I.Simple lipids

1.True fat

Triglycerides (TG)
Triacylglycerol (TAG)

L/O/G/O

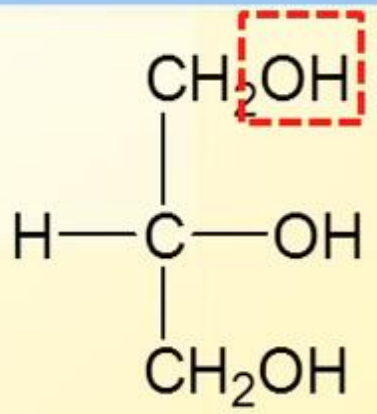
I. Simple lipids

1.True fats (*neutral fats*)

- These are esters of glycerol and various fatty acids.
- If all the three hydroxyl groups of glycerol are esterified, fats are known as triacylglycerol (TG; TAG).

Triglyceride (TG; TAG)

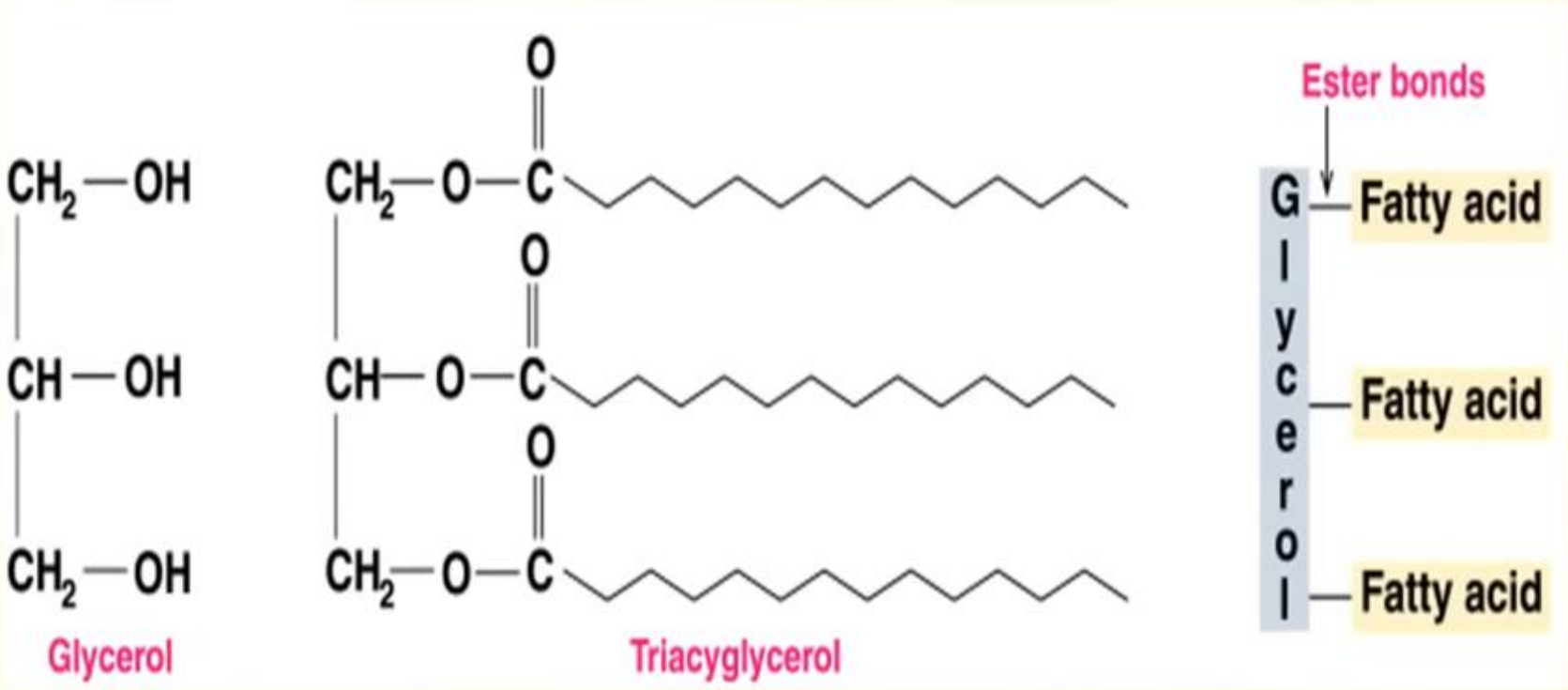
$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}COOH$



glycerol

Formation of an ester:

Triglyceride (TG; TAG)



Triglyceride (TG; TAG)

- **Physical properties depend on the fatty acid components.**
  - the melting point increases as the *number of carbons* in the hydrocarbon chain increases and as the number of *double bonds* decrease.
  - triglycerides rich in unsaturated (**cis double bonds**) fatty acids are generally liquid at room temperature and are called **oils**.
  - triglycerides rich in saturated fatty acids are generally semisolids or solids at room temperature and are called **fats**.

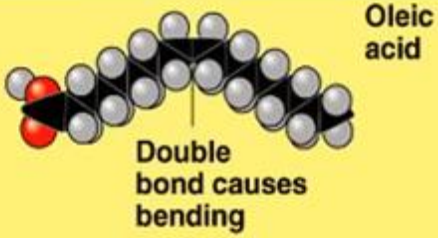
Most animal fats

- solid at room temperature

(a) Saturated fat and fatty acid

Plant, vegetable & fish fats

- liquid at room temperature



(b) Unsaturated fat and fatty acid

Biological importance of true fats

1. They form reserve foods in animals. In animals, they are found as **depot fat** in the subcutaneous tissues. This depot fat is mobilized during starvation to **produce energy** and so its amount is variable, and thus true fats are known as ***variable element of fat.***

2. They are the most compact form in which energy can be stored.

(1 gm of fat → 9.3 KCal).

3. True fats are also found as **supporting material** in some parts of the body as around the kidneys.

Classification of triglycerides (TG;TAG)

L/O/G/O

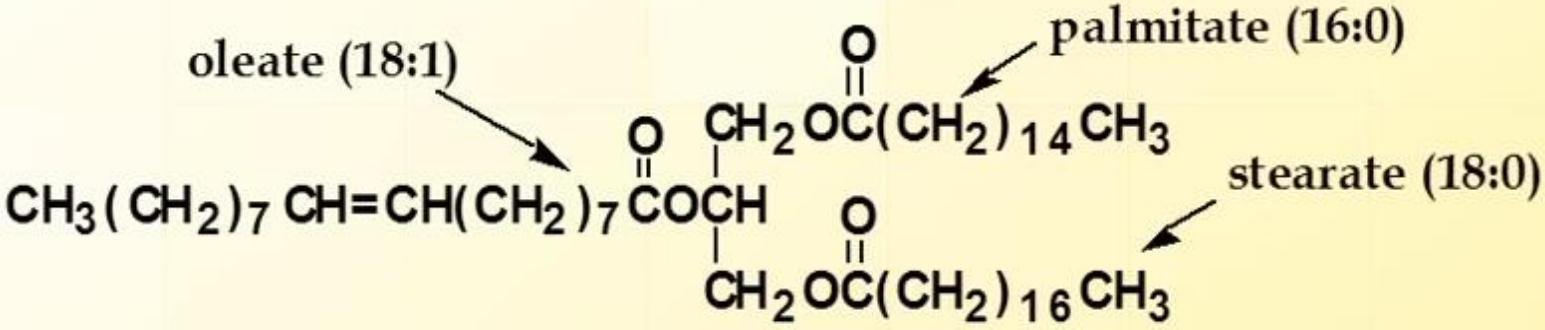
Triglycerides (TG; TAG)

They may be:

1. **Simple triacylglycerols:** i.e. contain a **single kind of fatty acid** in all the three ester positions. e.g. ***Tristearin***, ***Tripalmitin*** and ***Triolein.***
2. **Mixed triacylglycerols:** i.e. contain 2 or more **different fatty acids** in the molecule. e.g. ***1,3- Distearopalmitin***

Triacylglycerol (TG; TAG)

- ex.Triglyceride is derived from glycerol plus one molecule each of palmitic acid, oleic acid, and stearic acid, the three most abundant fatty acids.



A very non-polar molecule (storage fat)
Mixed TG

Derived & associated lipids

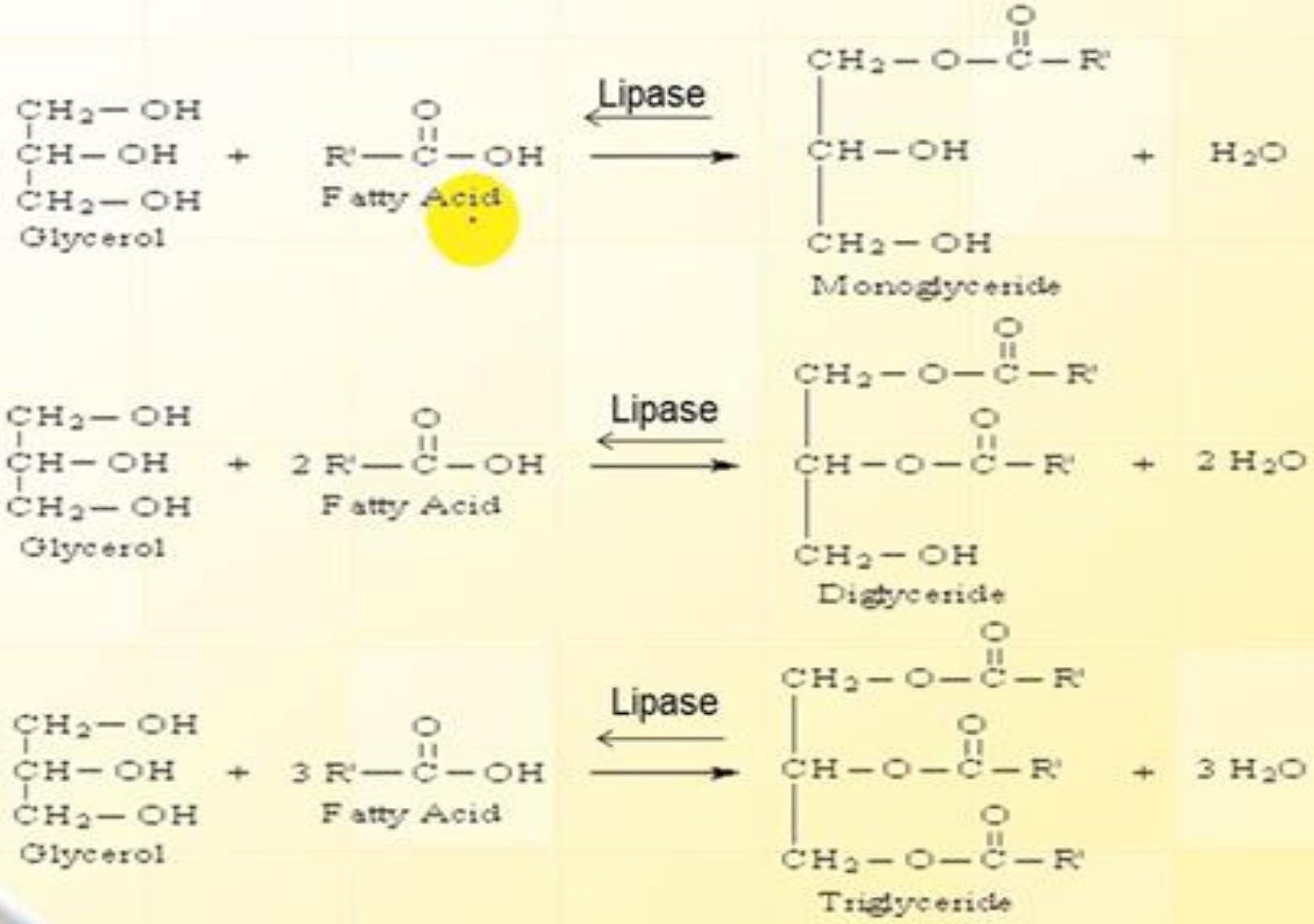
They include:

1. Fatty acids.
2. Glycerol.
3. Alcohols (other than glycerol).
4. **Monoacylglycerol & diacylglycerol.**
5. Steroids (sterols, steroid hormones, bile acids).
6. Carotenoids.
7. Fat Soluble vitamins (D, E, K, A).

Definition:

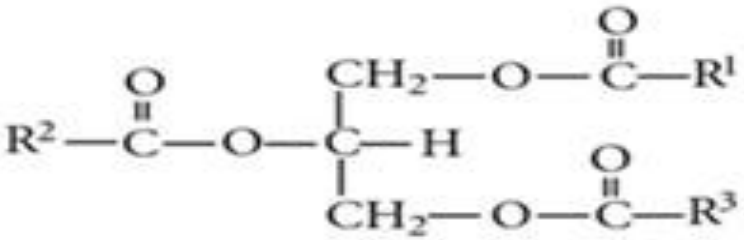
- They are either **derived from** simple and compound lipids (1,2,3,4) or **associated with** lipids (5,6,7) and they possess the **general physical characteristics of lipids.**

Monoacylglycerol; monoglycerides (MAG; MG)
Diacylglycerol; diglycerides (DAG; DG)
Triacylglycerol; triglycerides (TAG; TG)

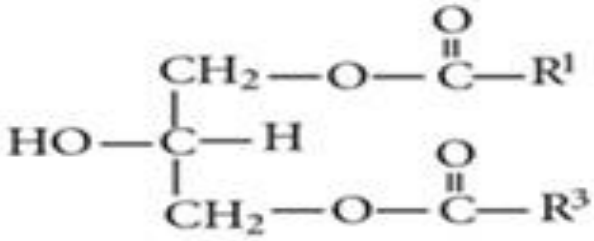


Diacylglycerol; diglycerides (DAG; DG)

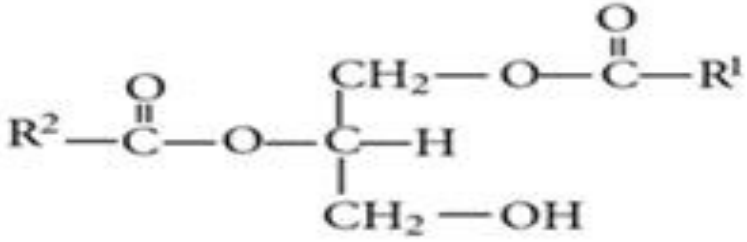
- MAG & DAG are intermediate in TG metabolism.
- DAG acts as signal molecule.
- MAG is more polar than DAG, however TG are hydrophobic.



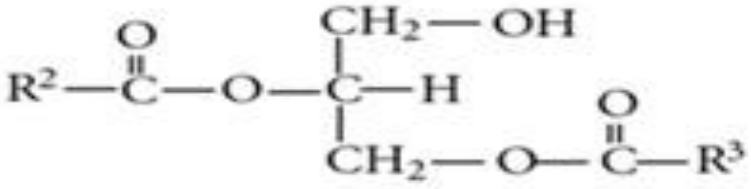
1,2,3-triacyl- -glycerol (TAG)



1,3-diacyl- -glycerol (DAG)



1,2-diacyl- -glycerol (DAG)



2,3-diacyl- -glycerol (DAG)

II. Complex lipids

1. Phospholipids

A. Glycerophosphlipids:

i. Phosphatidic acid.
ii. Lecithin (phosphatidyl choline) & Dipalmitoyl lecithin.
iii. Cephalin (phosphatidyl ethanolamine).
iv. Phosphatidyl Serine.
v. Phosphatidyl inositol.
vi. Diphosphatidyl glycerol or Cardiolipin.

L/O/G/O

B. sphingophospholipids

1. Sphingomyelin.

II- Complex lipids

1.Phospholipids.

Structure: (alcohol + FA + P +/- Base)

- Their amount remains constant even in starvation (constant element of fat).
- They can be hydrolysed by phospholipases.

Function:

- major constituents of all **cell membranes.**
- components of **bile.**
- **signal mediators.**
- components of **lung surfactant.**
- components of **lipoproteins**

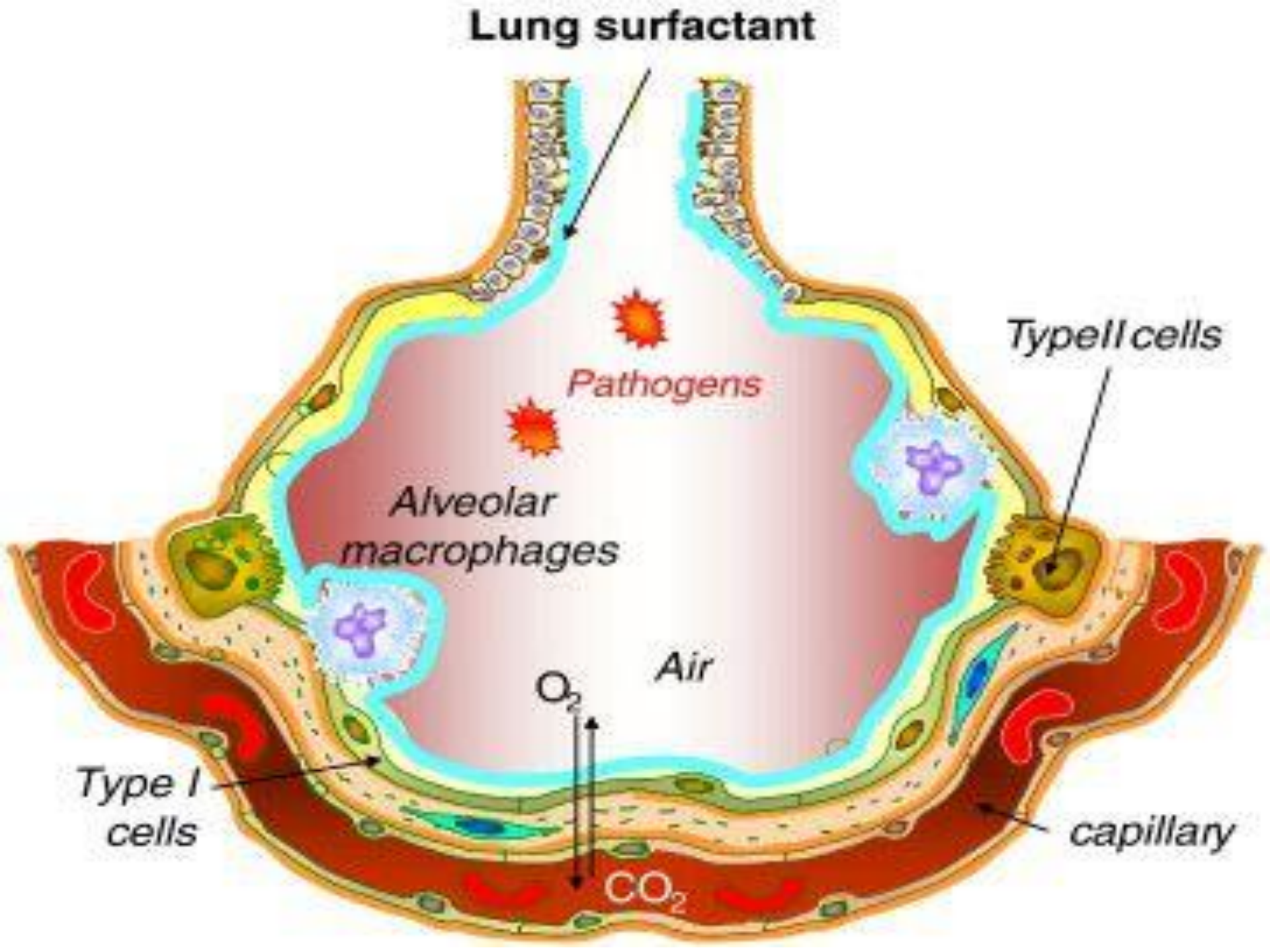
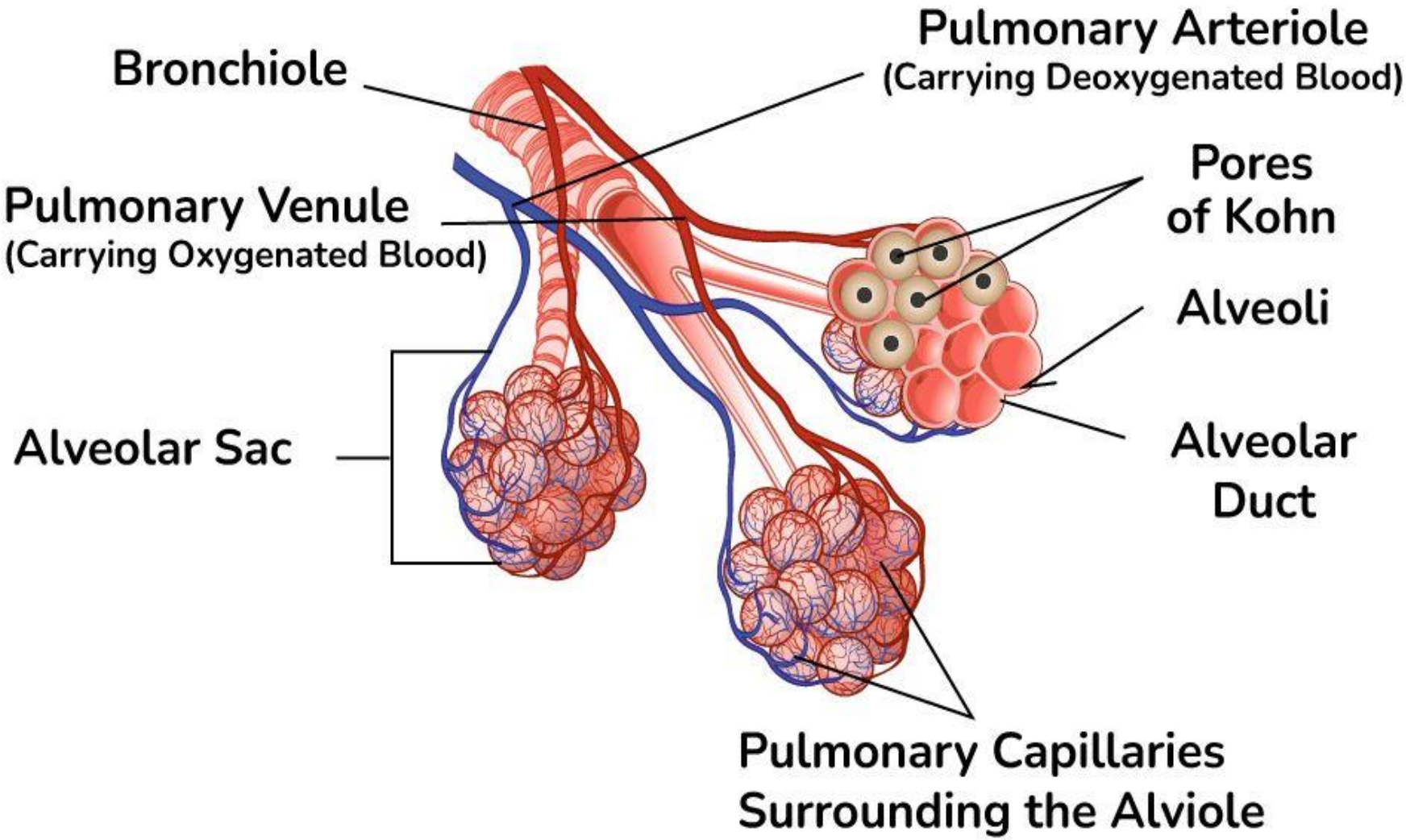

Lung surfactant
Pathogens
TypeII cells
Alveolar
macrophages
Air
O_2
Type I
cells
capillary
CO_2

Diagram of Alveoli

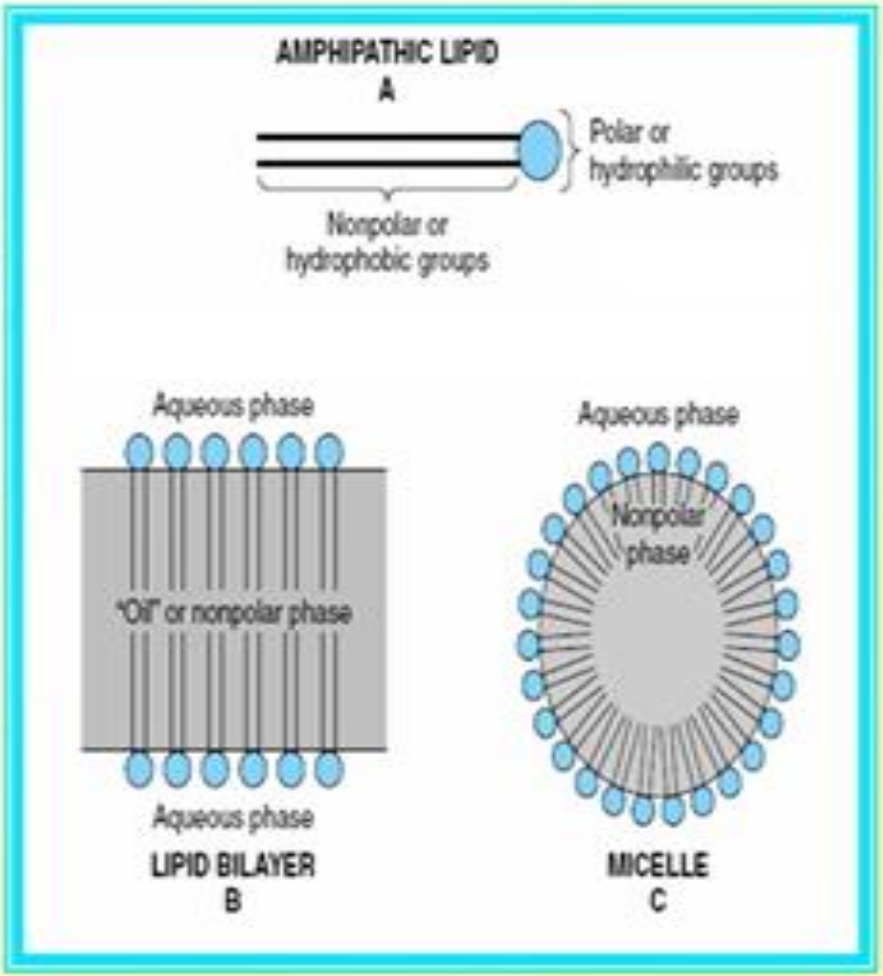


II- complex lipids

1.Phospholipids.

Properties:

- They are **amphipathic lipids** that contain both **polar** and **non polar part** in the same molecule.
- They form micelles in water which are involved in solubilization of lipids in intestinal lumen helping their digestion and absorption.



II- complex lipids

1.Phospholipids. A. Glycerophospholipids :

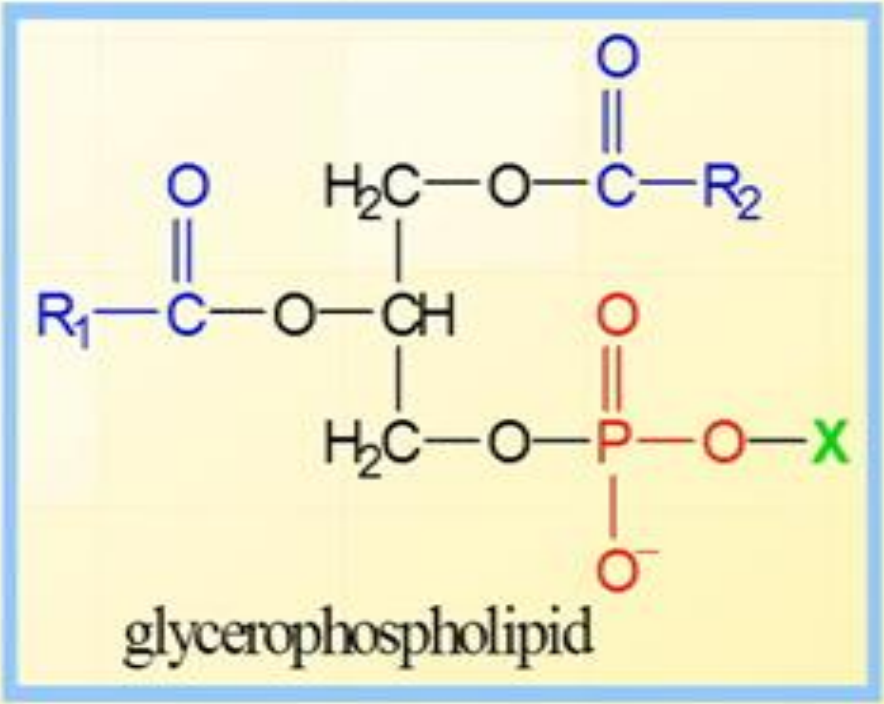
- The fatty acids present in phosphoglycerides are: one mostly **saturated in the 1st position** of glycerol, the **2nd is unsaturated** fatty acid. **Both are high** fatty acids.
- Phospholipids because they have phosphoryl bases as polar, hydrophilic, heads **(ionizable heads)** in addition to their hydrocarbon non polar hydrophobic tail are considered **(amphipathic).**

II- complex lipids

1.Phospholipids. A. Glycerophospholipids :

Each glycerophospholipid includes

- **a polar region:**
  P_i, & the group (X) are polar head
- **non-polar** hydrocarbon tails of fatty acids (R_1, R_2).

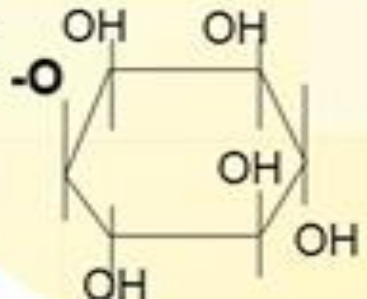


glycerophospholipid

Amphipathic

II- complex lipids

1.Phospholipids. A. Glycerophospholipids

Name and Formula	Name of Phospholipid
ethanolamine $-OCH_2CH_2NH_2$	phosphatidylethanolamine (cephalin)
choline $-OCH_2CH_2\overset{+}{N}(CH_3)_3$	phosphatidylcholine (lecithin)
serine $-OCH_2\underset{\underset{NH_3^+}{|}}{C}HCO_2^-$	phosphatidylserine
inositol -O 	Phosphatidyl inositol

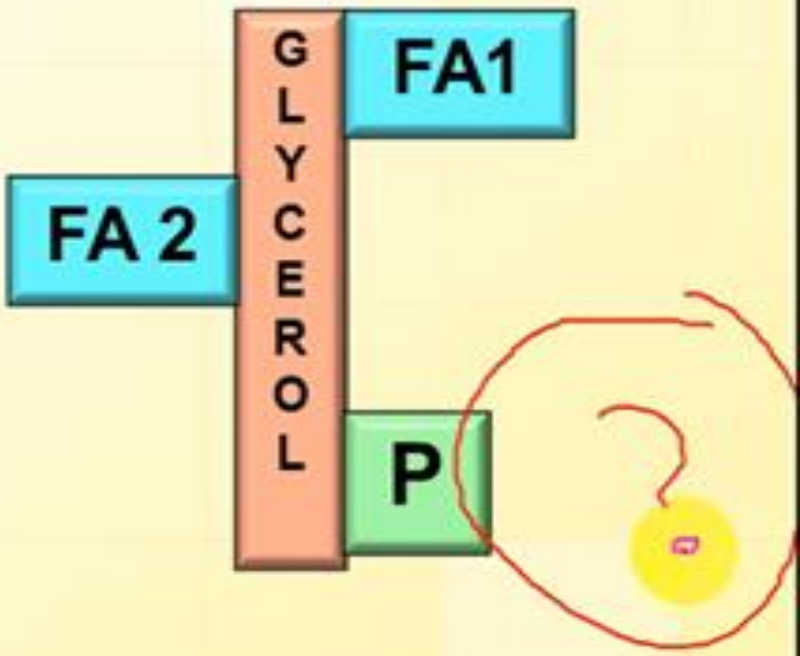
II- complex lipids

1.Phospholipids. A. Glycerophospholipids

Types of Glycerophospholipids

i. Phosphatidic acid:

- it is the **precursor** of all glycerophospholipids.
- It is present mainly as **intermediate** compound during the synthesis of phosphoglycerols and TG.
- It occurs in **very small amounts** in the cell.
- It has **no base.**

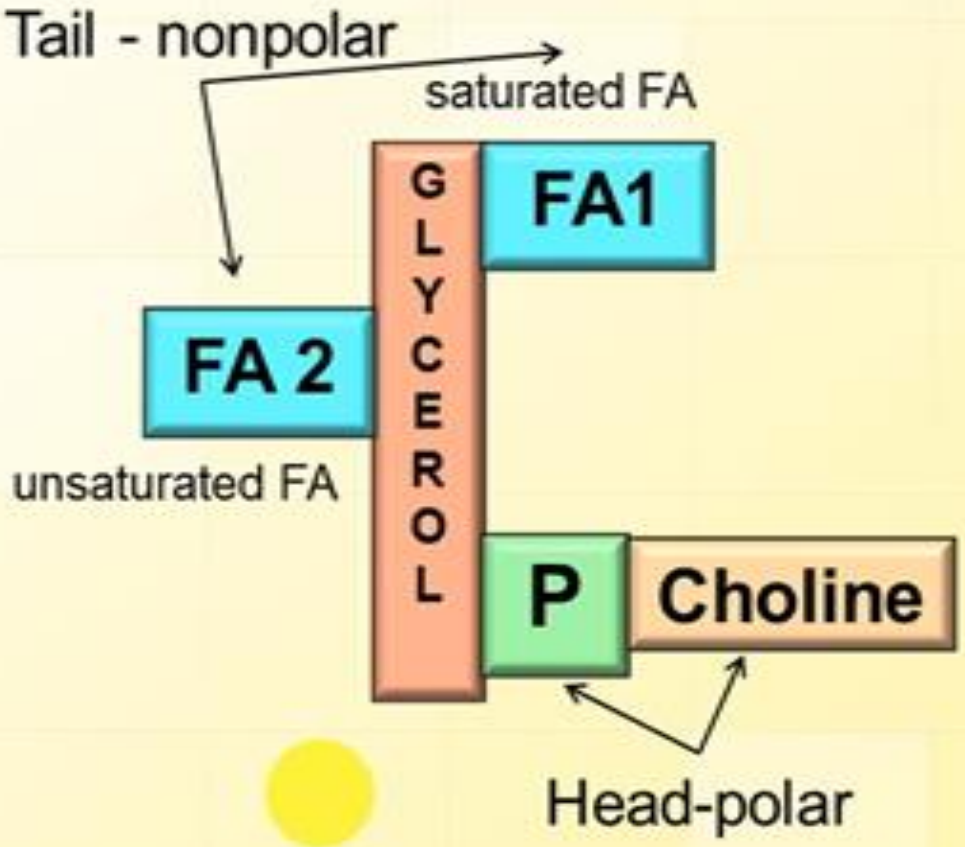


II- complex lipids

1.Phospholipids. A. Glycerophospholipids :

ii. Lecithin (phosphatidyl choline):

- It is the **most abundant** phosphoglyceride in animals.
- The base here is **choline.**
- It is present in the animal's cell **membrane**.



II- complex lipids

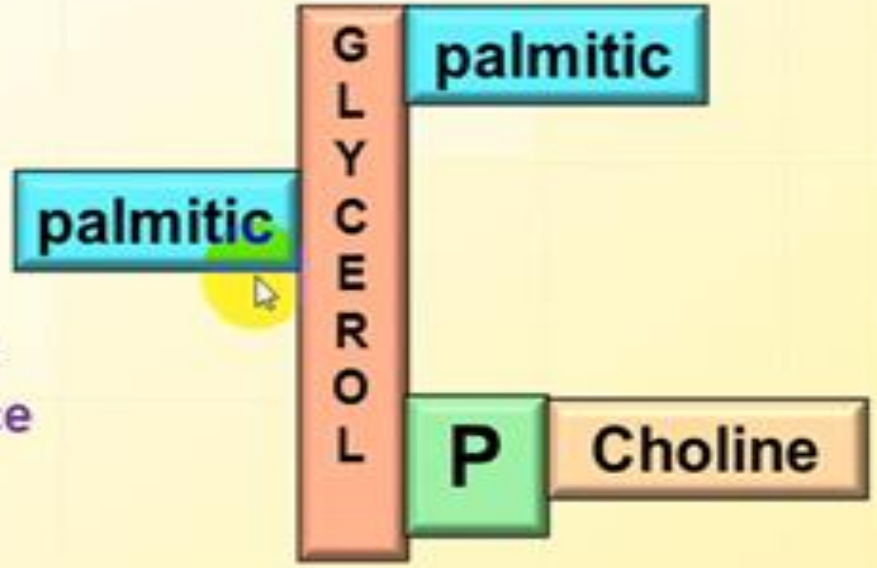
1.Phospholipids. A. Glycerophospholipids :

Dipalmitoyl lecithin :

- in this phosphlipid position 1,2 of glycerol are occupied by palmitate.
- This phospholipid is the major lipid components of lung surfactants

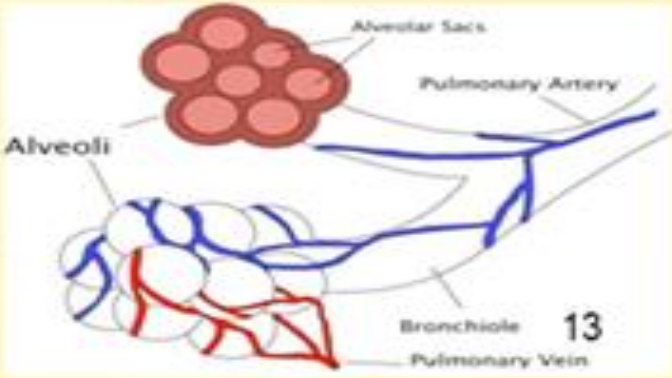
(The extracellular fluid lining the alveoli).

- Surfactants serve to decrease surface tension of the fluid layer therefore prevent alveolar collapse.



Infant respiratory distress syndrome:

- caused by lack of surfactant.
- commonly suffered by premature babies born before 28–32 weeks of gestation.



II- complex lipids

1.Phospholipids. A. Glycerophospholipids :

iii. Cephalin (phosphatidyl ethanolamine):

- It is another abundant phosphoglycerides which is also found in animal cell **membranes**.
- The base is **ethanolamine**.
- Cephalin is one of the important **blood clotting factors**.

iv. Phosphatidyl Serine:

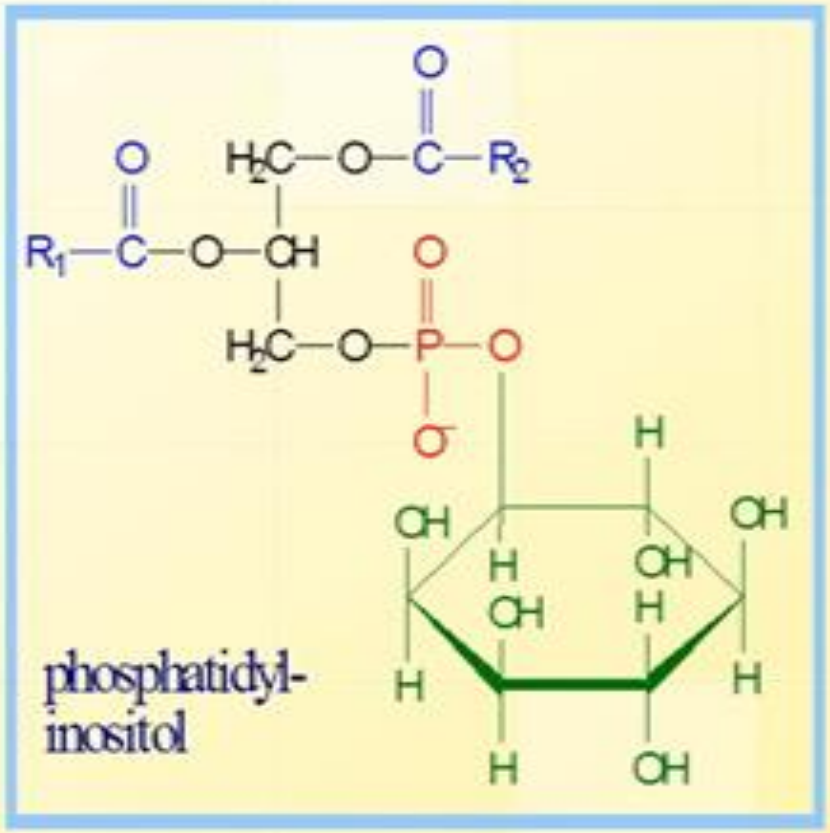
- It is cephalin-like and present in membranes and many tissues.

II- complex lipids

1.Phospholipids. A. Glycerophospholipids :

v. Lipositol (phosphatidyl inositol):

- The polar head here is the cyclic hexose sugar alcohol **inositol** (myoinositol).
- In addition to being a **membrane lipid**, phosphatidylinositol has roles in **cell signaling**.



II- complex lipids

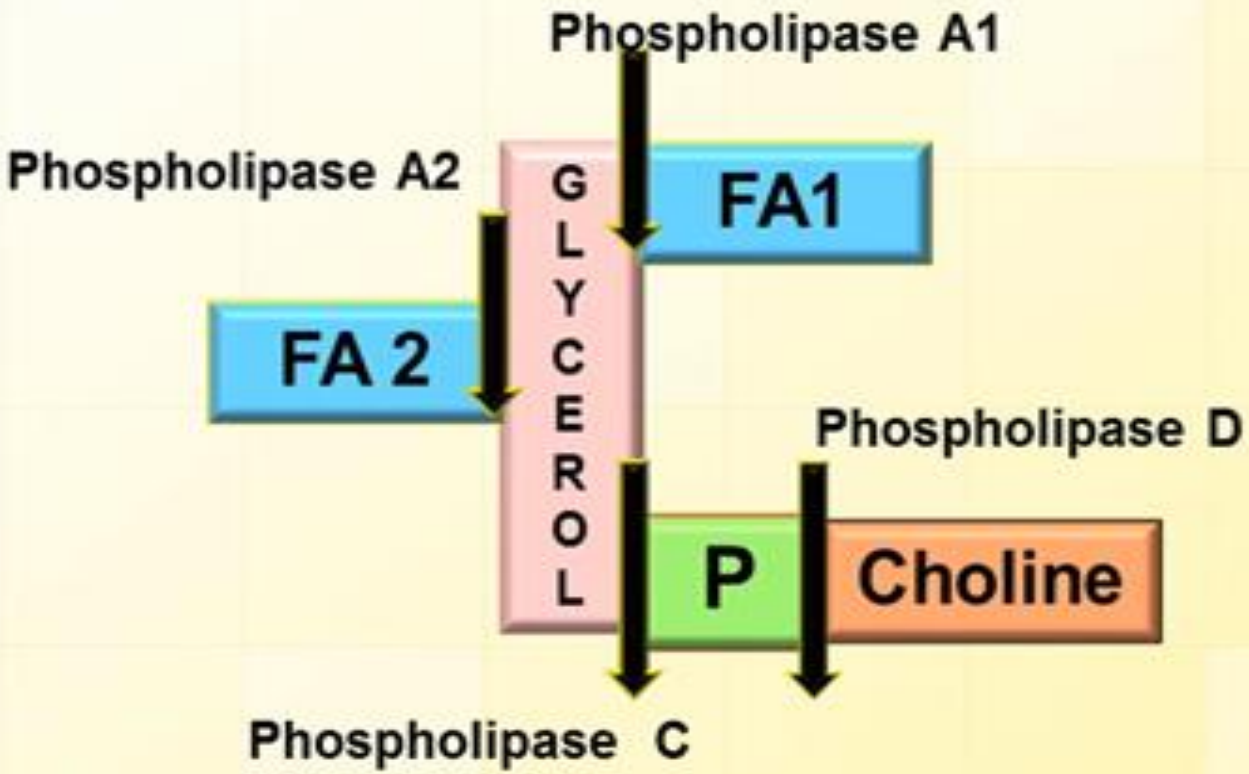
1.Phospholipids. A. Glycerophospholipids :

vi. Diphosphatidyl glycerol or Cardiolipin

- It is composed of **2 molecules of phosphatidic acid** attached to a glycerol molecule.
- Cardiolipin is present in large amounts in the **inner membrane of mitochondria**.

Degradation of Phospholipids

Phospholipases



Lysolecithin

Phospholipase A_2

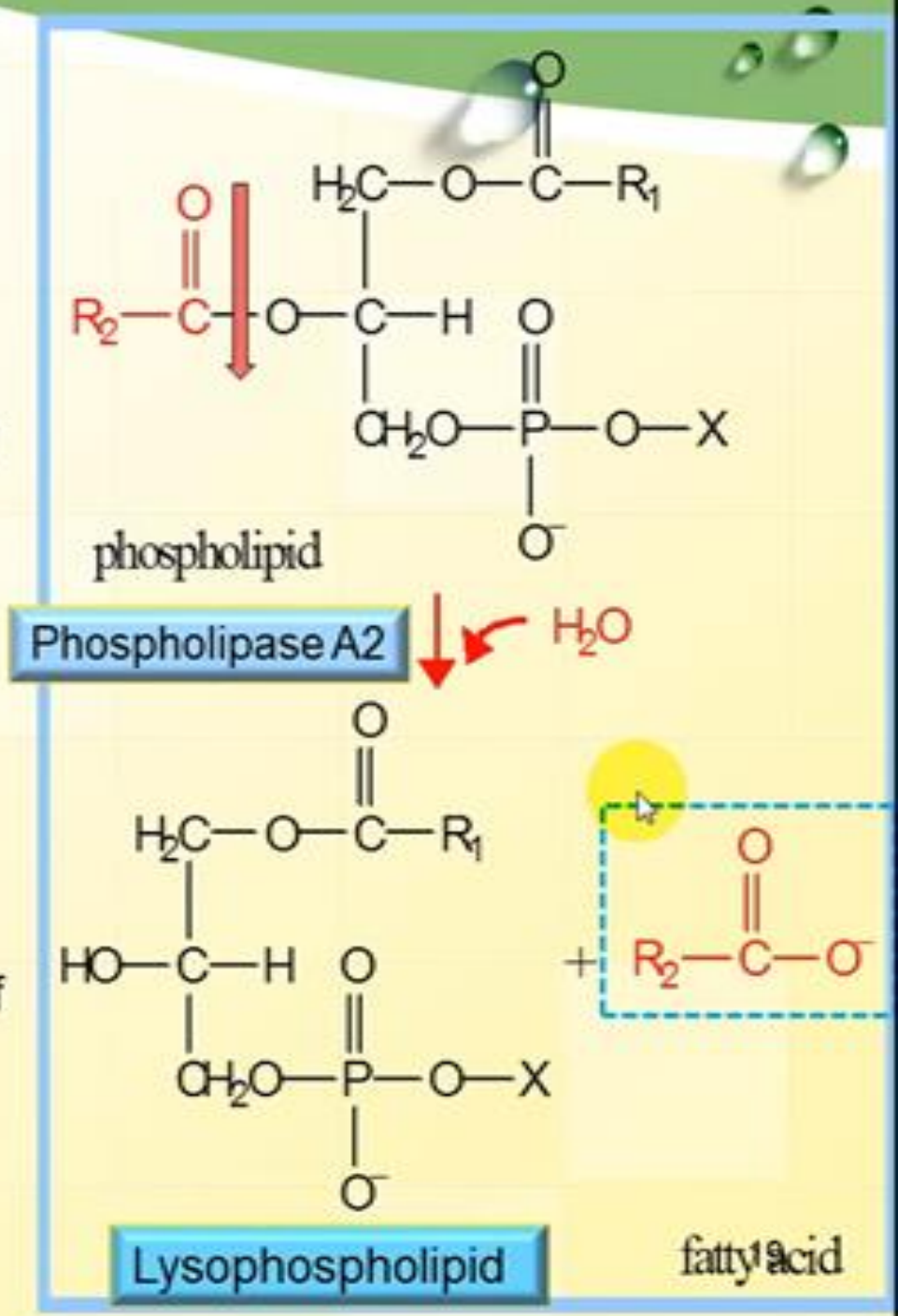
- is secreted by the **pancreas**.

- It hydrolyzes the **ester linkage** between the fatty acid & the hydroxyl on **C2** of phospholipids.

Cobra venoms contain Phospholipase A_2. These venoms, injected into the blood, produce lysophospholipids that:

- ***disrupt cell membranes***
- ***lyse blood cells***
- ***neurotoxic effect*** (degeneration of the nerve terminal and skeletal muscle).

Thank you
Good Luck



«إن اللّه يحب إذا
عمل أحدكم عملاً
أن يتقنه»

حديث شريف

A THEORETICAL LECTURE IN MEDICINAL CHEMISTRY

MSC ABDULKHALEQ SAAD