**Foundations of Human Biology 1**

**Week 1 – Chemistry video transcript**

Hello, Foundations of Human Biology students, and welcome to your first content video. As you may know my name is Bella and along with Andrea I'll be teaching you some of the topics in this course. I am also always here to answer any question that you may have. Any of the topics seemed too overwhelming? No worries. Let me or your tutor know and we can work our way through the complex thing that is the human body together. If you have a question about these topics please make sure to post it in the discussion forum. 9 times out of 10 other students have the exact same question.

So today's videos start to look at chemistry, but not to worry you won't need your lab coat, we're just looking at some basic fundamentals of what our body is made of, and I apologize in advance for my terrible dad jokes you're about to see. The human body is a complex organism, but have you ever really thought about what it's made of? no okay let's break it down. The body is made up of lots of organ systems, which we will cover throughout this course. An organ system is made up of all the organs that are involved in that system, for example the digestive system is an organ system made up of the mouth, the oesophagus, the stomach, the small and large intestine, the liver and the pancreas. Although these are all part of an organ system, they are also each individual organs, and those organs are made up of different types of tissue, and that tissue is made up of different types of cells, and those cells are made up of organelles, and those organelles are made up of macromolecules, and those macromolecules are made up of molecules, and those molecules are made up of elements, and those elements are made up of atoms, so basically all of us and all of our differences are really just made up of around 20 different types of elements, and in order for us to understand the complexities of the human body, we have to understand all of this, right down to the atoms, and that, also known as chemistry, is what this short video will look at.

So let's start with the basics; what is an element and what is an atom. All matter both living, you sitting there, and not living, the computer you're watching this on, is made up of elements. You might have seen a table a bit like this in your science classroom. This is a periodic table and lists all the known elements. There are over 100 elements but luckily for us, we only need to focus on around 20 for the body. The smallest part of an element is an atom, and an element is made of only one type of atom. So an atom is the smallest part of an element that has the characteristics of that element. It consists of three major subunits; protons, neutrons and electrons. A proton has a positive electrical charge, and is found in the nucleus of the atom. A neutron is electrically neutral or has no charge, and is also found in the nucleus, and an electron has a negative charge and is found in the electron shell orbiting around the nucleus. The number of protons in the nucleus give it its atomic number – maybe you've seen those little numbers in the periodic table at your school science classroom? They are atomic numbers and every atom has a different atomic number. This atom has two protons so therefore I know it's helium as helium is the only atom with two protons.

The electrons have a very important role in bonding so let's look into that. In nature an element does not usually exist by itself but rather combines with other element to form compounds or molecules. These are a combination of atoms of usually more than one element that are so tightly bound together that they behave as one unit. There are a few different ways that these atoms combine together so let's take a look. So what type of bond an atom will form is all based on the electrons in the outer shell of the atom. An atom ideally wants eight electrons in its outer shell to make it stable and happy. This is known as the Octet Rule. It can get to this happy state by either gaining, losing, or sharing electrons, and depending on which of these it does determines what type of bond it is.

Let's look into these bonds a little further. First off, chemical bonds. A chemical bond is a force or attraction between positive and negative electrical charges, that keep two or more atoms closely associated with each other to form a molecule. What's interesting about chemical bonds, is that as a molecule the physical characteristics are very different from when they were just elements. Let's take the example of hydrogen and oxygen. As elements they are both gases, however when they form a molecule through chemical bonds, it turns into a liquid form - water.

And next we have a love story that starts with chemistry and ends in 'assault'. Also known as ionic bonds. Ionic bonds involves the loss of one or more electrons by one atom, and gain of electrons by another atom. This love story starts with sodium. A sodium atom has one electron in its outer shell and in order to become stable it tends to lose that electron so now the sodium atom has one more proton than it has electrons. Remember that protons have a positive charge, and electrons have a negative charge, so now sodium has a positive charge of 1, and is now called an ion. Let's leave sodium for a minute but we'll come back to him. The other atom in this love story is chloride. It has seven electrons in its outermost shell, and in order to become stable it tends to gain one electron. When it does this it turns into an ion, as it has one more electron than it has protons, and therefore has a negative charge of one. So back to sodium. Remember how it wanted to lose an electron and chloride wanted to gain one it's like a match made in heaven, they complete each other, or at least stabilize the outer electron shells of each other, and you know how in love stories they say that opposites attract well it's certainly true for sodium and chloride. Now that they have stabilized their outer electron shells, they have opposite charges with sodium being positive, and chloride being negative, and are thus attracted to each other. I told you that this love story ends in 'assault', and the result of this joining is sodium chloride, or more commonly known as a salt get it 'assault' - 'a salt', okay I'm sorry I won't pay me with my terrible jokes anymore. Instead I'll tell you a bit more about ions.

Normally in atoms, protons will equal the number of electrons, and therefore it has a neutral charge. We were just discussing ions when we were looking at sodium and chloride. When an atom loses or gains one or more electrons, in an effort to stabilize it electron shells, its charge changes as the number of protons and electrons are no longer the same, and it is then called an ion. If it has a positive charge or more protons than electrons, it is called a cation. So in our previous example, sodium was the cation. If it has a negative charge, or more electrons than protons it is called an anion and in the previous example chloride was the anion.

Moving on to covalent bonds. Covalent bonds involve the sharing of electrons between atoms. For this example let's use my favourite thing to breathe, oxygen. An oxygen atom has six electrons in its outer shell, and so needs two more electrons to be stable. To do this it can share two electrons with another oxygen atom, also sharing two electrons. Together they form a molecule of oxygen gas, just like what we're breathing in right now. Carbon is an important element in biology and in fact makes up around 20% of your body weight. The element carbon always forms covalent bonds. It can share its electrons with hydrogen, oxygen, nitrogen, or other elements. It has four electrons to share with other atoms, and when carbons four electrons are shared with four atoms of hydrogen, which each share their one electron, it forms methane gas. And the pesky little thing is not only smelly, but it's also contributing to global warming.

Disulfide bonds are covalent bonds formed between two atoms of sulfur, usually within the same large protein molecule. These bonds are very important in maintaining the shape of a protein. If we take the example of insulin it must have a very specific three-dimensional shape in order to function properly, and regulate blood glucose levels.

The last bond we'll be covering today are hydrogen bonds. These bonds do not involve the sharing of electrons, but rather result because of the property of hydrogen atoms. It's all about opposites attracting again. When a hydrogen atom shares its one electron in a covalent bond with another atom, its protons then get a slight positive charge. This then might be attracted to an atom with a slight negative charge, like nitrogen or oxygen. Although hydrogen bonds are weak, they are important in maintaining shape which is especially important in large molecules like DNA, where shape is integral to function. You can test out hydrogen bonds for yourself. Take some glass, and put a few drops of water on it. See how it forms in 3-dimensional beads, instead of smearing all over the glass? This is thanks to hydrogen bonds attracting water molecules together. This is important for the water in our body as it does things like making sure blood flows in a continuous stream in our vessels.

So as you can see chemistry is fundamental to human biology, and there are many different elements that make up your body. Have a look in your ebook to see what these elements are, and make note of which ones are the most predominant. Table 2.1 on page 24 of your ebook will help you there, and remember any questions, we are here to help.