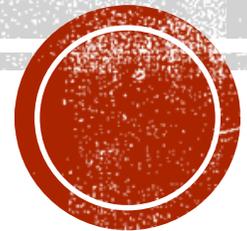
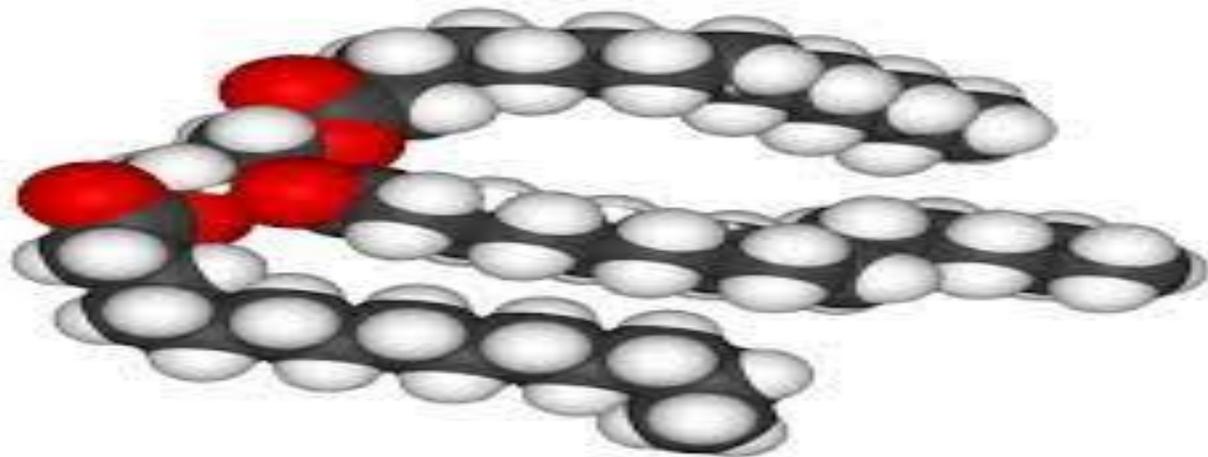


Lipid Chemistry



Students Learning Outcomes

❖ *By the end of this lecture, the students should be able to:*

1. **Define lipids.**
2. **Summarize the biological importance of lipids.**
3. **Classify lipids**
4. **Describe the structure and function of F.A, Phospholipids, and lipoproteins.**
5. **Correlate the knowledge to the clinical situation.**



Case Scenario

A 57 years old male patient admitted in the hospital with chief complaints of chest pain since 2 months radiating to left upper limb. The patient had history of dyspnea on exertion, palpitation and sweating. He had history of cerebrovascular stroke.

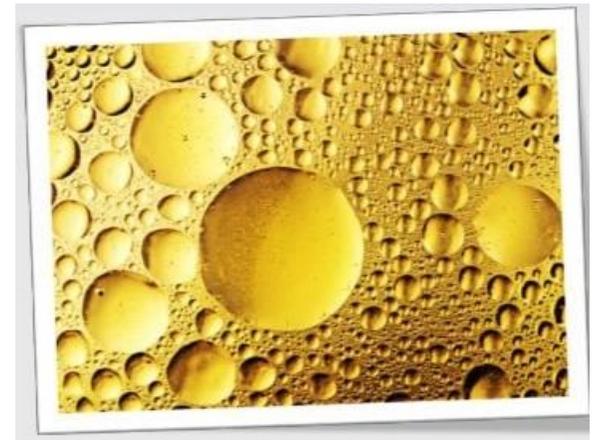


Definition of lipid

Lipids are compounds which are relatively **insoluble in water**, but freely **soluble** in non-polar organic solvents like benzene, ether, acetone, chloroform.

Why we study Lipid?

1. **Source of energy**: they yield **twice** the energy produced by the same weight of carbohydrates or proteins (**in absence of Carbohydrates**)
2. **Energy store** in adipose tissue serve as.



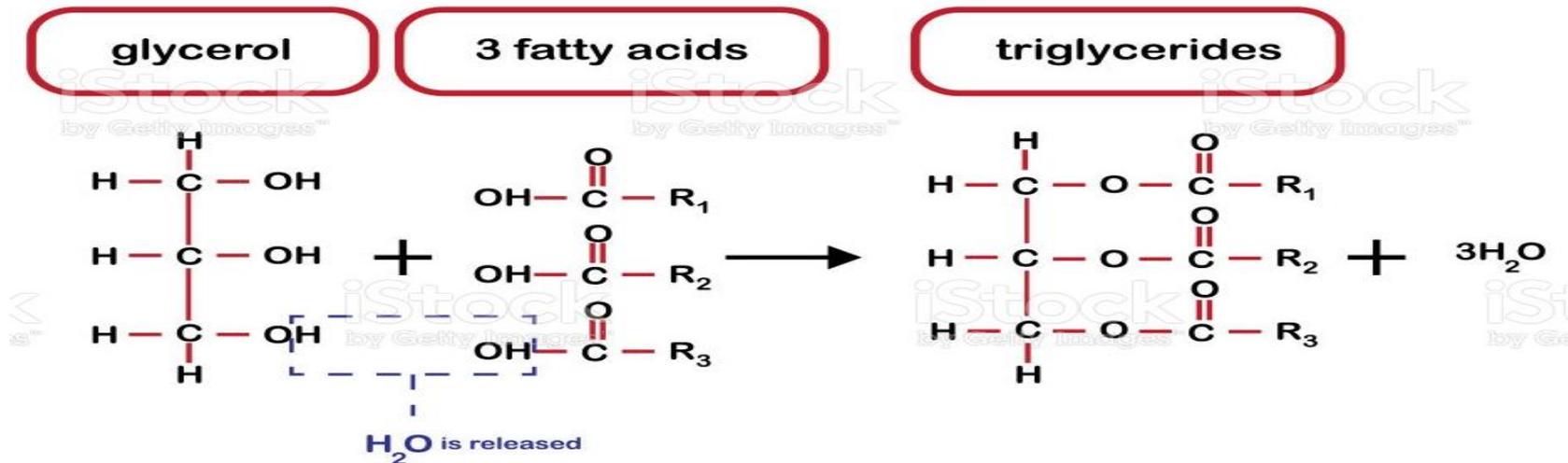
Classification of Lipid

Simple lipid	Compound lipid	Derived lipids
Formed of fatty acids + fatty alcohol	Formed of lipid part + non-lipid part	substances derived from simple lipids and compound lipids by hydrolysis
Fats and Oils	<ul style="list-style-type: none">• Phospholipids.• Glycolipids.• Sulpholipids.• lipoproteins	<ol style="list-style-type: none">1- Fatty acids.2- glycerol.3- Steroids.



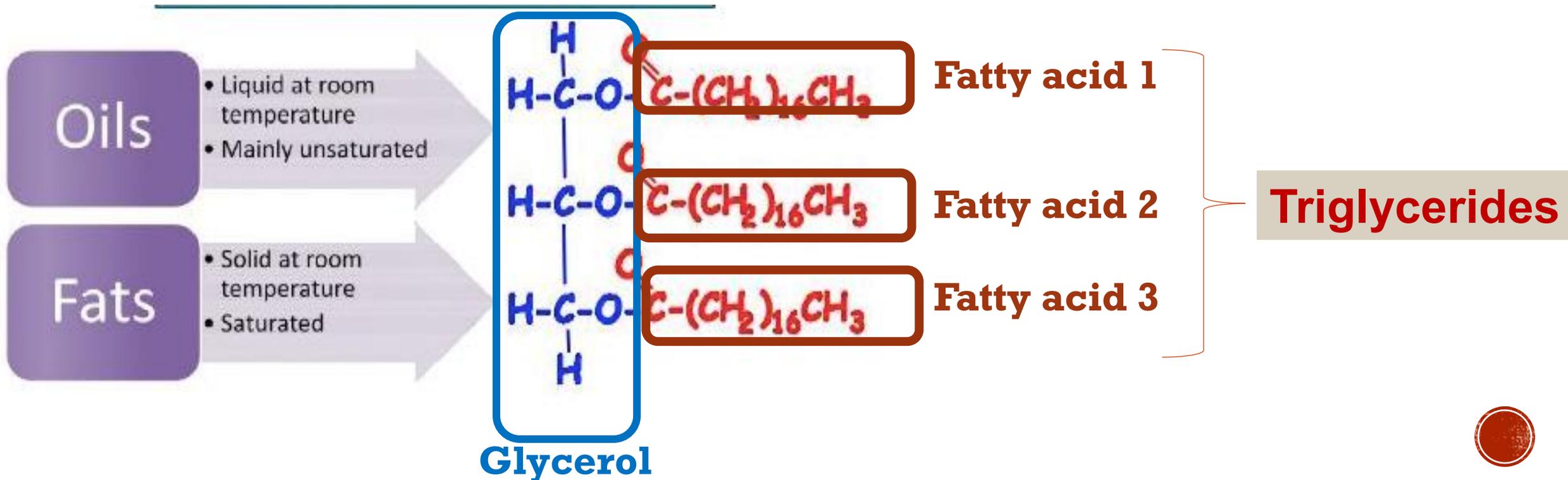
Definition of simple lipid

They are esters of **fatty acids** with **fatty alcohol**



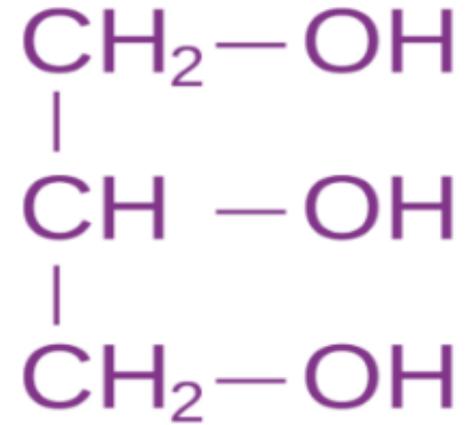
Example of simple lipid

Fats and oil eg. Triglycerides



A) Glycerol

- ✓ It is a polyhydric alcohol containing **3 OH** groups.
- ✓ It is **miscible** with water.
- ✓ **Importance of glycerol: Used**



1. In treatment of

A) **coronary heart disease** like angina (act as **Vasodilator**)
nitroglycerin

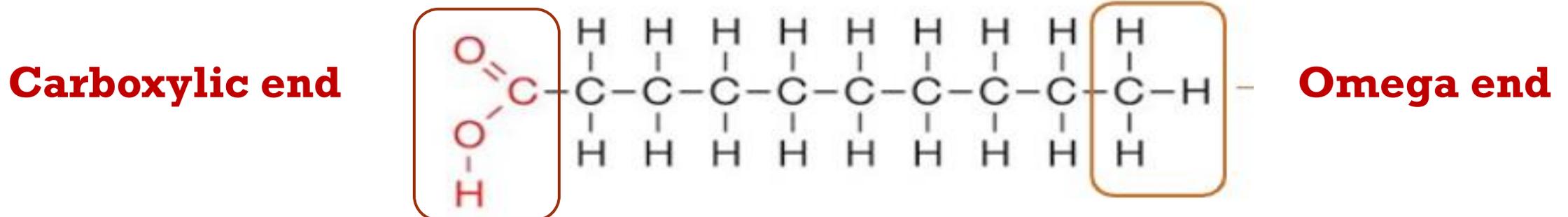
B) **glaucoma** due to its ability to **dehydrate tissue** from its content of water

2. In **Pharmaceutical and cosmetic** preparations
3. As **explosive**

B) Fatty Acids (FAs)

Structure of FA

- A fatty acid consists of a **straight chain** of an even number of **carbon** atoms, with:
 - **Hydrogen atoms** along the length of the chain and at one end of the chain (**omega end**)
 - **Carboxyl group** (—COOH) at the other end (**carboxylic end**)



Classification of FA

- **Classification: according to absence or presence of double bonds to:**

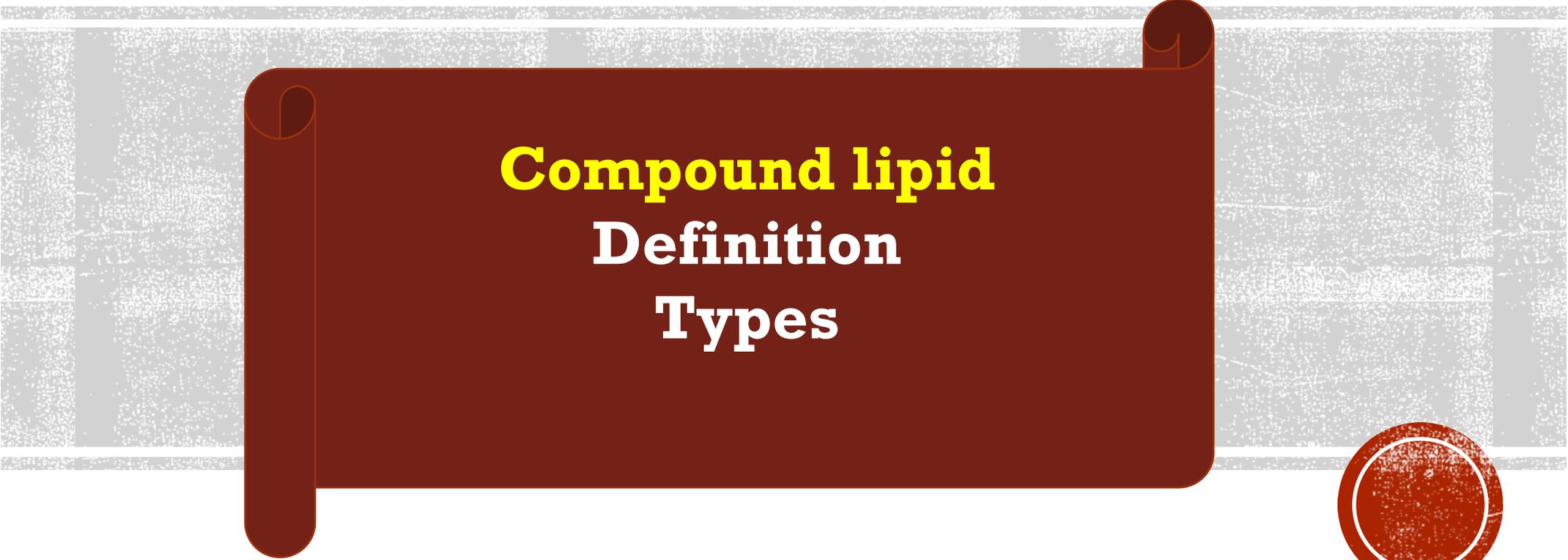
Saturated FAs		Unsaturated FAs	
No double bond		Presence of double bond	
short chain FAs	long chain FAs	Mono-unsaturated FAs	Poly-Unsaturated FA (PUFA), (Essential) FAs
Up to 10 carbon atoms.	More than 10 carbon atoms	contains 1 double bond	more than 1 double bond
<ol style="list-style-type: none"> 1. Acetic acid (2C) 2. Butyric acid (4C) 3. Caproic acid (6 C) 	<ol style="list-style-type: none"> 1. Palmitic acid (16C) 2. Stearic acid(18C) 	Oleic acid (18 C+ 1 double bond)	<ol style="list-style-type: none"> 1. Linoleic acid: (18C+ 2 = bonds). 2. Linolenic acid: (18C+ 3 = bonds). 3. Arachidonic acid: (20C+ 4 = bonds).
			<ol style="list-style-type: none"> 1. They must be taken in diet because the body cannot synthesize them 2. Essential for growth 3. Essential for synthesis of phospholipid & prostaglandins

Examples of fatty acids

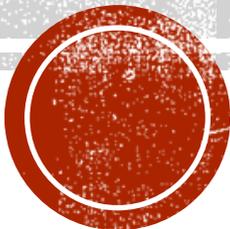
(a) Saturated fatty acids:

Common name	No. of carbons	Structure
Acetic	2	CH ₃ -COOH
Butyric	4	CH ₃ -CH ₂ -CH ₂ -COOH
Caproic	6	CH ₃ -(CH ₂) ₄ -COOH
Palmitic	16	CH ₃ -(CH ₂) ₁₄ -COOH
Stearic	18	CH ₃ -(CH ₂) ₁₆ -COOH





Compound lipid
Definition
Types



Definition of compound lipid

They are lipids conjugate with non lipids (other groups)

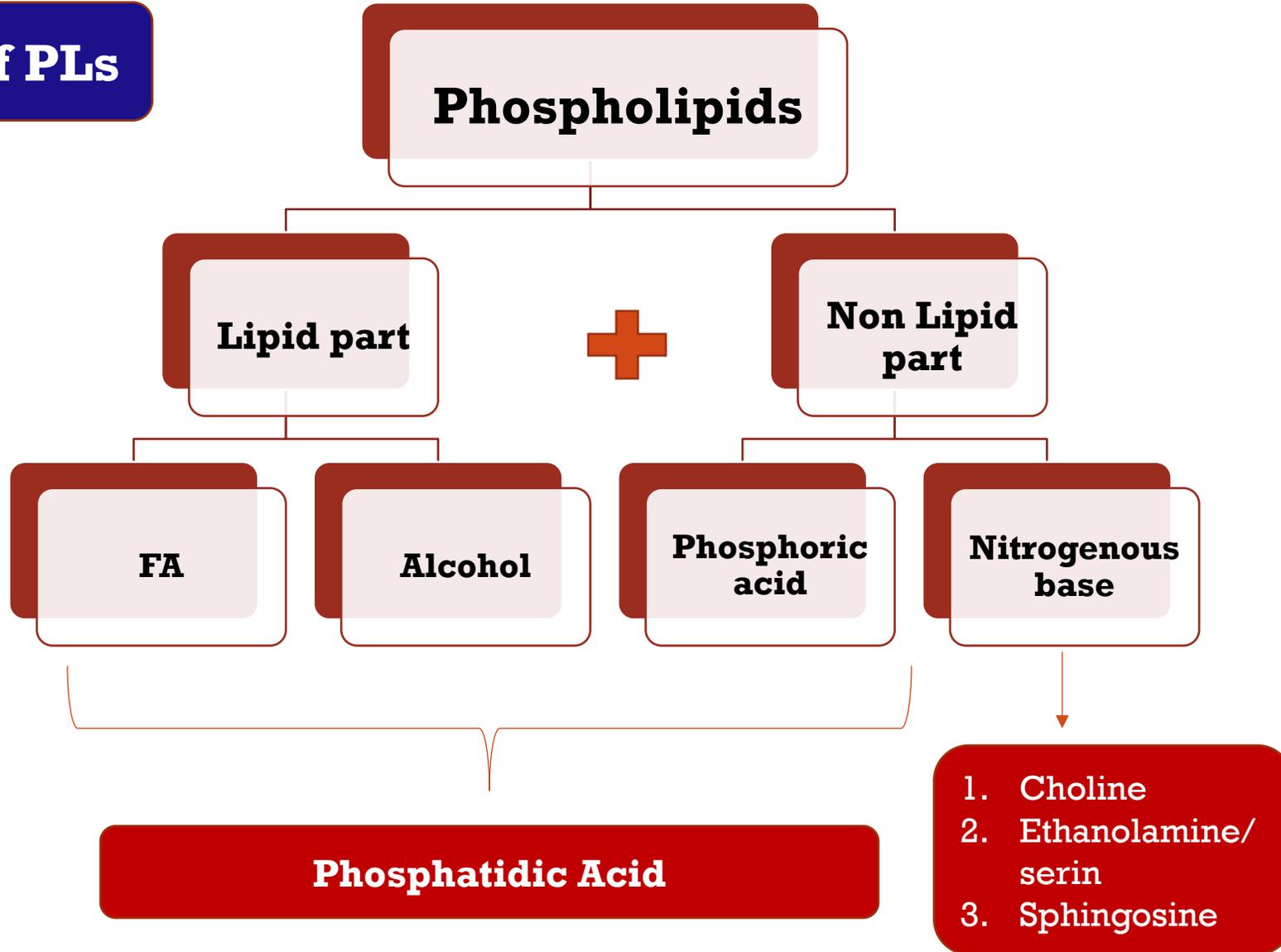
Types of compound lipid

Compound lipid	lipid	Non lipid
1. Phospholipids	Lipid +	Phosphoric acid
2. Glycolipids		Carbohydrate
3. Sulpholipids		Sulphate
4. Lipoproteins		Protein



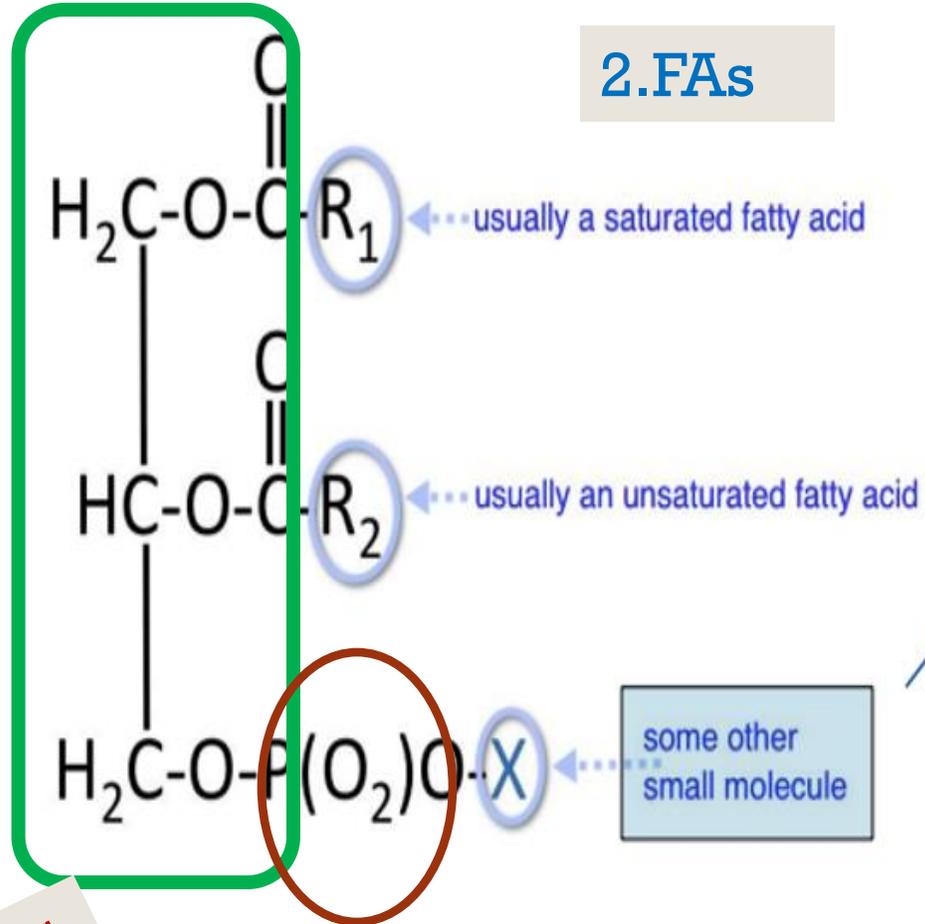
1. Phospholipid (PL)

Structure of PLs



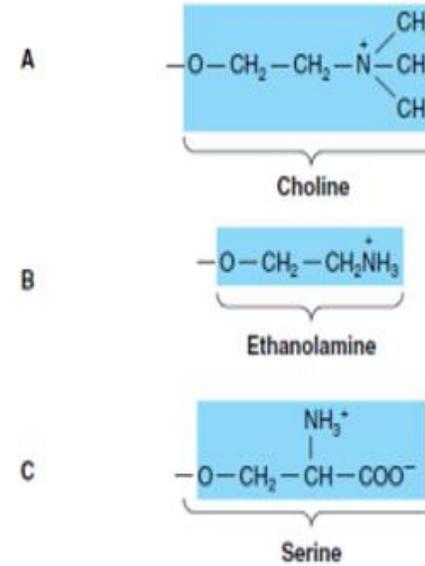
1. Alcohol= glycerol

2. FAs



Phosphatidic acid

3. Phosphoric acid



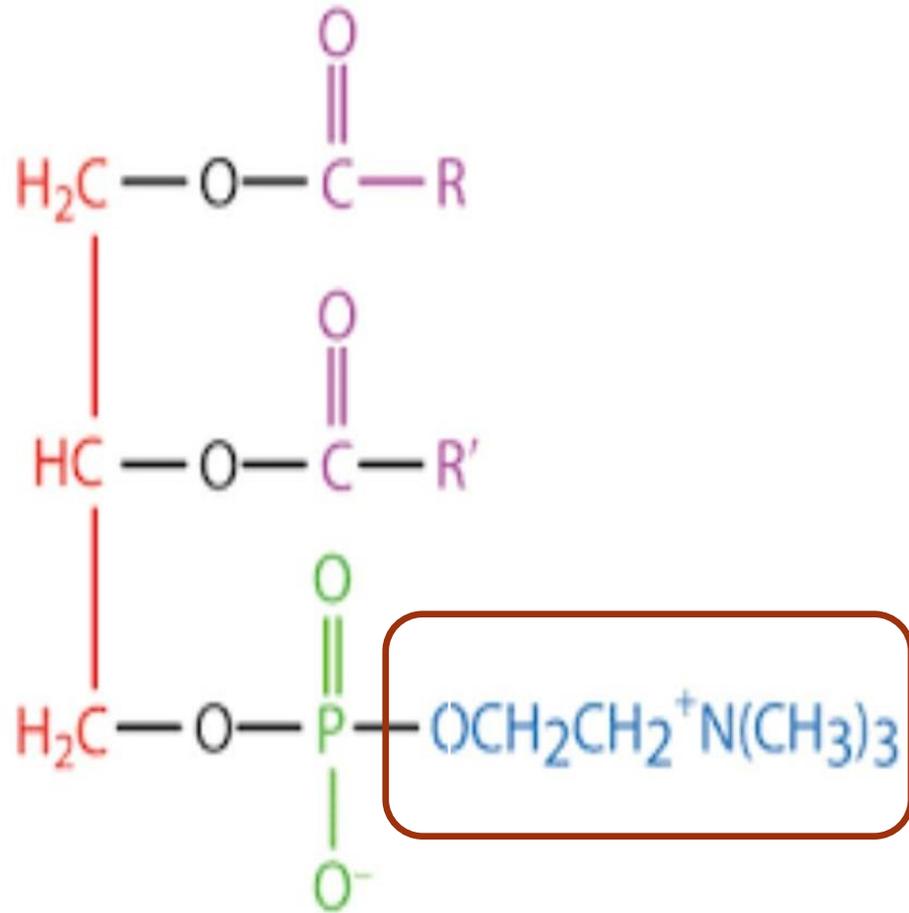
4. Nitrogenous base



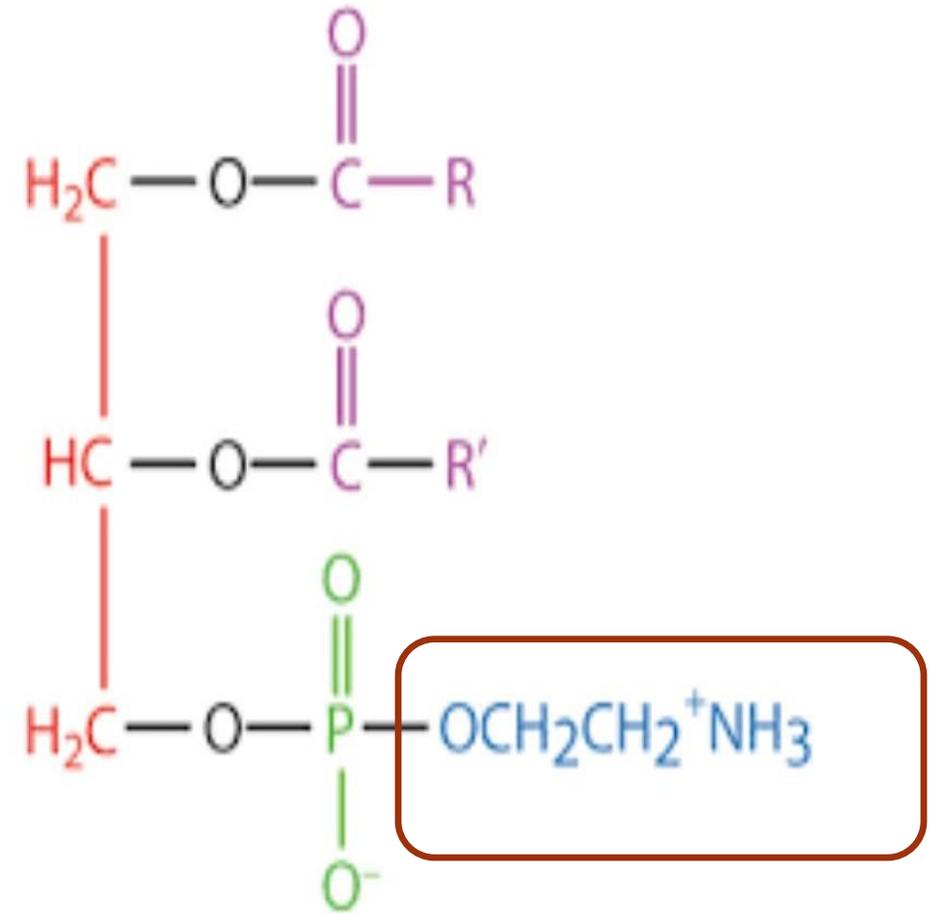
Types of PLs

	Lecithin phosphatidyl choline	Cephalin	Sphingomyelins
Nitrogenous base	Choline.	Ethanolamine or serine	Sphingosine & Choline
Function	<p>in the cell membrane. (most abundant PLs) lipotropic factor (prevent accumulation of lipids in the liver) Lung surfactant (preventing lung collapse)</p>	They have a role in blood coagulation because they share in the structure of thromboplastin, which is essential for blood clotting.	abundant in the nervous system in the myelin sheath.
Deficiency	Respiratory distress syndrome		





Phosphatidycholine
(lecithin)

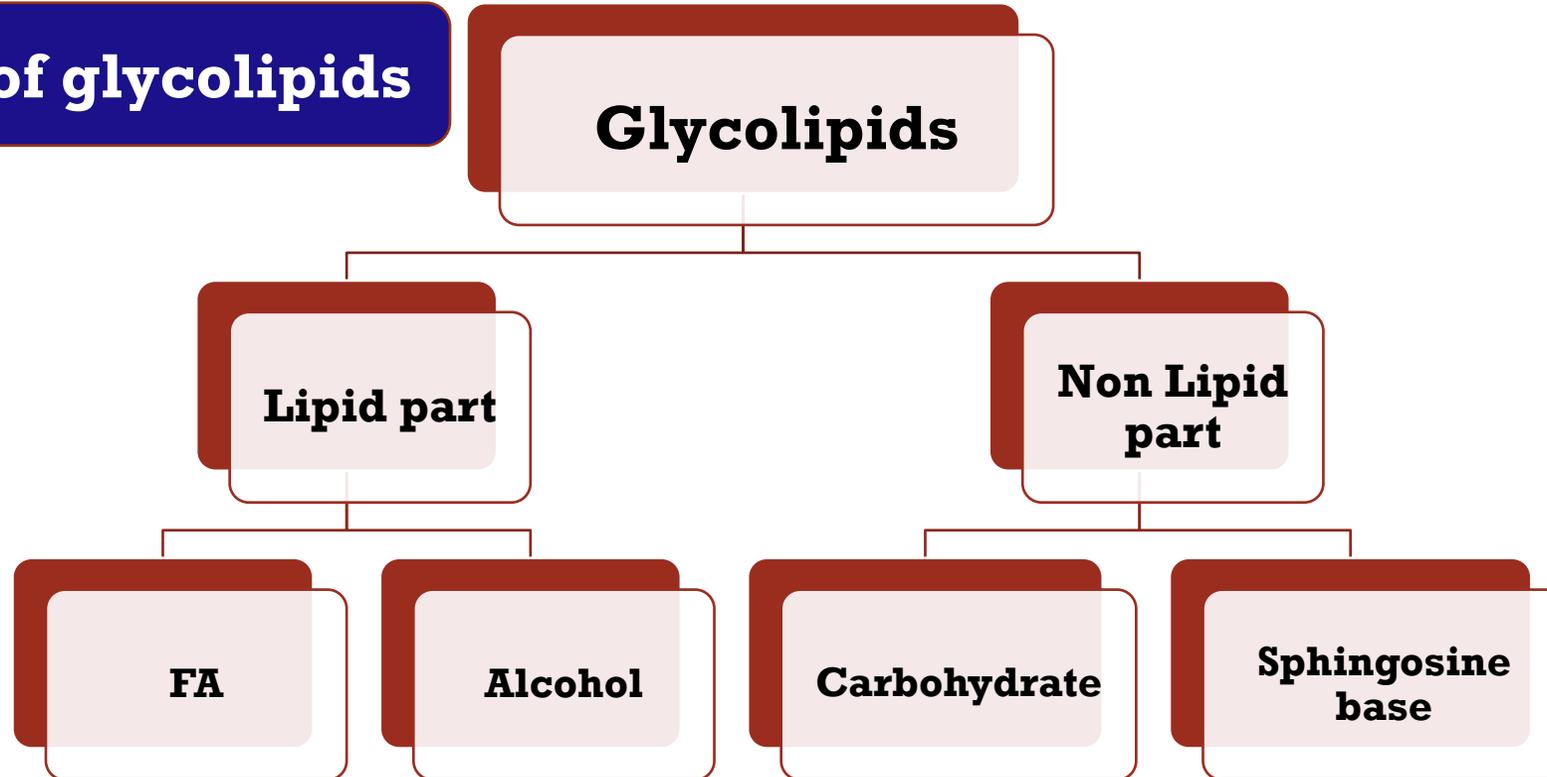


Phosphatidylethanolamine
(cephalin)



2. Glycolipids

Structure of glycolipids



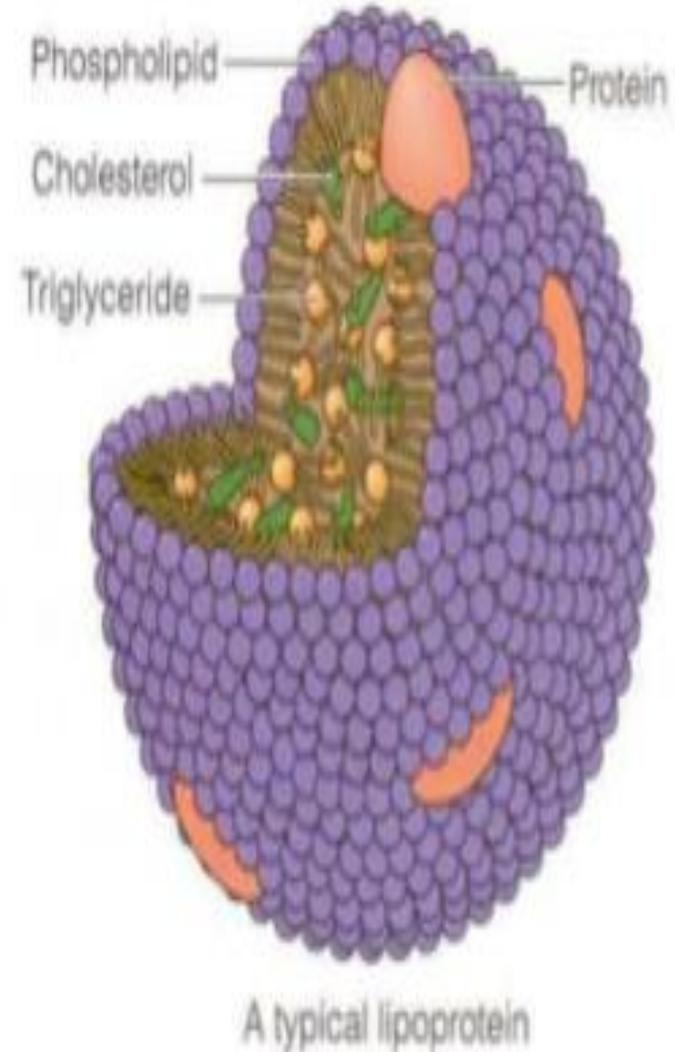
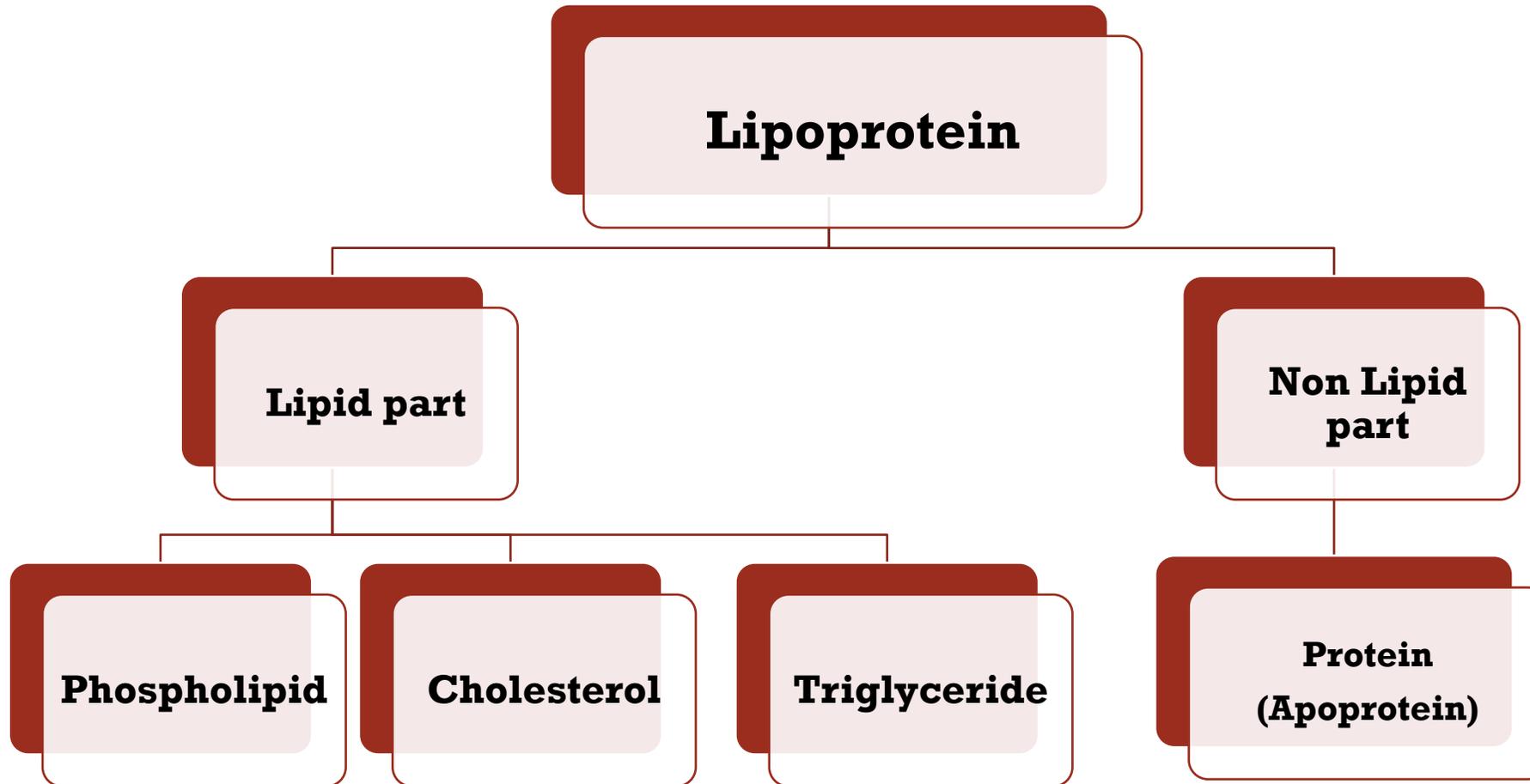
Function of glycolipids

- They are present mainly in the **nervous tissues** i.e. **brain and nerves**.
- They act as **electric insulators of nerve impulses**.



3. Lipoproteins

Structure of lipoproteins



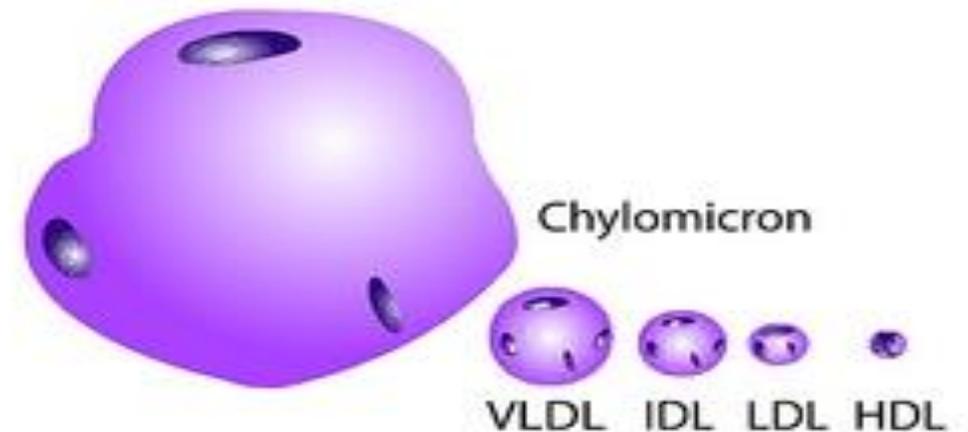
Function of lipoprotein

Lipid transport in the blood:

- Lipids are insoluble in water can't be transported in blood freely
- Binding of Lipids to protein to make lipoproteins → water-soluble → lipid is transported in the blood

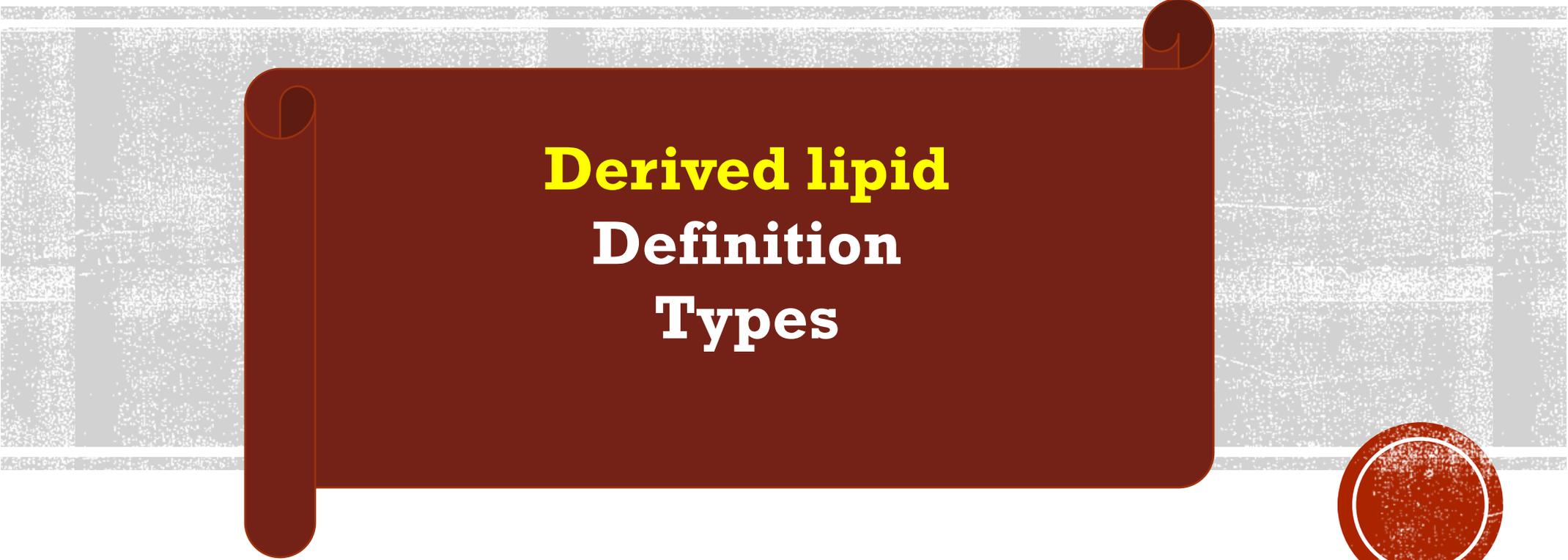
Types of lipoproteins

- 1-Chylomicrons (CM)
- 2-Very Low Density Lipoprotein (VLDL)
- 3-Low Density Lipoprotein (LDL)
- 4-High Density Lipoprotein (HDL)

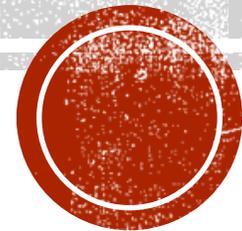


	Chylomicrons	VLDL	LDL	HDL
Site of synthesis	Small intestine	Liver	Blood	Liver
Structure	Mainly triglycerides,	Mainly triglycerides,	Mainly cholesterol	Mainly proteins & phospholipids
Function	Transport exogenous dietary triglycerides From: small intestine To: the tissue.	Transport endogenous triglycerides From: liver To: tissue.	Transport cholesterol From: liver To: peripheral tissues.	Transport cholesterol From: tissues To: liver. (Retrograde (reverse) cholesterol transport)





Derived lipid
Definition
Types



Derived lipids

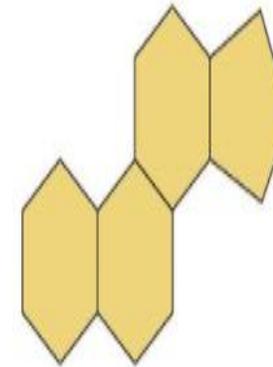
- They are compounds :
derived from simple lipids and compound lipids by hydrolysis

1. **Fatty acids**
2. **Glycerol**

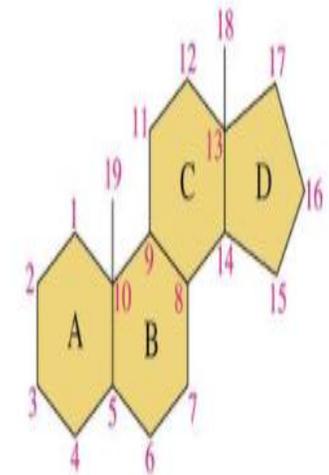
and substances **related to lipids** as steroids

1. **Cholesterol**
2. **Steroid hormones (sex hormones)**
3. **Vitamin D**
4. **Bile acids and salts**

(All of them contain a **steroid nucleus**)



Steroid nucleus



Steroid numbering system





learn from
The Past

live in
The Present

plan for
The Future



REFERENCES

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- ❑ **Vasudevan's Textbook of Biochemistry For Medical Students, 6th Edition.**
- ❑ **Lippincott's Illustrated Reviews: Biochemistry, 8th edition**

