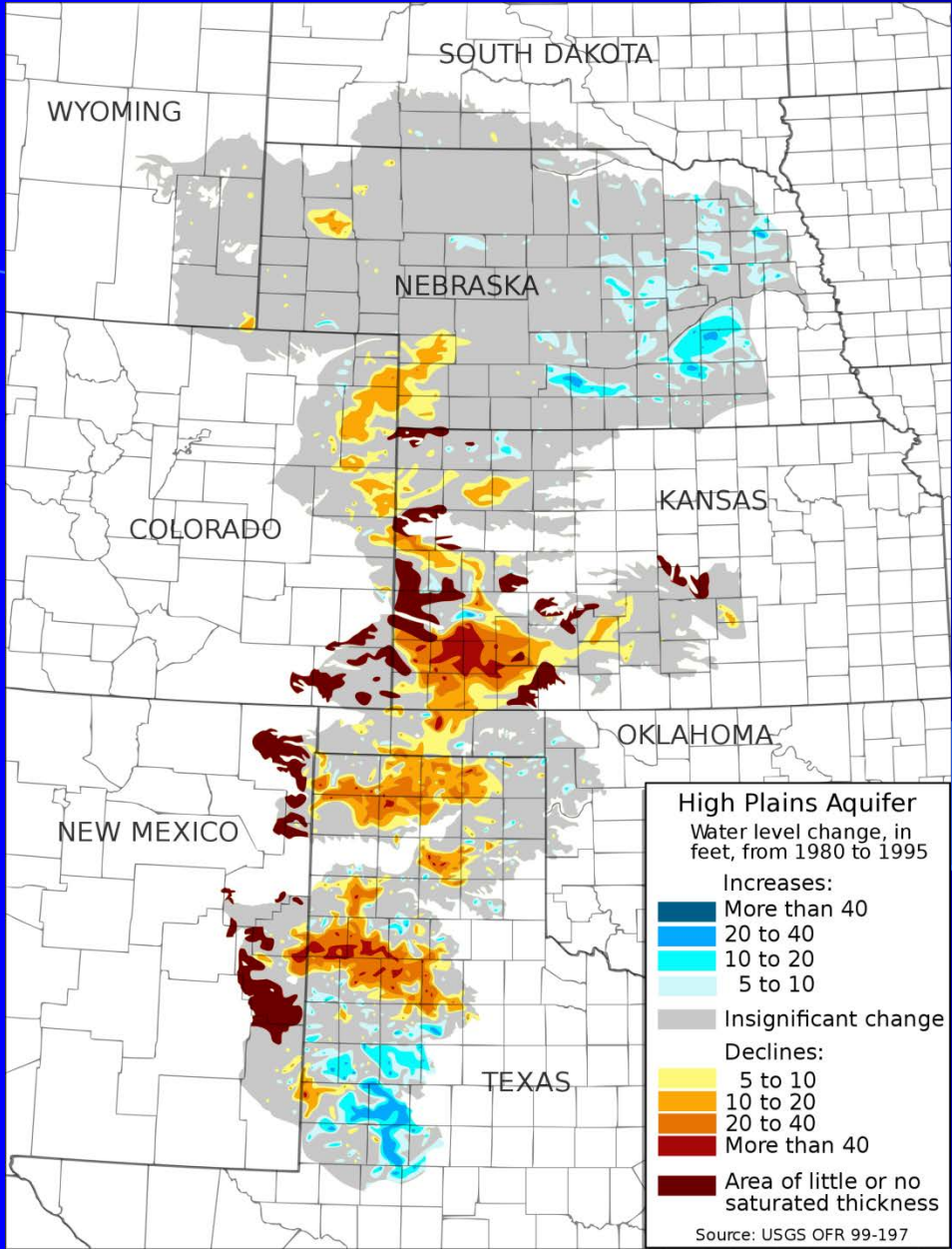
Cone of depression in an unconfined aquifer



Cone of depression in a confined aquifer and effective stress

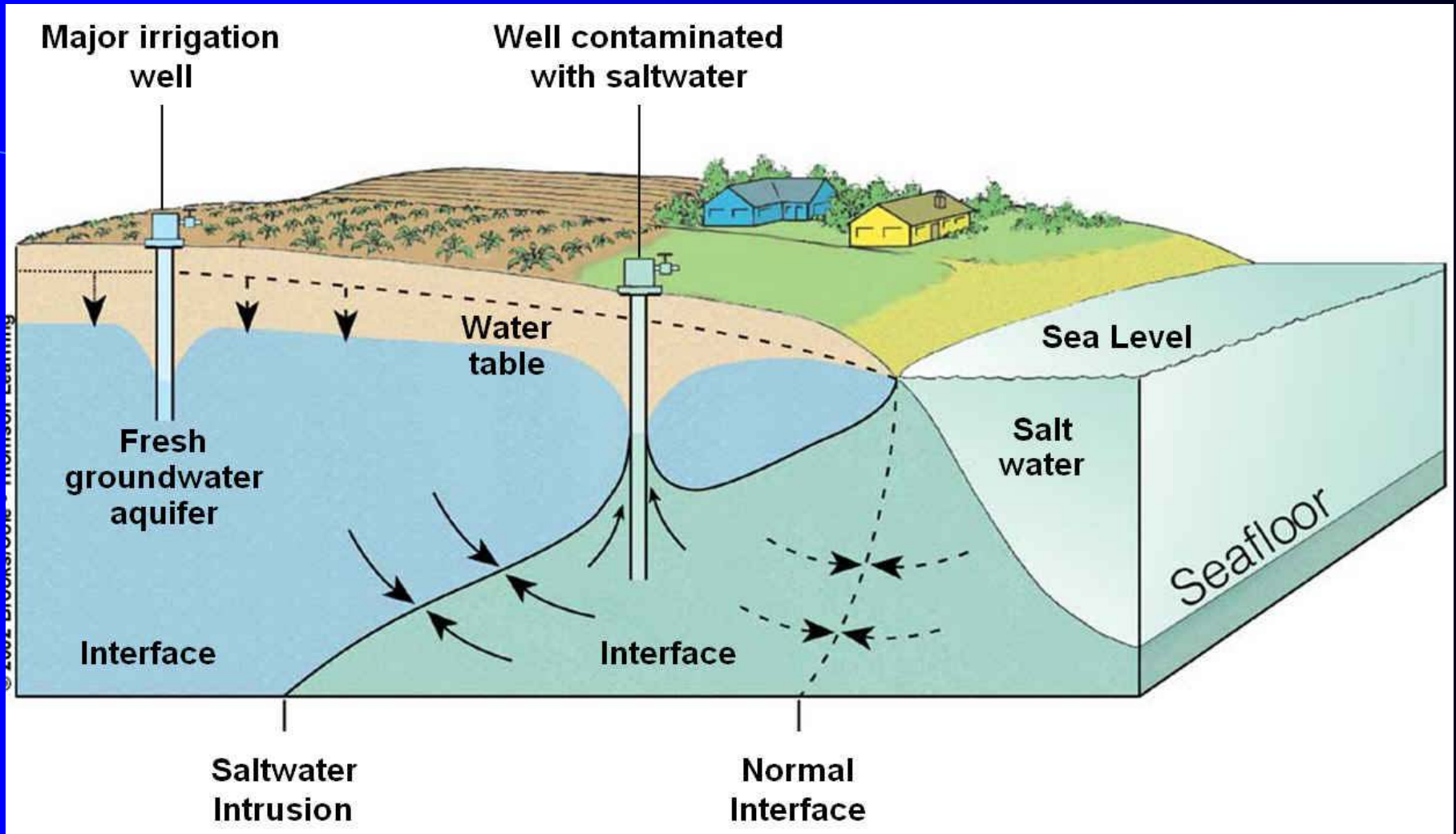


Resource sustainability – withdrawals from the High Plains aquifer

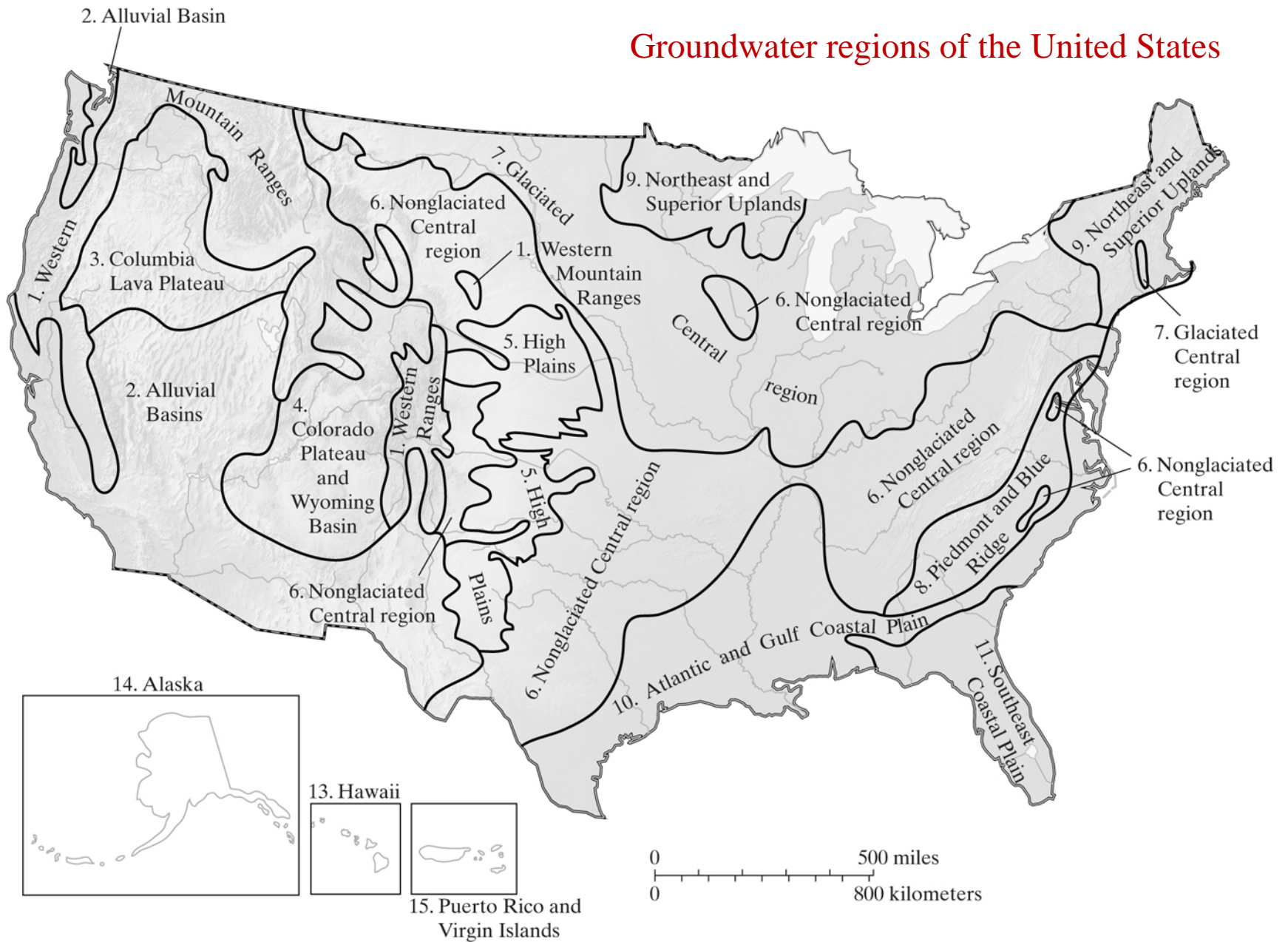


(c)

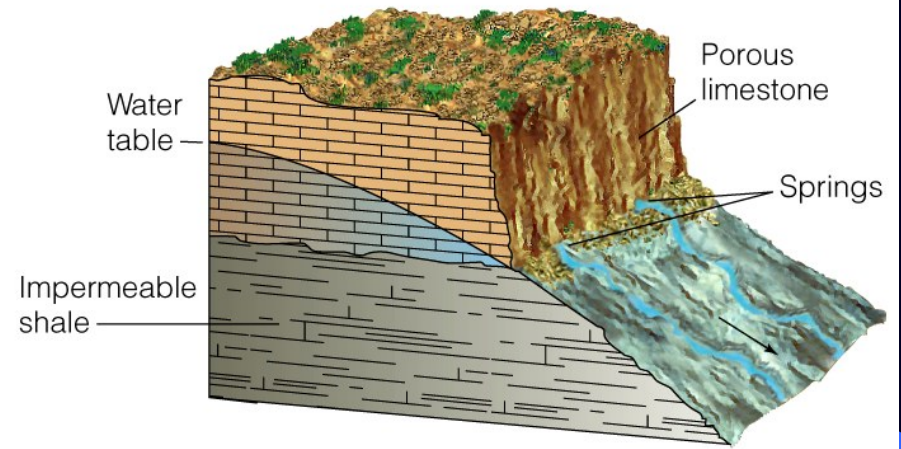
Salt water incursion



Groundwater regions of the United States

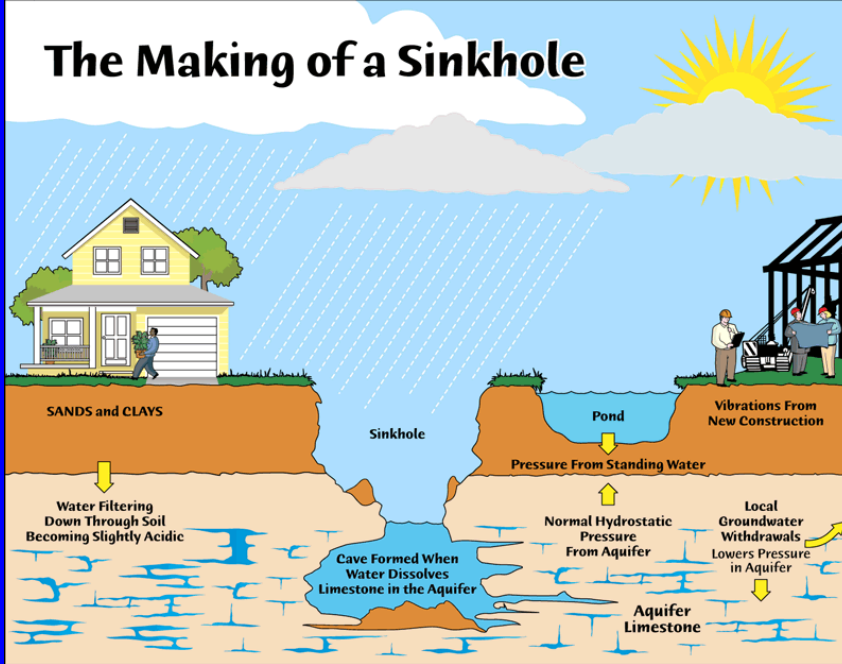


Springs



Sinkholes

The Making of a Sinkhole



Caves

Caves: subsurface cavities formed by dissolution of rock

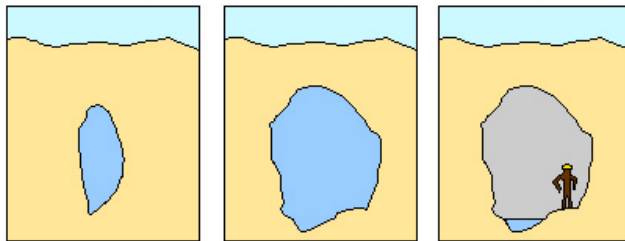
Steps in the Formation of Caves

1. Extensive chemical weathering

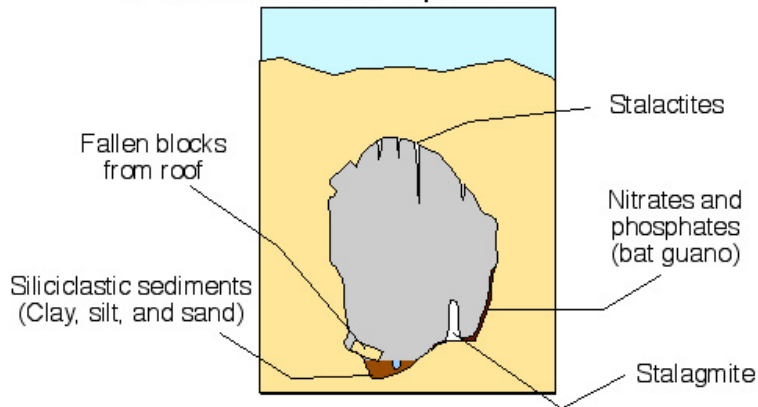
Requirements:

- a. Abundant groundwater
- b. Soluble bedrock (limestone) ((gypsum))

2. Lowering of water table (for an air-filled cave)



3. Formation of cave deposits



4. More of 1, 2, & 3 in various orders

LBR 3/2002



Karst

