

### 3.1.3 Lipids

#### Content

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 ( $\text{RCOOH}$ ) 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.

# Introduction to lipids

**Lipids** are a diverse group of compounds that are insoluble in water but soluble in organic solvents such as ethanol.

The most common types of lipid are **triglycerides** (sometimes known as true fats or neutral fats), but other important lipids include waxes, steroids and cholesterol.



Like carbohydrates, lipids contain carbon, hydrogen and oxygen, but they have a higher proportion of hydrogen and a lower proportion of oxygen.



# Triglycerides

- Lipids are a group of diverse chemicals.
- The most common type are triglycerides which are usually known as fats and oils



**What is the difference between them?**

**Fats are solid at room temperature and oils are liquid at room temperature**



## What is the structure of triglycerides?

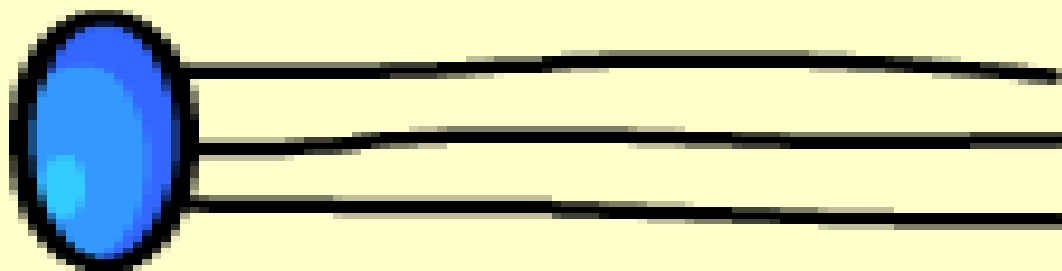
Triglycerides are made from a **glycerol backbone** joined to three **fatty acid chains**.

Click "play" to find out more about each of these parts.





## Saturated and unsaturated fatty acids



Fatty acids are either **saturated** or **unsaturated**.

Click a button to find out more.

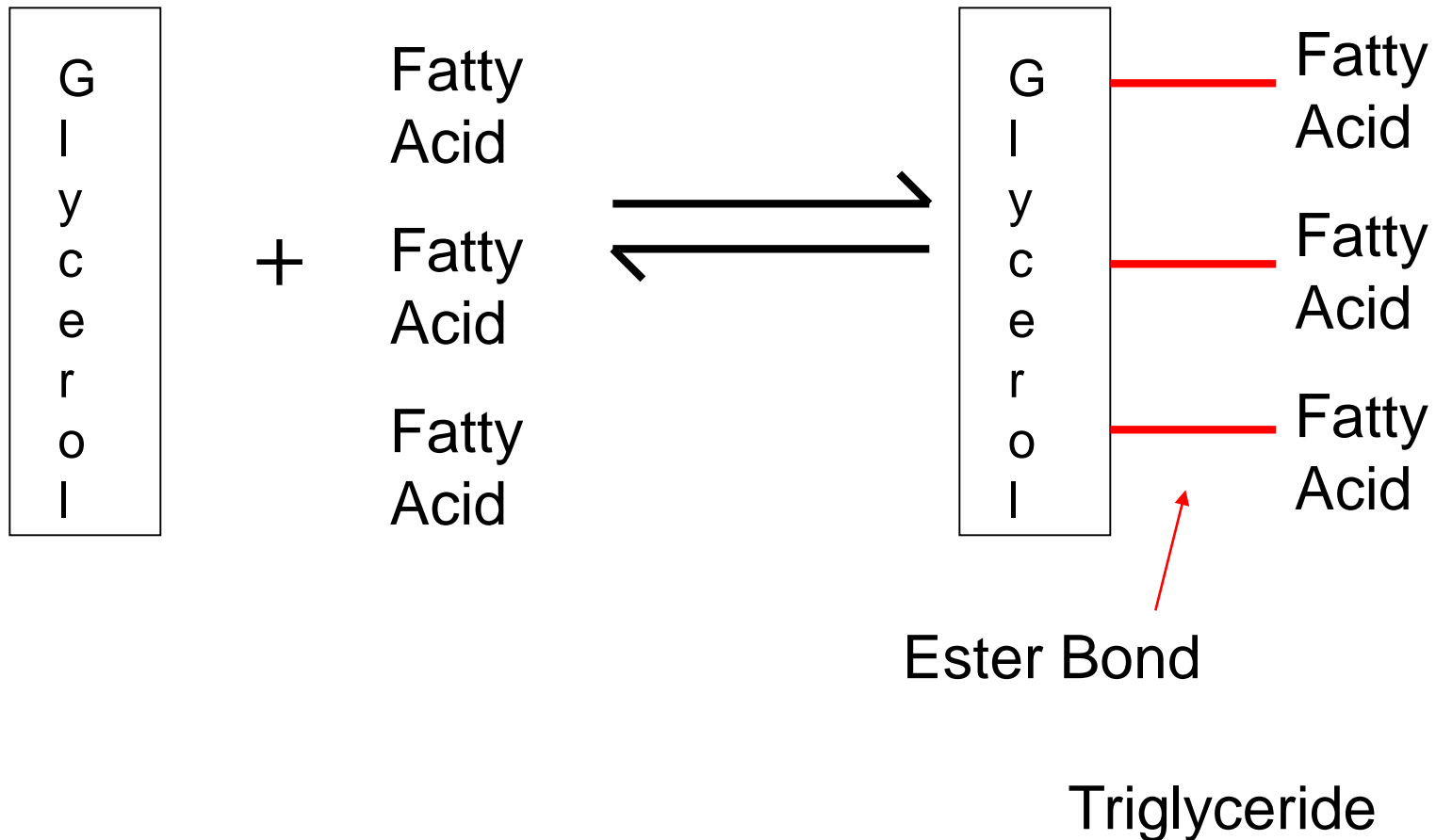
[saturated](#)

[unsaturated](#)

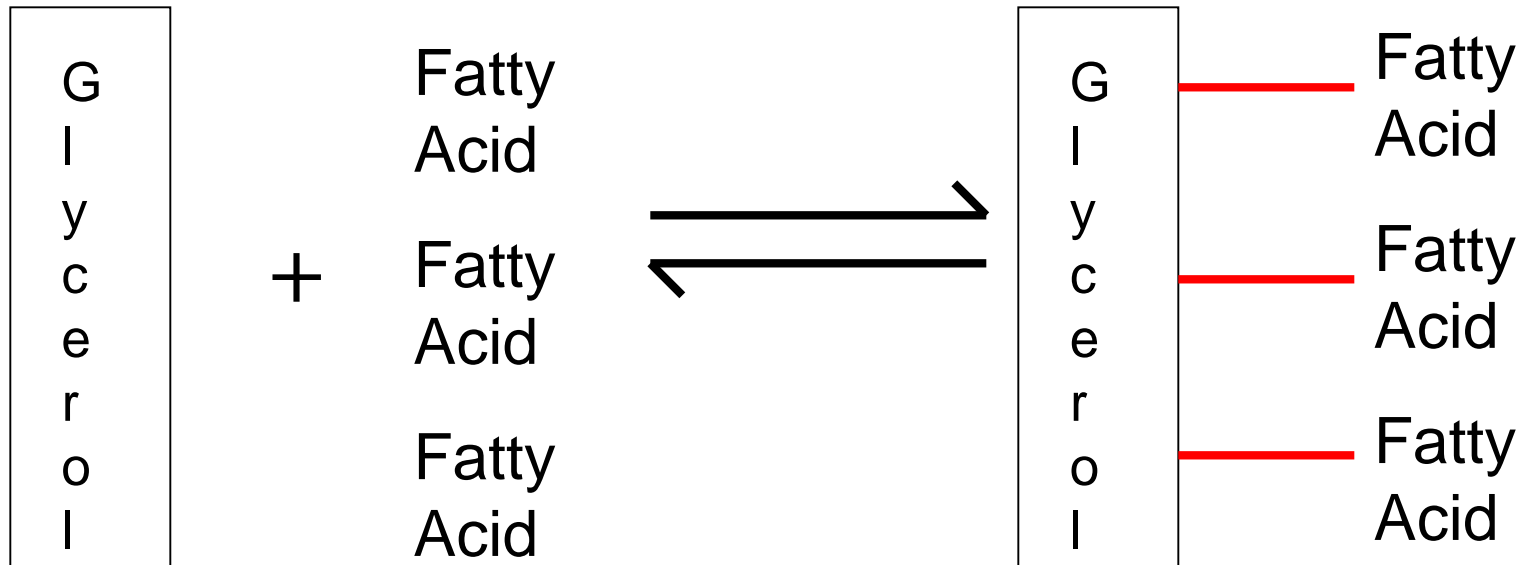
[cis / trans](#)



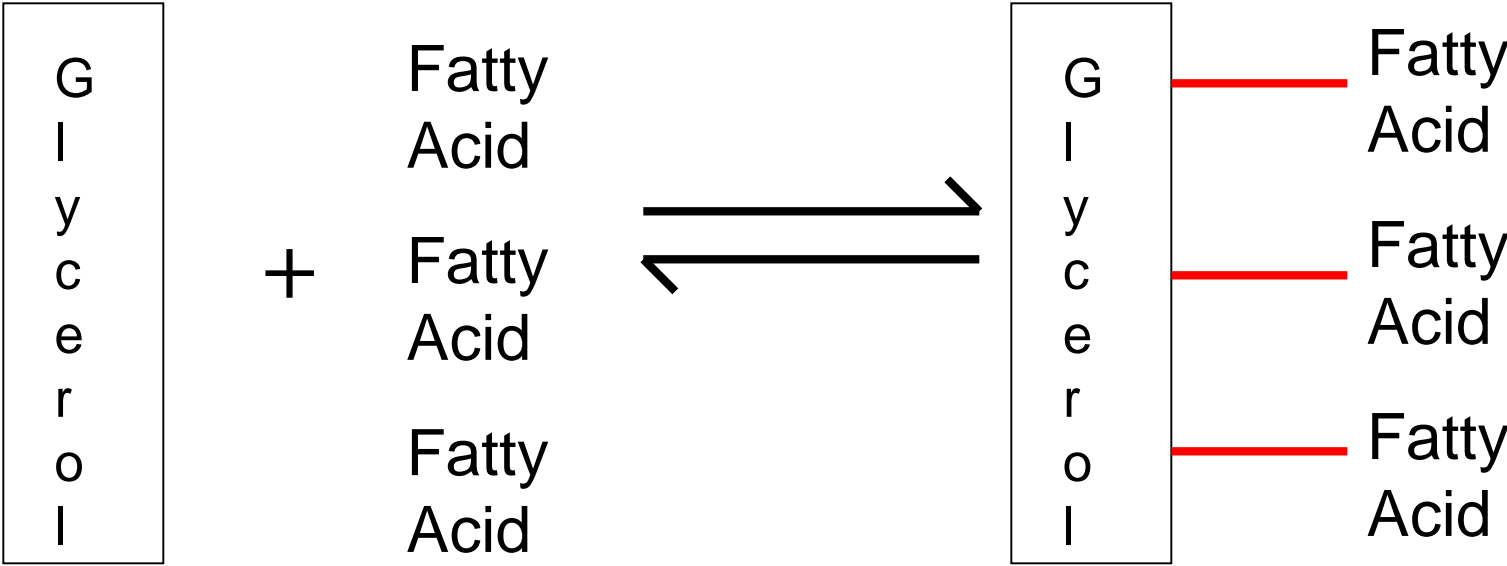
A triglyceride is made of **1 glycerol** molecule and **3 fatty acids** joined together by **ester bonds**



Label your diagram to show which reaction is a **condensation reaction** and which is a **hydrolysis reaction**



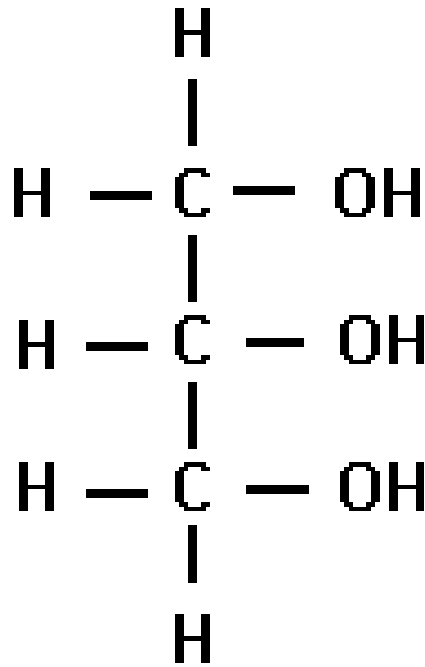
**Condensation**  
**release of H<sub>2</sub>O**



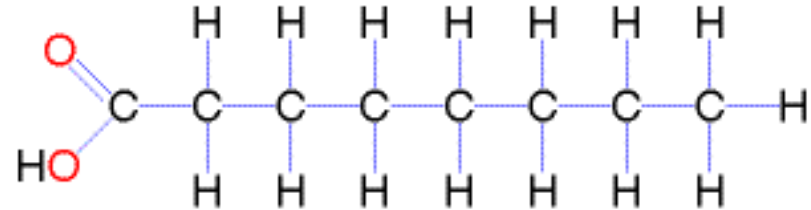
**Hydrolysis**  
**addition of H<sub>2</sub>O**



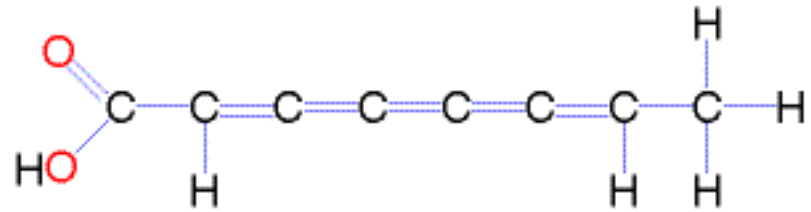
# Glycerol Structure



# Fatty Acid Structure



Saturated



Unsaturated

Biology Program '04

The length of the hydrocarbon fatty acid tail can vary. They are hydrophobic and are insoluble in water



## What is the emulsion test for lipids?

Lipids can be detected by the emulsion test.

Click "start" on the test tube to find out more.



# The Emulsion Test for Lipids

In your practical book:

Write a **brief** method for the experiment, including how to tell whether or not lipids are present.

Record your results in a suitable table.

Using the molecular structures of glycerol and fatty acids show how a triglyceride is formed

Can you remember the rules?

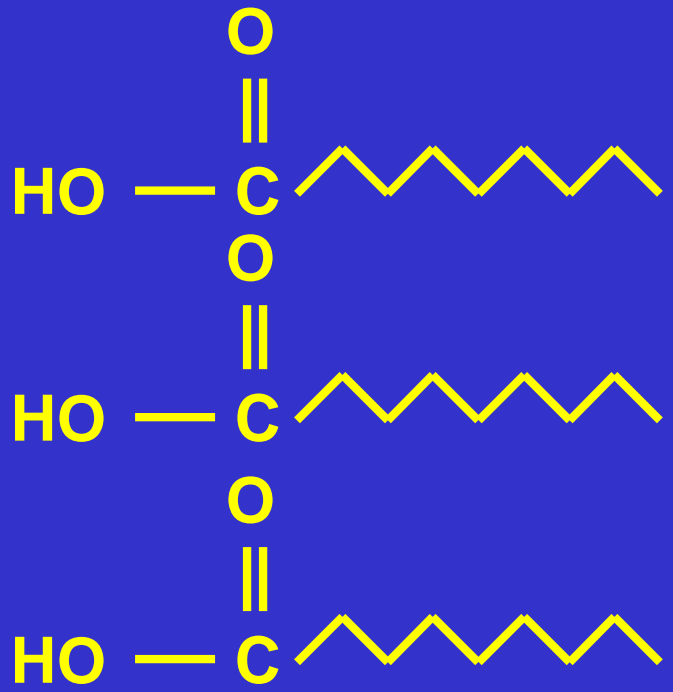
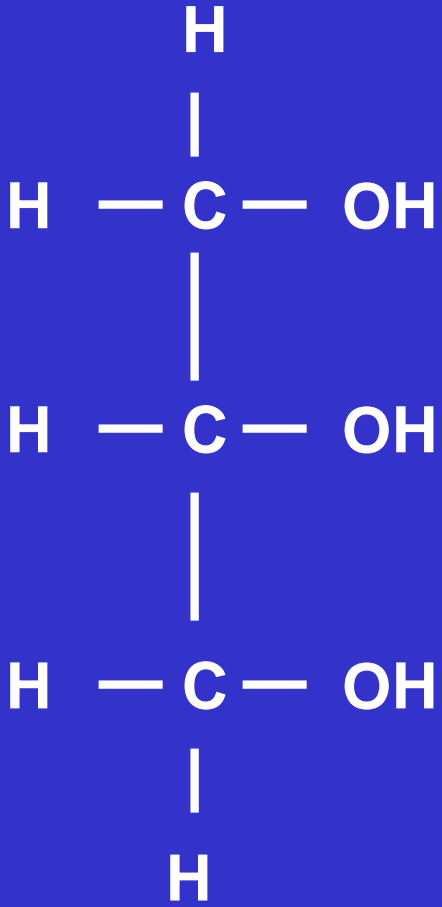
**Rule 1 draw a circle around the groups involved**

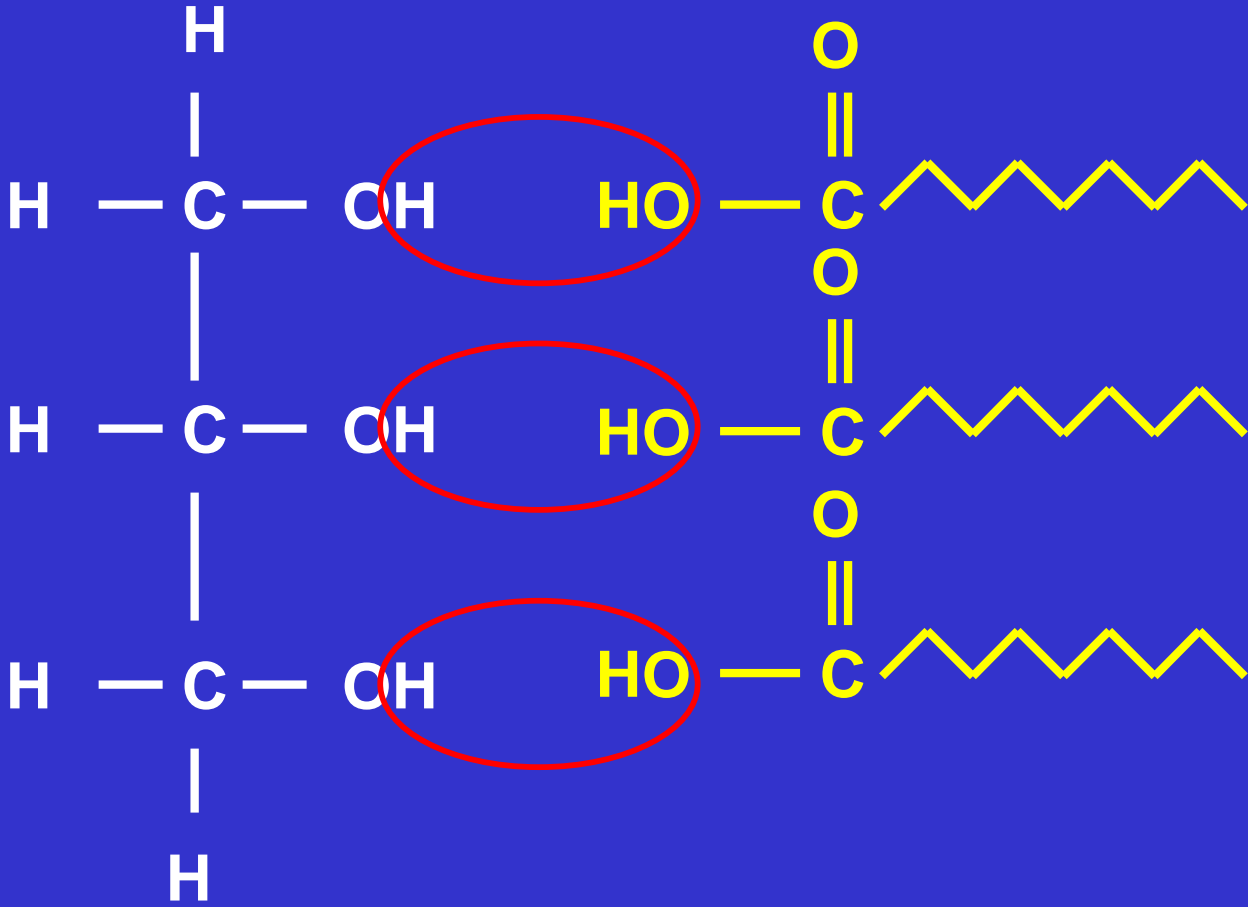
**Rule 2 show water is released**

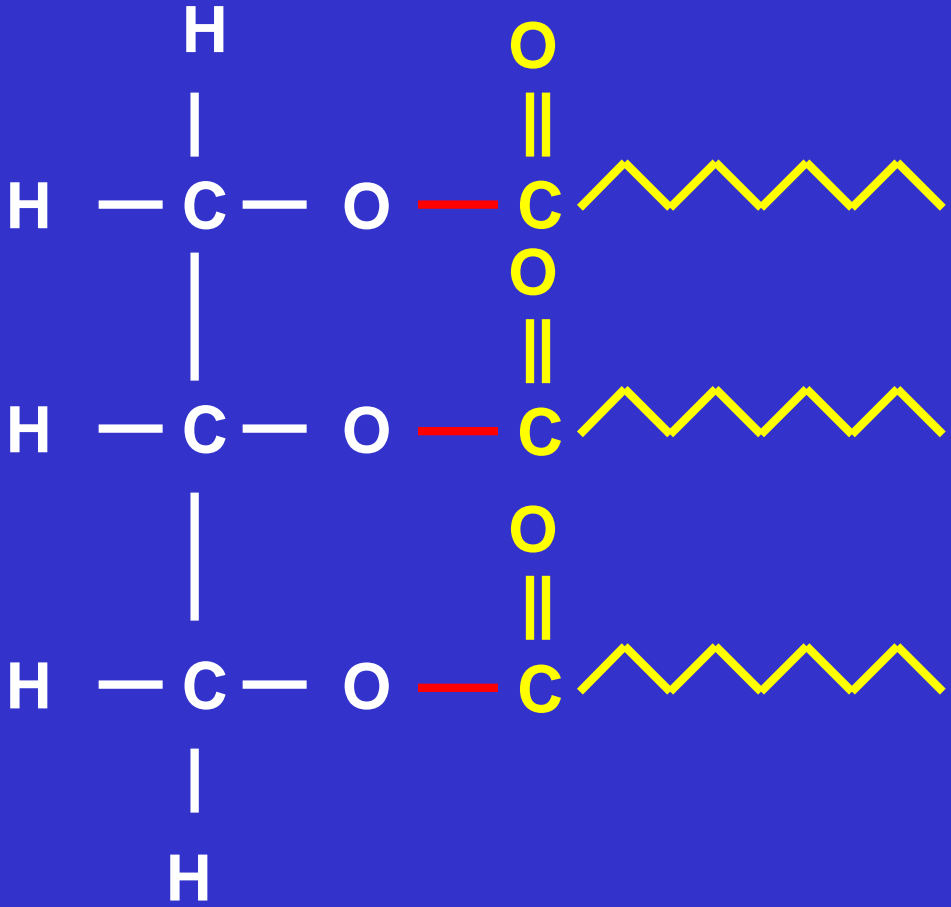
**Rule 3 circle and name the new bonds formed**



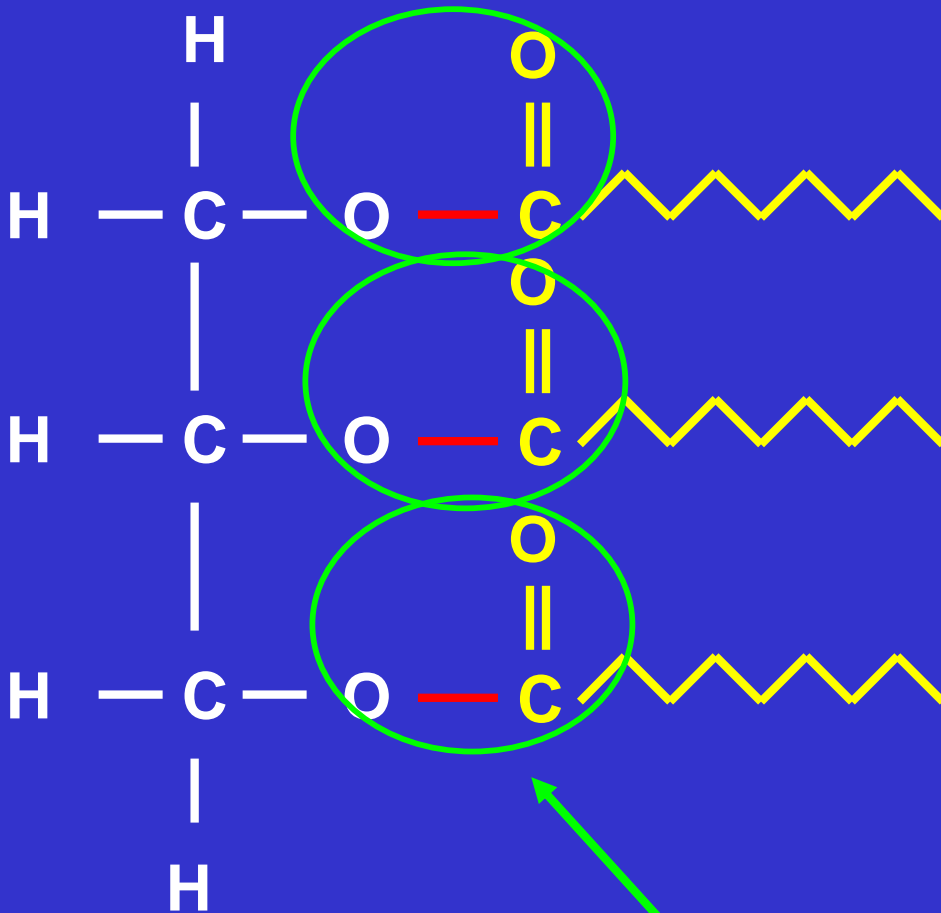
**Rules**







**+ 3H<sub>2</sub>O**



+ 3H<sub>2</sub>O

Ester Bond



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# Role of lipids

The major biological role of lipids is as an energy source. Lipids provide more than twice the amount of energy as carbohydrates – about 38 kJ/g.

Lipids are stored in **adipose tissue**, which has several important roles, including:

**heat insulation** – in mammals, adipose tissue underneath the skin helps reduce heat loss.

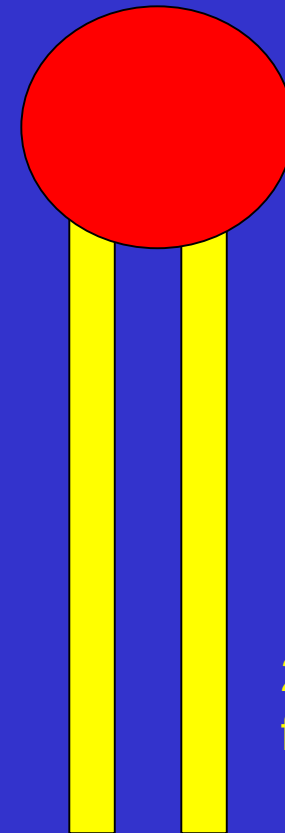


**protection** – adipose tissue around delicate organs such as the kidneys acts as a cushion against impacts.



# Phospholipids

- Special type of lipid which are a major component of **cell membranes**
- One of the fatty acid tails is replaced by a **phosphate** group which is polar
- This makes part of the molecule **hydrophilic** (water 'loving') and part of the molecule **hydrophobic** (water 'hating')



Hydrophilic head containing glycerol and a phosphate group

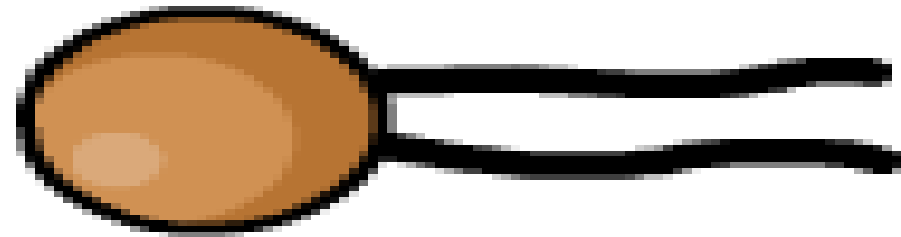
2 hydrophobic fatty acid tails



## What are phospholipids?

Phospholipids are a major component of cell membranes.

Click "play" on the phospholipid to find out more about their structure and properties.





What are the features of these lipids?

Lipid 1/2: This is a molecule of

