Biological Molecules - Lipids.

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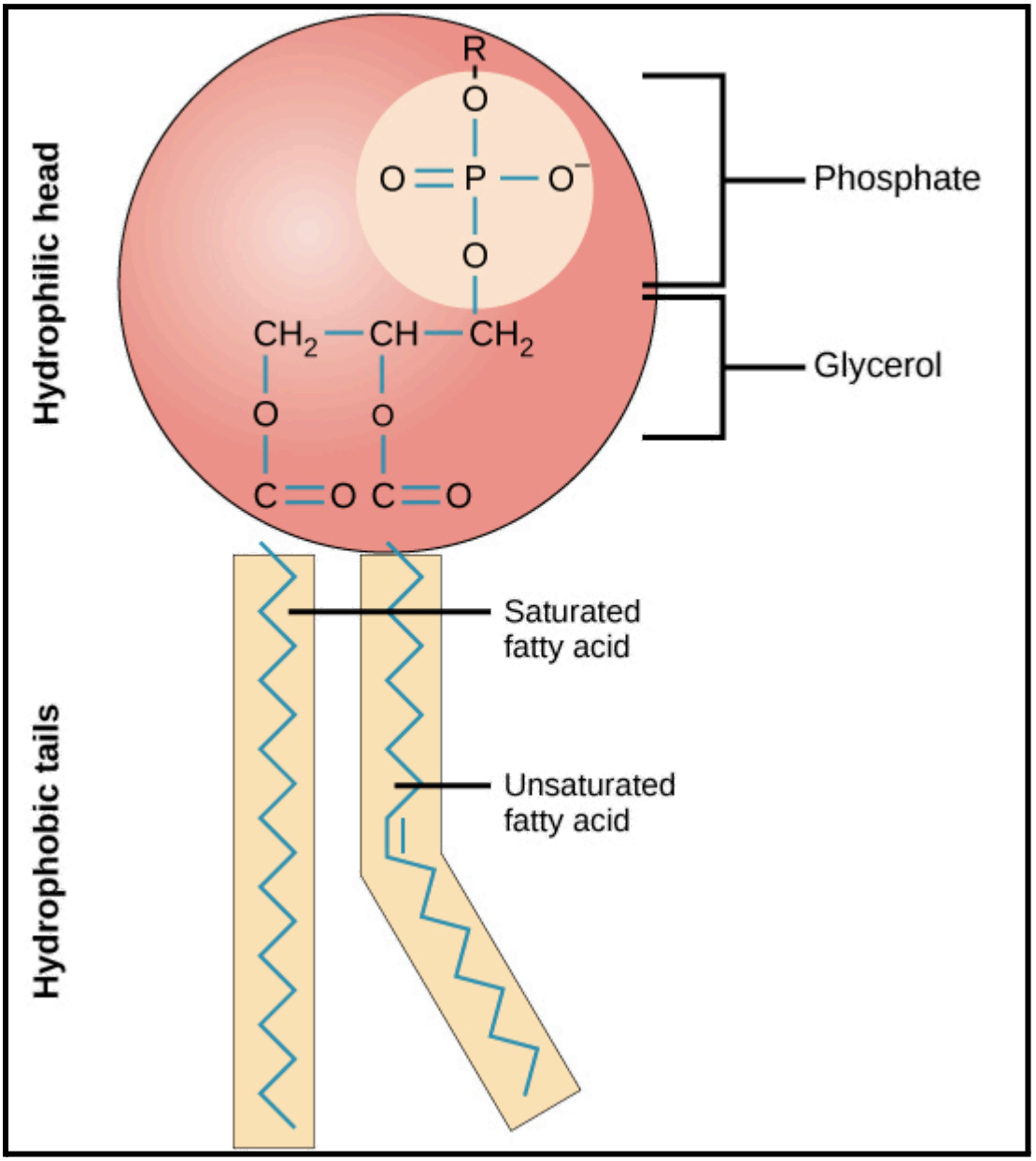
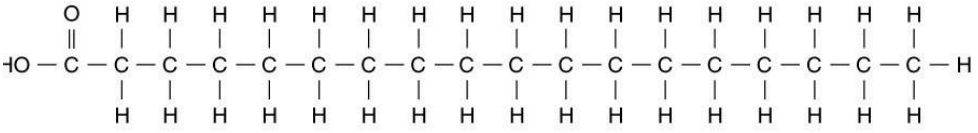
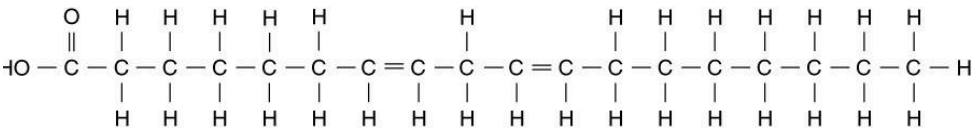


Lipids

Knowledge Organiser

Cholesterol	**a lipid that plays an important part in living organisms. Some of the cholesterol required by the body is taken in with food and some is synthesised in the liver . Cholesterol is an important component of plasma membranes . It is also a precursor of bile salts and steroid hormones such as testosterone and progesterone . High concentrations of cholesterol in the blood, however, are associated with atheroma and coronary heart disease . Its concentration is therefore often monitored in older people and drugs such as statins may be given to reduce blood cholesterol.**
Emulsion Test	**The Ethanol Emulsion Test is a food test which determines the presence of a broad group of naturally occurring compounds known as lipids. Lipids consist of fats and oils. The sample is first dissolved in ethanol. (Lipids are soluble in ethanol but insoluble in water) The sample is then added to water. If lipid is present it immediately comes out of solution as small droplets which are less dense than water forming a milky/ cloudy layer of emulsion floating at the top.** **A layer of cloudy white suspension forms at the top of the solution. You can see the tiny globules of fat suspended in the solution. This an emulsion.**
Fatty acid	**molecules with a COOH group at one end and a hydrocarbon tail at the other. They can be absorbed into the blood and are important respiratory substrates. Fatty acids with long hydrocarbon tails are important constituents of fats and oils (triglycerides). Fatty acids with double bonds are described as unsaturated. They have much lower melting points than fatty acids, in which there are no double bonds. Triglycerides that contain unsaturated fatty acids therefore tend to be liquid at temperatures of around 20°C. They are called oils and are found mainly in plants. Those which contain saturated fatty acids are solid at this temperature. They are called fats and are mainly found in animal cells.**  (a) Stearic acid  (b) Linoleic acid
Fluid Mosaic Model	**A model showing the way that scientists think that molecules are arranged in a plasma membrane. Even with an electron microscope it is not possible to see the molecular structure of a plasma membrane, so it was necessary to construct a model to explain its various properties. Today, the most widely accepted model is the fluid mosaic model. This was originally suggested by Singer and Nicolson in 1972.** **The fluid mosaic is a double layer of phospholipid molecules within which protein molecules are scattered. Some of these proteins move freely within the phospholipid layers, while others are anchored rather more firmly to structures within the cell. The term 'fluid mosaic' refers to the membrane's structure as a patchwork of different molecules that are free to change in position. The protein molecules in the membranes have many important properties, among which are the following.**

	• They may act as enzymes. For example, there are important enzymes involved in carbohydrate and protein digestion on the cell-surface membranes of the epithelial cells in the small intestine. • They act as carrier proteins. These are involved in the processes of active transport and facilitated diffusion. • They may act as specific receptors for hormones.
Glycerol	**A substance that is an important component of triglycerides and phospholipids. Triglycerides consist of three fatty acid molecules that are linked by condensation to a molecule of glycerol. In phospholipids, one of the fatty acids is replaced by a phosphate group.**
Hydrophilic	**Having an affinity for water or capable of interacting with water through hydrogen bonding. Hydrophilic molecules typically have polar groups enabling them to readily absorb or dissolve in water as well as in other polar solvents.**
Hydrophobic	**Meaning water fearing. Hydrophobic compounds do not dissolve easily in water, and are usually non-polar. Lipids and other long hydrocarbons are hydrophobic.**
R-Group	**Fatty acids are long molecules with a polar, hydrophilic end and a non-polar, hydrophobic tail. The hydrocarbon chain can be from 14 to 22 CH_2 units long. The hydrocarbon chain is sometimes called an R group, so the formula of a fatty acid can be written as R-COOH.**
Phospholipid	**a type of lipid that contains a phosphate group. You can see that the glycerol has two fatty acids joined to it. In a triglyceride molecule there would be a third fatty acid. In a phospholipid molecule this third fatty acid is replaced by a phosphate group. The phosphate-containing head of the molecule is water soluble, unlike the fatty acid tail. This property is important in the structure of a plasma membrane .**
Saturated Fatty acid	**If there are no C=C double bonds in the hydrocarbon chain, then it is a saturated fatty acid (i.e. saturated with hydrogen). These fatty acids form straight chains, and have a high melting point. Triglycerides containing saturated fatty acids have a high melting point and tend to be found in animals. At room temperature they are solids (fats), e.g. butter, lard.**
Unsaturated Fatty acid	**If there are C=C double bonds in the hydrocarbon chain, then it is an unsaturated fatty acid (i.e. unsaturated with hydrogen). These fatty acids form bent chains, and have a low melting point. Fatty acids with more than one double bond are called poly-unsaturated fatty acids.** **Triglycerides containing unsaturated fatty acids have a low melting point and tend to be found in cold-blooded animals and plants. At room temperature they are liquids (oils), e.g. fish oil, vegetable oils.**
Triglycerides	**A lipid consisting of three fatty acid molecules that are linked by condensation to a molecule of glycerol. Triglycerides are the commonest naturally occurring lipids. Most of those found in animals are fats, that is they are solid at a temperature of about 20°C. This is due to the fact that they contain a high proportion of saturated fatty acids. Fats play an important part in energy storage. A given mass of fat will yield a greater amount of energy than the same mass of a carbohydrate such as starch or glycogen. This is because they have a greater proportion of hydrogen atoms in their molecules. In addition to this, fats play an important role in insulating against heat loss.**

Lipids

- ➔ **Triglycerides and phospholipids are two groups of lipid.**
- ➔ **Triglycerides are formed by the condensation of one molecule of glycerol and three molecules of fatty acid.**
- ➔ **A condensation reaction between glycerol and a fatty acid (RCOOH) forms an ester bond.**
- ➔ **The R-group of a fatty acid may be saturated or unsaturated.**
- ➔ **In phospholipids, one of the fatty acids of a triglyceride is substituted by a phosphate-containing group.**
- ➔ **The different properties of triglycerides and phospholipids related to their different structures.**
- ➔ **The emulsion test for lipids.**
- ➔ **Students should be able to;**
- ➔ **recognise, from diagrams, saturated and unsaturated fatty acids**
- ➔ **explain the different properties of triglycerides and phospholipids.**

➔ **Triglycerides and phospholipids are two groups of lipid.**

➔ **Triglycerides are formed by the condensation of one molecule of glycerol and three molecules of fatty acid.**

1. **Draw the structure of glycerol.**

2. **Draw the structure of a saturated and unsaturated fatty acid.**

3. **A condensation reaction between glycerol and a fatty acid (RCOOH) forms an ester bond.**

Draw a diagram to show how a condensation reaction is involved in the formation of an ester bond.

Identify the Ester bond by drawing a box around it.

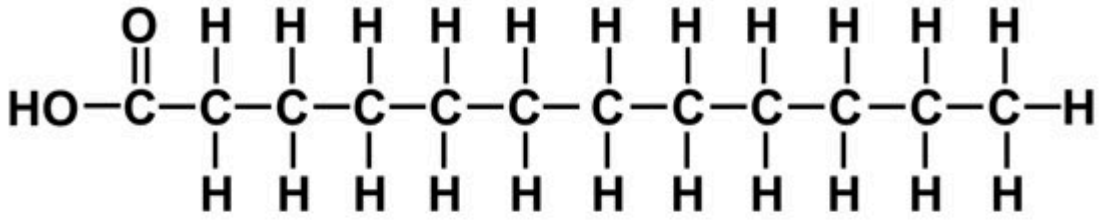
Notes:

Lipids

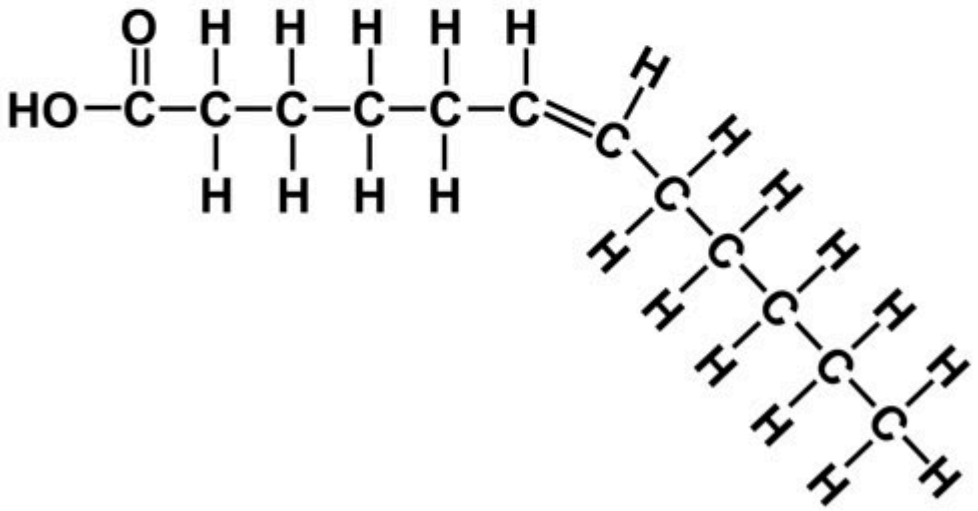
- ➔ **The R-group of a fatty acid may be saturated or unsaturated.**
- ➔ **Students should be able to;**
- ➔ **recognise, from diagrams, saturated and unsaturated fatty acids**
- ➔ **explain the different properties of triglycerides and phospholipids.**

4. On the diagrams below identify the R groups and the carboxylic acid groups.

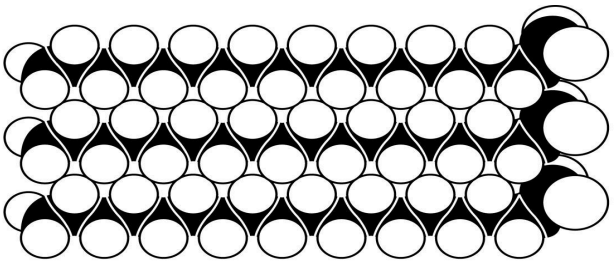
Saturated Fatty Acid

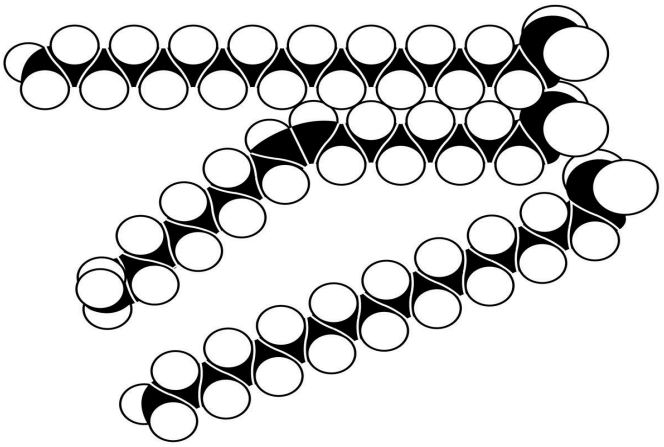


Unsaturated Fatty Acid



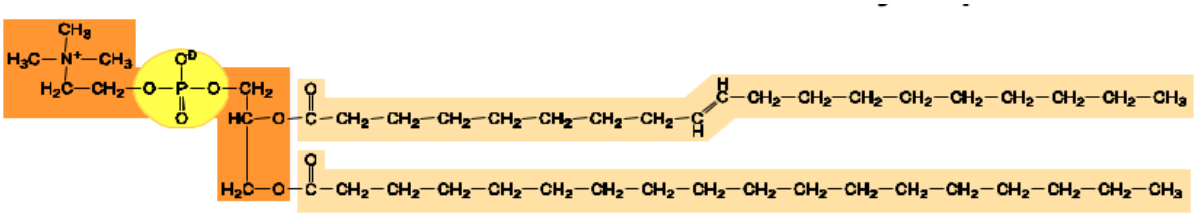
5. **What are the different physical characteristics between triglycerides that are composed of saturated fatty acids only and triglycerides formed from unsaturated fatty acids.**





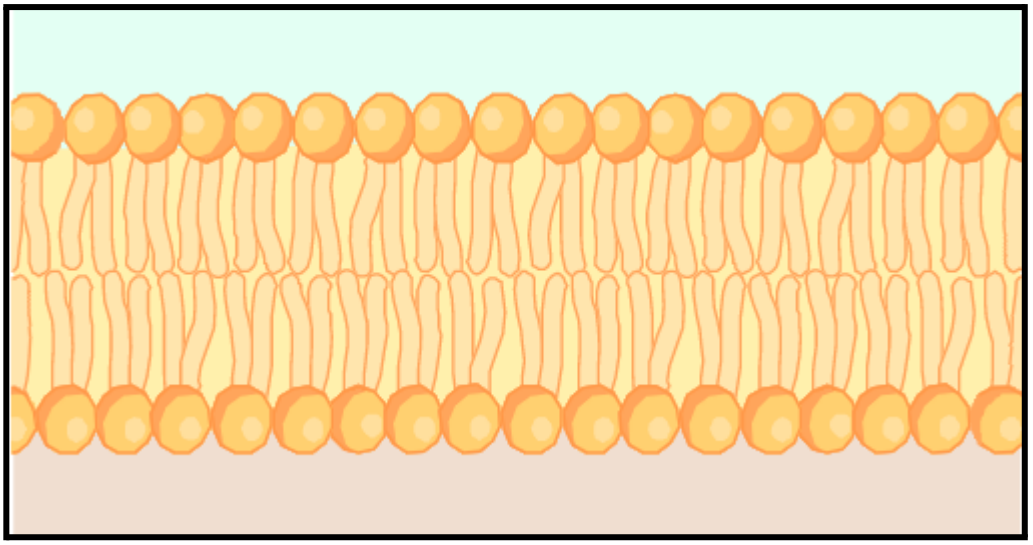
6. **In phospholipids, one of the fatty acids of a triglyceride is substituted by a phosphate-containing group.**

Draw a diagram to show the structure of a phospholipid to indicate the hydrophobic and hydrophilic parts of the molecule.



Phospholipid

7. **What properties do phospholipids have that are different from triglycerides? What is the significance of this difference in relation to cell structure?**



8. **The emulsion test for lipids.**

Explain how you would carry out the emulsion test for a lipid and what you would observe that indicates the presence of a lipid?