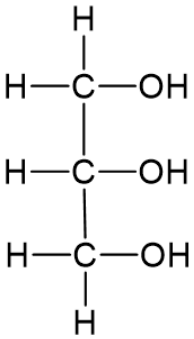
BIOLOGY
Topic Summary

LT2 - TRIGLYCERIDES

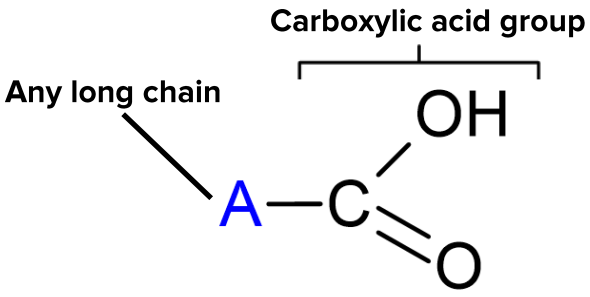
Triglycerides are a group of lipids that form the majority of human (and other vertebrates) body fats. They are used as a long term energy store and can be broken down to release this energy when needed.

Triglyceride structure:

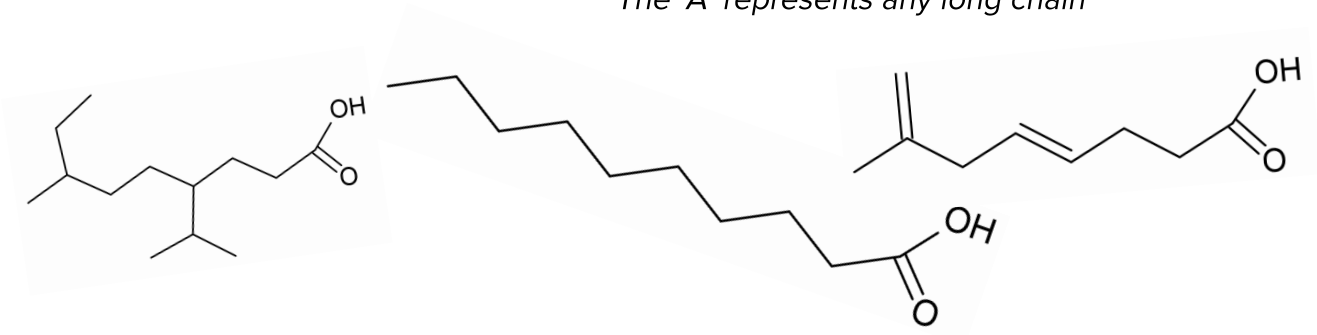
Triglycerides are formed from 3 fatty acid chains and a glycerol molecule holding them together. Fatty acids are a classification of molecules that have a carboxylic acid group with a long chain emerging from it. The 3 fatty acid chains in a triglyceride can all be different from each other.



▲ *A glycerol molecule*

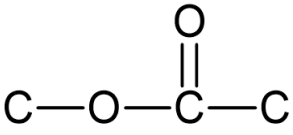


▲ *A carboxylic acid group on a fatty acid. The 'A' represents any long chain*

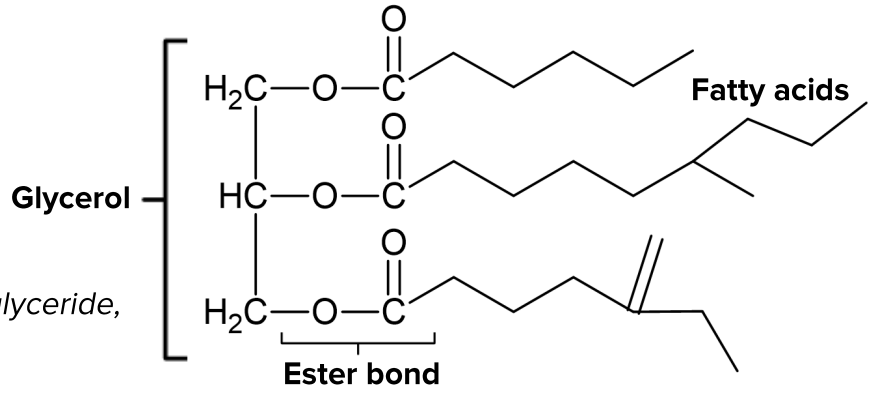


▲ *Three examples of fatty acid molecules. They all have a carboxylic acid group at the end of a long chain.*

The glycerol molecule in a triglyceride is attached to each fatty acid via an ester bond. An ester bond involves a carbon atom bonded to three other atoms; a single bonded carbon, a double bonded oxygen and a single bonded oxygen which is then bonded to another carbon. This bond takes place between the OH groups of a glycerol molecule and the carboxyl groups of fatty acids.



▲ *An ester group*

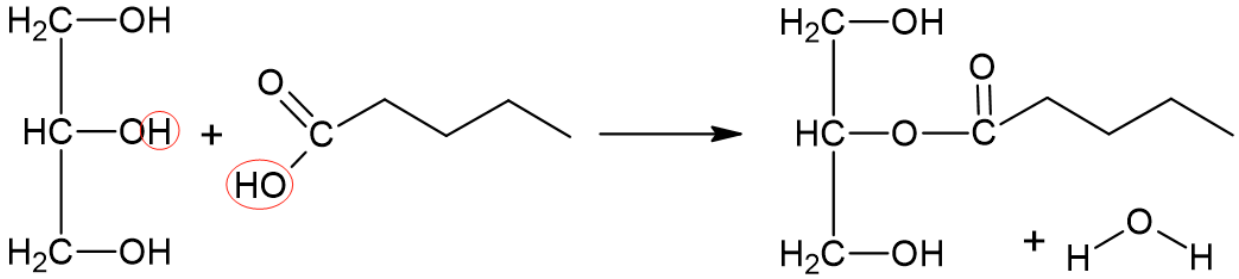


► *Structure of a typical triglyceride, showing ester bonds*

Condensation and hydrolysis reactions:

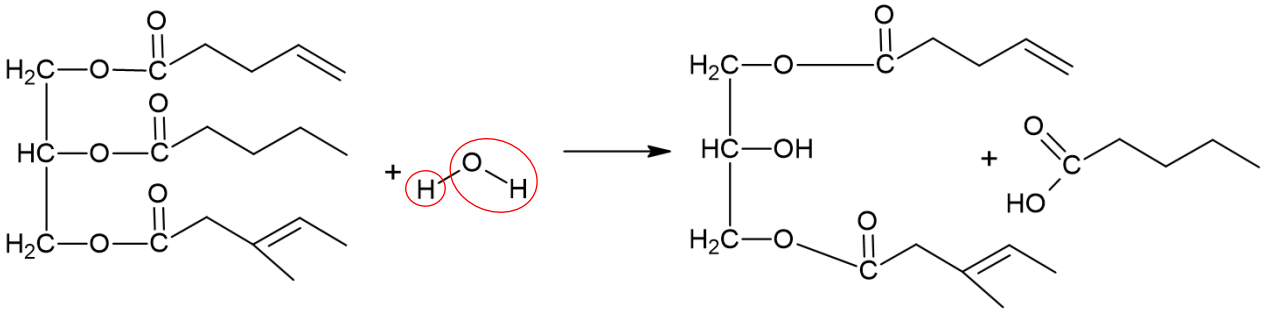
Condensation reactions (also called anabolism) happen when two or more molecules react together to form a larger molecule and water, hence the name condensation. These reactions are particularly important when forming large polymer molecules like polysaccharides (sugar polymers such as cellulose or starch) from their monomers. It is also the mechanism by which many other large molecules are formed, including triglycerides.

When a glycerol molecule reacts with a fatty acid molecule the OH group from the carboxylic acid group and a hydrogen from one of the glycerol OH groups are removed. The left over oxygen from the OH group forms a covalent bond with the carbon on the carboxylic acid group, forming an ester bond. This forms a monoglyceride. The oxygen atom on the removed OH group then forms a covalent bond with the removed hydrogen atom to form a water molecule. This happens two more times and a triglyceride is formed.

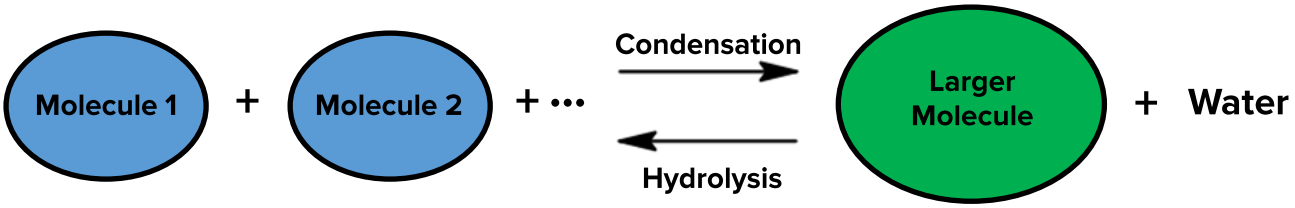


▲ *Condensation reaction between glycerol and a fatty acid to form a monoglyceride and water*

A hydrolysis reaction (also called catabolism) is the opposite of a condensation reaction, it involves the splitting of a larger molecule into their smaller constituents using water, hence the term hydro (water) lysis (breaking). In the case of a triglyceride reacting with water, the water molecule would attack an ester bond, causing it to break. Then the water molecule would split into a hydrogen atom and an OH group. The oxygen on the OH group would bond with the end carbon on the fatty acid, reforming the carboxylic acid group, while the oxygen on the glycerol molecule would form a bond with the hydrogen atom, reforming the OH group. This would form a diglyceride.



▲ *Hydrolysis reaction between a triglyceride and water, forming a fatty acid and a diglyceride*



▲ *A diagram showing the general form for condensation and hydrolysis reactions*