18 - Acid/Base reactions

Acidic Affair: Unraveling Reactions with Bases

Video 18 - Transcript

Hi everyone. Welcome to video number 18. Today we're going to be looking at acid/base reactions. Now generally speaking, a chemical reaction occurs when a substance or a molecule is combined with another molecule, or when a substance or molecule is broken down into different molecules or another substance. In most chemical reactions, bonds are broken and new chemical bonds are formed. Generally, we can write an expression for chemical reactions like so: we have reactants and these can be converted into products. A simple example of this is the dissociation of water, which produces H+ ions and OH- ions. Here we have our reactants, and here we have our products. Now notice, this symbol here that are used is different from this one. This arrow indicates that the reaction is only occurring in that direction. However, this equilibrium sign indicates that the reaction is reversible. Now in terms of acids and bases, the reason why we want to focus a little bit on this, is because as you go through your study of biology, you will explore and you will see a number of different reactions that are occurring, that are acid/base reactions. Now generally speaking, an acid plus a base will give us what we call a salt and water. We know already that salts are ionic compounds. We have various ways of defining acids and bases. This little table here indicates the different ways in which we can do this. We have certain scientists that have come up, or we call it theories here, that have come up with different ways to define acids and bases. The Arrhenius definition of an acid is that it is a substance that produces H+ ions in solution. In the previous video, you would recall that we said that pH is a negative logarithmic function of H+ ions. The higher the amount of H+ ions you have in solution, the more acidic your solution is. On the other side, an Arrhenius base is a substance that releases H+ ions in solution. Now, if we look at the Bronsted-Lowry theory of what an acid is, an acid is a proton or H+ donor, whilst a base is an H+ acceptor. Finally, the third, the Lewis definition of an acid is that it is an electron acceptor, versus a base, which is an electron donor. Now in video 19, when we look at oxidation and reduction, we're going to explore this relationship between H+ ions and as well as oxygen atoms in relation to electron acceptors and electron donors. But for now, let's just focus on acids and bases. So water - if you look at the dissociation that we've written here, for water, water can act as either an acid or a base. Notice that water can produce H+ ions in solution, but it also at the same time, produces OH- ions in solution. And of course, these are produced to the same extent. This is why water has a pH of around seven - pure water that is. So why are acid base reactions important in biology? Many biological processes utilize acid base reactions in order to fulfill a particular function. Now, as you go through looking at specific biomolecules like proteins and in particular enzymes, you will see that enzymes work at specific pH values. Different enzymes that are located in different, cells and tissues will require different pH values. If we think about the process of digestion, for example, the pH of our saliva in our mouth is about neutral. It's actually around 6.7, very close to seven. If you think about the mouth, if it were a very acidic environment, then your food may not taste so great. It makes sense that our mouth or saliva is around pH 6.7 The stomach, on the other hand, has a pH of about 2.0 This is quite acidic. This also makes sense because in the stomach, this is where a lot of digestion takes place. We have a lot of breaking down what we call hydrolysis of the food that you eat - the carbohydrates and proteins and lipids that you consume. This low pH is necessary for the production of gastric juices, which facilitates the breakdown of these large macromolecules into smaller molecules. Further down in the digestive system, the pancreas - the pH around there is about 8.0 The pH in the pancreas is slightly alkaline. This is of course different to what we see in the stomach, which is quite acidic. Then even further in the digestive system, in the small intestine, you will see that the pH is 7.3 - just slightly alkaline. Even though we appreciate that the pH of our blood needs to be maintained at about 7.3 to 7.4, we still have to remember that different parts of our body, not the blood, but we're thinking about cells and tissues now, and organs - will need to be maintained at different pH levels in order for those cells to conduct the metabolic processes that they're designed for. All of these are governed through acid/base reactions and the use of buffers. That's all for now, and I'll see you in the next video, where we look at oxidation and reduction.