15 - Functional Groups

Molecular Architects: Navigating Functional Diversity

Video 15 - Transcript

Hi everyone. Welcome to video number 15. Today we're going to be looking at functional groups. Before we get into functional groups that we see in biomolecules, let's talk a little bit about carbon. Carbon is one of the most versatile atoms on Earth. It possesses four valence electrons, and as such, can form 4 covalent bonds with a variety of other atoms, such as hydrogen, oxygen, nitrogen, and of course, other carbon atoms as well. The formation of carbon to carbon bonds was an important event in chemical evolution. Organic life is made up of carbon containing compounds. There is an almost infinite array of molecular shapes with various combinations of single and double bonds that are possible. Carbon is best suited to act as the scaffold of organic molecules due to phenomenon called catenation. Catenation is the bonding of atoms of the same element into a series or in a chain form. If the chain is open, then we have a linear, otherwise known as aliphatic or open chain compound. If the chain is closed and the ends are bonded to each other, then we form a ring, otherwise known as a cyclic compound. Now, whilst carbon is integral in providing the framework of organic molecules, further diversity in form and therefore function, is provided by functional groups. Functional groups are a series of atoms bonded within a compound that is responsible for the chemical reactions that that compound is able to exhibit. Functional groups generally contain hydrogen, nitrogen, oxygen, phosphorus, and sulfur. These functional groups play a very important role within biomolecules. For example, amino groups, which is -NH2 functional group - these attract a proton and can act as bases; carboxylic acid groups such as the -COOH group, these are of course, acids and therefore can release a proton into solution. Carbonyl groups -C=O These have sites that link molecules into larger, more complex compounds. -OH, alcohols, otherwise known as hydroxy groups, These tend to act as weak acids. We have a variety of others. Here I've shown you some of the functional groups that we find in our organic molecules. We have alkenes, here we have, of course, the characteristic double bonds of alkenes. We find alkenes, for example, in chains of unsaturated fatty acids. Here, we are also showing you alcohols - we find alcohols in carbohydrates such as glucose. We have carboxylic acids, which are intermediates in the degradation pathways of many of our biomolecules - amino acids, fats, and carbohydrates. We have carbonyl groups, which are found in carbohydrates as well as urea. We have amines, which are found in our amino acids. We have aromatic groups which are our ringed or closed chain compounds. These tend to be seen in proteins via our aromatic amino acids, as well as in lipids in the form of steroids. Finally, we're showing you here the thiol group. This thiol group contains sulphur, and is responsible as well for the three dimensional configuration of proteins. There are many other functional groups

that you may come across. The phosphate functional group, for example, the amide functional group. We have esters as functional groups and there are many others. As you go through your study of biology and you meet biological molecules, it would be very important for you to be able to identify which functional group is present in the molecule, because that will give you an idea of what that molecule does in the body.