Week 3 Lecture 0

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1 Administrative drivel

The exam will cover through today's material, sans lipids

2 More on Biochistry: The Chemistry of Life

2.1 Atoms interact in different ways

- Atoms for *Chemical bonds* between each other based around their electrons
- Atoms do chemistry in order to fill up the outmost energy level in the atom (for most elements in LIFE that is 8 electrons, by H (hydrogen) needs only 2)
- Usually, for each proton there is an electron in the atom, so atoms are electrically neutral.
  - this can be changed by adding or removing energy from the system
- e.g.
  - Hydrogen (H) requires 1-more electron to fill it's outermost energy level
  - Oxygen requires 2-more electrons to fill it's outmost energy level (it has 6 in its outer shell usually, and it wants to have 8 in it's outmost shell)
  - If we have 2 H, and 1 O in the states above, the can share electrons to get up to their desired number (This is an example of a covalent bond)
- in the periodic table, in a given column tend to form the same types and number of bonds, since they have the same number of outermost elecctrons in their "default state". i.e. the outermost shell of electrons has the same number of electrons among the atoms in a given column.
- The noble gasses (right most in the periodic table) have full outer shells in their default state, so they don't like to bond

2.2 Ionic bonds - between ions

- Atoms will give up one of their electrons to another to fill their outermost shell.
- **Salts** do this!
  - Sodium (Na) has 1 electron in outer shell
  - Chlorine (CL) has a "hole" (7 electrons in valence shell)
  - Na gives it's electron to Cl
  - the result is 2 **ions**: Cl is negatively charged (Cl^-) and Na is positively charged (Na^+)

2.3 Covalent bonds- electron is shared

- characterized by **sharing** electrong
- Molecules are chemicals that are atoms combined by covalent bonds
- very strong bond
- e.g.
  - Water
  - methane (natural gass)
  - oxygen (O_2)

2.4 Polarity, seperation of electric charge

- due to unequla sharing of electrons between two atoms
- now, opposite charges between molecules attract
- e.g.
  - in water (H_2), oxygen likes to hoard the electron, making the oxygen end negative, and the side that the hydrogen live on is negative in the molecule.

2.5 Hydrogen bonds, relatively weak

- e.g. 2 water molecules can be bonded along their oposite chage (oxygen side of one water molecule bonds to the hydrogen end of the other water molecule, since the O side has a negative charge, and the H side has a negative charge)
- Happens between neighboring molecules
- Happens between polar molecules (see the previous section)

- (usually forms a latice with Xs made up of O in the middle surrounded by 4 Hs)
- easily broken, but happen everywhere, and are very "usefull" in life molecules
- more generally, we call charge bonds like these "polar bonds"

2.6 More about water

- It's got good properties
  - Works as a solvent for life! (due to mild polarity)
- living things are mostly water (by mass)
- The polarity of water means polar and charged atoms and molecules can dissolve in it
  - e.g. salt
  - water surrounds the Cl^- and Na^+ (with oposite charge pole facing the respective molecule) untill there is no more water molecules, or no more salt.
- solvents allow cells to bring things in and out of themselves

Definition 1. *Molecule.* a formation of more than 1 atom that has covalent bonds between the atoms (usually)

2.7 Important organic molecules

- Carbs
- Lipids
- ...

2.7.1 Carbohydrates

- substances found in starchy plant materials (usually)
- Glucose
  - 6 carbons in a ring ish thing, with hydrogens and oxygens
  - the product of plant's photosynthesis
  - this is the sugar in your blood
- all 1 to 2 to 1 ratio of carbon, hydrogen, oxygen respectively
- Monosaccharides – simple sugars

- either 5 or 6 carbons
- differ in shape, structure, arrangement
- glucose, fructose, etc

* Disaccharides
  - composed of 2 simple sugars
  - e.g. lactose (milk sugar), sucrose (table sugar)
  - lactose is galactose + glucose
  - glucose + fructos = sucrose
  - sugars are hooked together on their respective oxygens
* sugar names end in "ose"
* Polysaccarides (not sugars!)
  - starch – most common poly... in plants
    * made up of the composition of more than 2 simple sugars
    * sugars are hooked together on their respective oxygens
    * this is long term energy storage for plants
    * starch in some seeds is to provide energy for the seed to germinate
    * most fruits have a lot of starch, some roots do too
    * when fruits become ripe, the fruit breaks down the starches into sugars which attract other animal to distribute the seeds of the plant.
  - Glycogen
    * characterized by many branching chains, instead of single chains in the starches.
    * the way humans store energy (most vertebrates as well) store it in their liver and muscles for long term energy
    * too much glycogen will get converted to fat (lipids)

2.7.2 Lipids

- super energy dense molecules
- stores long term excess energy
- this can be a problem in humans, since it can be hard to get rid of.
- consist of fats and oils
- key components:
  - glycerol + fatty acids

- when you have 3 fatty acid chains that are attached to the glycerol "backbone" you get a **triacylglyceral** or **triglyceride**
- fatty acid: long chain of carbons with a bunch of hydrogens, the end OH tends to break off and bonds with the clycerol making water and a lipid.
- fatty acids are the basic lipid, and there are many different kinds, and can be combined into a wide veriety of triglycerides.
- almost all fatty acids have an even number of carbons

- Triglicerides:
  - Main long-term energy storage in humans
  - lipids are stored in fat cells in a vessicle
  - migratory birds in late summer will double their weight in fat and burn it off in migration
- fatty acids vary
  - straight if all of the carbons are single bond
    - tend to be solid at room temp, since they can line up with each other
    - called saturated
    - tend to make fat deposits in the arteries long term, which is noo good.
  - you get a kink in the acid if there's a double bond in the carbon chain
    - plants tend to make these
    - tend to be liquid at body temp, since the acide don't line up as easily
    - called unsaturated