Unit 2: Biochemistry

Content Outline: Water Properties (2.2) – Part 1

1. Life and Water
   1. Water, mainly found *inside* of cells, makes up 70 –95% of the organisms body for *all* life forms on earth.
2. Water is a **Polar** Molecule (has a positive and a negative end)
   1. Oxygen has a *slightly negative charge* because it is more electronegative (it has a stronger hold on the electrons because it has eight positive protons).
   2. Hydrogen has a *slightly positive charge* because it is less electronegative (it has a weaker hold on the electrons because it only has one positive proton).
   3. Water’s polarity allows for it to make **Hydrogen** **bonds** *easily*.
   4. This polarity makes it possible to conduct electricity very well. (Remember, electricity is flowing electrons.)
   5. The polarity allows for a single water molecule to bind to *4 other water molecules at a time*.
3. **Cohesion** 
   1. This term refers to *water molecules binding to other water molecules*.
   2. This property is made possible because of **Hydrogen** **bonds.**
   3. This is important in how water moves up a plant.
4. **Adhesion**
   1. This term refers to *water molecules binding to something other than water molecules*.
   2. This property is made possible because of **Hydrogen** **bonds.**
5. **Surface Tension** 
   1. This is the linking together of water molecules on the *surface of a body of water*.
   2. This property is made possible because of **Hydrogen** **bonds.**
6. Water helps with *temperature regulation*in organisms and on the earth.
   1. Water is theonly substance on earth to be found in all 3 states naturally. (solid, liquid, and gas)
   2. Water can act as a huge heat “piggy” bank. (Such as when the sunlight hits the oceans and other water bodies and the water heats up *slowly* as it absorbs the light energy.)
   3. Thisproperty is made possible because of **Hydrogen** **bonds**.
   4. It takes tremendous amounts of E to break all four hydrogen bonds *at once* and turn liquid water to a gas.
   5. This is a important worldly effect as it helps to *keep the temperature of earth stable* (the water absorbs the energy of sunlight, so we don’t fry, and then releases that same energy at night, so we don’t freeze… remember that one side of earth is always in the sun and the other side is dark so temperature is stable.)
   6. Kinetic E terms associated with water.
      1. **Heat** – This measurement is the *total amount of kinetic E* in a substance.
      2. **Temperature** – This measurement is *the intensity* of all the heat in a substance as the molecules move. (The faster they move… the hot it gets and the slower they move… the colder it gets.)
   7. Ice cubes and cold drinks (The hot drink molecules lose energy as they try to warm up the frozen water molecules thereby causing the drink to “cool”.)
7. **Evaporative Cooling**
   1. *Putting heat E into water*, causing the water to evaporate and *carry the heat E away from the body* thus providing a cooling of the organism to occur as the E leaves.
   2. Wind *increases* the effect of cooling by carrying the water vapor away from the body. **Humidity**, water vapor in the air, *decreases* the effect because water can’t evaporate into the air as it is already full of water vapor.
8. Expansion of Water when it freezes
   1. Water *condenses* down to 4% Celsius; after that, the colder it gets, the more it expands.
   2. Life was and still is able to survive under the *floating* ice that occurs at the poles and during winter.

**Water Properties – Part 2**

1. Water is the **Universal Solvent** (It can dissolve most things)
   1. **Solvent** – Liquid that is *doing the dissolving* of another substance.
   2. **Solute** – Substance *being dissolved* in the solute.
   3. **Solution** – Substance possessing *equal distribution* of material. (Kool-aid is a good example.)
   4. **Hydrogen** **bonds** of water make each situation possible.
   5. **Hydration shell** – Water *surrounding* a molecule. Substance is dissolved and “disappears”.
   6. Oils, grease, and fat are *non-polar* and therefore water can’t grab and dissolve. (Need salt to make a molecular bridge to dissolve… most dishwashing liquids are just *saltwater* with coloring.)
2. **Hydrophobic** “hydro” means water; “phobic” means fear of
   1. Water *cannot attach* to the substance because the substance is non-polar.
   2. The substance “hates” water’s polarity.
3. **Hydrophilic** “philic” means love of
   1. Water *can attach* to the substance because the substance is polar.
   2. The substance “loves” water’s polarity.
4. “WET” Chemistry Terminology
   1. **Dissociation** 
      1. Refers to *water breaking apart* into H+ (Proton) and an OH- (Hydroxide Ion).
      2. **Acid** – a substance that *gives away H+*. (Measured on a **pH** scale.)
         1. Scale goes from 0 to 14.
         2. 7 neutral
         3. On the pH scale: <7- substance is an **acid**; >7 – Substance is a **base**
      3. **Base** – a substance that *gives away OH-.* (Measured on a p**OH** scale.)

a. On the pOH scale: < 7 – substance is a **base**; > 7 – substance is an **acid**

* 1. **Buffer**
     1. A substance *that can resist changes in pH or pOH*.
     2. It can take on or gives off a H+ or OH- to maintain the pH or pOH concentration.
     3. Good example is Human Blood –The buffer is Bicarbonate ( HCO₃¯ ).
        1. Bicarbonate helps keeps blood at a pH of 7.4 ideally
        2. It is needed because of the food, drink, air or other substances we put into our bodies
        3. HCO3- can take on H+ from the blood to become H2CO3 (carbonic Acid) to *raise* blood pH.
           1. The H2CO3 then travels to the lungs where it is *converted* to H2O (water) and CO2.
        4. OR H2CO3 can give off a H+ to become HCO3-and H+ to *lower* blood pH.
  2. **Acid Precipitation** (Refers to Rain, Snow, Sleet, Ice, or Fog with a low pH.)
     1. Water falling in the environment that has a pH of *less than 5.6*.
     2. Mainly because of SO (Sulfur Oxide) and NO (Nitrous Oxide) in the air to combine with water.
        1. Both are found in fossil fuels when burned. (Such as oil, gasoline, or diesel fuel.