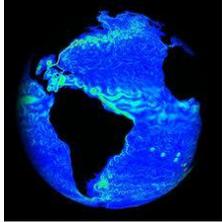


Introduction to the Hydrosphere

The Water Cycle and Surrounding Systems

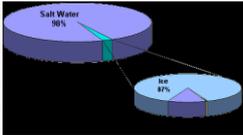
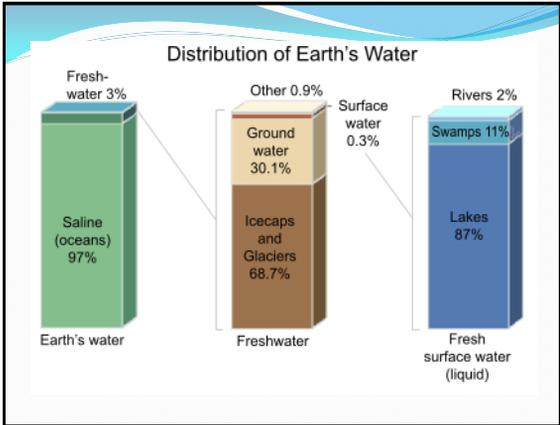
The Hydrosphere

- Includes all of the Earth's waters, fresh and salt in all states of matter
- Includes standing liquid water as well as gaseous water (clouds) and solid ice
- Can be thought of as the "blood of our ecosystems" – an unhealthy hydrosphere will kill the biosphere



The World's Major Water Supplies

- >97% of the world's water is salty
- <3% is fresh
 - Of this, 77% is trapped in glaciers and ice caps
 - 22% is below ground
 - 0.47% is in bodies of water (lakes, streams, etc.)
 - 0.03% is in clouds

Groundwater

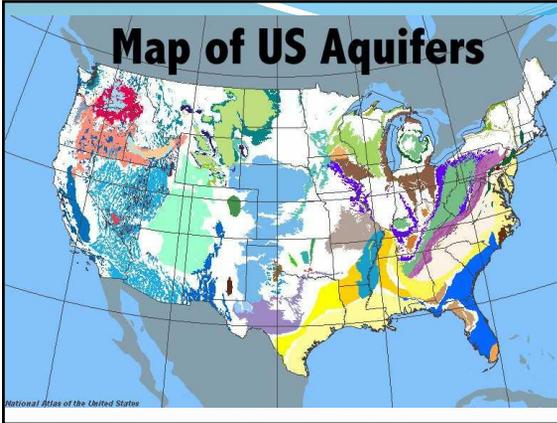
- Water beneath the surface found between layers of rock and soil of varying permeability
- Water table: uppermost layer in the ground where the water saturates the soil
- Groundwater FLOWS out towards larger bodies of water (the ocean) or downhill



Aquifers

- Two main types:
 - Unconfined: porous rock and sands which water easily flows in and out of
 - Confined: water resource is surrounded by impermeable rock or clay → harder to recharge because water doesn't flow as easily
- Most areas have both





Water Use in Different Aquifers

- Unconfined are recharged quickly, so water pollution is more likely, but water is also more available
- Continuously pulling from confined is unsustainable as they can take up to 10,000-20,000 years to recharge

CROSS SECTION OF EARTH SHOWING PARTS OF AN AQUIFER

Wells

- Artesian wells: drill into confined aquifers and use pressure to bring water to ground level
- Wells pull from their immediate area creating a cone shaped area with depleted water – **cone of depression**

Aquifers and wells

Source: Environment Canada

CONTAMINANTS:

- Bacteria, viruses
- Nitrate
- Chemical cleaning compounds
- Paint thinners, similar products

Recharge

- Aquifers that are unconfined are recharged easily by precipitation
- Confined aquifers must be recharged using an opening to the groundwater (often a spring)

Surface Resources: Rivers

- Carry water via surface channels in the lithosphere
- Overflow of rivers occurs in a floodplain and is an important and natural process
 - Deposits nutrients
- Three largest rivers:
 - Amazon (S. America)
 - Congo (Africa)
 - Yangtze (China)

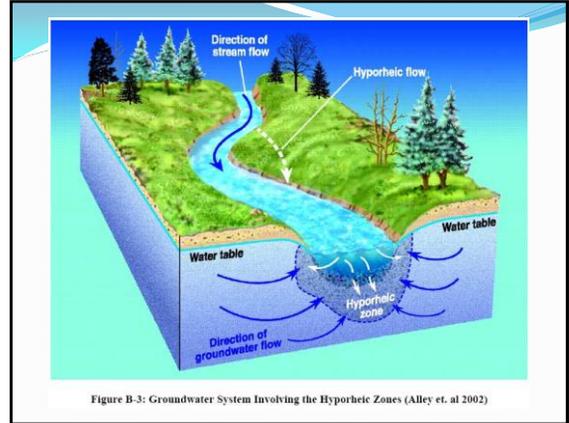
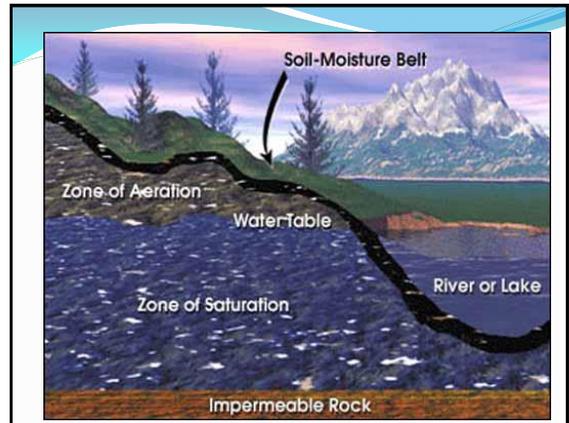


Figure B-3: Groundwater System Involving the Hyporheic Zones (Alley et. al 2002)

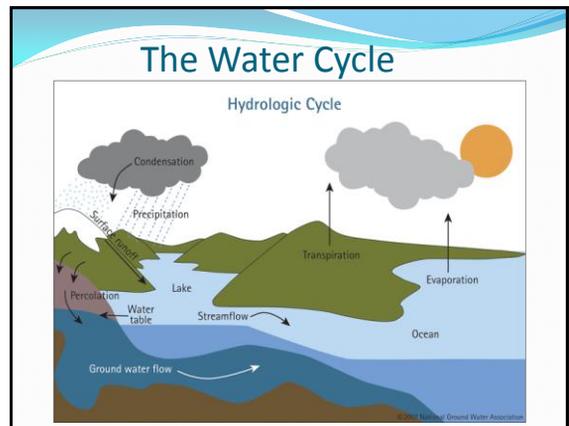
Surface Resources: Lakes and Ponds

- Collected water at lithosphere depressions
- Can be formed through tectonic or glacial activity
- Lakes are graded based on their productivity (remember—photosynthetic rates!)
 - Oligotrophic: low productivity, clear waters
 - Mesotrophic: medium productivity
 - Eutrophic: high productivity, often green or scummy over-nutriented waters



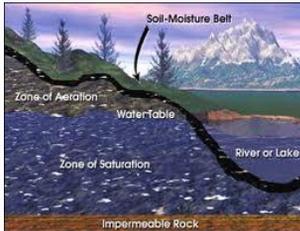
Atmospheric Water

- Very small percentage, but essential
- People in areas with little to no surface water rely on this resource
- Important to nutrient cycling and soil fertility as well as basic hydration



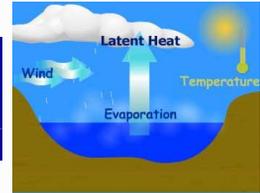
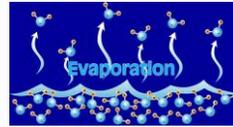
Standing Water and Groundwater

- Water is found in multiple types of bodies, whether they be salt or fresh (obvious)



Evaporation

- Water is heated by solar energy and as a result some atoms escape and evaporate
- This can purify water—salt and most mineral or chemical water pollutants do NOT evaporate



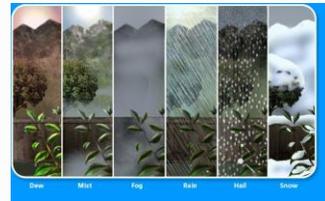
Condensation

- As water vapor rises, it cools and condenses into clouds
- Clouds are moved by wind currents
- Carries water around the globe or locally



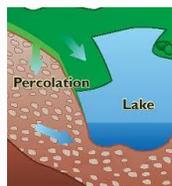
Precipitation

- Rain, snow, sleet, etc.
- Makes water available to the biosphere and ground sources



Percolation

- Infiltration of water into the ground after precipitation
- Important because it recharges groundwater supplies and makes water available for plants to draw from



Water Infiltration is Affected by Many Factors...

- Water infiltration can be prevented by:
 - Paving
 - Overly compacted soils or hard pans
 - Excess agriculture
 - Lack of plants
 - Slope-building



