Biology 1305 – Modern Concepts in Bioscience – Campbell Textbook

Hello everyone! I hope you all are doing well. My name is Gabriel Andino, and I am one of the Master Tutors for Biology 1305 this semester! I am a junior Cell and Molecular Biology student, and I pretty much adore Biology with all my heart. I am joined by Jaycie Moore, who is a sophomore Biology major, and we will be making the resources for you all. We are super excited to make these resources for you guys, and we hope you use it to aid your studying efforts.

Remember that the Tutoring Center offers free individual and group tutoring for this class. Our Group Tutoring sessions will be every Thursday from 5:00-6:00 PM CST. You can reserve a spot at https://baylor.edu/tutoring. We hope you sign up!:)

In this week's resource, we will discuss: electronegativity, electron shells, polarity, and hydrogen bonding

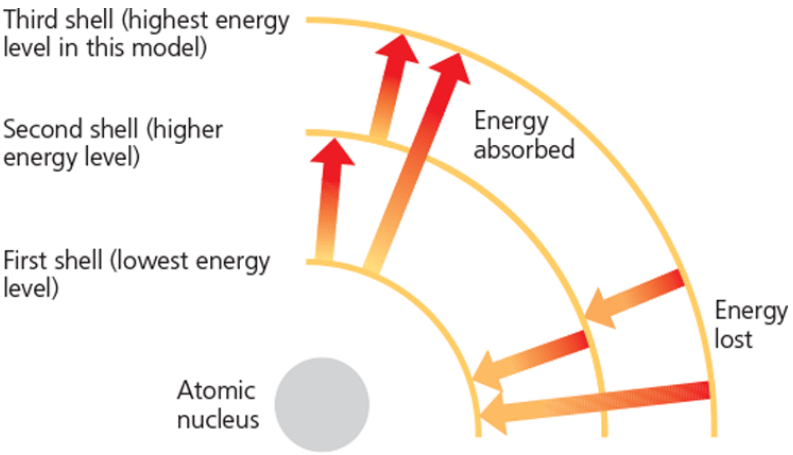
Chapter 1 focuses mostly on some general overarching themes in Biology that students rarely struggle with, so I am going to jump right in with chapter 2. Below I have included links to videos from the tutoring center on these concepts, and I highly recommend you use them as refreshers.

Subatomic Particles and Atomic Mass
Electron Shells, Electron Orbitals, and Valence Electrons
Covalent Bonds
Ionic Bonds
Van der Waals Forces
Hydrogen Bonds
Isotopes

While this is not all-inclusive, these are some of the biggest topics to be aware of moving into this chapter. I highly recommend you visit our biology Youtube page as there are videos for **EVERY SINGLE MAJOR TOPIC COVERED IN BIO 1305**!!

Bio 1305 Youtube Link

Below is a figure representing a nucleus and its electron shells, which play essential factors in an atom's reactivity and bonding preferences. I am going to include questions you should be asking yourself and answering. **All answers will be at the end of the document, but I recommend you try answering the questions yourself first and not just looking up the answers**.



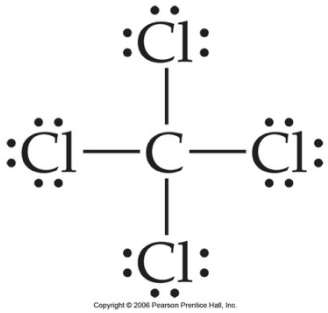
To your left, you will notice a depiction of an atom and its surrounding electron shells. While many people will be tempted to suggest that the atom is similar to our solar system (sun=nucleus, electrons orbit like planets), please note that this is **not true**!

Each electron can inhabit an **electron shell**, which is an area in which you have a high probability of finding an electron. Some shells are closer to the nucleus and others are more far away.

You will notice in the diagram that the farther away you get from a nucleus, the higher energy the electron orbital becomes. This is mostly due to the fact of the instability associated with the fact that the electrons are separated from their attractive nucleus, but now we are getting into physics and I won't bore you with that. An electron can only move between shells when it has **energy put into it, or it becomes "excited".** Electrons that are excited will jump to higher electron shells, but eventually lose their energy and "fall" back down to their original shell **releasing light!**

Valence electrons are located in the outermost shell. These electrons are used in bonding as they are the highest energy and easiest to share between atoms. This can be explained by the fact that they are not as attracted to the nucleus, given they are farther away.

An element's properties are determined **by its number of valence electrons**. Remember an atom wants to have a full outer shell of electrons or a full 'octet'. The closer it is to having a full outer shell, the more reactive!



Now, I want to turn your attention to bonding. The properties of bonds are very important and you will often rely on them to understand the basis of the chemical reactions you will see throughout your undergraduate career.

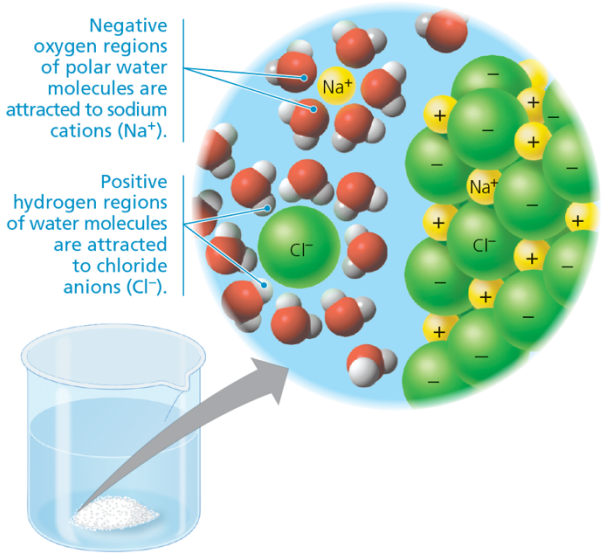
The first concept I want to introduce is the concept of **electronegativity**, which is an atom's affinity for electrons. The more electronegative an atom is, the more likely it is to "hog" or "steal" electrons away from other atoms. You can think of it like the rude kid at the playground that won't share any of his toys "electrons" but wants all of the other atoms' toys and takes them from the atoms. The 5 electronegative elements you should absolutely be aware of are (in order from most to least): **Fluorine, Oxygen, Nitrogen, Chlorine, Sulfur, Phosphorus**

Electronegativity plays an important role of determining the **polarity of a bond**. Above you will see tetrachloromethane (CCl_4). In it we see carbon bonded to 4 separate chlorine atoms. We know from the list given above, that chlorine is more electronegative than carbon. This means chlorine is going to hog the electrons in the bond between chlorine and carbon. The sharing of electrons in this bond is considered to be **unequal**. This is a **polar bond**. Conversely, a nonpolar bond would be an **equal sharing of electrons**. So, atoms of similar electronegativity (Carbon-Carbon bonds) will not be considered polar.

Remember, understanding the chemical context of life is essential in understanding.. well, life! Don't neglect this even if you think you remember it from high school. I promise learning this now will make your life much easier in the future.

In chapters 3 and 4, you begin learning about water and how it facilitates life, as well as a bit about carbon's contribution to molecular diversity. Below I have included links to videos from the tutoring center on these concepts, and I highly recommend you use them as refreshers. These topics include information concerning the following:

Water and its Properties
Water as a Solvent
Hydrophobic vs Hydrophilic
Acids, Bases and the pH Scale
Carbon and Molecular Diversity
Isomers
Functional Groups



Water is the most important liquid on this planet! Without it, nothing would be possible. Due to its overwhelming importance, you need to be able to understand its essential properties, and more importantly, know why they are in water. e

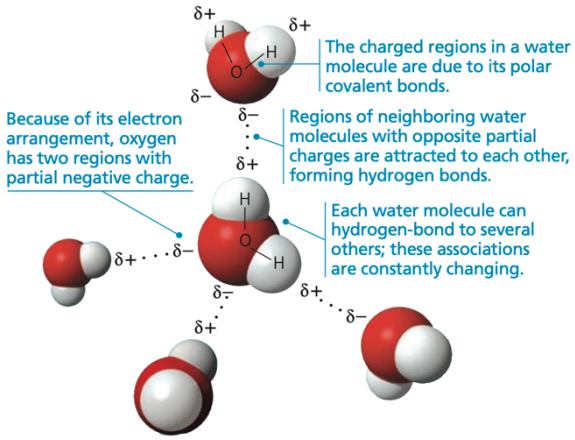
These are the essential properties of water. I could define them for you, but it is good memory work if you write them out yourself and put them into your own words! (use your glossary for this if you're stuck).

- Cohesion
- Adhesion
- Surface tension
- Evaporative cooling

How is water able to do all of this? Well my friends, it all comes back down to the fact that water is a polar molecule and is capable of **hydrogen bonding with itself.**

A hydrogen bond is an intermolecular interaction that is seen in a lot of polar solvents, but specifically I am going to talk about water. **Please remember, hydrogen bonding is NOT exclusive to just water!**

Figure 3.2 Hydrogen bonds between water molecules.



Remember how water is a polar molecule? We have an electronegative oxygen bound to two weak hydrogens. The oxygen hogs those electrons in the bond, yielding a **partial negative charge** on the oxygen, and a **partial positive charge** on the hydrogen (remember, electrons are negative, so the atom that steals them away should be more negative)

Now imagine if we have a glass of water that is full of moles upon moles of water molecules. Looking at the picture to the left, you will notice something happening between the partial negative oxygen and the partial positive hydrogen atoms **between water molecules**. Those lines are written to suggest they are **attracted to one another**, like a magnet! This attraction that you see is the beautiful hydrogen bond in all of its glory. It is this interaction that is responsible for all of waters properties.

Unfortunately, in terms of functional groups and isomers, you do have to play the memorization game. **I highly recommend you make flashcards or quizlet these as functional groups and isomers play important roles in biological systems.** See you next week!