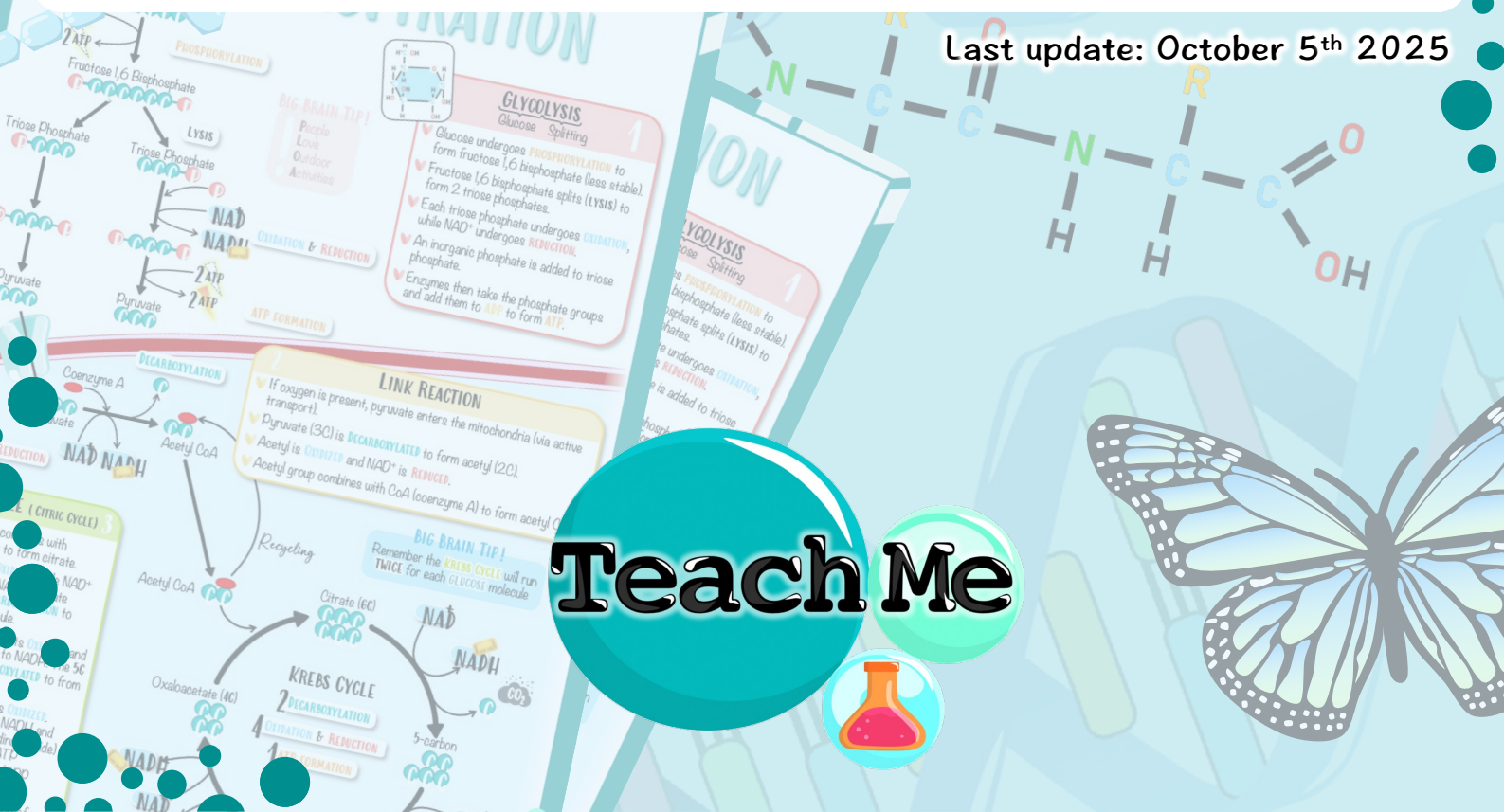


TeachMe

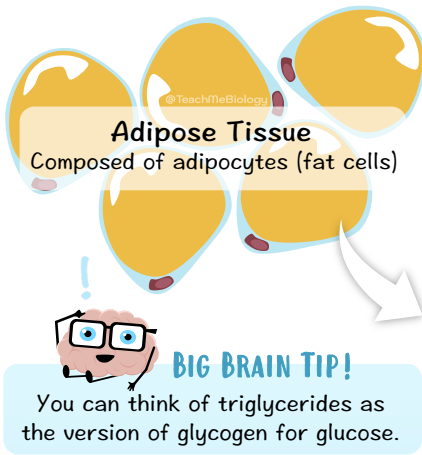
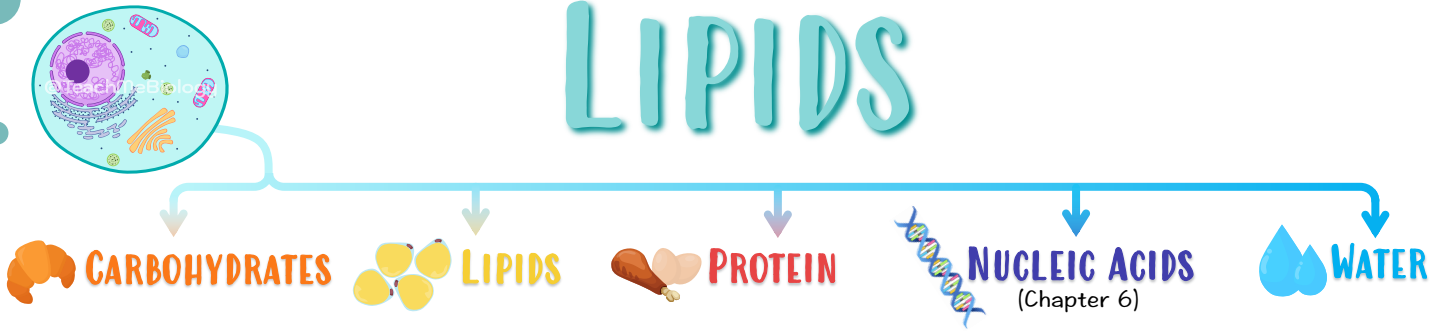
STUDY NOTES

CHAPTER 2 – BIOLOGICAL MOLECULES LIPIDS

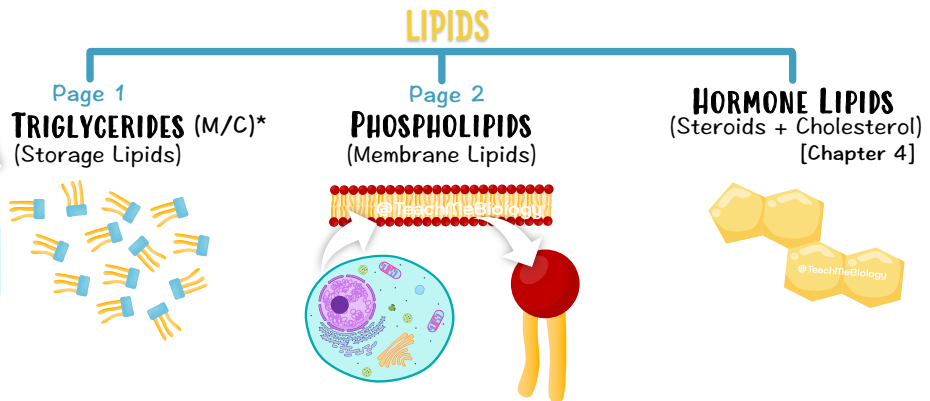
Last update: October 5th 2025



LIPIDS

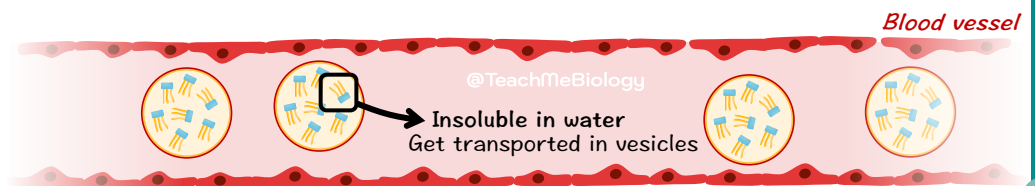
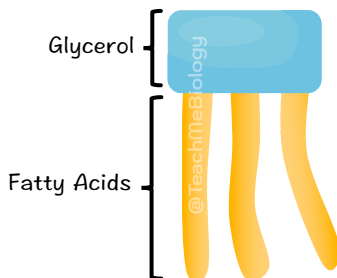


Lipids are molecules composed of carbon, hydrogen, oxygen and phosphorus. You learn about three main types of lipids, mainly focusing on **TRIGLYCERIDES** (which are the storage form of lipids) and **PHOSPHOLIPIDS** (which make up the plasma membrane).



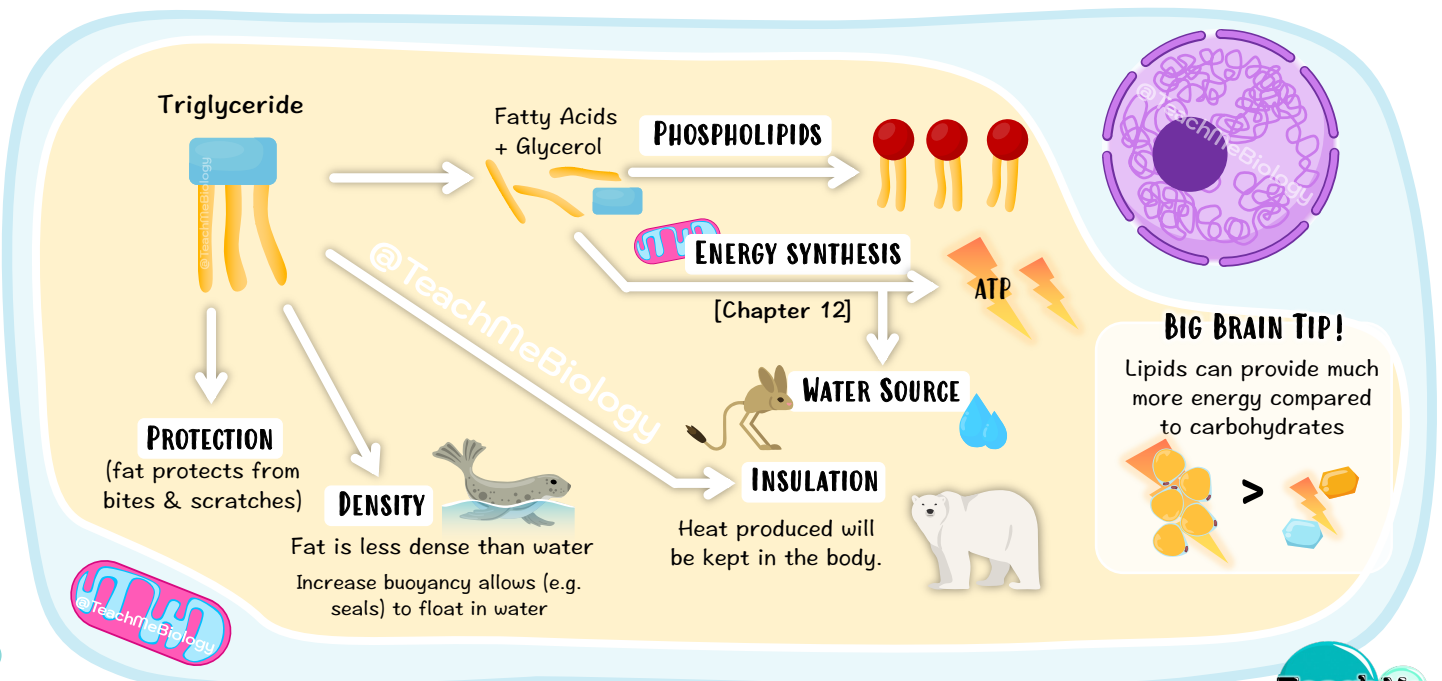
Notice how lipids are not considered when it comes to the idea of monomer and polymer: as it is not a repeat of the same monomer!

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.

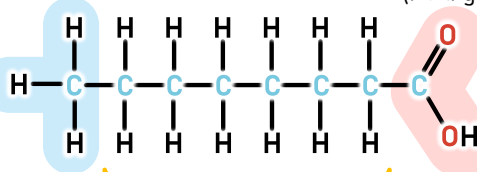
They are made up of one **GLYCEROL** and three **FATTY ACIDS** (structure on page 2) and serve many purposes:



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

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

METHYL GROUP



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

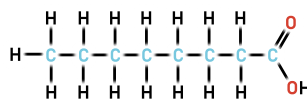
CARBOXYL GROUP (Acid group)

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)

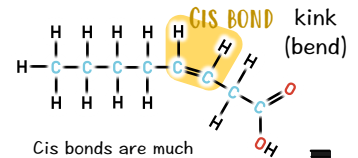
Occur as fats (solid)



MONOUNSATURATED FATTY ACID

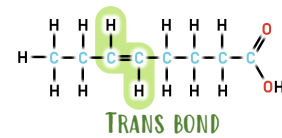
one

Occur as oils (liquid)



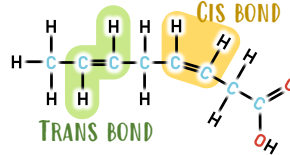
Cis bonds are much more common (>99%)

No kink



POLYUNSATURATED FATTY ACID

many

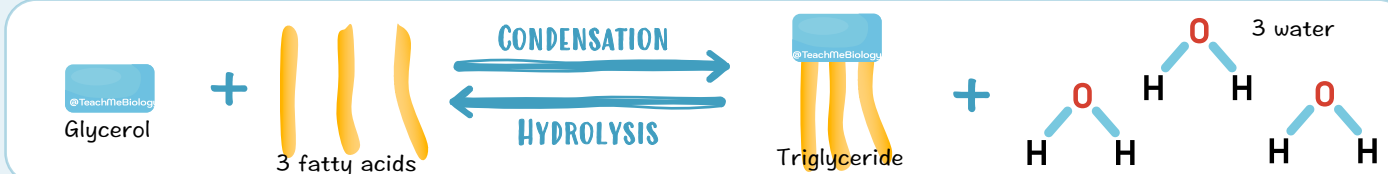


Cis double bonds introduce a bend (kink) in the hydrocarbon chain, whereas trans double bonds maintain a straighter structure.

Why is that important?
See page 3

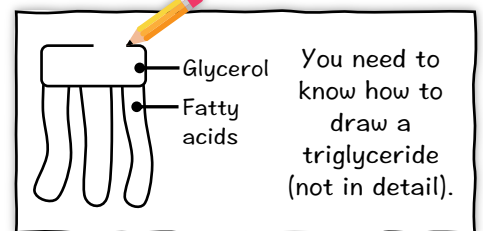
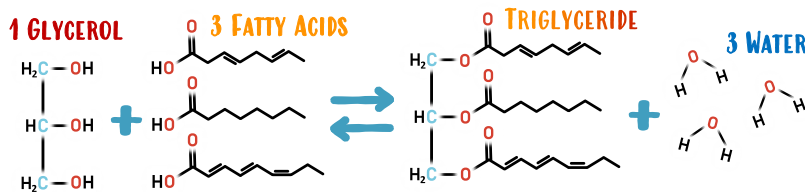
How do glycerol and fatty acids link together? ... and unlink!

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"

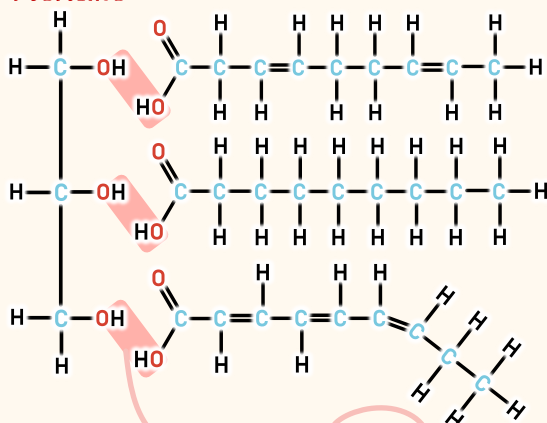
These are the skeletal structures of fatty acids and triglyceride; C's and H's are omitted.



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

1 GLYCEROL

3 FATTY ACIDS

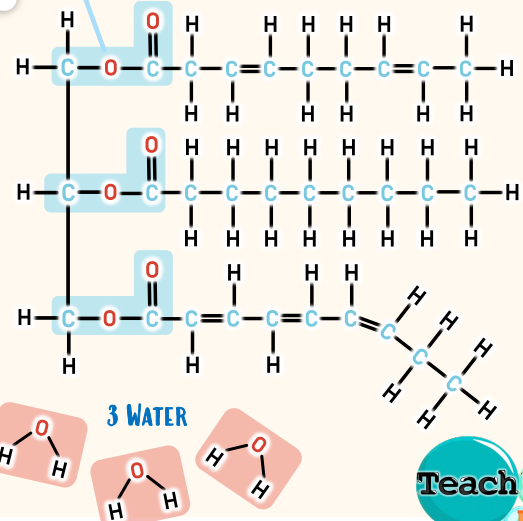


Condensation

Happens between an acid and an alcohol

ESTER BOND

TRIGLYCERIDE



Teach Me

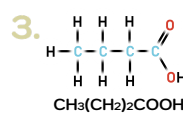
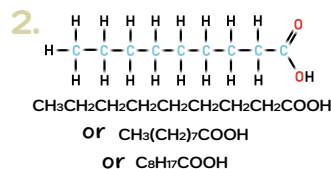
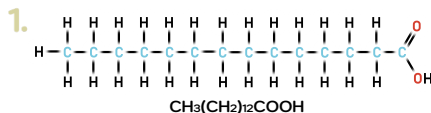
CHAPTER 2 - BIOLOGICAL MOLECULES

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).

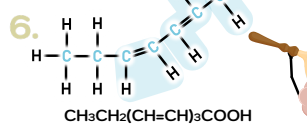
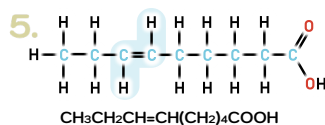
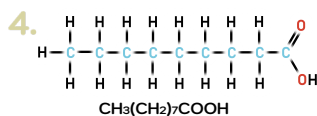
CARBON CHAIN LENGTH



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)

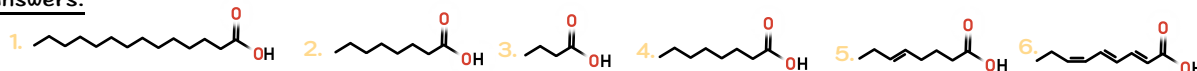
MELTING

Liquid at RT
(Oils)

Test Yourself!

Draw each fatty acid structure above in its skeletal form.

Answers:



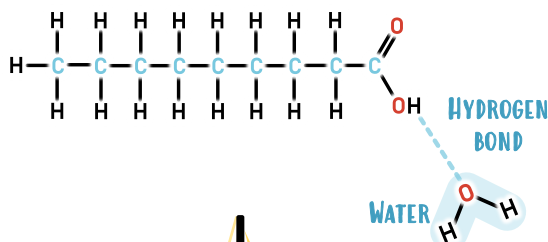
LIPIDS V.S CARBOHYDRATES SOLUBILITY

FATTY ACID
Non-Polar Water insoluble Hydrophobic

VS.

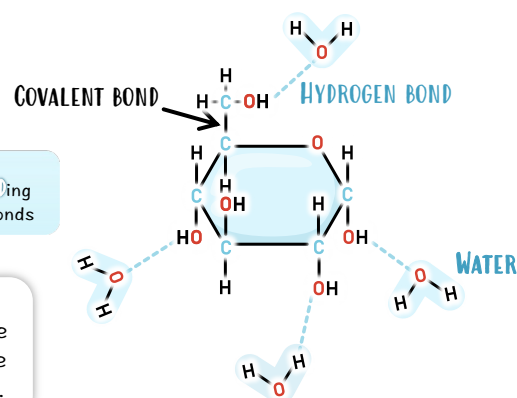
GLUCOSE
Polar Water soluble Hydrophilic

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 **HYD**ing
Weaker than covalent bonds

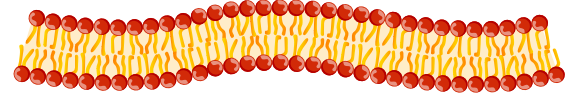
Carbohydrates are transported freely in the blood while lipids require special vesicles to move.



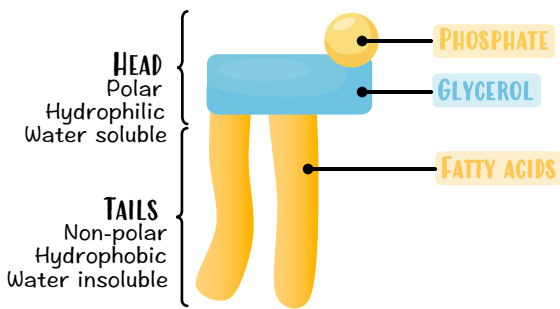
PHOSPHOLIPIDS



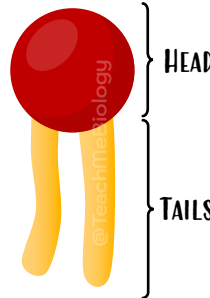
Phospholipids are **AMPHIPATHIC** – has both hydrophobic & hydrophilic regions.



They make up the **PLASMA MEMBRANE** (as a bilayer).
(Chapter 4)



A simplified version:



SEMI-PERMEABLE BARRIER

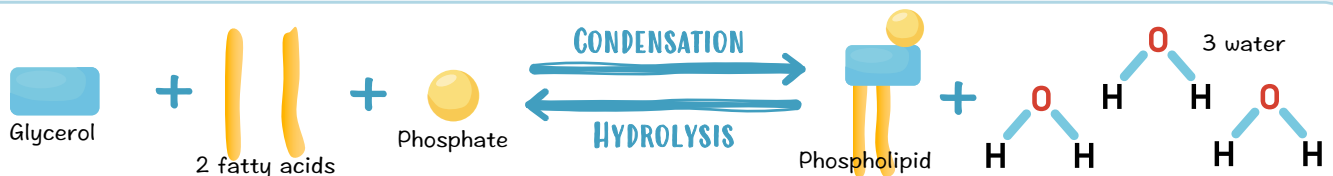
Blocks water soluble substances from passing.

MEMBRANE FLUIDITY REGULATION

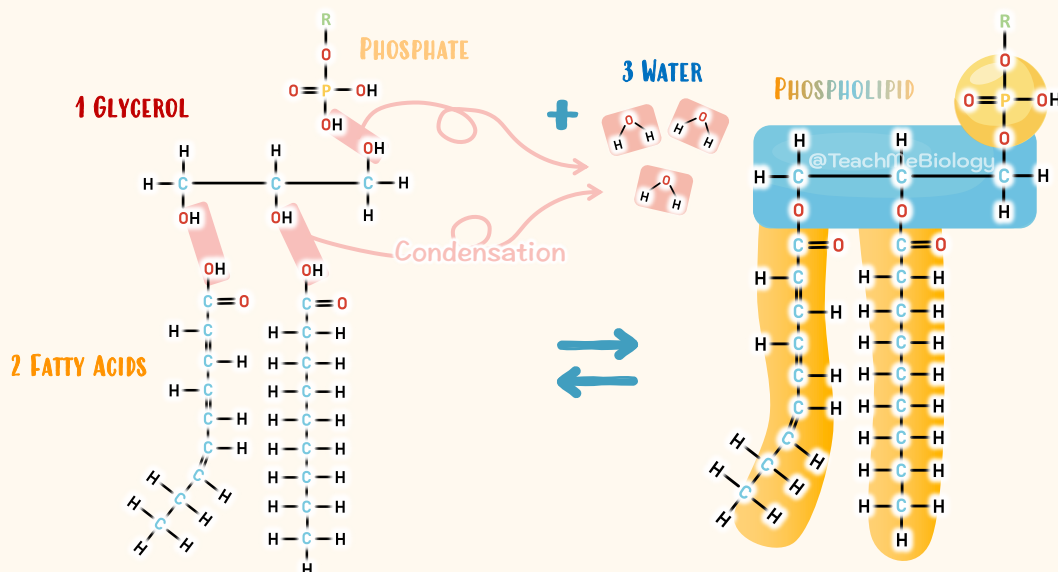
HOLD MEMBRANE PROTEINS IN PLACE

How do phospholipids form?

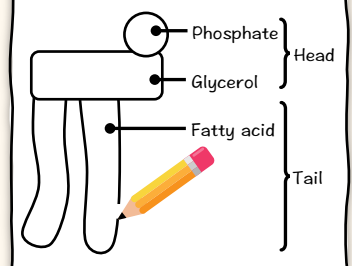
CONDENSATION – Chemical reaction involving the joining together of two molecules by **REMOVAL** of a water molecule.
“Water formation”



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:



Summary Triglyceride vs. Phospholipids

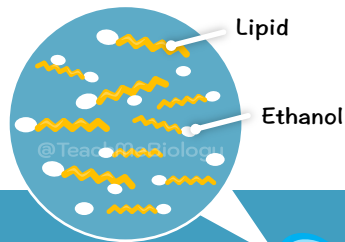
FEATURE	TRIGLYCERIDE	PHOSPHOLIPID
Phosphate	None	Yes
Fatty Acid Tails	3	2
Polar/Non-polar	Non-Polar	Polar Phosphate Head
Water molecules released during formation	3	3
Purpose	Energy Storage	Part Of plasma membrane

Testing for the presence of lipids

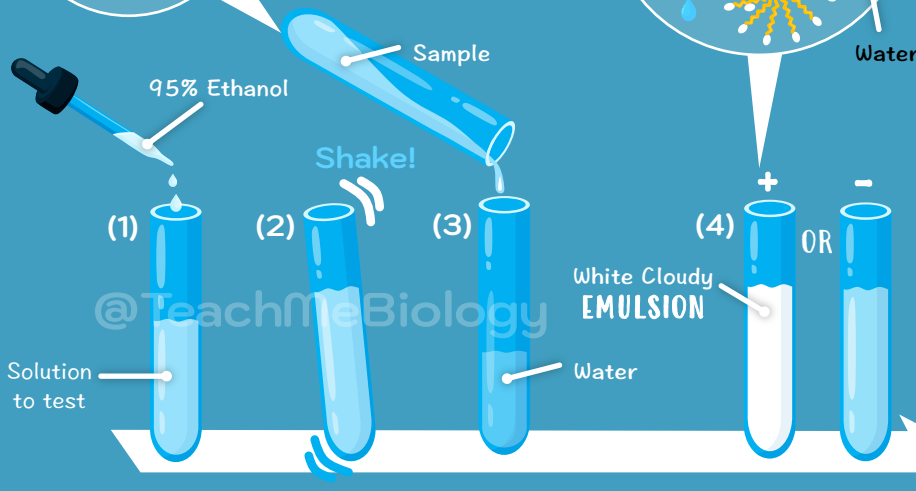
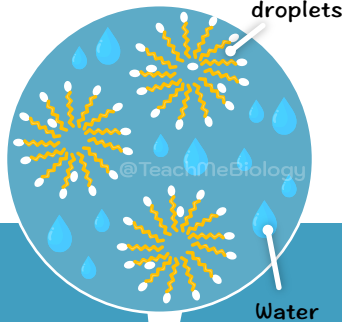
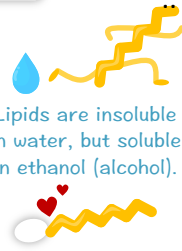
EMULSION TEST FOR LIPIDS

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**.

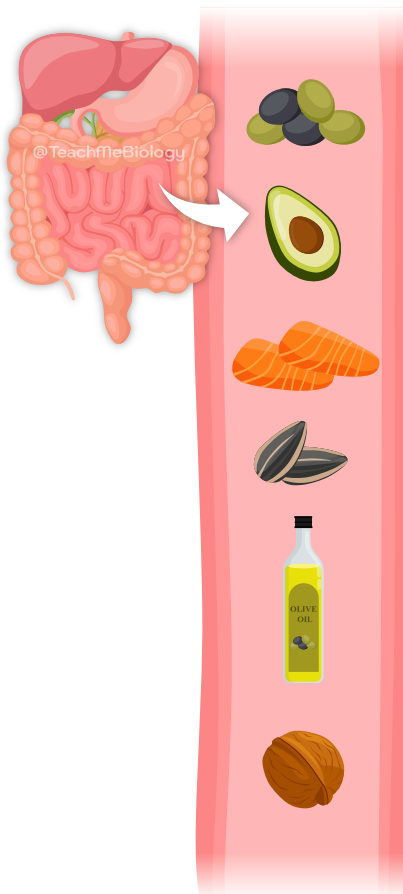
Ethanol is water soluble and doesn't mind interacting with it.

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.

Which foods contain which kinds of lipid?

[not part of the syllabus, only for your own curiosity]



SATURATED FATTY ACIDS (Limit intake)



PHOSPHOLIPIDS (neutral)

Way too many foods!

CHOLESTEROL



MONOUNSATURATED FATTY ACIDS (CIS) (very healthy)



POLYUNSATURATED FATTY ACIDS (CIS) (healthiest)



UNSATURATED FATTY ACIDS (TRANS) (unhealthy)

