Water Facts

* Water is weird
  + Solids are usually heavier than liquids (of the same chemical), so solids sink below their liquid melt; water works the other way around as ice floats on liquid water
  + Water absorbs or releases huge amount of heat without changing its temperature very much; it is very difficult to heat or cool
  + Water dissolves almost anything to some extent
  + Water promotes the oxidation of metals
  + Water fries electronics
  + Water absorbs red light so large amounts of it look blue
  + Water has a high surface tension (due to hydrogen bonding) so it is easier to float on it than most liquids
* Pollution
  + Not necessary chemically impure; involves “normal intended use”
    - Salt water is not polluted in the ocean but is polluted in an aquifer used for drinking water
    - Water which is hotter than normal due to being used to cool reactors like gas or coal-fired electric power plants or nuclear power plants and which causes proliferation of some nuisance plant or animal in a body of water which it is returned to after use is considered to be “thermally polluted”
  + Chemical pollution of land causes water pollution because rain water leaches chemicals in soil into bodies of water like rivers and lakes
    - Fertilizer leached off of fertilized agricultural land can cause excessive algae growth in lakes resulting in oxygen depletion and very smelly fish kills
    - Toxic chemicals leached out of hazardous waste landfills and garbage dumps can work their way into water tables or lakes and rivers and poison people and/or fish
  + Plastics are currently causing major pollution problems in the world’s oceans
  + Lead pollution from lead water pipes caused a recent crisis in Flint, Michigan, and has recently been found to be problematic in many other places
  + BOD (biochemical oxygen demand) measures organic chemical pollution of water indirectly by measuring how much oxygen bacteria need to use to consume organic chemicals contaminating water samples; there is a high BOD “dead zone” in the Gulf of Mexico caused by a high organic load which causes bacteria to consume all of the oxygen in the water in the process of eating these organic chemicals; this water could be considered to be polluted partly by virtue of lacking a chemical (oxygen) rather than having chemical contaminants
  + Brackish (salty) water in aquifers results from overuse of the water in these aquifers resulting in ocean water from a nearby ocean leaching in to replace the water depleted from these aquifers
* Consumption
  + In the 1980’s US industry was the big consumer of water; since then government regulations (mostly at the state level) forced industry to recycle and use some ocean water along with fresh water, so now thermoelectric power is the second largest user of fresh water
  + The largest consumer of fresh water is now agriculture (irrigation, 70% worldwide)
  + US households use only about 1/3 as much fresh water as agriculture and about 1/2 as much water as thermoelectric plants; nonetheless governments usually pressure consumers more than either of these sectors to conserve water when shortages occur (money talks)
  + Worldwide water usage is mindboggling; 4.3 trillion metric tons of fresh water is used worldwide per year (4,300 gigatons); the total weight of all life on earth plus everything created by man over our entire existence is only 2,270 gigatons; we use almost twice as much fresh water by weight in a year as the weight of everything ever made plus all life on earth; mankind consumes 11000 times our total body weight in fresh water annually
  + American annual fresh water consumption (2024 data)
    - Based on (84% of 322 B gal/day tot x 8.3 Lb/gal x 365 day/yr) ÷ (2000 Lb/ton x 333 M population) = 1230 tons/person-yr total
    - Home use about 170 tons/person
    - Irrigation (for food) about 540 tons/person
    - Steam for electricity production about 370 tons/person
    - All other use about 150 tons/person
    - It takes about 12000 times his weight in water per year to support a 200 Lb American
* Purification
  + Wastewater treatment
    - Primary and secondary
      * Screening (separate out solid things like junk people flush down toilets)
      * Aeration (allows bacteria to eat biodegradable organic chemicals)
      * Settling (allow sludge to settle out after aeration; sludge is landfilled)
      * Decantation (separate liquid from sludge after settling)
      * Disinfection (kill bacteria in liquid after decantation)
      * Recycle liquid (return treated liquid to environment, ie. rivers or lakes)
* Tertiary (if primary and secondary treatment is insufficient)
  + Denitrifying bacteria remove nitrates and ammonia
  + Carbon filtration removes nonbiodegradable water-soluble organic chemicals
  + Ion exchange removes dangerous heavy metals and radioactive heavy radioisotopes
  + Reverse osmosis removes salt if necessary
* Home treatment
  + Carbon filtration (organics and heavy metals)
  + Reverse osmosis (brackish or salty water)
  + Water softeners (hard water containing calcium or magnesium)
* Seawater
  + Reverse osmosis is best
  + Distillation is also useable
* Heavy metal radioisotopes are removed from water using ion exchange resins like resorcinol-formaldehyde; this is how water from the Fukushima Daichi reactor accident is being treated