

TeachMe

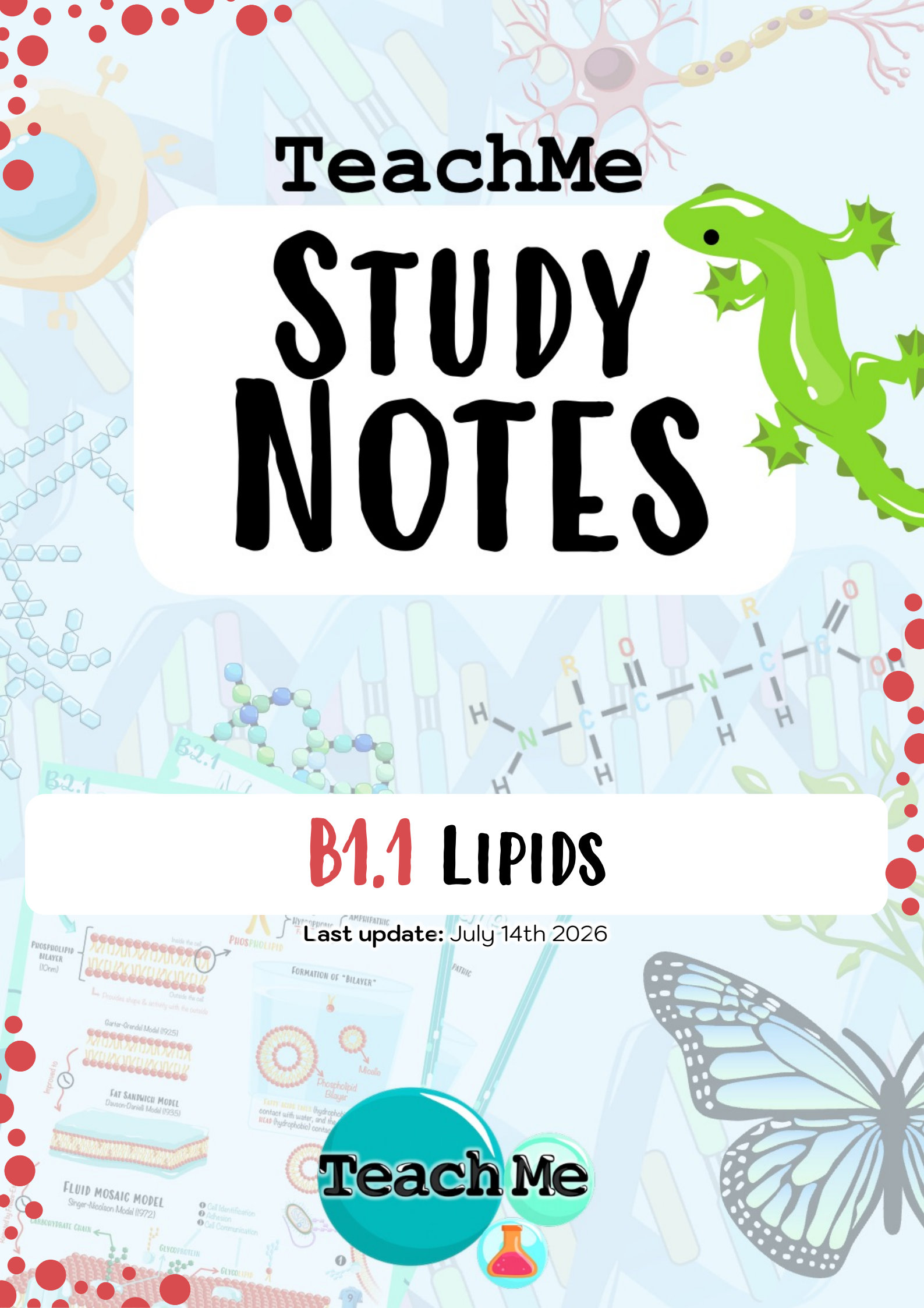
# STUDY NOTES



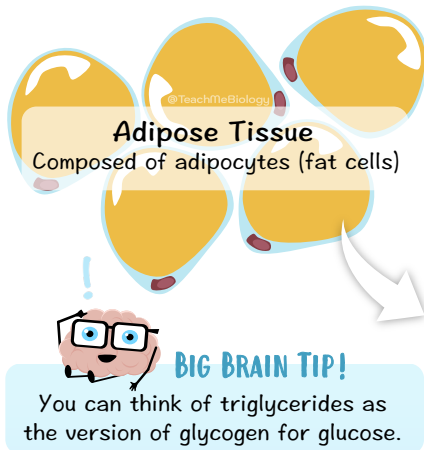
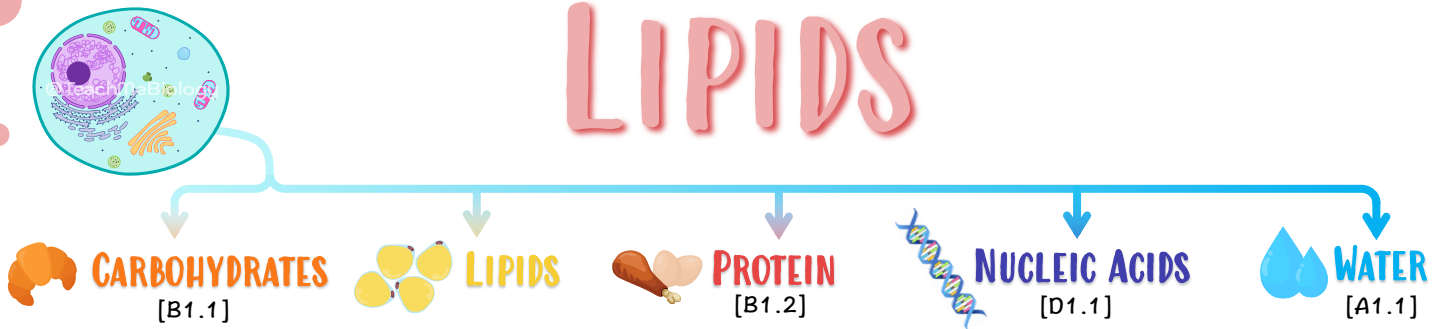
## B1.1 LIPIDS

Last update: July 14th 2026

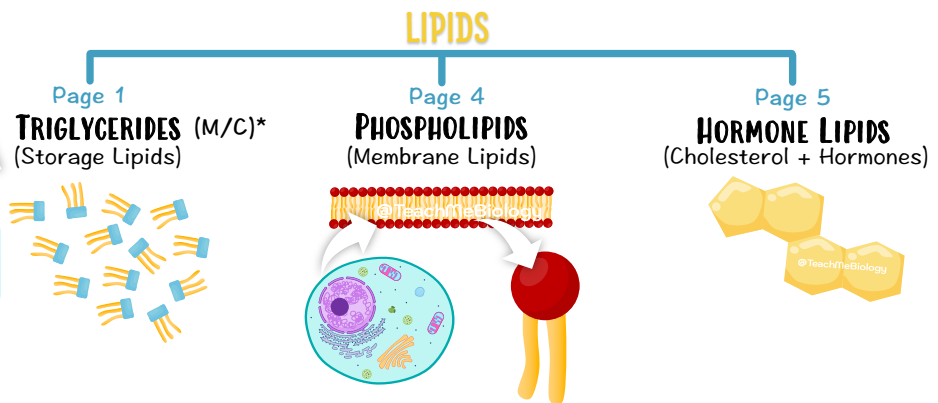
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# LIPIDS

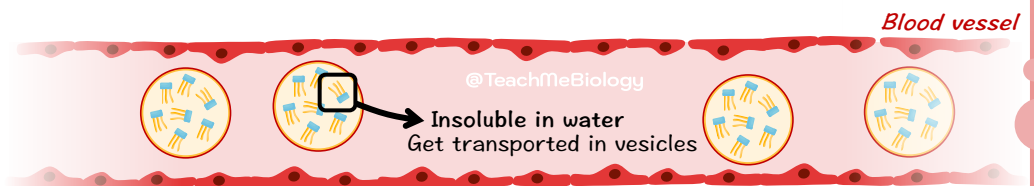
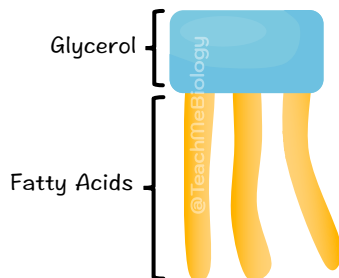


Lipids are molecules composed of carbon, hydrogen, oxygen and phosphorus. You learn about three main types of lipids, mainly focusing on **TRIGLYCERIDES** (which are the storage form of lipids) and **PHOSPHOLIPIDS** (which make up the plasma membrane).



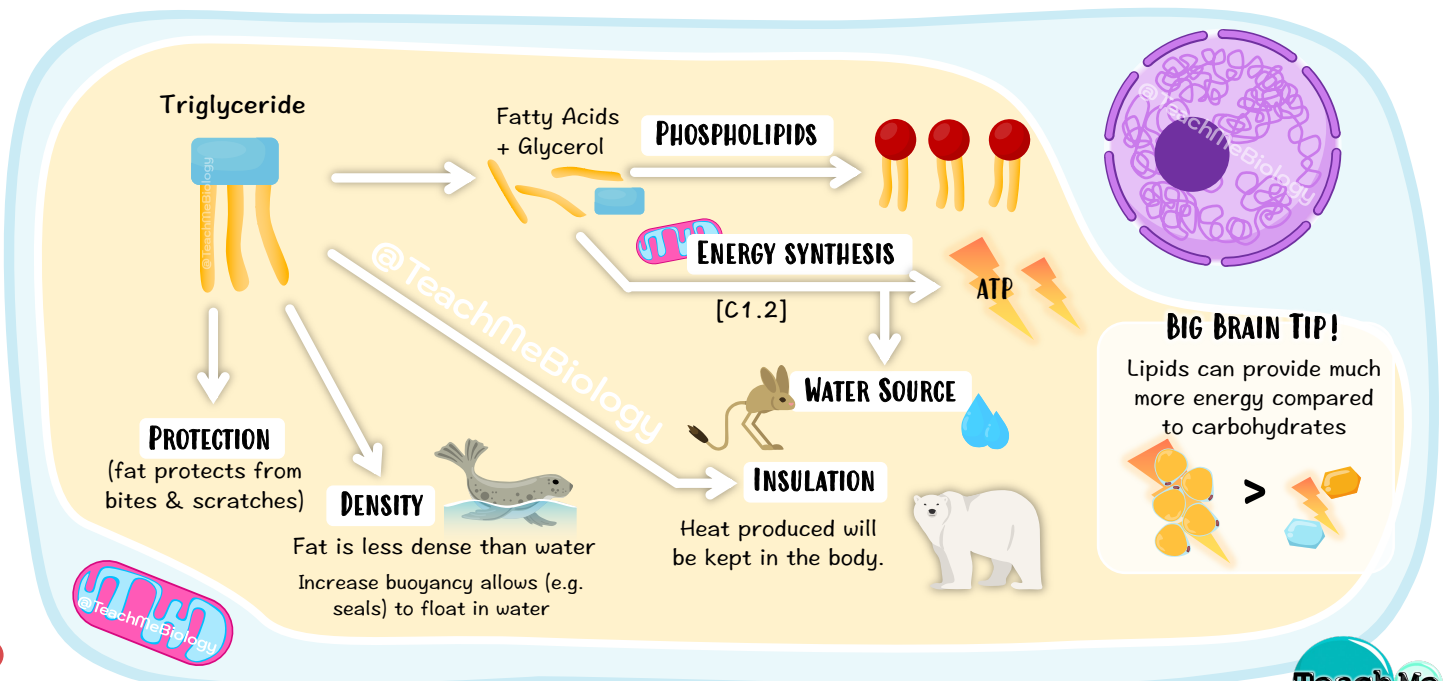
Notice how lipids are not considered when it comes to the idea of monomer and polymer: as it is not a repeat of the same monomer!

## TRIGLYCERIDES



Triglycerides are non-soluble (don't dissolve in water), they therefore need to be transported via the blood within vesicles. Triglycerides are then stored in adipocytes.

They are made up of one **GLYCEROL** and three **FATTY ACIDS** (structure on page 2) and serve many purposes:



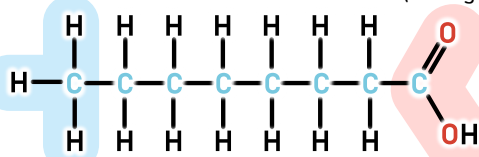
\*M/C: abbreviation for "Most Common".

*Some Adipocyte (fat cell)*

**FATTY ACID** (acid)  
You need to know how to draw it!

**METHYL GROUP**

**CARBOXYL GROUP** (Acid group)



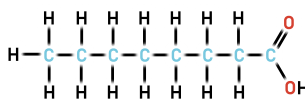
**HYDROCARBON CHAIN**  
Chain length can vary (4-->24)

Fatty acids share a **COMMON STRUCTURE** but differ in the degree of **HYDROGEN SATURATION**. Removal of hydrogen atoms results in the formation of double bonds, which may be in a **cis** or **trans** configuration.

**SATURATED FATTY ACID**

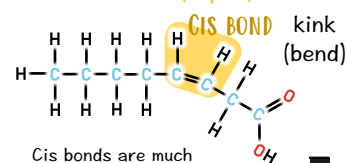
(with hydrogens)

Occur as fats (solid)



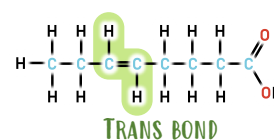
**MONOUNSATURATED FATTY ACID**  
one

Occur as oils (liquid)

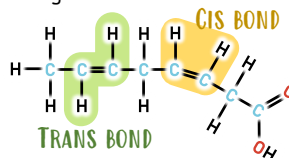


Cis bonds are much more common (>99%)

No kink



**POLYUNSATURATED FATTY ACID**  
many



Cis double bonds introduce a bend (kink) in the hydrocarbon chain, whereas trans double bonds maintain a straighter structure.

Why is that important?  
See page 3

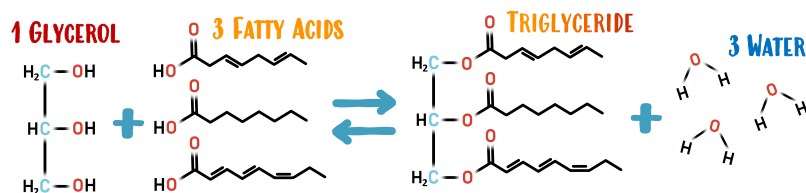
How do glycerol and fatty acids link together? ... and unlink!

**CONDENSATION** – Chemical reaction involving the joining together of two molecules by **REMOVAL** of a water molecule.  
“Water formation”



**HYDROLYSIS** – Chemical reaction by which two molecules are formed through the breaking of a chemical bond by the **ADDITION** of water.  
“Water Splitting”

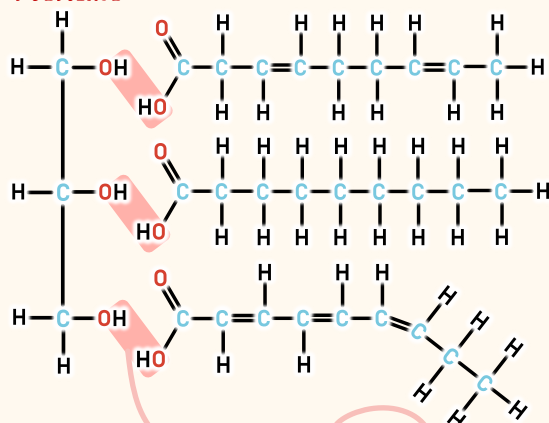
These are the skeletal structures of fatty acids and triglyceride; C's and H's are omitted.



You need to know how to draw a triglyceride (not in detail).

**1 GLYCEROL**

**3 FATTY ACIDS**

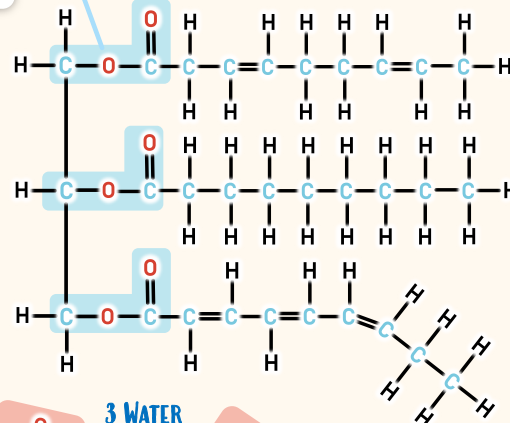


Condensation

Happens between an acid and an alcohol

**ESTER BOND**

**TRIGLYCERIDE**



3 WATER



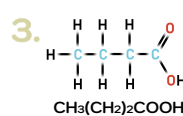
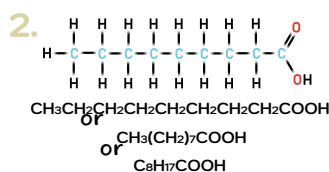
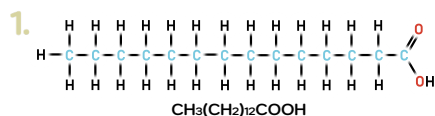


The physical properties of a fatty acid are influenced by both the **LENGTH OF ITS HYDROCARBON CHAIN** and the **NUMBER OF DOUBLE BONDS** it contains:

Fatty acids with longer chains and fewer double bonds tend to have higher melting points, making them more likely to be solid at room temperature (fats).

In contrast, shorter chains and a higher degree of unsaturation lower the melting point, so these fatty acids are more likely to be liquid at room temperature (oils).

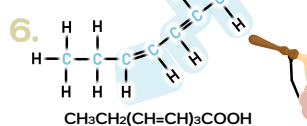
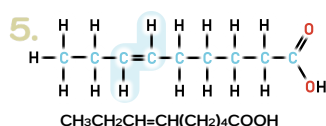
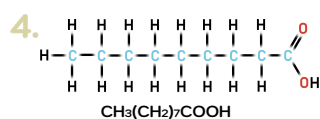
### CARBON CHAIN LENGTH



### BIG BRAIN-TIP!

For each compound, we also provide the condensed structural formula. In exams, you might be shown these formulas and asked to identify features such as the presence of double bonds or whether the fatty acid is saturated or unsaturated. Understanding how to read these condensed formulas is therefore very useful.

### NUMBER OF DOUBLE BONDS



Solid at RT  
(Fats)

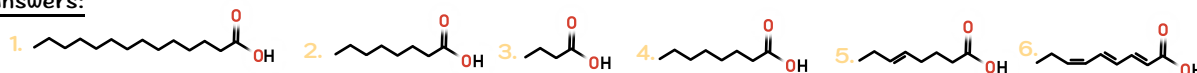
MELTING

Liquid at RT  
(Oils)

### Test Yourself!

Draw each fatty acid structure above in its skeletal form.

Answers:



### LIPIDS V.S CARBOHYDRATES SOLUBILITY

#### FATTY ACID

Non-Polar

Water insoluble

Hydrophobic

VS.

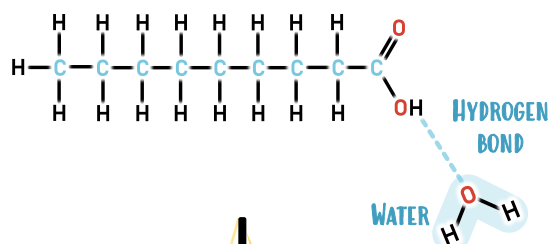
#### GLUCOSE

Polar

Water soluble

Hydrophilic

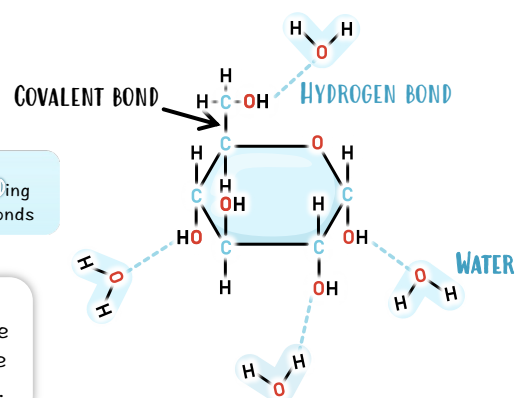
A compound is considered water-soluble if it can form hydrogen bonds with water. Glucose has many hydroxyl groups, making it polar and soluble, whereas lipids lack these groups and are therefore insoluble.



### BIG BRAIN TIP!

Hydrogen bonds are HYDing  
Weaker than covalent bonds

Carbohydrates are transported freely in the blood while lipids require special vesicles to move.



Blood vessel



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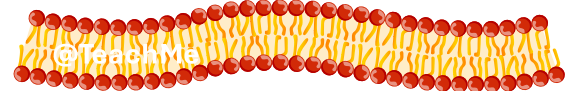
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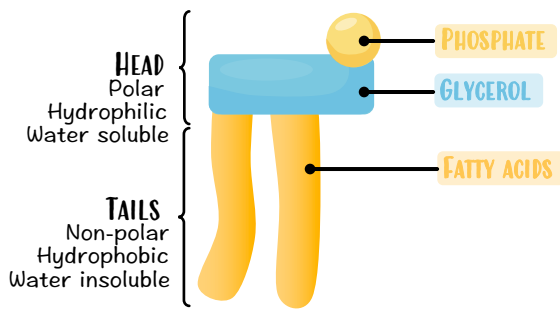
# PHOSPHOLIPIDS



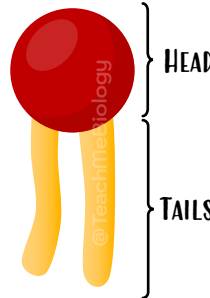
Phospholipids are **AMPHIPATHIC** – has both hydrophobic & hydrophilic regions.



They make up the **PLASMA MEMBRANE** (as a bilayer). (B2.1)



A simplified version:



## SEMI-PERMEABLE BARRIER

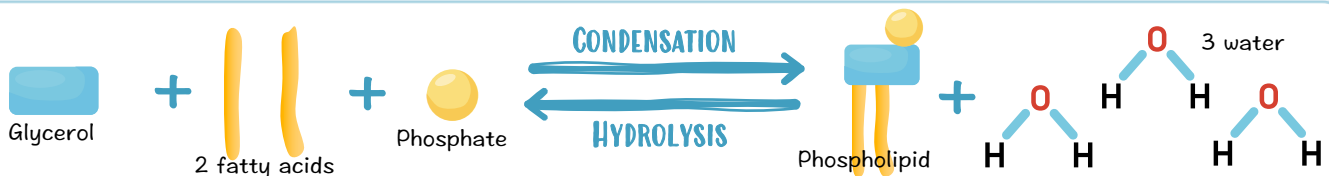
Blocks water soluble substances from passing.

## MEMBRANE FLUIDITY REGULATION

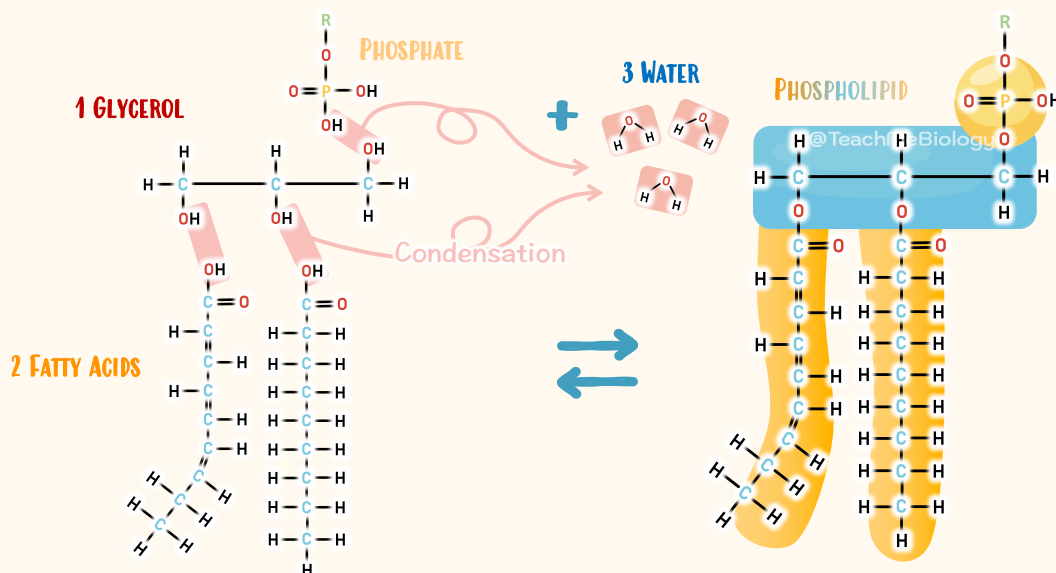
## HOLD MEMBRANE PROTEINS IN PLACE

## How do phospholipids form?

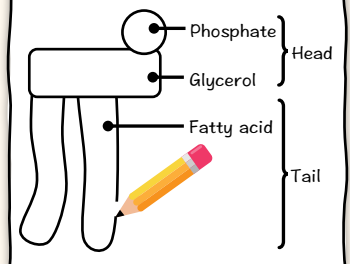
**CONDENSATION** – Chemical reaction involving the joining together of two molecules by **REMOVAL** of a water molecule.  
“Water formation”



**HYDROLYSIS** – Chemical reaction by which two molecules are formed through the breaking of a chemical bond by the **ADDITION** of water.  
“Water Splitting”



If asked to draw a phospholipid, you do not need to show the full molecular structure, this is enough:

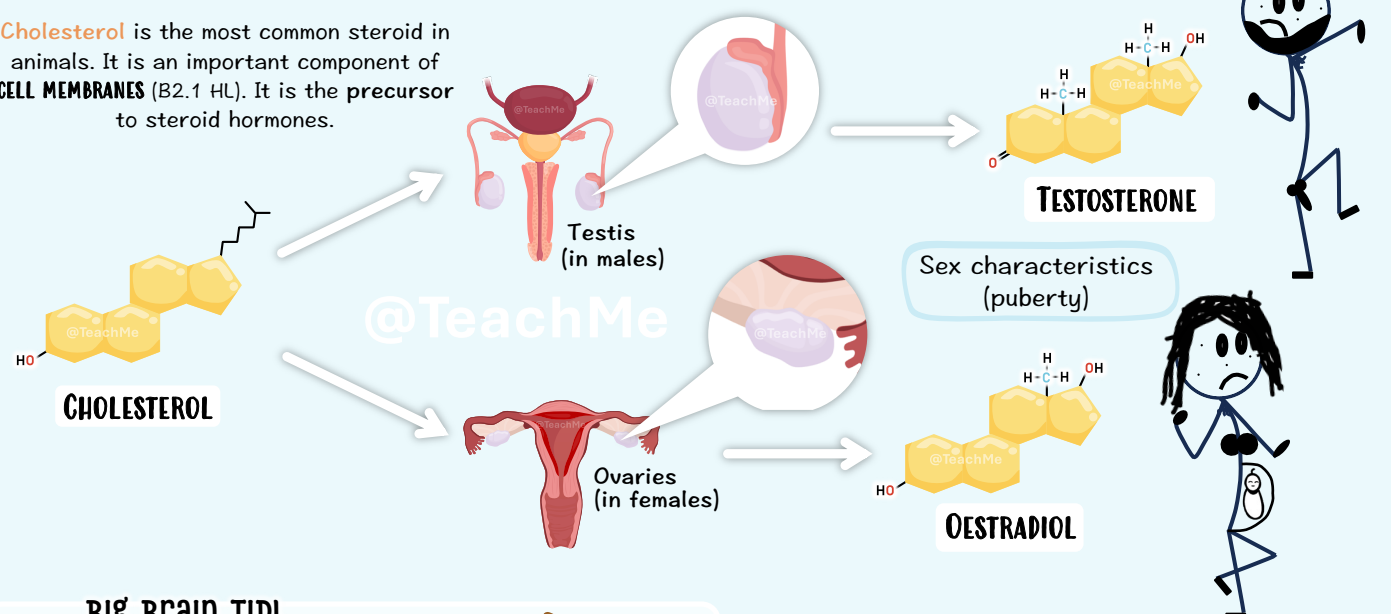


# STERIODS

Steroids are a class of **hydrophobic lipids** characterized by **4 FUSED CARBON RINGS**. Unlike triglycerides and phospholipids, they are **NOT** built from fatty acids.

Types: **Cholesterol & Hormones**

**Cholesterol** is the most common steroid in animals. It is an important component of **CELL MEMBRANES** (B2.1 HL). It is the **precursor** to steroid hormones.



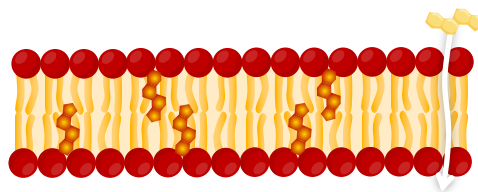
## BIG BRAIN TIP!

You only need to be able to recognize the general structure of steroids



Some steroid molecules act as **HORMONES**. Steroid hormones, such as **TESTOSTERONE** and **OESTRADIOL**, are synthesised from **CHOLESTEROL** and regulate many processes in the body, including the development of **secondary sex characteristics**.

Cholesterol embedded in membrane



Non-polar steroids can pass through the phospholipid bilayer.

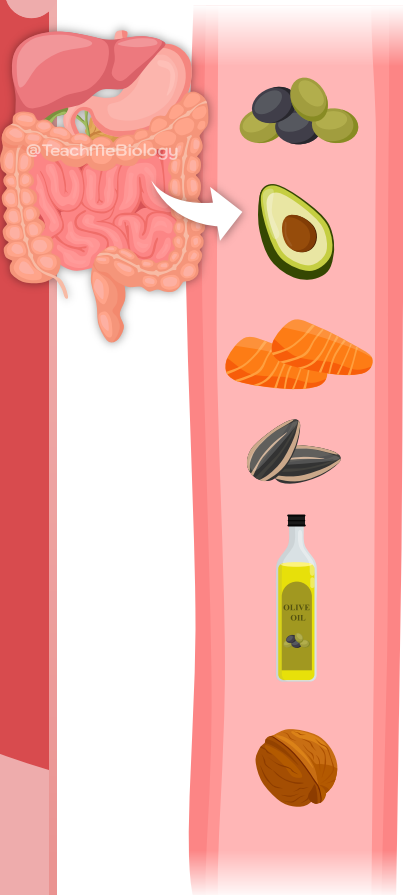
## Summary Triglyceride vs. Phospholipids vs. Cholesterol

| Feature    | TRIGLYCERIDE  | PHOSPHOLIPID  | CHOLESTEROL  |
|------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Components | Glycerol + 3 fatty acids                                                                         | Phosphate group + glycerol + 2 fatty acids                                                         | Four fused carbon rings                                                                           |
| Properties | Non-polar                                                                                        | Amphipathic (polar and non-polar)                                                                  | Non-polar                                                                                         |
| Purpose    | Energy storage, thermal insulation, protection, buoyancy                                         | Main component of plasma membrane, glycolipids                                                     | Component of plasma membrane, regulates membrane fluidity, precursor of steroid hormones          |

# Which foods contain which kinds of lipid?

[not part of the syllabus, only for your own curiosity, you need to know about the health impacts of lipids]

Foods contain different types of lipids, each with different structures and effects on health. While lipids are an important source of energy, some are healthier choices than others.



## → SATURATED FATTY ACIDS (Limit intake)



In animals they are often **SATURATED** (less often unsaturated)



In plants usually **UNSATURATED** (rarely saturated)

## → PHOSPHOLIPIDS (Neutral)

[Many Many Foods]

## → CHOLESTEROL



↑ INPUT > OUTPUT ↓

Excess energy intake causes surplus lipids to be stored in **ADIPOSE TISSUE**.

## → MONOUNSATURATED FATTY ACIDS (Cis) (Very healthy)



## → POLYUNSATURATED FATTY ACIDS (Cis) (Healthiest)

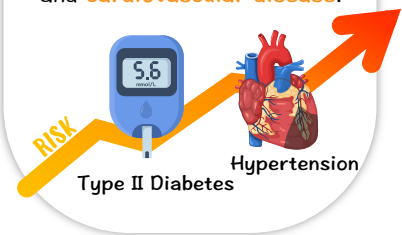


## → UNSATURATED FATTY ACIDS (TRANS) (Unhealthy)



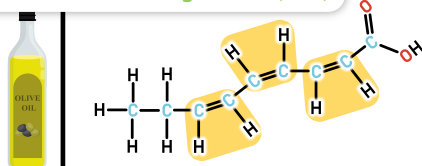
## CHRONICALLY OVERWEIGHT

Over many years, chronic obesity increases the risk of **Type II diabetes**, **hypertension** and **cardiovascular disease**.



Not all dietary lipids affect health equally. Cis-unsaturated fats are generally healthier than saturated fats, while trans fats have the most harmful effects on cardiovascular health.

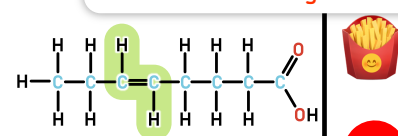
## Polyunsaturated fatty acids (Cis)



## Phospholipids



## Unsaturated fatty acids (Trans)

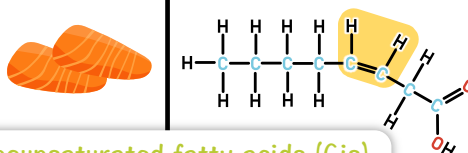


HEALTHIEST

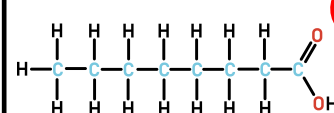
NEUTRAL

UNHEALTHY

## Monounsaturated fatty acids (Cis)



## Saturated fatty acids



This is not tested on the exam, but this experiment may be used in data-based questions.



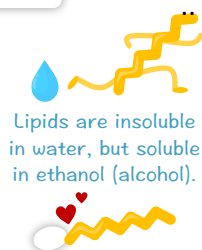
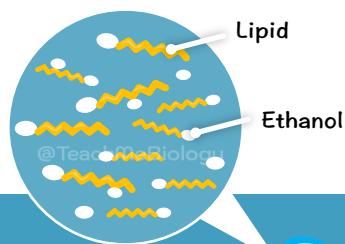
**Extension content!**

## Testing for the presence of lipids

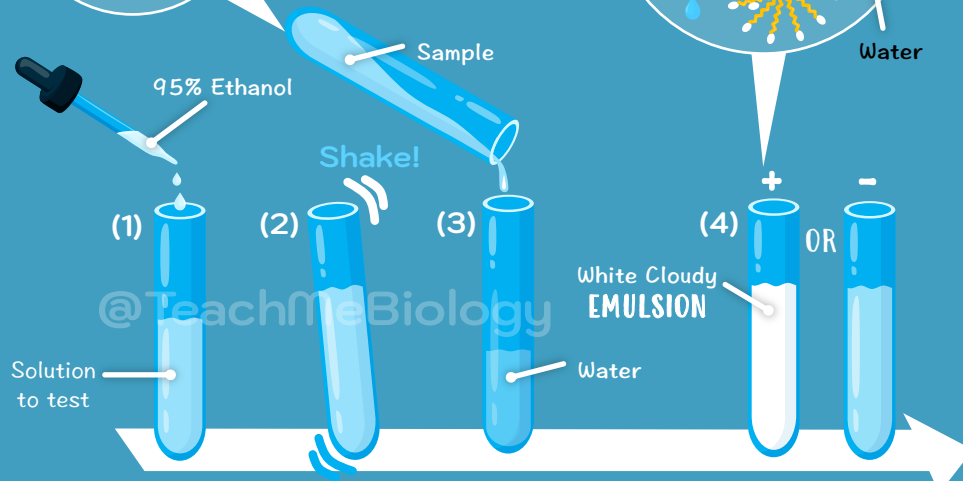
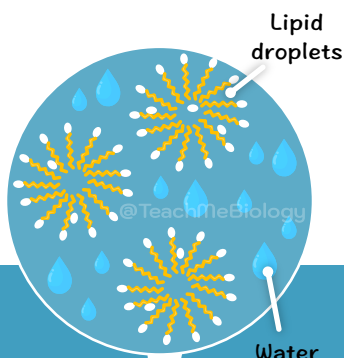
### EMULSION TEST FOR LIPIDS

Testing the presence of lipids in a sample.

Lipids dissolve in the ethanol.



Lipids are insoluble in water, but soluble in ethanol (alcohol).



#### Qualitative test

- (1) Add 95% ethanol to the test solution.
- (2) Shake sample vigorously.
- (3) The solution is then poured into a tube containing water.
- (4) Observe the Result

#### IF LIPID IS PRESENT

A **CLOUDY WHITE** suspension is formed. The lipids do not dissolve in water but can dissolve in ethanol. Hence **TINY LIPID DROPLETS** will form as the lipids aggregate together and interact with ethanol, while escaping water. This kind of mixture is called an **EMULSION**.

Ethanol is water soluble and doesn't mind interacting with it.

#### IF LIPID IS ABSENT

The ethanol just mixes into the water. Light can pass straight through this mixture since there are no tiny lipid droplet scattering the light. It looks completely transparent.



NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.