10 - Covalent Bonding

The Covalent Canvas: Painting with Shared Electrons

Video 10 - Transcript

Hi everyone, welcome to video number 10. Today we are going to be exploring the concept of covalent bonding. Covalent bonding is the most important type of intramolecular bonds that we're going to study. Because biomolecules which make up living things, bond for the most part, covalently. Covalent bonding occurs between non-metals. These are going to be the elements in groups 5, 6 & 7 of the periodic table. Now atoms in group IV, for example, C, these are my semiconductors - When group IV atoms are bonded to non-metals, they will have some covalent character as well as some ionic character, but they're generally also termed covalent compounds. That makes sense, because life is carbon based. Life is made up of covalently bonded molecules. In a covalent bond, the atoms share electrons to attain stable electron configurations, meaning - full outermost shell of electrons. Some covalent substances include, for example, oxygen, carbon dioxide, water, and glucose. These are some typical covalent substances that we will meet as we go through our study of biology. Now, between non metals, there is generally a small electronegativity difference. Generally a small electronegativity difference between the atoms. The smaller the difference, the larger is the covalent character, and the two electrons of the covalent bond are shared more equally between the atoms. Now this makes sense because when we looked at ionic bonding in a previous video, we said that if the electronegativity difference is larger, that increases the ionic character of the bond, making it more polar. With covalent bonding, we have small electronegativity differences. And therefore, covalent bonds tend to be less polar. Generally, an electronegativity difference of less than 1 - less than one, indicates a covalent bond. If we have a difference between 1 - 1.8, we say that this is a polar covalent bond. If we have a difference more than 1.8, this is said to be an ionic bond, which is of course polar. I've drawn here for you. Methane. Methane is a very simple hydrocarbon - comprises of one carbon atom, shown in the middle, and four hydrogen atoms as shown here on all sides. Carbon and hydrogen. These are two non metals. They're going to bond covalently. Covalent bonding involves the sharing of electrons through overlap of my orbitals. Here I have my hydrogen, the pink x. Well, these x's represent the one electron in each hydrogen atom. Carbon has four electrons in its outermost shell, shown by the dots. Therefore, when they share in this manner, all of my hydrogens attain a stable electron configuration two in its outermost shell. Carbon attains a stable electron configuration - eight - in its outermost shell. This is a stable covalent compound. This is how covalent compounds form through overlap of orbitals and sharing of electrons. At this level of study, we must be able to differentiate between ionic and covalent compounds. But also appreciate that most ionic compounds that we will come across will have

some covalent character, and some of the covalent compounds that we may come across will have some ionic character. This is due to this scale or this range that we see with regards to electronegativity differences. If we think about a typical covalent bond. Another one, think of HCl. HCl is a common acid, hydrochloric acid. The type of bond that exists between hydrogen and chlorine in HCl is a covalent bond. Here I have two non metals, we have overlap of orbitals, and they're sharing electrons to make that bond. However, even though we're saying that covalent compounds have small electronegativity, differences and are generally non polar. That does not mean that in this covalent compound like HCl, it's non polar because we know that HCl dissolves in water, HCl has a polar covalent bond. If we think about the electronegativity difference here, it's actually about 1.1. Okay, We're looking at an electronegativity difference between H and Cl - 3.2 and 2.1 to give us an overall difference of 1.1 - which is basically going to indicate a polar covalent bond. In covalent bonding, the mutual attraction of two positive nuclei - remember these nuclei are all positively charged because that's where my protons are. We have a mutual attraction of the two positive or the multiple positive nuclei of the atoms. With the negative electrons that are contained as my orbitals overlap is what holds the entire thing together. The sharing of electrons results from overlap of orbitals. Now, covalent bonding, as I said, is going to be the most important type of intramolecular bond when dealing with the molecules that make up life. As we said, we can have oxygen, we can draw oxygen like this. And we can show you just oxygen, we can write like so - has two covalent bonds between the two atoms. If one covalent bond, like here is two electrons, then a double bond, or two covalent bonds - four electrons. We can see here that oxygen is forming a double bond, two covalent bonds between the two atoms to allow for each atom to have its outermost shells filled, and therefore stabilized. We will continue to meet covalent bonding. As we go through our study of biology, Keep in mind that this is the most important type of intramolecular bonding that is seen amongst molecules. It's going to be very important for us to ensure that we recognize that there is a range of covalency when we're looking at covalent compounds, depending on the electronegativity difference.