# 6 - Molecules

## Molecular Masterpieces: Artistry in Chemical Bonding

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### Video 6 - Transcript

Hi everyone. Welcome to video number 6. Today we're going to be discussing the concept of molecules. Now a molecule is formed when two or more atoms join together via chemical bonding. There are a few ways in which atoms can bond. These are ionic, metallic, and covalent bonding. Now we're going to explore these three types of bonding in subsequent videos. Today what we want to focus on is to explore some of those molecules that you will meet as you progress through your studies in biological sciences. We want to be able to understand their chemical formulae, how to draw them, and of course their names. I'm going to list out a few of these molecules that you're going to meet over and over again. We'll start with oxygen. Oxygen is a diatomic molecule, which means that it comprises of two atoms. The chemical formula of oxygen is two. We can draw oxygen like this, where there is a double bond between the two oxygen atoms. Oxygen is a gas at room temperature and pressure. Another important molecule that you're going to meet many, many times is carbon dioxide. Carbon dioxide has a formula of CO2 Carbon dioxide is a triatomic molecule. It comprises of one carbon atom and two oxygen atoms. Again, double bonds between the carbons and the oxygens. Carbon dioxide is, of course, a gas at room temperature and pressure. Another important molecule that you're going to meet over and over again is water. Water is also a triatomic molecule. Comprises of one oxygen atom and two hydrogen atoms. Water, however, is a liquid at room temperature and pressure. Let's also look at glucose. I'm sure we've all heard of this molecule, Glucose. Glucose is actually a very large molecule made up of 24 atoms. We can draw glucose like this. We can see that glucose has a number of OH groups, otherwise known as hydroxyl groups, six C atoms, six O atoms, and 12 H atoms. The formula for glucose C6H12O6 Now, humans have evolved to utilize glucose as the main source of fuel in cells. Just like a car burns or oxidizes gasoline, which powers the engine, our cells burn or oxidize glucose to make energy to power our cells. Another important molecule that you may meet as you progress through your studies is phosphoric acid. The formula for phosphoric acid is H3PO4 We can draw this like so we see that phosphoric acid has three OH groups and this double bond O group here Now the reason why I bring this to your attention is because of the process of phosphorylation. Phosphorylation is the process of adding a phosphate group to molecule. The phosphate group being  PO43- The PO43- anion is basically the same as what we've drawn, except we remove our hydrogens. The addition of a phosphate group onto a molecule, such as an enzyme for example, actually activates it. Phosphorylation is a very important process in biology. We will also find phosphate groups in the building blocks of nucleic acids, which ultimately form DNA and RNA. The last molecule we want to look at today

is carbonic acid. Carbonic acid, H2CO3 Carbonic acid generates the bicarbonate anion HCO3- We can draw carbonic acid like so. The reason why I bring this to your attention is because the bicarbonate anion HCO3- serves as a component of the major blood buffer system of humans, thereby playing a critical role in the maintenance of ph in our cells. Bicarbonate can also be used in a variety of ion transporters, often working in coupled systems to transport other ions and organic substrates across cell membranes. Now I want to point out that all of these molecules that we have looked at here are all bonded via covalent bonding. You will find, for the most part, that molecules and living systems bond covalently to one another, and therefore they share electrons. When we say life is carbon based, we mean that the main molecules which support life use carbon as the main building block of the molecules. If we recall, when we looked at the periodic table, carbon is in group number 4. It's a semiconductor and it has four electrons in its outermost shell. Carbon would rather share electrons in order to gain a full outer shell, rather than formally give away or accept electrons. Finally, today I want to make mention of a few terms which we should ensure that we do not confuse when we're using them in sentences. These terms are element, molecule, and compound. A chemical element is a substance that cannot be broken down into other substances. Now when we say cannot be broken down into other substances, we mean that it cannot be broken down without losing the properties of that element. We already know that elements comprise of atoms. We have explored the basic structure of the atom, and we know that they comprise of subatomic particles. When we say cannot be broken down, remember that we're referring to the fact that it can't be broken down into other substances without losing its own chemical and physical properties. The periodic table represents all of the elements known to exist with their symbols, atomic numbers, and mass numbers. We've already explored this. Now a molecule is a group of two or more atoms. A group of two or more atoms that are held together by our attractive forces or our chemical bonds. I can have a molecule of water, a molecule of glucose, or a molecule of carbon dioxide. Molecules are represented by chemical formula, as well as structural formula, which we have shown you here today, which gives us an idea of the three dimensional configuration of the molecule in space. Now a compound is a chemical substance comprised of many identical molecules. Many identical molecules. Now, these molecules will contain atoms from more than one chemical element held together by chemical bonds. A molecule consisting of atoms of only one element is therefore not a compound. A compound often looks and behaves differently from its constituent atoms. For example, if we think about water. Water is triatomic molecule consisting of three atoms. It's a liquid at room temperature and pressure. But if you think about hydrogen and oxygen on their own, hydrogen is a gas. Oxygen is a gas. But when they combine in this way, it becomes a liquid. It is generally very important for us to be able to recognize molecules, be able to draw them the way that we have today, and be able to understand that they all bond via chemical bonding. That's all for now. In the next video, we're going to look at the different types of bonding in great detail.