<u>LIPIDS</u> <u>(Fat-soluble Compounds)</u>

Three different types of lipids are examined in Bio 12:

i. **Fats** -- used for long-term energy storage (eg. a black bear is able to hibernate for five months using 4000 calories per day from fat metabolism).

-- When fats are metabolized, they create twice the ATP than that of starch/glycogen/protein (gross, not net, however).

-- insulates the body against heat loss (extremely thick in marine mammals such as whales, seals, etc...)

-- forms a protective 'cushion' around major organs.

-- sometimes referred to as ***neutral fats*** (due to their non-polar nature) or ***triglycerides*** (described below).

-- excess fat gets stored in adipose cells, which swell and shrink as fat is deposited and withdrawn from storage.

-- see fig 2.22 p. 34

ii. **Phospholipids** -- major constituent of cell membranes.

iii. **Steroids** -- form an important group of hormones (chemical messengers) (eg. testosterone, aldosterone, estrogen, progesterone).

* all three of these have in common the fact that they are heavily laden with C-H bonds and are therefore non-polar (they are all unable to dissolve to any appreciable degree in water).

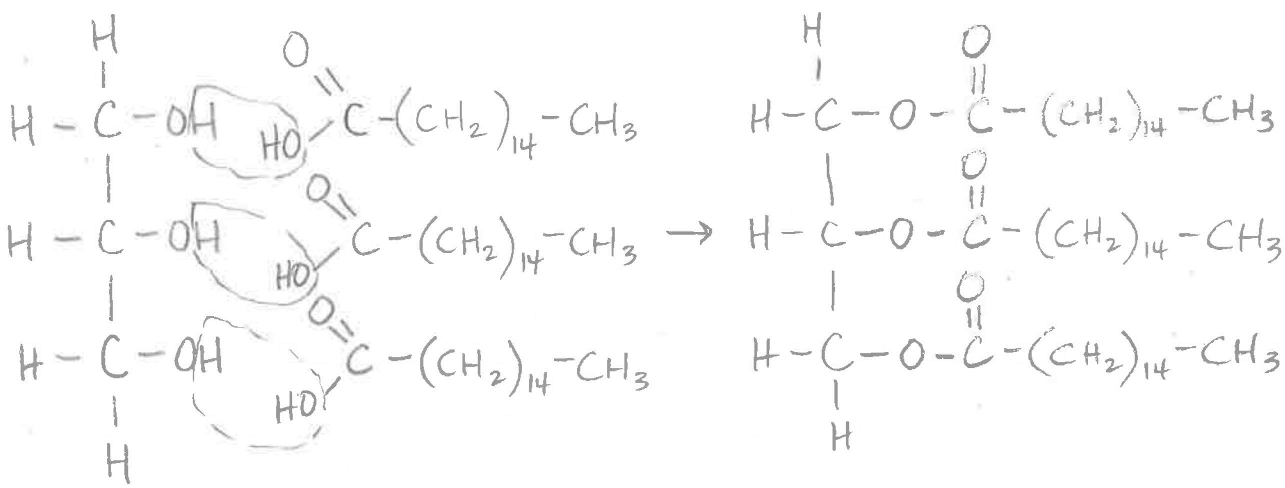
<u>FATS</u>
-- large molecules, but not polymers like proteins/carbs.

-- animal fats, such as bacon grease, lard, and butter are known as *saturated fats* and are solids at room temperature, whereas plant fats, like corn oil, peanut oil, and olive oil are known as *unsaturated fats* and are liquids at room temperature.

Structure of fats:

-- a fat or oil is formed when one GLYCEROL molecule joins with three FATTY ACID molecules through dehydration synthesis (this results in the formation of 3 water molecules) (again, see fig 2.22 p. 34).

-- glycerol is a type of alcohol that possesses three hydroxyl (-OH) groups which react with the carboxyl (carboxylic acid) end of all three fatty acid molecules (an example of an esterification reaction).



Glycerol + 3 Fatty Acids ----------> NEUTRAL FAT + 3 H_2O (triglyceride)

Fatty Acids

-- most fatty acids have between 16-18 carbon atoms per molecule (similar to gasoline molecules with respect to structure and energy storing abilities).

-- the 'head' of a fatty acid consists of a carboxylic acid (carboxyl) group which is polar.

-- the 'tails' consists of a long, non-polar hydrocarbon chains.

-- there are two types of fatty acid molecules:

i. SATURATED FATTY ACIDS

-- have no double bonds between carbons, thus the carbon atoms (which are only able to make 4 total bonds) are *saturated* with hydrogen atoms.

-- very straight, rigid molecules (no 'kinks')

-- saturated fatty acids are found in animal fats.

ii. UNSATURATED FATTY ACIDS

-- have at least one double bond that exists between two carbon atoms, thus two or more carbons are said to be *unsaturated* with hydrogen atoms.

-- the presence of double bonds accounts for 'kinks' in the structure of unsaturated fatty acids (due to cis/trans structure in alkenes of organic chemistry).

-- these kinks where the double bonds are located prevent the molecules from packing together closely enough to solidify at room temperature.

-- because of this, unsaturated fatty acids are found in plant oils, accounting for their liquid nature.

-- vegetable oils may be HYDROGENATED to make margarine (to hydrogenate a molecule means to add hydrogen molecules to an unsaturated fat in order to break the double bond between carbons and 'saturates' the oil so it may solidify at room temperature).

-- to summarize, a SATURATED FAT possesses all saturated fatty acids (and tends to solidify and form plaques in blood vessels (*atherosclerosis*) due to its 'stackability'), whereas an UNSATURATED FAT possesses at least one unsaturated fatty acid and is a healthier fat due to its lack of 'stackability'.

PHOSPHOLIPIDS

-- the structure of a phospholipid molecule is quite similar to that of a neutral fat except that it involves one glycerol, TWO fatty acids, and one phosphate group (PO_4^{3-}).

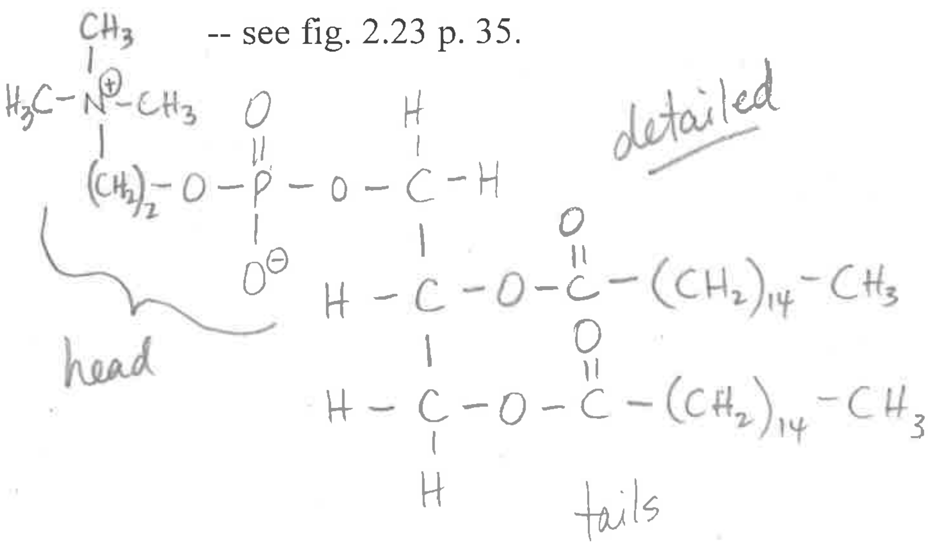
-- additional small, polar molecules (usually containing Nitrogen) can be linked to the phosphate group giving phospholipids some diversity in structure.

-- the polar portion of the molecule (PO_4^{3-} group) forms the *head* and the non-polar portion (the fatty acid tails) forms the *tail* of the molecule.

-- the head, therefore, is relatively polar and is attracted to water whereas the tail is quite non-polar and repelled by water.

-- tend to form a bilayered cell membrane with tails pointing inward and heads outward (more later in the Cell Membrane Unit).

-- see fig. 2.23 p. 35.



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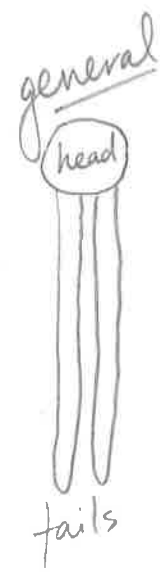

STEROIDS

-- possess a structure that is very different from fats/phopholipids.

-- have a backbone of four fused carbon rings similar to the structure of cholesterol.

-- cholesterol serves as a common component in cell membranes and an important precursor from which most other steroids are synthesized (it also associates quite easily with saturated fats to form plaques and atherosclerosis).

-- examples include: cholesterol, and the hormones testosterone, aldosterone, estrogen, progesterone etc.

-- see fig. 2.24 p. 35.

NUCLEIC ACIDS

In this unit, we will only look at one monomer-style Nucleic Acid:

ATP (Adenosine Triphosphate) (Adenosine = Adenine + Ribose sugar)

-- ATP is a *nucleotide* molecule that functions as an energy carrier in cells.

-- glucose produces too much energy for most cellular reactions so it spreads its energy out into ATP molecules (like changing a $100 bill for $5 bills)

-- it is a product of Cellular Respiration which takes place in mitochondria.
Glucose + oxygen ----------> Carbon dioxide + Water + ATP energy

-- ATP is hydrolyzed (by water) to produce ADP (Adenosine Diphosphate) and energy; more specifically, water cleaves off a phosphate group by hydrolyzing its high-energy bond, thus releasing the stored energy.

-- see fig. 2.29 p. 41.

Structure: