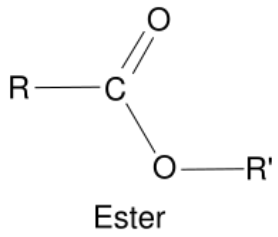
What to Know, Chapter 24 Lipids

General Information

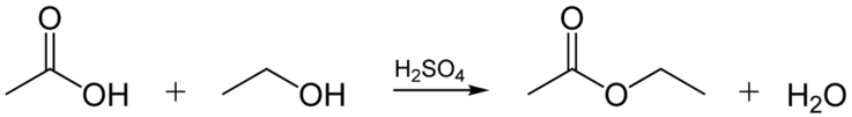
Waxes, triglycerols, steroids, prostoglandins have the general structures given on p. 746.

An Ester has the following structure.



Ester

An Ester is created by a reaction between an alcohol and something with a carboxy group.



Fatty Acids

Fatty acids are long unbranched carbon chains with a carboxyl group on one end.*

Fatty acids almost always contain an even number of carbons.*

Fatty acids join with alcohols, the fatty acids and alcohols form an ester linkage.

The long hydrophobic chain on fatty acids is called the tail of the fatty acid.

Saturated fatty acids do not contain a carbon – carbon double bond in their tail.

Unsaturated fatty acids contain at least 1 carbon-carbon double bond in their tail.

Unsaturated fatty acid tails cannot line up next to each other.

All naturally occurring fatty acids are “cis” fatty acids not “trans” fatty acids.

Hydrogenation of unsaturated fats converts them to saturated fats.

Saturated fatty acids have lower melting points than unsaturated fatty acids.

Melting points of fatty acids also depend on chainlength.

Naturally Occurring Fats

Fats and oils that we encounter daily are usually combinations of several types of fat.

Lard and olive oil contain more than 5 types of fatty acids.

The characteristics of lard and olive oil are determined by the relative amounts of these fatty acids. Proportionately lard contains more saturated fatty acids than olive oil. Lipids that are solid at room temperature generally contain more saturated fatty acids than lipids that are liquid at room temperature.

Waxes

Waxes are made by the combination of extremely long alcohols and a saturated fatty acid.

Waxes occur naturally on fruits, vegetables, plant leaves, fur, and the feathers of water birds.

Waxes are also put on fruits and vegetables in order to keep them fresh.

Waxes dissolve in nonpolar solvents like gasoline.

Triacylglycerols

Triglyceride and Triacylglycerol are different names for the same thing.

Triacylglycerols are nonpolar, and uncharged.

Triacylglycerols are formed when the alcohol glycerol reacts with fatty acids. When this happens a structure with 3 ester linkages between the alcohol and the fatty acid are formed.

The fats in adipose tissue are triacylglycerols.

In white adipose cells, adipocytes, triacylglycerols form a droplet. The droplet determines the size of the adipocyte.

In brown adipose cells triacylglycerols form many small droplets. In these cells the triacylglycerols are used to generate heat in mitochondria.

Fatty acids are most commonly found in triglycerols.

Hydrolysis of Fats

Hydrolysis of fats is a traditional way of making soaps.

Hydrolysis of a lipid can occur when it is heated in the presence of a strong base.

In the presence of a strong base fatty acid esters break down to give an alcohol and a fatty acid salt. (See the top of page 756)

The carboxylic portion of the fatty acid is polar.

Micelles are a grouping of molecules with polar and nonpolar parts. These molecules are arranged as shown on p756 of the text. This arrangement creates nonpolar region in the middle of the micelle.

The soap molecules arrange themselves in micelles. (See the diagram on p. 756)

The micelles allow nonpolar molecules to dissolve in a water solution, and this is what gives soap the ability to clean.

Phospholipids

Phospholipids have a small polar region and a long nonpolar chain.

Most phospholipids resemble triacylglycerols in which 1 of the fatty acids has been replaced with a phosphate group.

Glycerolphospholipids are the most common fat found in cell membranes.

Some phospholipids are derived from an amino alcohol called sphingosine.

The phosphate derivatives made from sphingosine are called sphingomyelins.

Sphygomyelins are important for brain function.

Sphygomyelins are a major component of the coating around nerve fibers.

Spingomyelins like phosphoglycerols have 2 hydrophobic tails.

Glycolipids

Glycolipids are lipids with a carbohydrate group attached.

Glycolipids are found in cell membranes. The carbohydrate portion of these lipids extends into the polar surrounding solvent.

Glycolipids frequently function as receptors, and as transmitters.

There are both glyceroglycolipids and sphingoglycolipids.

Ganglioside is a sphingoglycolipids.

Tay Sachs is a terminal genetically determined illness that results from an overabundance of a spingolipid, ganglioside, in neural tissues.

Tay Sachs is rare and more often found in people of Eastern European descent.

Like Sickle Cell Anemia both parents must be carriers in order for the disease to be seen.

Cholesterol

Cholesterol is a steroid, but it is not a hormone. (Like testosterone etc..)

Cholesterol is flat, rigid, and nonpolar.

It is found in the hydrophobic region of cell membranes.

Cholesterol increases the rigidity of cell membranes, probably because it is rigid.

Cell Membrane Structure

Cell membranes are composed of a phospholipid bilayer as shown on p. 763 and p.764.

The polar heads of the lipids that make up the membrane are oriented toward the water and the nonpolar tails are oriented inward.

Prostaglandins

Their general structure as given on p. 746.

Prostaglandins seem to have a role in controlling and stimulating many biological processes.

Prostaglandins are quickly metabolized by our bodies so they act locally.

Prostaglandins, or there derivatives, are important medically.

A prostaglandin is used to prepare the cervix for labor. It can be used to induce abortion.

Prostaglandins and there derivatives are also used to treat some types of high blood pressure.

*This is not true in all organisms.