

# LIPID COMPOUNDS OF PHYSIOLOGICAL SIGNIFICANCE

- **Very important**
- Extra explanation

“STAY FOCUSED AND NEVER GIVE UP”

# OBJECTIVES:

## Functions of lipid compounds

- Clinical problems
- Lipid compounds of physiological importance
- Complex lipids:  
Phospholipids, glycolipids and lipoproteins

# Functions of lipids

**Major energy source of the body**

**Note** :It gives more energy than carbohydrates. However carbohydrates are an immediate energy source.

**Structural components of cell membrane**

**Important regulatory molecules**

**Steroid hormones**

**Prostaglandins** ( Secretions that have hormone-like effect around area of secretion)

**Fat soluble vitamins** ( A,D,K, and E)

**Signaling molecules** :  
Inositol triphosphate (IP3)

## LIPIDS AND RELATED CLINICAL PROBLEMS

- These clinical problems occur due to excessive lipid intake

Coronary Heart  
Diseases

أمراض القلب المزمنة

Atherosclerosis  
and  
Hypertension

تصلب الشرايين و ارتفاع ضغط الدم

Obesity السمنة

**Note:** Obesity: maybe genetic, endocrine stimulate.

# LIPID COMPOUNDS

- Heterogeneous group

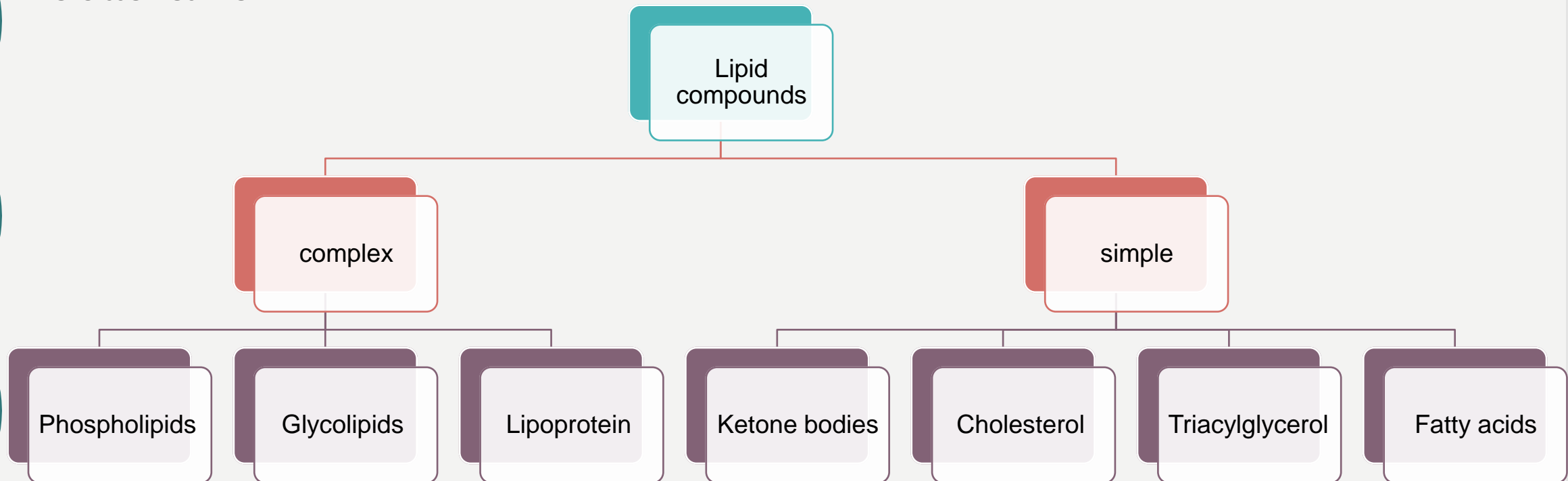
Composition contains a lot of different components

- Relatively water insoluble Due to increase in non-polar components

Exception Ketone Bodies which are WATER SOLUBLE

- Soluble in non-polar solvents

Like dissolves like





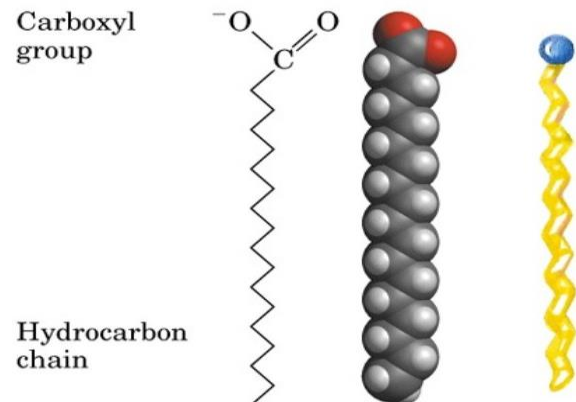
# FATTY ACIDS {FA}

## STRUCTURE

$\text{CH}_3(\text{CH}_2)_n$	$\text{COO}^-$
Hydrophobic hydrocarbon chain	Hydrophilic carboxyl group (ionized at pH 7)

Fatty acids are amphipathic ( have both hydrophobic & hydrophilic regions )

## Fatty Acid Structure



## CLASSIFICATION

**1-Chain Length.** Short, medium, fatty acids in milk long e.g. : **Palmitic acid 16:0**  
very long e.g. : **Nervonic acid 24:1**

**2- Degree Of Saturation** مدى التشبع ( saturated & unsaturated)

- saturated **HAS NO DOUBLE BONDS**, common in animal fats.
- Unsaturated : ,common in plants fats.

1- **mono** or **poly** unsaturated ( **one or more double bonds**)  
2- **Cis-** or **trans-**form of double bond

**3-Essential fatty acids** ( that the body cannot produce )

- 1- **Linoleic acid, 18:2** the precursor of arachidonic acid
- 2- **Linolenic acid, 18:3**
- 3- **arachidonic acid 20:4**

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

**Note** : deficiency of essential FA results appearance of effects(symptoms) on the body.

**Note** : short 4 carbons  
Medium 6-12 carbons  
Long 14-20 carbons  
Very long over 22 carbons

# PLASMA FATTY ACIDS (FFA)

- Esterified form (~90%)

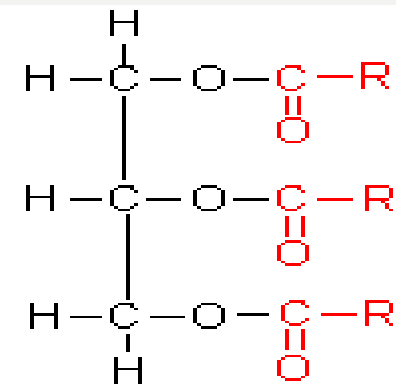
In triacylglycerol, cholesterol ester, phospholipids  
(as part of lipoproteins)

- Free-form (un Esterified) = FFA (*Free Fatty Acids*)

Free- form is transported with albumen protein.

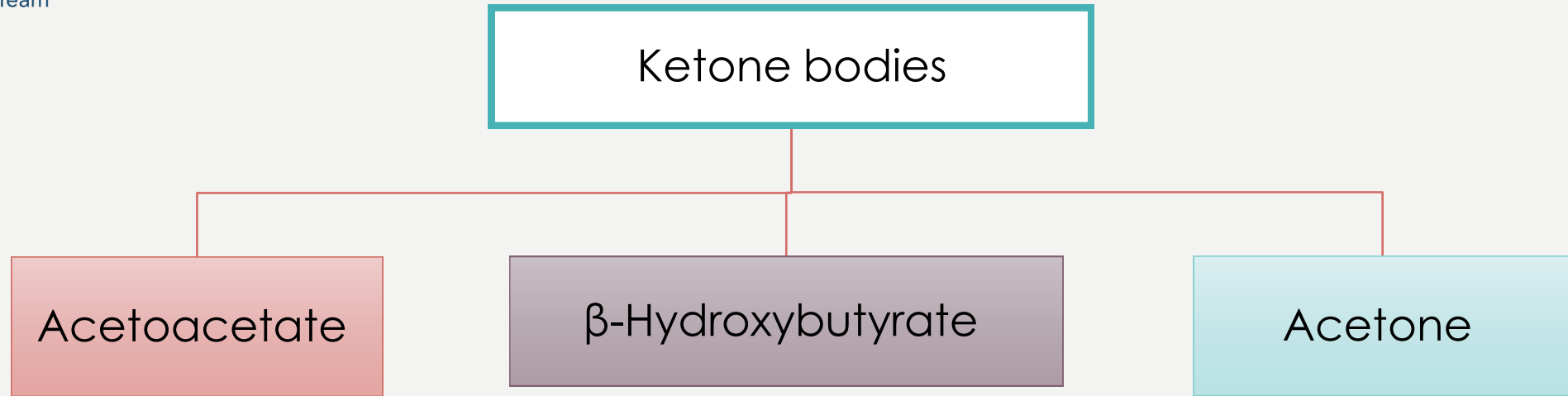
# TRIACYLGLYCEROL

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

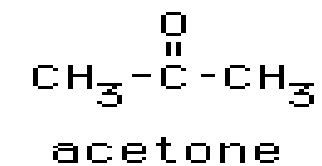
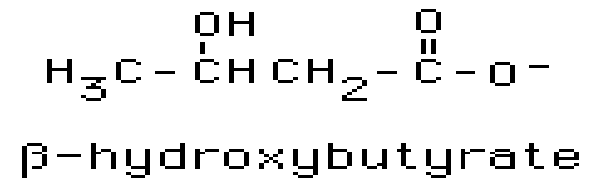
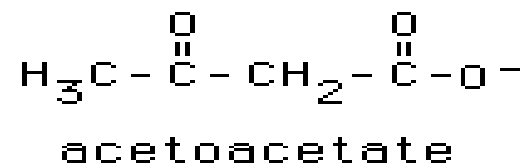


Triacylglycerol





### The Ketone Bodies



- Ketone bodies are water-soluble.
- Increase of Acetoacetate and β-Hydroxybutyrate in diabetic's blood cause *Diabetic Ketoacidosis* when not taking medications which result to coma.

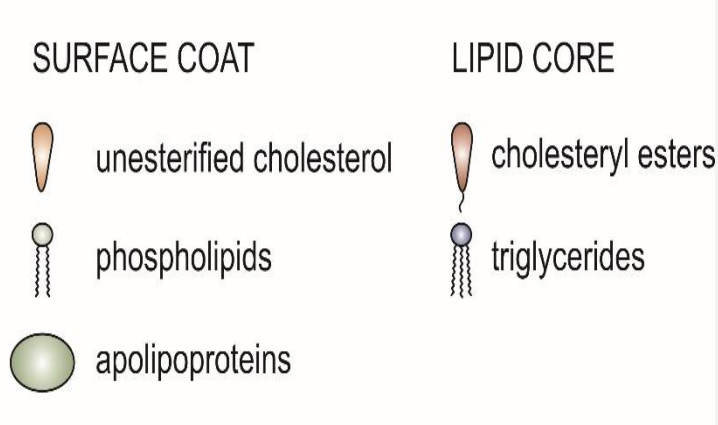
# Complex lipids

Phospholipids

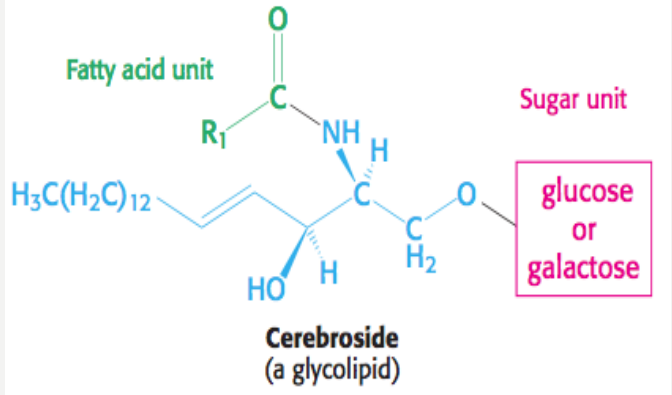
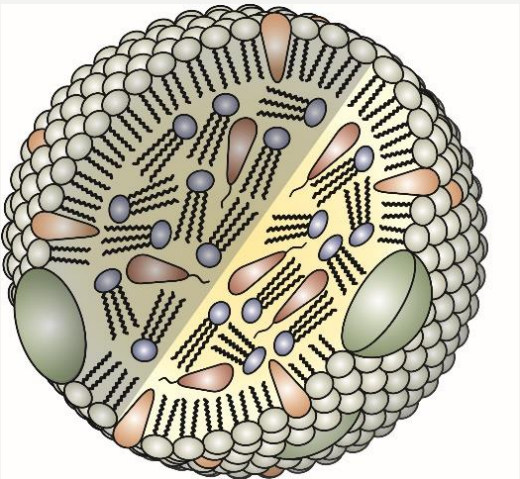
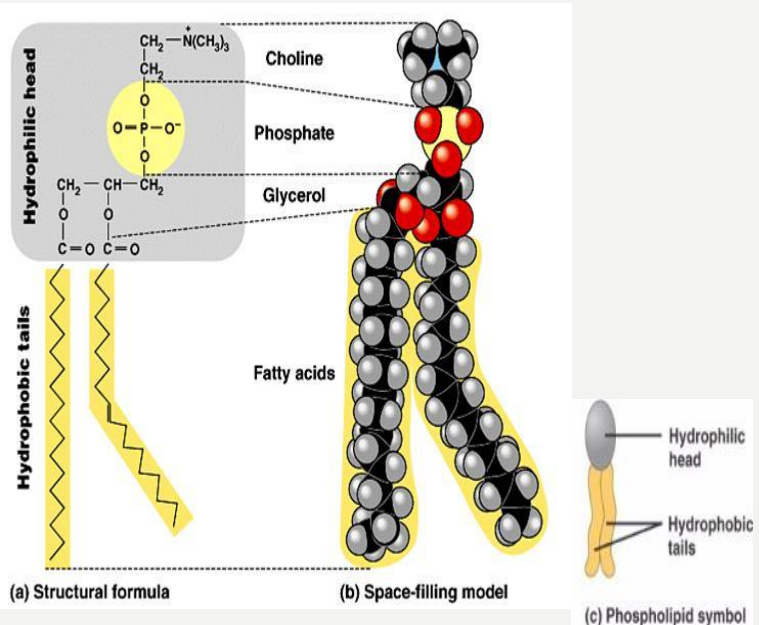
Lipoprotein

Glycolipids

Glycerol  
+  
2 fatty acids  
+  
Phosphate group



Lipids  
+  
attached  
carbohydrate



# Phospholipids

## Glycerophospholipids

Glycerol-containing phospholipids.  
Parent compound: Phosphatidic acid

## Sphingo-phospholipids

Sphingosine-containing phospholipids.  
e.g. **sphingomyelin** (Myelin sheath)

1- Phosphatidylcholine  
(Lecithin).

e.g. **Surfactant**  
(Dipalmitoylecithin)

2- Phosphatidyl inositol  
(Signaling molecule)

# CHOLESTEROL

➤ **Major Sterol** <sup>(1)</sup> of animal tissues

➤ **Component of cell membranes**

➤ **Precursor** (مرسل) for:

**Bile acids**<sup>(2)</sup> & salts

**Vitamin D**

**Steroid hormones:**

1- **Mineralocorticoids** e.g., **Aldosterone**

2- **Glucocorticoids**, e.g., **Cortisol**

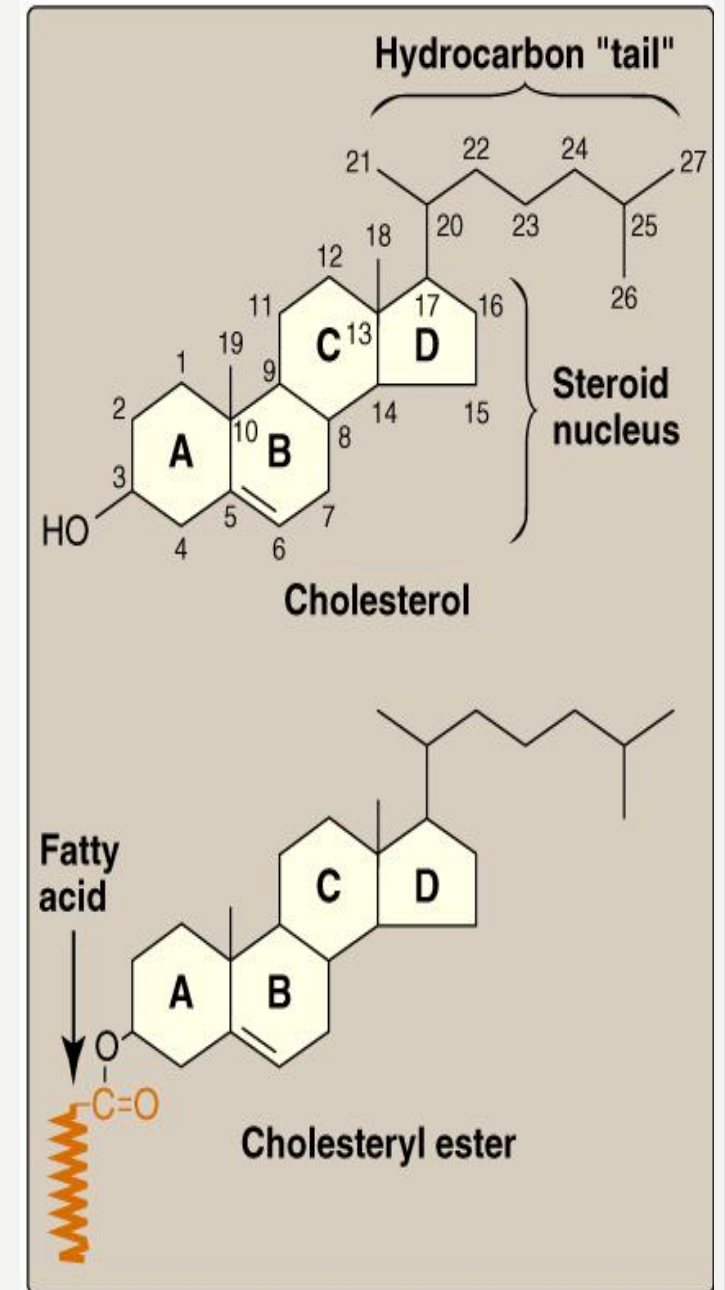
3- **Sex hormones**, e.g., **Testosterone Estrogen & progesterone**

➤ **Hypercholesterolemia** ارتفاع الكوليسترول

➤ **Atherosclerosis & CAD** تصلب الشرايين و أمراض الشريان التاجي

(1): **Sterols**: also known as steroid alcohols, are a subgroup of the steroids and an important class of organic molecules. They occur naturally in plants, animals, and fungi, with the most familiar type of animal sterol being cholesterol. Cholesterol is vital to animal cell membrane structure and function and a precursor to fat-soluble vitamins and steroid hormones.

(2): **Bile acids** are steroid acids found predominantly in the bile of mammals and other vertebrates. Different molecular forms of bile acids can be synthesized in the liver by different species. Bile acids are conjugated with taurine or glycine in the liver, forming bile salts.



# LIPOPROTEIN STRUCTURE

It consists from two parts:

➤ **Protein part:** **Apoproteins** ( it called Apo-lipoproteins too).

Its functions: 1- Structural    2-transport

3-Enzymatic function    4-Ligands for receptors

➤ **Lipid part:** the type of lipids depend on the type of lipoproteins.

## ■ Composition of lipoprotein :

	Chylomicrons
<b>(VLDL)</b>	Very low density Lipoprotein
<b>(LDL)</b>	Low density Lipoprotein
<b>(HDL)</b>	High density Lipoprotein

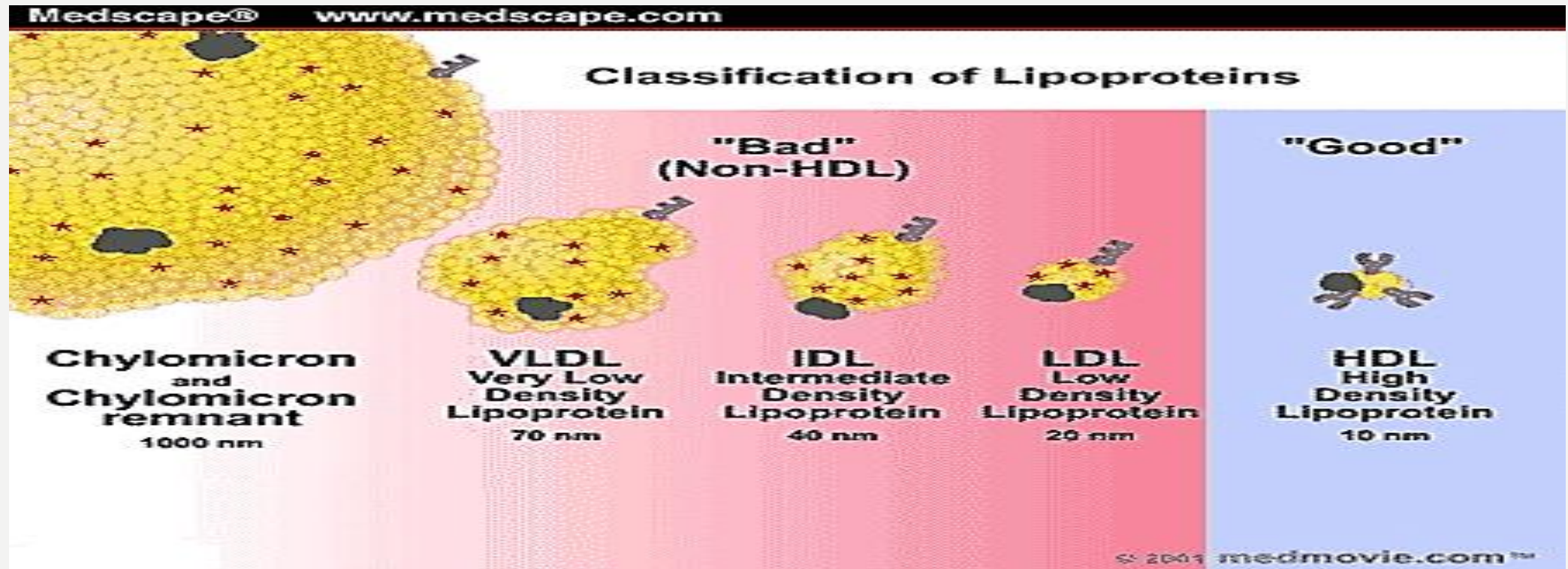
**Note** : lipids cannot move in the ECF by themselves (because they are not polar ) SO they bind to protein to help them to move in the ECF

**Note** : the good carrier lipoprotein is **HDL**

While **LDL** & **VLDL** are bad carriers



# PLASMA LIPOPROTEINS



Triacylglycerol transport		Cholesterol transport	
<b>Chylomicrons</b>	TG of dietary origin	<b>LDL</b>	Mainly free cholesterol
<b>VLDL</b>	TG of endogenous synthesis	<b>HDL</b>	Mainly esterified cholesterol

Q1: All Fats are insoluble in water ?

(T) or (F)

Q2: Arachidonic Acid is considered essential Fatty Acid when linolenic Acid is deficient ?

(T)Or(F)

Q3:Triacylglycerol is the storage form in adipose tissue?

(T)or(F)

Q4:Phosphatidyl inositol is a signaling molecule ?

(T)or (F)

Q5: Triacylglycerol is transported by chylomicrons and VLDL ?

(T)or (F)

Q6: The storage form in the body is ?

1-Triacylglycerol

2-Acetoacetate

3-Acetone

Q7: which compound is not considered simple lipid ?

1-Triacylglycerol

2- cholesterol

3-phospholipid

Q8: which compound is not considered complex lipid ?

1-lipoprotein

2-Glycolipid

3-Fatty Acid

Q9: Which compound is a cholesterol transporter?

1-LDL

2-HDL

3-Both



## ANSWERS:

Q1: F

Q2: F

Q3: F

Q4: T

Q5: T

Q6: 1

Q7: 3

Q8: 3

Q9: 3

## :Boys Team

- عبدالعزيز المالكي.
- مهند الزهراني.
- أحمد الرويلي .
- محمد الصهيل .
- خالد النعيم .
- إبراهيم الشايح.
- محمد الدغيثر.
- عبد الله الشنيفي.

\* نستقبل إقتراحاتكم وملاحظاتكم على:

[@435biochemteam](https://twitter.com/435biochemteam)

[435biochemistryteam@gmail.com](mailto:435biochemistryteam@gmail.com)

[@biochemteam435](https://www.instagram.com/biochemteam435)

435 Biochemistry Team

## :Girls Team

- شهد العنزي.
- نوره الرميح .
- بدور جايدان.
- علا النهير.
- أفنان المالكي.
- ساره الحسين.
- دلال الحزيمي.
- فاطمه الدين.
- جواهر الحربي.
- جوهره المالكي.
- خوله العريني.
- لجين السواط.
- منيال باوزير.
- نوره القحطاني.
- رزان السبتي .
- رهنف العباد .
- وضحي العتيبي.
- ساره العنزي .
- منيره الحسن.

