

WATER RESOURCES

* WATER (H₂O)

- * originally formed within the earth & brought to surface by **outgassing**
- * collected on surface after earth cooled some 3.8 BYBP
- * covers 71% of earth by area * constitutes 70% of our bodies
- * **Distribution- 97.22% oceans and other saltwater bodies, 2.78% freshwater**

* of freshwater: 77% ice and glaciers, 22% groundwater, 1% lakes ponds rivers and streams

** HYDROLOGIC (Water) CYCLE

- * **evapotranspiration * condensation * precipitation * run-off**

** Groundwater

- * 2nd largest potential source of freshwater (22%)
- * accumulates by **percolation** through the soil
- * how well it percolates is controlled by:
 - * **porosity**: the percentage of rock or soil that is void (pore) space, how much water a rock or material can hold

* **permeability**: capacity of a material to transmit fluids through it

** passes through zone aeration, a permeable layer;

** collects in the zone of saturation, which is above an impermeable layer
the water table upper limit of the zone of saturation

This zone of saturation is considered an **unconfined aquifer** when there is a permeable layer above it and an impermeable layer

The zone of saturation is considered a **confined aquifer** where there is an impermeable layer above and below it, it is recharged (resupplied) in select places.

* impermeable layer may be of 3 types:

- 1) **aquitard**
- 2) **aquiclude**
- 3) **aquifuge**

* may develop other features:

* **artesian well**: a flow of water onto the surface under pressure,

CONFINED AQUIFERS

* **spring**: a surface flow of water that emerges from underground, not under pressure

* **stream**: water flowing on the surface, in a watercourse, where the water table is above the surface; permanent or temporary

Ground Subsidence- ground sinks from too much water draw out

Saltwater intrusion- in coastal areas; fresh water is replaced by saltwater with too much draw out of the groundwater

* **Water Uses**

How much?

* **Humans withdraw about 35% of the world's reliable runoff (rivers and lakes, streams)** by some estimates use will double within the next 2 decades with some areas exceeding their reliable surface runoff

* U.S. has plenty of fresh water, but often in the wrong place and/or time, Or it is too polluted

* eastern U.S. is in better shape than central to western parts

What for?

* **Primary uses: 70% used for irrigation** on 18% of world's cropland to produce 40% of the worlds food

* **industry another 20%**, with the remaining **10% to cities & residences**

* **Water Scarcity** is caused by one or more of the following 4 factors:

1. **Dry climate**: not enough precipitation to meet human needs
2. **Drought**: a period of 21 days or longer with precipitation at least 70% below normal
- c. **Desiccation**: drying of the soil due to deforestation and overgrazing by livestock
- d. **Water stress**: low availability due to increasing population relying on the limited supplies

* **recent effects** of one or more of these factors:

500 million people live in countries with water stress

1.2 billion poor people cannot afford safe drinking supplies

droughts have killed over 24000/year since 1970 and created millions of environmental refugees

* **potential problems**:

* increasing population creates increasing demand on and waste of regionally limited supplies and increasing potential for pollution

EX: China, India, Africa, Middle East, South America

* Can lead to violent conflicts over water rights, claims, usage, etc.

EX: Middle East: along Nile River; Jordan River Basin;
Tigris & Euphrates river systems

* Increasing industrialization of developing countries increases usage and pollution

* **ways to supply more water:**

* **build dams & reservoirs:**

Benefits: control supply, produce hydroelectricity, supply water for irrigation, industry recreational activities and jobs

Costs: ecological damage, large building costs, changes down river flow dynamics sediment build-up

* **water transfers:**

Benefits: gets water where it is most needed for rural and/or urban uses

Costs: ecological damage, increased pollution, potential for increased waste

EX: California Water Project, Aral Sea

* **withdraw more from groundwater sources:**

Benefits: can be removed year round, less loss to evaporation often less expensive to develop

Costs: if withdrawn faster than it can replenish itself results in lowering of water table, aquifer depletion, aquifer subsidence, saltwater intrusion in coastal areas, reduced stream flow

* **desalination:** removing dissolved salts from ocean water to create "fresh water"

* 1) **distillation:** heating salt water until it evaporates and the salts are left behind, then condensing it as fresh water

* 2) **reverse osmosis:** salt water is pumped at high pressure through a membrane which allows water molecules to pass through but not salts

* some 13,300 plants in operation in 120 countries

* **advantages:** ample supply of salt water (in coastal regions)

* **disadvantages:** high energy demands, produces large quantities of waste water (brine) with high levels of salt and minerals currently supplies less than .2% of the world's water needs.

* **harvest water from ice caps & ice sheets:** not economically feasible at this time, although melt water from alpine glaciers is common in many areas

* **Water Overabundance (Flooding)**

* usually a more seasonal problem associated with a rainy season or spring snow melt

* many rivers annually overflow their banks which produces a rich, fertile floodplain

and source of recharge for groundwater

* but people like to settle in these areas for these same reasons, which leads to problems: