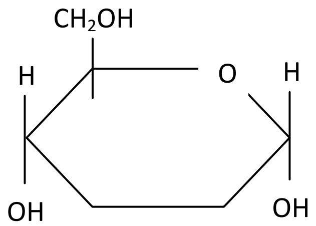
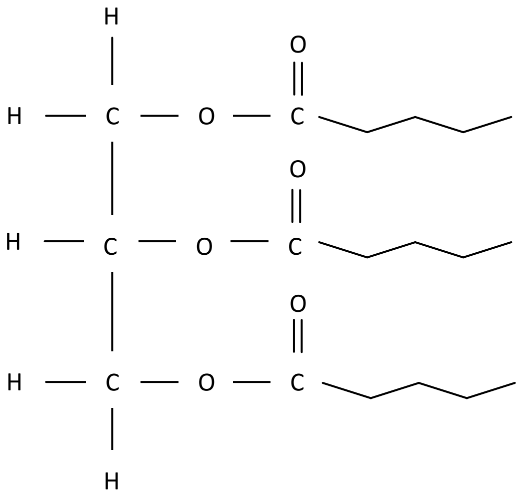
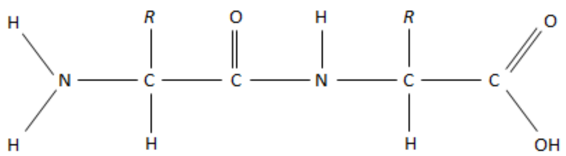
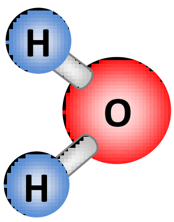
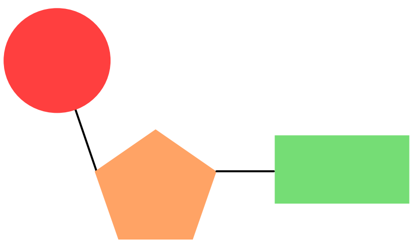
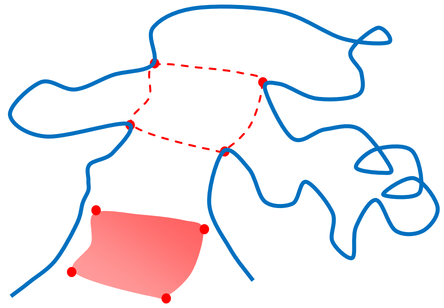
Biochemistry and Chemical Bonds

An introduction to the chemistry behind biomolecules

What is biochemistry? Well, it's the study of biology at a molecular level. So the emphasis of this unit is the biological significance of chemical molecules. As part of the course, there are *six* biological molecules that you need to know about:

	**Carbohydrates** These molecules are one of many vital to life. They are used for energy (for both storing and supplying energy), and in some cases can be used structurally, such as *cellulose*
	**Lipids** These come in many varieties: fats, oils, cholesterol, steroids, and more, and have uses in cellular membranes, insulating and protecting, and also act as a minor energy supply
	**Proteins** Proteins have several uses, such as for transport and structure; but they are also the basic components of all enzymes, hormones, antibodies, haemoglobin, ribosomes, and many more materials
	**Water** Another essential life component, this is the most important content of many reactions forming most of these molecules, and also metabolic reactions; water is also an essential structural component in plants, and in the diet of animals
	**Nucleic acids** These are responsible for the formation of both DNA and all forms of RNA molecules, consisting of individual *nucleotides*

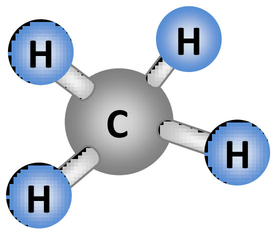


Enzymes

These are *proteins* which are used in many reactions – their function is to *catalyse* metabolic reactions in the vast majority of living organisms

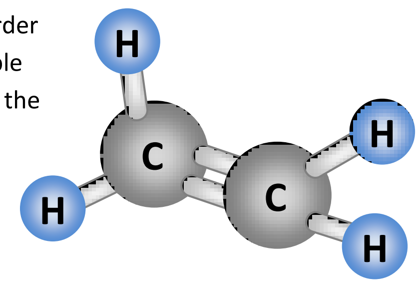
There is a lot of chemistry knowledge in the Biological Molecules section of this module, which is why it is important that you are aware of a few chemistry basics, such as the types of **chemical bond**. This unit on Biological Molecules is centred around **organic chemistry** (organic being 'involving carbon'). All of the molecules studied are *carbon-based*, with the exception of water, which only contains the elements hydrogen and oxygen.

Covalent bonds



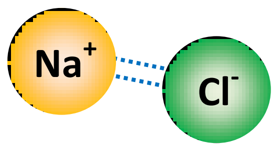
As you may well know from GCSE chemistry, a stable atom is one with a completed outer **energy level** (**shell**). For the majority of elements, this number is eight, which goes for carbon too. Carbon, however, naturally has *four* electrons in its outer energy level: so to stabilise it must share four electrons with other atoms, which forms **covalent bonds**. So it can form four covalent bonds – and these can be with other carbon atoms, or other atom types.

Double bonds



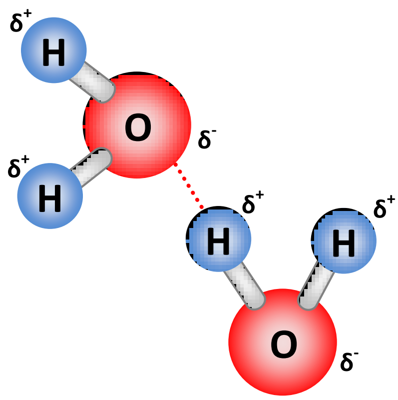
These types of covalent bond also exist, where atoms share multiple electrons in order to stabilise where there is a lack of available atoms. Common examples of the double bond are found within carbon and oxygen atoms (the carbon C=C double bond and the carbon-oxygen C=O double bond).

Ionic bonds



An **ionic bond** occurs between two *oppositely* charged **ions**. This will always take place between a *metal* and a *non-metal* ion. This involves the *donation* of electrons from the outer energy level, rather than the sharing which happens in covalent bonds. The metal ion will donate one or multiple electrons to the non-metal, which causes the metal to become **positively charged** (due to the loss of a *negative* electron) and the non-metal to become **negatively charged**. The two **polar** ions then are brought together due to the opposite charges. These bonds are much weaker than covalent bonds.

Hydrogen bonds



This is possibly the most important type of bond studied in this unit. It is found in just about every molecule you could think of. **Hydrogen bonds** are used to hold together individual **monomers** into large groups, called **polymers**. They form where a *slightly* positively charged part of a molecule meets a *slightly* negatively charged part of another molecule. We use the denotation of **δ** to represent **electronegativity**, where δ^- denotes a slight negative charge, and δ^- denotes a slight positive charge. These bonds are extremely weak, often describe merely as "interactions" – but when thousands of these bonds form in a polymer to hold the structure together, they are enough to stabilise a large polymerised structure.