بسم الله الرحمن الرحيم

Lipid Compounds of Physiological Significance

By

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Objectives

- **Functions of lipid compounds**
- **Clinical problems**
- **Lipid compounds of physiological importance**
- **Complex lipids:**

  Phospholipids, glycolipids and lipoproteins

Functions of lipid compounds

- **Major energy source for the body**
- **Structural component of cell membranes**
- **Important regulatory molecules:**

e.g., Fat-soluble vitamins
Steroid hormones
Prostaglandins
Signaling molecules: Inositol triphosphate (IP3)

Lipids and Related Clinical Problems

- Obesity
- Atherosclerosis and hypertension
- Coronary heart diseases

Lipid Compounds

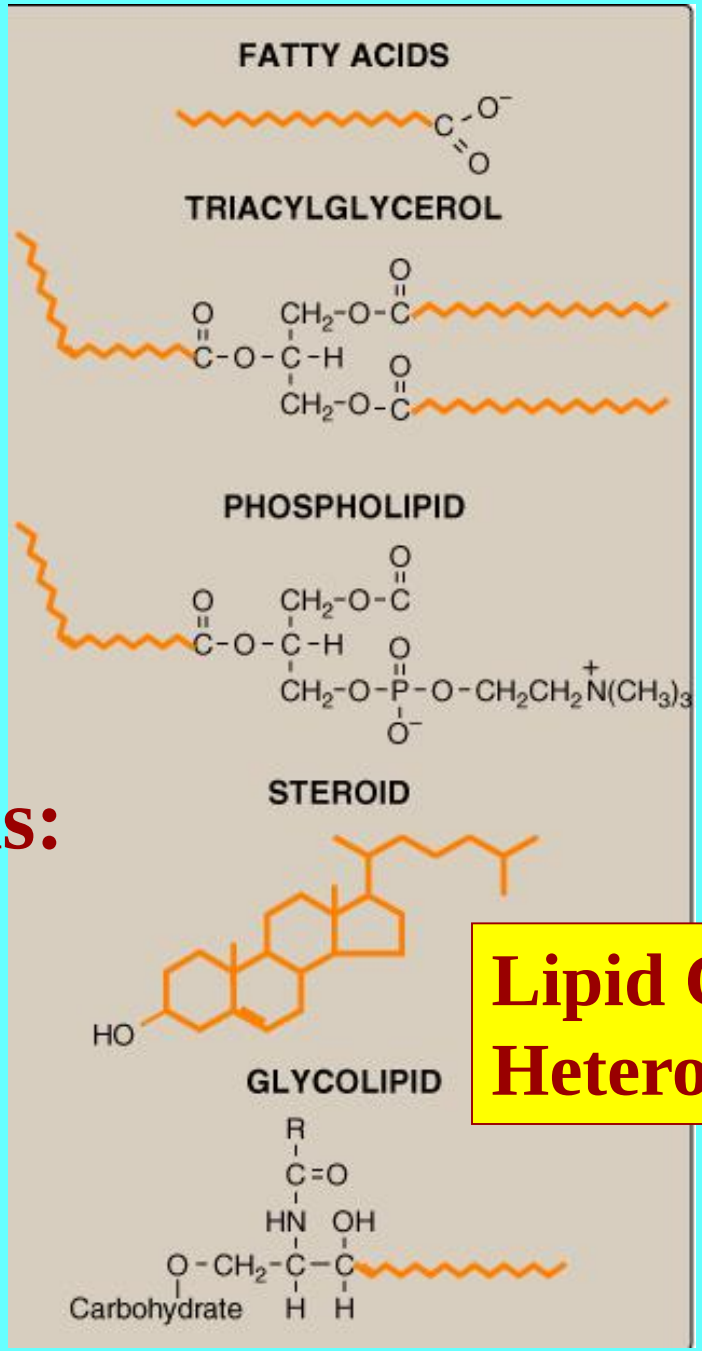
- Heterogeneous group
- Relatively water-insoluble (? Exception)
- Soluble in non-polar solvents

A. Simple Lipids:

- Fatty acids
- Ketone bodies
- Triacylglycerol
- Cholesterol

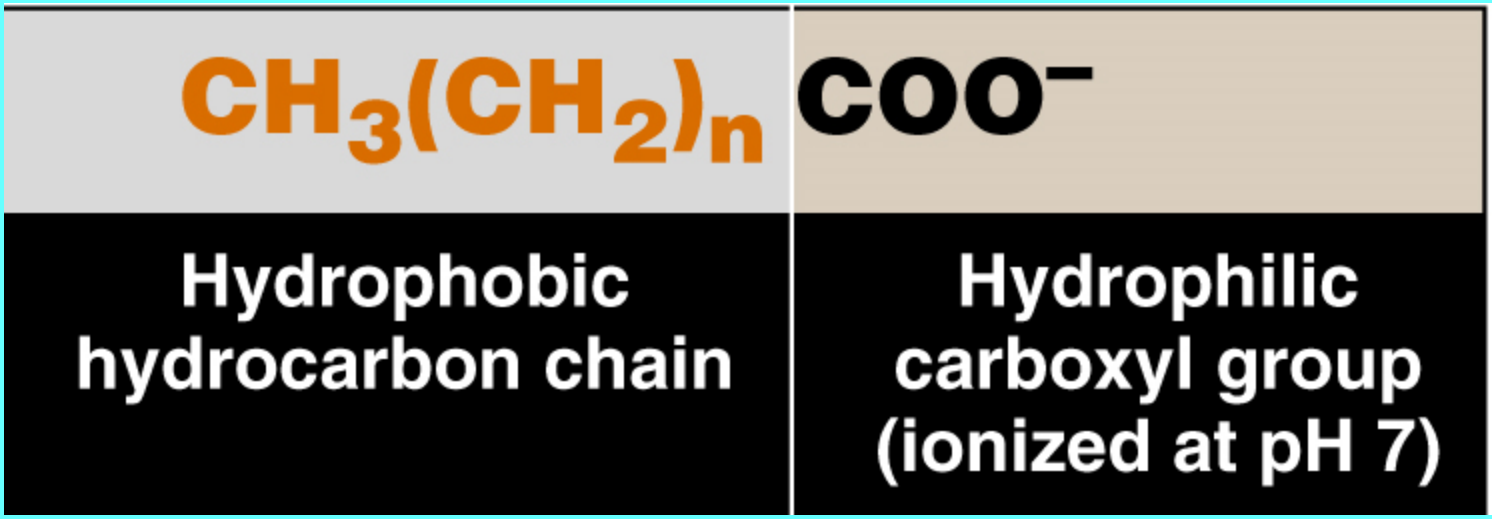
B. Complex Lipids:

- Phospholipids
- Lipoproteins
- Glycolipids



Lipid Compounds: Heterogeneous Group

Fatty Acids (FA)



Amphipathic: Both hydrophobic & hydrophilic parts

Fatty Acids

1. Chain length:

Short-chain and Medium-Chain

Long-Chain **e.g., Palmitic acid 16:0**

Very long-chain **e.g., Nervonic acid 24:1**

2. Degree of saturation:

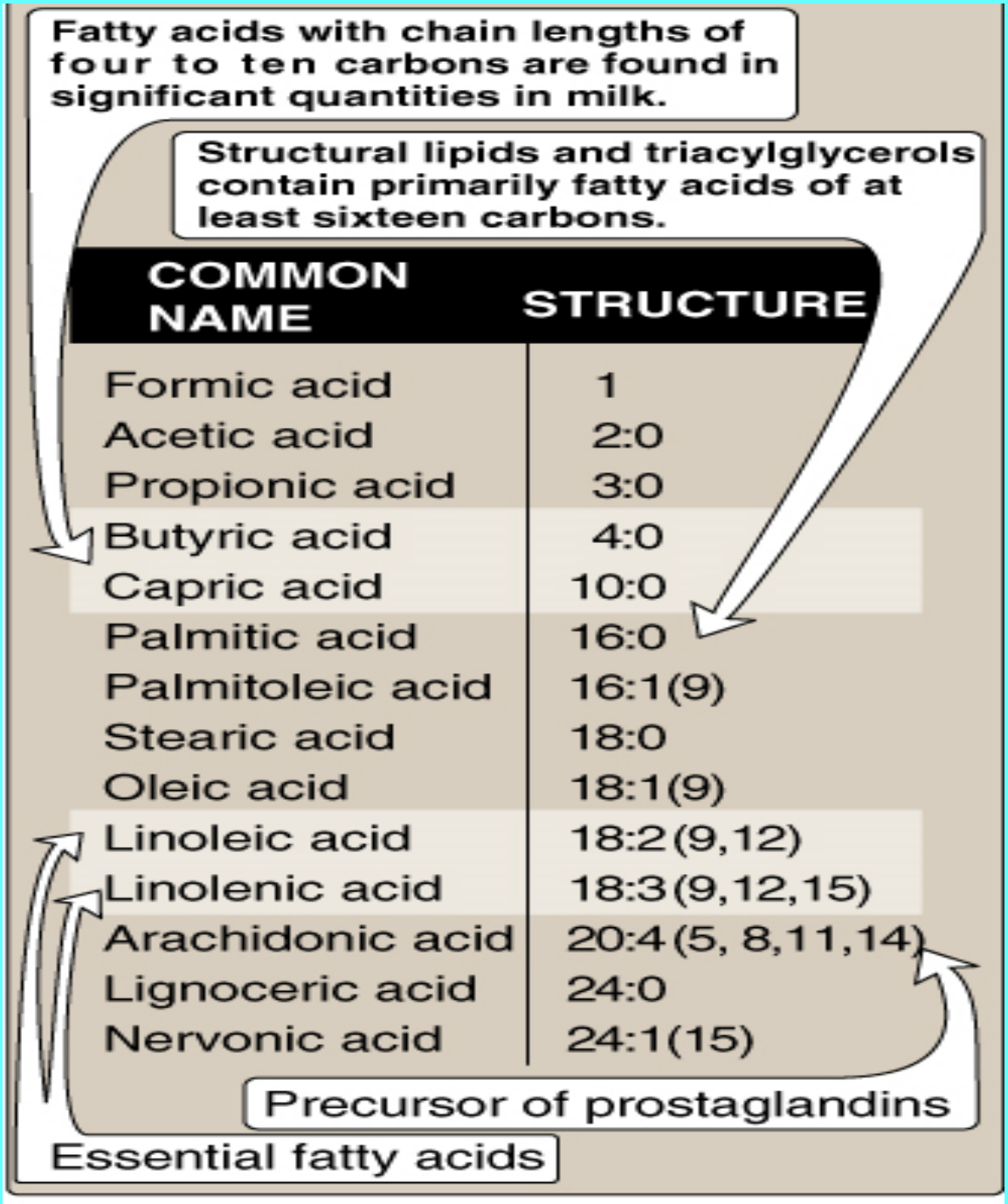
Saturated: No double bonds

Unsaturated: Mono- or poly-unsaturated

Cis- or trans-form

3. Essential fatty acids

Fatty Acids



COMMON NAME	STRUCTURE
Formic acid	1
Acetic acid	2:0
Propionic acid	3:0
Butyric acid	4:0
Capric acid	10:0
Palmitic acid	16:0
Palmitoleic acid	16:1(9)
Stearic acid	18:0
Oleic acid	18:1(9)
Linoleic acid	18:2(9,12)
Linolenic acid	18:3(9,12,15)
Arachidonic acid	20:4(5, 8,11,14)
Lignoceric acid	24:0
Nervonic acid	24:1(15)

Essential Fatty Acids

1. Linoleic acid, 18:2

2. Linolenic acid, 18:3

The precursor of prostaglandins, arachidonic acid 20:4, is also considered essential fatty acid if linoleic acid is deficient from diet

Plasma Fatty Acids

Esterified form (~90%):

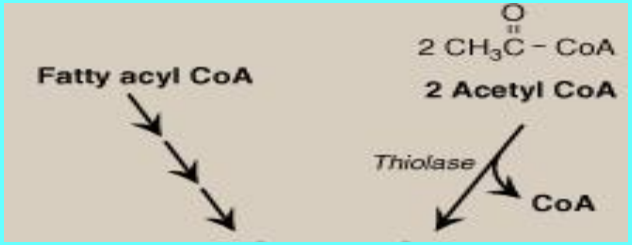
In triacylglycerol, cholesterol ester, phospholipids (as part of lipoproteins)

Free-form (unesterified):

Transported in association with albumin

Triacylglycerols

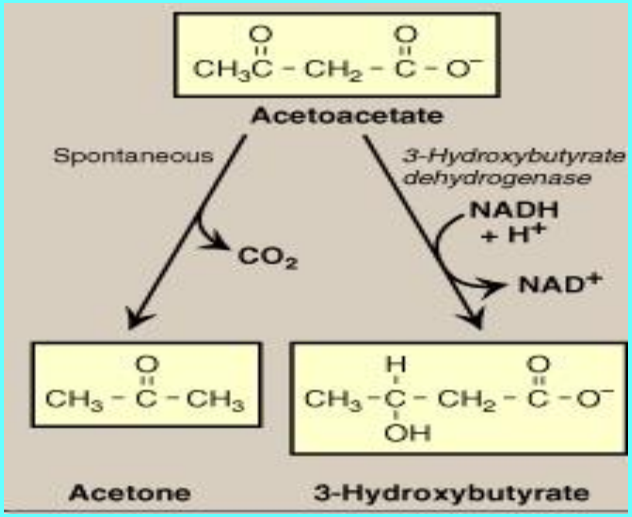
- **Storage form in adipose tissue**
- **~ 90% of dietary lipids**
- **Glyscerol plus 3 fatty acids**
- **Blood transport: Chylomicrons and VLDL**



Ketone Bodies

1. Water-soluble
2. Diabetic Ketoacidosis

1. Acetone
2. Acetoacetate
3. β-Hydroxybutyrate



Phospholipids

A. Glycerophospholipids

Glycerol-containing phospholipids

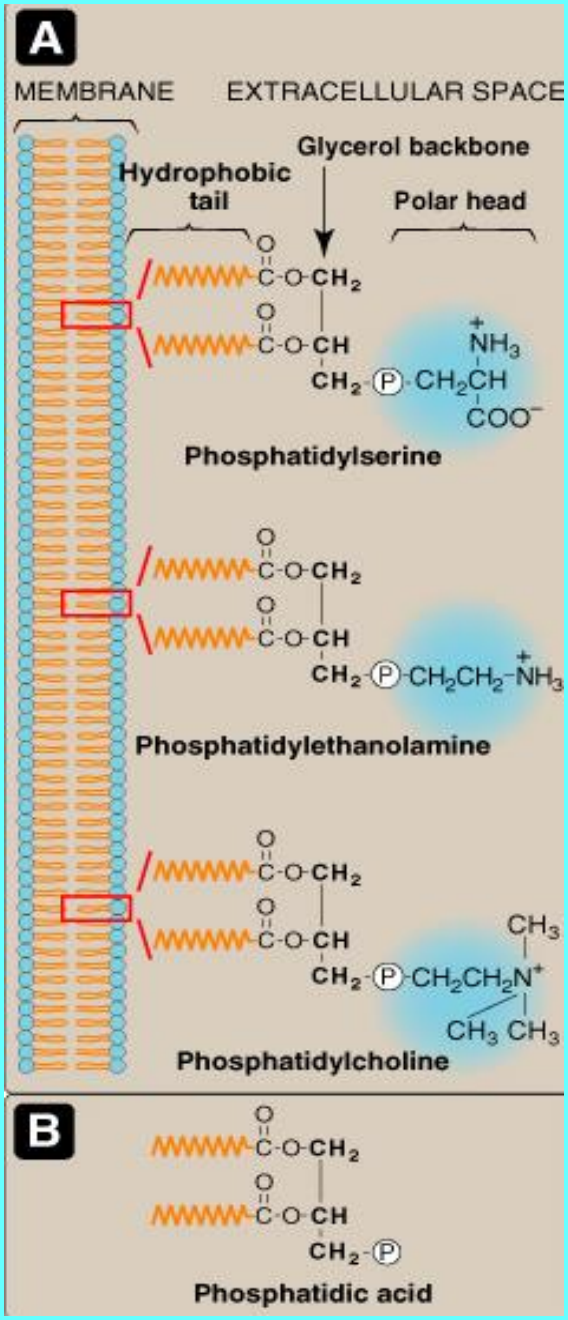
1. Phosphatidylcholine (Lecithin)
   e.g., Surfactant (Dipalmitoylecithin)
2. Phosphatidyl inositol (signaling molecule)

B. Sphingo-phospholipids:

Sphingosine-containing phospholipids:

e.g., sphingomyelin (Myelin sheath)

(To be discussed with CNS Block)



Phospholipids:
A. Glycerophospholipids

Parent Compound

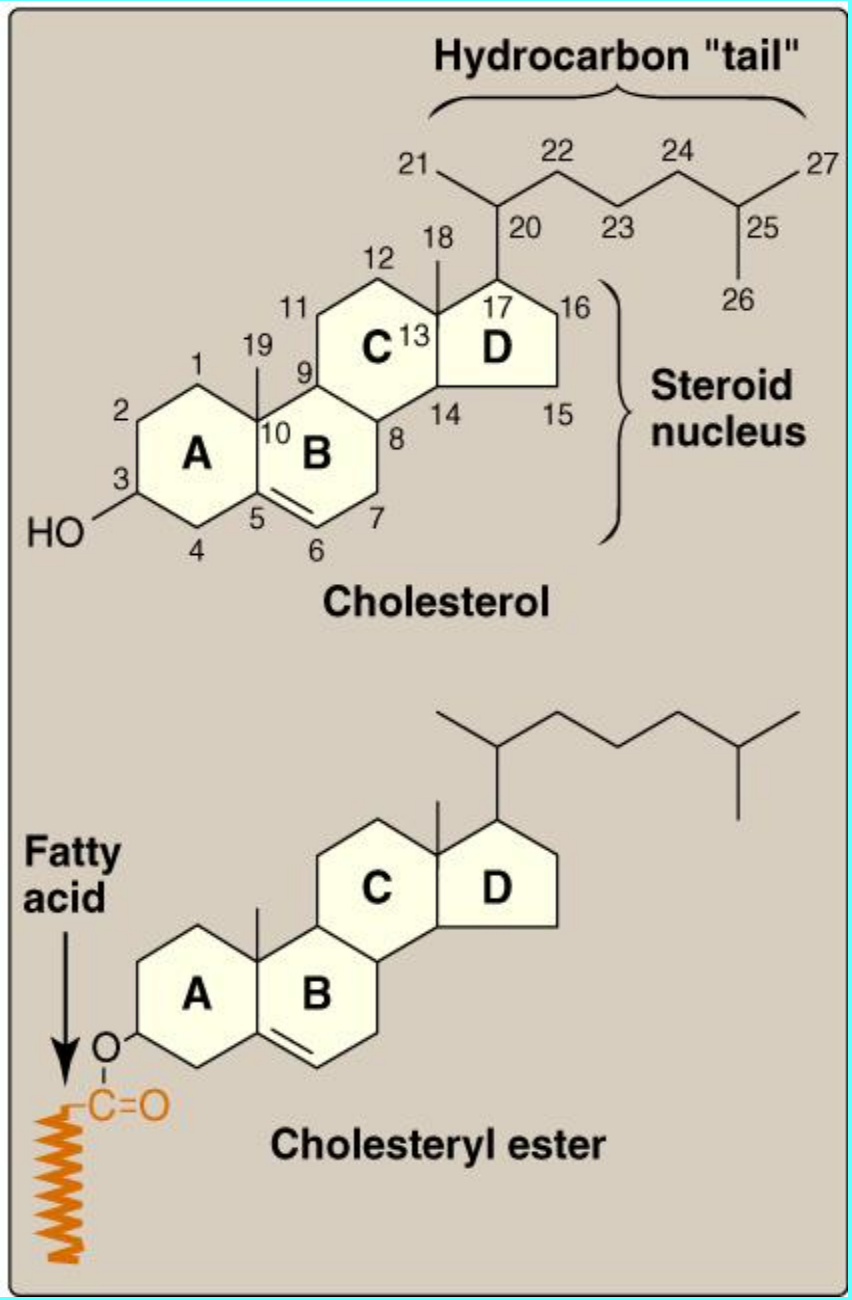
Phosphatidic acid

Members:

1. Phosphatidylcholine (Lecithin)

e.g., Surfactant (Dipalmitoyl lecithin)

Cholesterol: Structure



Overview and Functions

- **Major Sterol of animal tissues**
- **Component of cell membranes**
- **Precursor for:**
  - **Bile acids & salts**
  - **Vitamin D**
  - **Steroid hormones:**
    - **Mineralocorticoids e.g., Aldosterone**
    - **Glucocorticoids, e.g., Cortisol**
    - **Sex hormones, e.g., Testosterone**
      Estrogen & progesterone
- **Hypercholesterolemia: Atherosclerosis & CAD**

Lipoprotein Structure

Protein part: Apoproteins or apolipoproteins

Abbreviations: Apo-A, B, C

Functions:

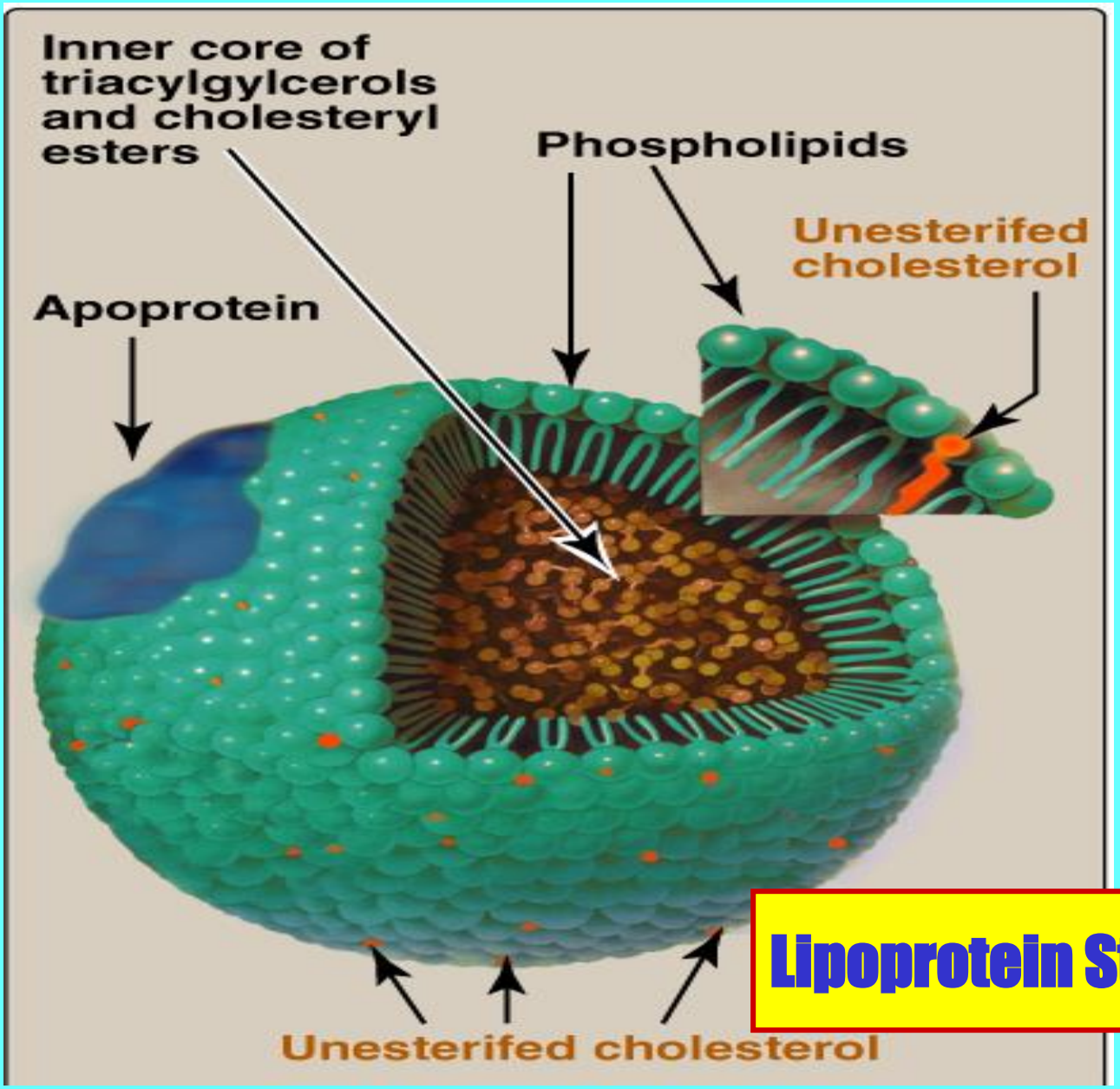
Structural and transport function

Enzymatic function

Ligands for receptors

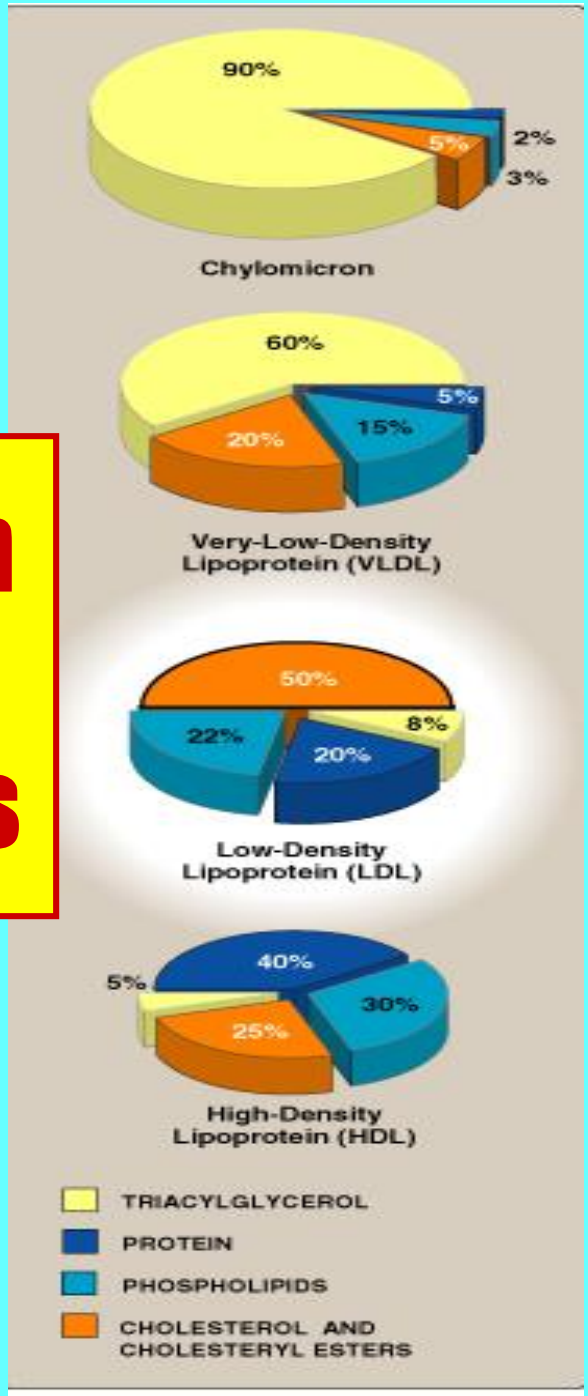
Lipid part:

- **According to the type of lipoproteins**
- **Different lipid components in various combinations**



Lipoprotein Structure

Composition of Lipoproteins

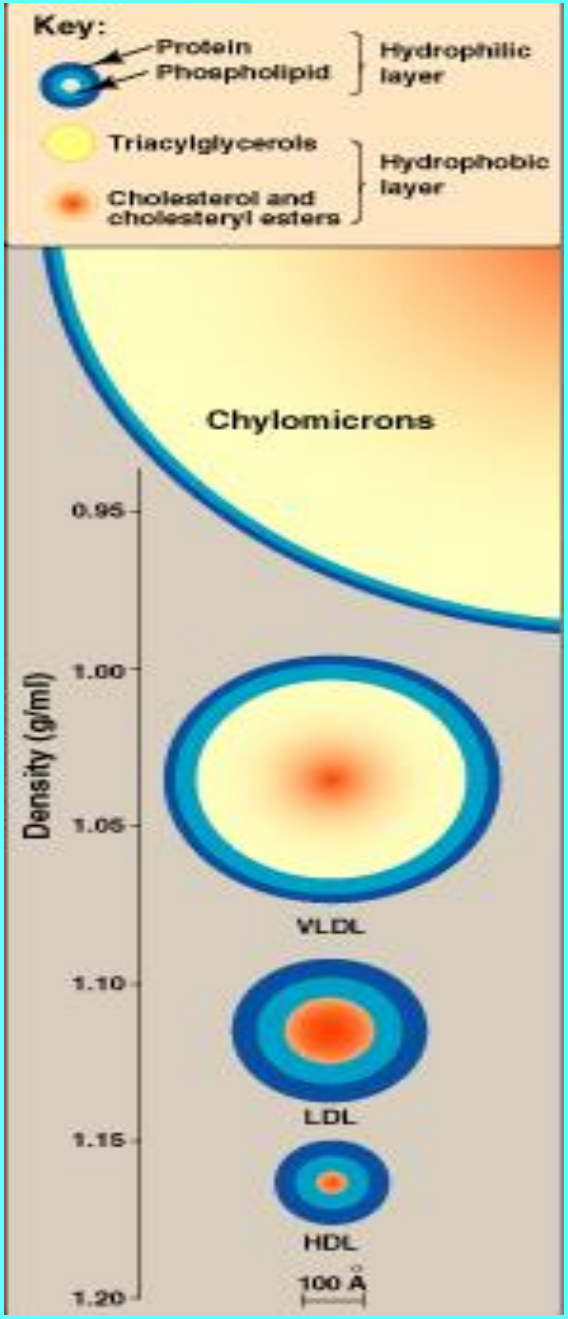


Chylomicrons

Very low density Lipoprotein (VLDL)

Low density Lipoprotein (LDL)

High density Lipoprotein (HDL)



Ultracentrifugation of Lipoproteins

Plasma Lipoproteins

Triacylglycerol transport:

Chylomicrons:	**TG of dietary origin**
VLDL:	**TG of endogenous synthesis**

Cholesterol transport:

LDL:	**Mainly free cholesterol**
HDL:	**Mainly esterified cholesterol**

Take Home Message

- Lipids are heterogeneous group of compounds
- Lipids are relatively water-insoluble
- Simple lipids:

  FA, TG, Ketone bodies, Cholesterol
- Complex lipids:

  e.g., Phospholipids, Lipoproteins
- Lipids have important physiological functions
- Lipid disorders are the basis for common human diseases, namely obesity and atherosclerosis