2: CARBON ATOMS and FATTY ACIDS

The carbon atom is like no other atom. It is so flexible in the ways that it can bond with other atoms, that it is the basis for thousands of molecules, many of which are found in living organisms. Starting with carbon, we can build sugars, proteins, fats, and nucleic acids —the essential molecules for life.

Carbon is element number 6 on the Periodic Table. This means it has 6 protons. Because it has 6 protons it also has 6 electrons. Of these 6 electrons, 2 fill the small inner shell and the remaining 4 occupy the outer shell. As you will remember, the outer shell would like to have 8 electrons in it, so carbon tries to bond with other atoms in order to gain 4 electrons. In other words, carbon has 4 places that it can bond to another atom.

The most basic carbon molecule is ***methane***: 1 carbon atom bonded to 4 hydrogen atoms. (The root "meth" means "one." The way you count carbon atoms isn't, "One, two, three, four," it's, "Meth, eth, prope, bute.") When we look at the electrical situation in this molecule, we see that the molecule is evenly balanced. The hydrogen atoms move around so that they are the maximum distance apart, evenly spaced around the carbon. We need to remember that hydrogens don't want to be right next to each other. Their positively charged protons don't like to be next to other positive charges. As they say, "Like charges repel, opposite charges attract." So the hydrogens space out evenly. This means that unlike water, methane does not have a positive and a negative side. All sides are the same. Methane is ***nonpolar***.

Another important feature of carbon is that it likes to bond to itself, making chains or rings. A 2-carbon chain is called ethane, a 3-carbon chain makes propane, and 4 is butane. You will perhaps recognize the words propane and butane and know them to be fuels we use in things like lighters and outdoor grills.

Methane is a very light molecule so it is a gas (at standard temperature and pressure). As the carbon chains get longer, the molecules get bigger and heavier. By the time we get to the 8-carbon chain called octane, we have a liquid. Octane is found in the gasoline (petrol) we put into cars. When carbon chains get to be really long they form solids such as wax. Plastics are also made of extremely long chains of carbon atoms, though sometimes other types of atoms are mixed in, too, such as chlorine in PVC (polyvinyl chloride).

Chemists use a short cut when drawing carbon chains. They draw only a zig-zag line. They know that at the point of each V there is a carbon atom. Since they all know this, they don't bother drawing it. They also assume, unless otherwise indicated, that there are hydrogens attached to the carbons in order to give each one its required 4 bonds. A carbon at the end of a chain will have 3 hydrogens and those in the middle will have 2.

The carbon chains found in our bodies are called ***fatty acids***. The chains are usually 12 to 18 carbons long, and they have a special group of atoms on one end. This group is called the ***carboxyl group***, or carboxylic acid, **COOH**. In the last lesson we briefly mentioned that a liquid with a lot of protons (hydrogen ions) in it will be acidic. In COOH, the H is not attached very well and can "fall off." Anything that creates loose H's is an acid. As we will see in the next lesson, this group has a special feature that will let us connect the carbon chain to other molecules, making larger structures. Just to confuse you, it will be the OH part of COOH that will fall off. However, this will not make the environment alkaline. The OH will immediately get picked up and joined to another atom to make a harmless substance.

The fatty part of a fatty acid is the carbon chain. We know that fats and oils are greasy and don't mix with water. Carbon chains are nonpolar so they don't have positive or negative sides that can attract water molecules. Other substances can dissolve fats, but not water. Water can only dissolve polar substances.