

Water Unit

Water Resources and Use

- Distribution/Availability- water is scarce, only 25% of water on Earth is fresh and most of that is in glaciers and ice caps, unevenly distributed
- Water Uses- drinking, agriculture, industry...
 - Consumptive use- water removed and not returned
 - Non-Consumptive use- water temporarily removed
 - Irrigation
 - Gravity flow- water comes from aqueduct or river
 - Drip irrigation- pipes deliver water to plant roots
 - Center pivot- water pumped and sprayed with sprinklers
- Water cycle
 - Transpiration- water goes through tree leaves
 - Evaporation- bodies of water evaporate into the air
 - Precipitation- rain, hail, snow
 - Condensation- water forms clouds
 - Infiltration- water seeps into the ground
 - Runoff- water drains off land
- Water Properties/Structure
 - Made up of hydrogen bonds (one molecule attracts another molecule)
 - High Specific Heat
 - Strong Cohesion (sticks together)
 - Ice is less dense than water
 - Water is a common solute (dissolves other things)
- Aquifers- porous formations of rock, sand, and gravel that hold ground water
- Groundwater- precipitation that doesn't evaporate or goes into water ways
 - 1/5th of Earth's freshwater supply
 - Aquifers- porous formations of rock, sand, and gravel that hold ground water
 - Confined Aquifer- porous rocks trapped between layers of non permeable layers (clay)
 - Unconfined Aquifer- no upper layer to confine it
 - Aquifer Recharge zone- any area where water infiltrates Earth's surface and reaches aquifer
 - Lateral Recharge- water move upwards
 - Zone of Aeration- spaces partially filled with water
 - Zone of Saturation- spaces completely filled with water
 - Water Table- boundary between two zones
 - Wells- create cones of depression (lead to contamination and salt water intrusion)
 - Getting depleted
- Reservoirs-store water
- Dams/Dikes/Levees- used to store water

- Dams-obstruction used to store water
 - Used to prevent floods, provide drinking water, irrigation, generate electricity
 - Hydroelectric Power-water flow turns turbine and creates energy/electricity
 - Dikes/Levees- mounds placed along river banks to hold in rising water
- Tributary- smaller river flowing into larger one
- Watershed- area of land drained by a river
- Riparian- riverside areas that are productive
- Lakes
 - Littoral Zone- region around edge of water body
 - Benthic Zone- region along entire bottom of water body
 - Limnetic Zone- open portions of the lake where sunlight penetrates
 - Profundal Zone- where sunlight doesn't reach
- Costs vs Benefits
 - Benefits
 - Power generation
 - Emission reduction
 - Irrigation
 - Drinking water
 - Flood Control
 - Shipping
 - Recreational Opportunities
 - Costs
 - Habitat alteration
 - Decline in fisheries
 - Pop. displacement
 - Sediment capture
 - Flooding disruption
 - Loss of rec. opportunities
- Case Studies
 - Aral Sea- loss volume due to diversion for cotton fields, loss of fish, toxic dust goes into the air
 - Salton Sea- California, runoff high in nutrients flow into the sea
 - Colorado River- brings water to 15 millions people, used for agriculture, extensively dammed and diverted
 - Mono Lake- California, volume has decreased while salinity increased
 - Idagon Simulation
- Ways of “making” more
 - Desalinization- expensive, requires fossil fuels
 - Residential ways- xeriscaping (landscaping using plants adapted to arid conditions), low-flow toilets and faucets

Ecosystems

- Ecology-study of how organisms interact with their environment
- Source (part of environment from which materials move) vs. Sink (part of environment that receives an input)
- Biotic vs Abiotic
 - Biotic- living (plants, animals...)
 - Abiotic- non living (water, air, temp...)
- Food chains/webs/energy flow/trophic levels
 - Trophic Levels- levels of consumers
 - Producers- autotrophs, source of all food
 - Consumers- heterotrophs, aerobic and anaerobic respiration
 - Decomposers- decompose
 - Omnivores-eat both plants and meat
 - Detritus Feeders/Scavengers-consume dead stuff
 - Food Chains- one link, relationship between trophic levels
 - Food Webs- many food chains together
 - Energy Flow goes from small to large
 - Rule of 10- only 10 % of energy goes on to the next trophic level
 - Energy pyramid
- Indicator (species that may show environmental change) /Keystone Species (strong impact in proportion to its abundance, removal impacts whole food web)
- Nitrogen Cycle
 - Made up of four processes
 - Nitrogen fixation- nitrogen taken from molecular form and converted into compounds
 - Nitrogen decay- Nitrogen is broken down by waste and is converted into ammonia
 - Nitrification- Ammonia is taken up by plants and converted to nitrates
 - Denitrification- make nitrates into nitrogen gas
- Carbon Cycle
 - Carbon stored in the lithosphere, ocean, biosphere, and atmosphere
 - In the sea- respiration, decomposition, carbonates in sediments
 - Land-plants, animals, photosynthesis
 - Carbon stored in oceans, lithosphere, organic matter, atmosphere, living and dead organisms
- Primary Productivity
 - Photosynthesis- plants make energy
 - Respiration- organisms use oxygen
 - Gross Primary Productivity-conversion of light energy to chemical energy
 - Net Primary Productivity- energy accumulated in plant biomass (NPP=GPP-respiration rate)
- Dissolved oxygen- amount of oxygen in the water

- Case Studies
 - Otters

BOD/Pollution

- BOD- demand for oxygen needed by organisms
 - Pollution Zone- BOD increases, DO decreases
 - Evens out
- Pollution- chemical, biological, or physical change in water quality that has a harmful effect on living organisms
 - Nitrates/Phosphates-add nutrients, contribute to eutrophication
 - Acid Mine Drainage-too many acids in water
 - Dissolved Oxygen- oxygen in water
 - Turbidity- total suspended and dissolved solids
 - Salinity-too salty, harmful to organisms
 - Fecal Coliform- bacteria indicate fecal contamination
- Point Source (discrete location of pollution) vs non point source (pollution from cumulative input over a large area)
- Toxic Chemicals- natural and synthetic (arsenic, lead)
- Thermal Pollution- warmer water holds less oxygen
- Polluted Water Solutions- treat sewage, disinfect, education, government enforcement
- Water Quality Standards-set standards for drinking and water ways water
 - EPA set Maximum Contaminant Levels (MCLS) for contaminants
 - Clean Water Act-illegal to discharge pollution without a permit and containing pollution
 - Safe Drinking Water Act- allowable levels for drinking water
- Easier to prevent than to correct!
- Septic Tanks- treat small volumes of waste
- Waste Water treatment- treat larger volumes of waste
 - Primary Treatment: removal of physical and solid waste
 - Secondary Treatment: oxygenation and removal (chemical processes)
 - Tertiary Treatment: filtration, chlorination, treatment for drinking and discharge
- Oligotrophic- high oxygen and low nutrient
- Eutrophication- process of water bodies gaining nutrients and losing oxygen
- Contaminants vs Pollutant
 - Pollutant- man made things that contaminate water
 - Contaminant-things that go into water that is harmful (include pollutants)
- Economics
 - Measure income by: gross domestic product, net domestic product
 - Marginal cost: damage increases as amount of pollution increases
 - Marginal cost of pollution abatement: as pollution amount decreases cost increases