

**BIOCHEMISTRY 1**  
**2<sup>ND</sup> CLASS**  
**UNIVERSITY OF ANBAR**  
**COLLOGE OF SCIENCE**  
**BIOLOGY DEPARTMENT**  
**2020-2021**

**Lipids**  
**Lecture one(1)**

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# Lipids

- \* Lipids and carbohydrate are the main source of nutrition for human-beings.
- \* Lipids are heterogeneous class of compounds that distributed in all living organisms, they are important because of:
  - 1-Major source of energy in animals, insects, birds and high- plant containing seeds.
  - 2-Activators of enzymes, many enzymes require lipid micelles for maximal activation.
  - 3-Lipids considered as basic constituents in cell wall structure.

- \* Lipids organic compounds contain carboxyl, phosphate and  $\text{NH}_3$  groups.
- \* Lipids belongs to amphiphile compounds because they contain polar ionic groups ( hydrophobic group).
- \* Lipids are characterized by their sparing solubility, in water and they are soluble in organic solvents, physical properties which reflect the hydrophobic nature of their structures.

# Classification of Lipids:-

Lipids are divided into three categories:

**1- Simple lipids:** are esters of fatty acids with glycerol

A-Neutral fats

B-Oils

C-Waxes

**2-compound lipids:** are esters of fatty acids with alcohol binding with other type of compounds. Like phospholipids, lipoproteins, glycolipids.

**3-Derived lipids:** are compounds produced when simple or compound lipids undergo hydrolysis. Derived lipids include such substances as fatty acids, glycerol, other alcohols, sterols (solid alcohol having a high molecular weight), fatty aldehydes and ketone bodies

# 1- Simple lipid:-

## Fatty acid:-

The principle component in most lipids –FA are straight chained contains 4-30 of C atoms as carboxylic acid which FA are carboxylic acid with straight chain of hydrocarbon residue either saturated or unsaturated contain 4- 30 of carbon atoms.

## A-Saturated F.A:- ( $C_nH_{2n+1}COOH$ )

- Inactive carboxylic fatty acids, solid in room temperature. Water solubility decrease with increasing number of C atoms
- *Example:* Butric acid C4 soluble in water as number of C atoms increase; their solubility in organic solvents increase.
- *Example:* Palmitic acid (C16 ), stearic acid (C18).

## B- Unsaturated fatty acids:-

- Active carboxylic fatty acids because they are containing one or more double bond; therefore they are liquid in room temperature.

■ *Example:*

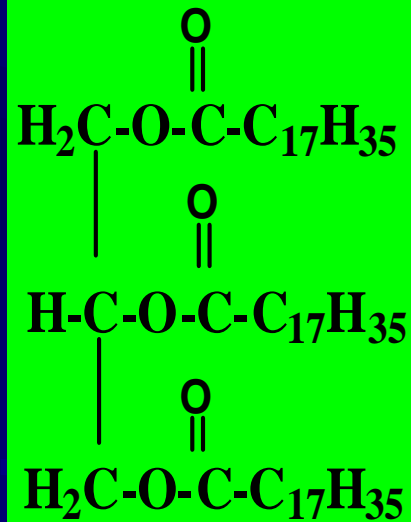
Stearic acid $C_{18}$	$C_{17}H_{35}COOH$	Saturated
Oleic acid $C_{18}$	$C_{17}H_{33}COOH$	$^9\Delta$
Linoleic acid $C_{18}$	$C_{17}H_{31}COOH$	$^9\Delta$ , $^{12}\Delta$
Linolenic acid $C_{18}$	$C_{17}H_{29}COOH$	$^9\Delta$ , $^{12}\Delta$ , $^{15}\Delta$



# Structural lipid

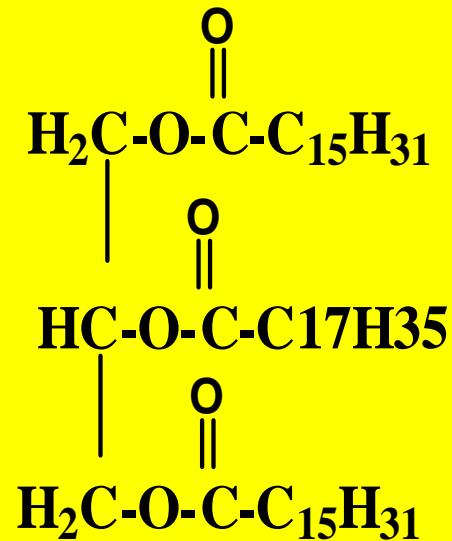
- They are esters of fatty acids with glycerol

**Fatty acid + glycerol  $\longrightarrow$  ester**



Simple glyceride

Tristearin



Mixed glyceride

2-Stearo-1,3-di Palmitin



## Reactions:-

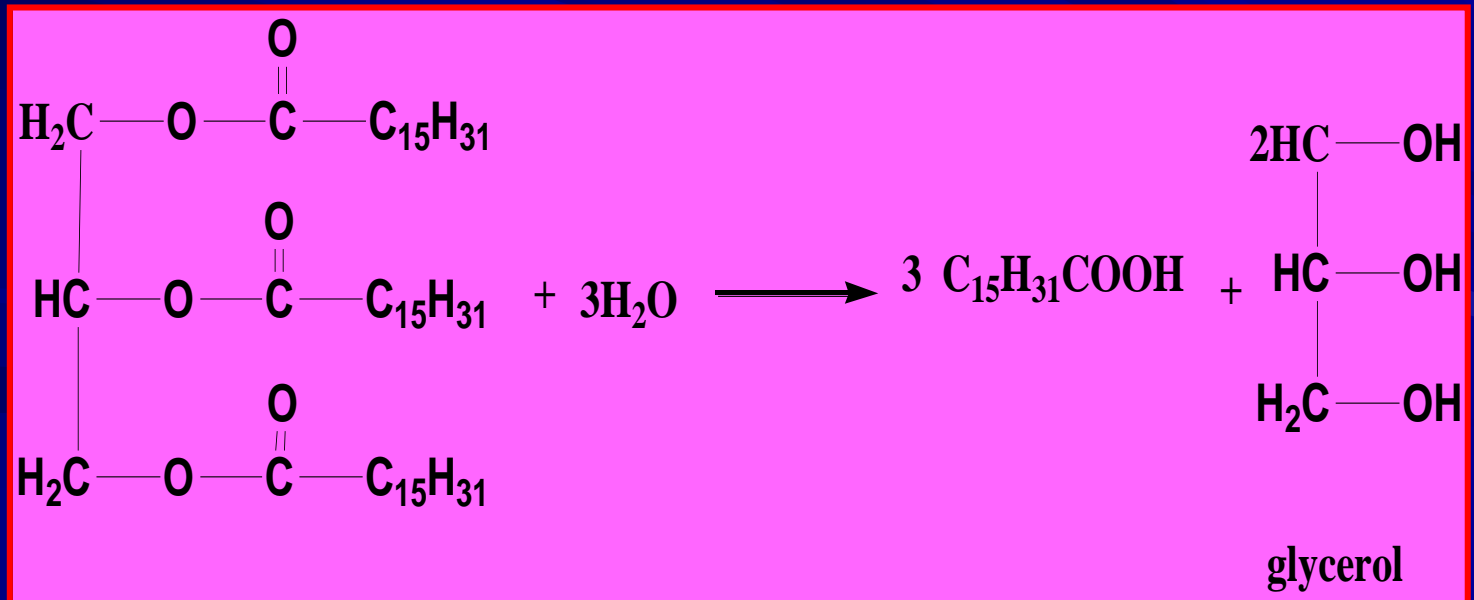
- If glycerides contain unsaturated F.A. They react with  $H_2$  or  $X_2$  or oxidized and if the glycerides contain saturated F.A. they can esterfication or hydrolysis.

# Chemical react:-

## ■ Hydrolysis :-

when fats are treated with enzymes acids, or bases, they hydrolyze to form fatty acids and glycerol.

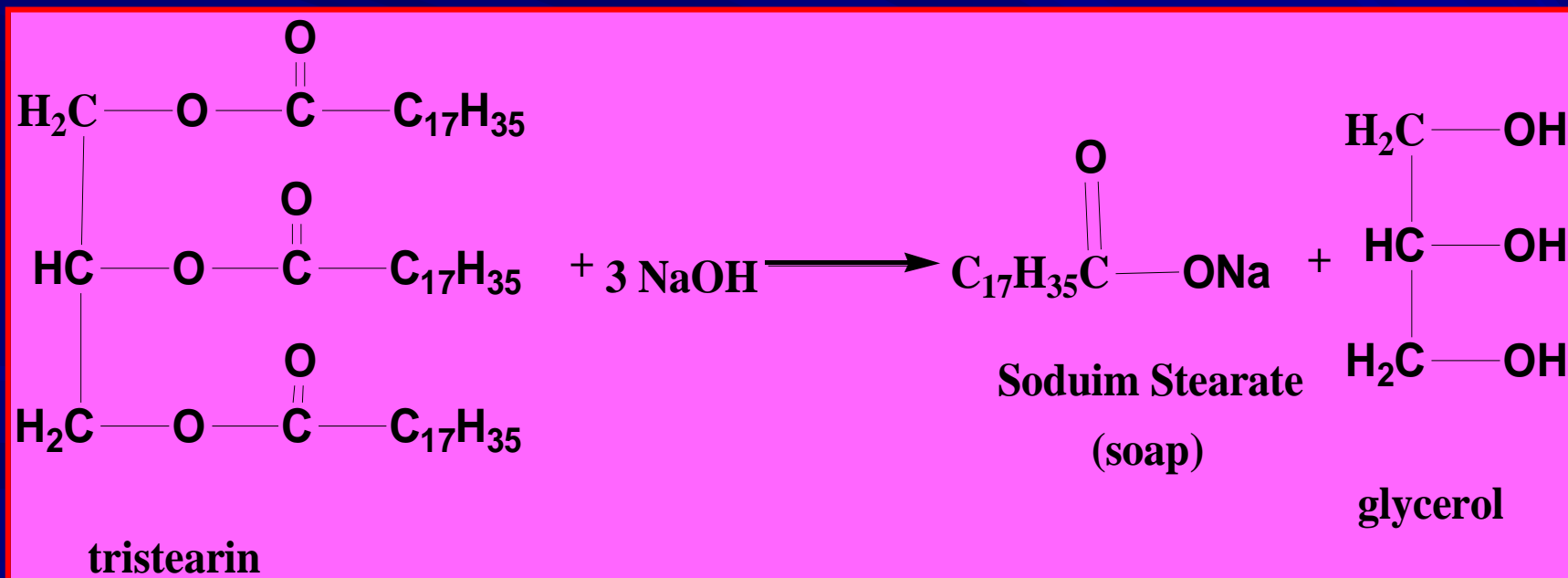
## ■ *Example:*



## ■ Saponification:-

Is the heating of a fat with a strong base such as NaOH to produce glycerol and the salt of fatty acid

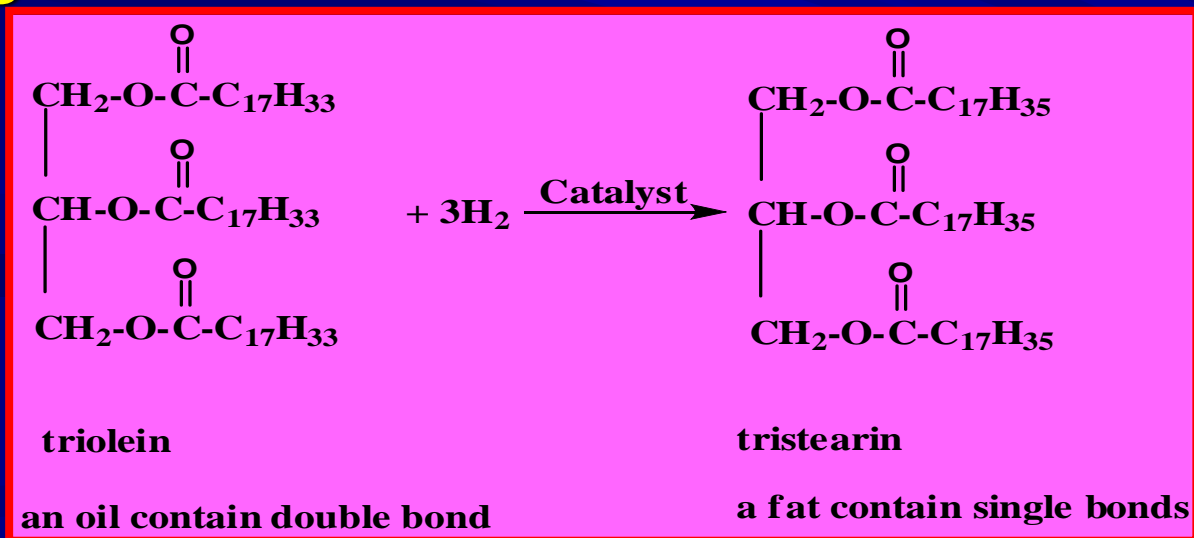
### ■ *Example:*



The sodium or potassium salt of a fatty acid is called a soap.

# Hydrogenation:-

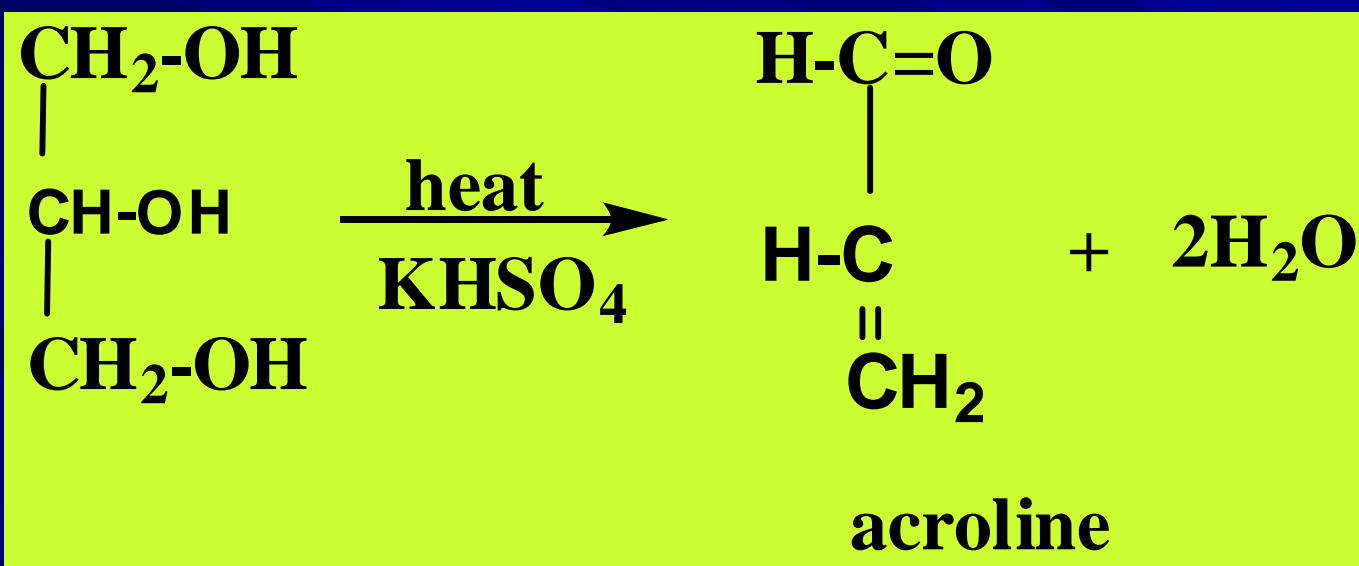
Fats and oils are similar compounds except that oils are more unsaturated, that is, oils contain many double bonds. These double bonds can change to single bonds upon the addition of hydrogen. Vegetable oils can be converted to fats by the addition of hydrogen in the presence of a catalyst this process is called hydrogenation.



## [Acrolein test] :-

It's a test for the presence of glycerol.

It is sometimes used as a test for fats and oils, since all fats and oils contain glycerol. When glycerol is heated to a high temp. especially in the presence of a dehydrating agent such as  $\text{KHSO}_4$ , an aldehyde acrolein results.



## Waxes:-

- Compounds produced by the reaction of a fatty acid with a high molecular weight monohydroxylic alcohol.  $C > 15$
- Waxes are insoluble in water, non reactive and flexible, hence waxes make excellent protective coatings.
- Example:      myricyl palmitate



## 2-Compound lipids:-

They are phosphate esters and can be divided into two categories

a- phosphoglycerides    b- phosphosphingosides

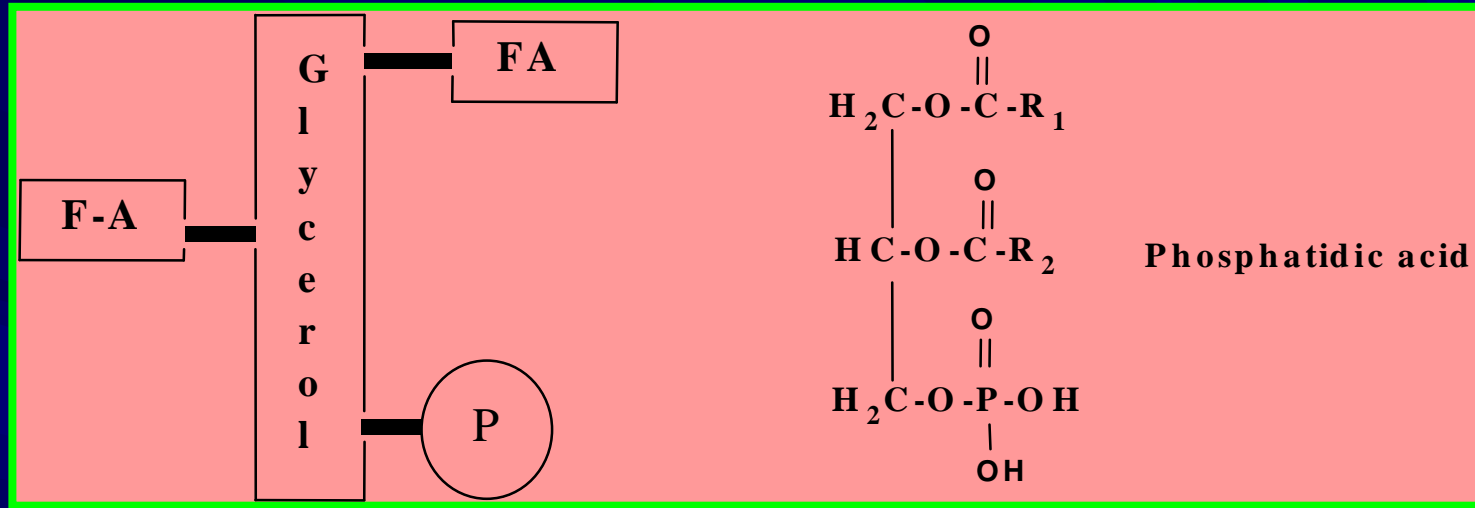
depending on whether the alcohol is glycerol or sphingosine.

- \* Phospholipids also contain a nitrogen compound
- \* Phospholipids are found in all tissues in the human body particularly in brain, liver, and spinal tissue. They are also occur in the membranes of all cells.



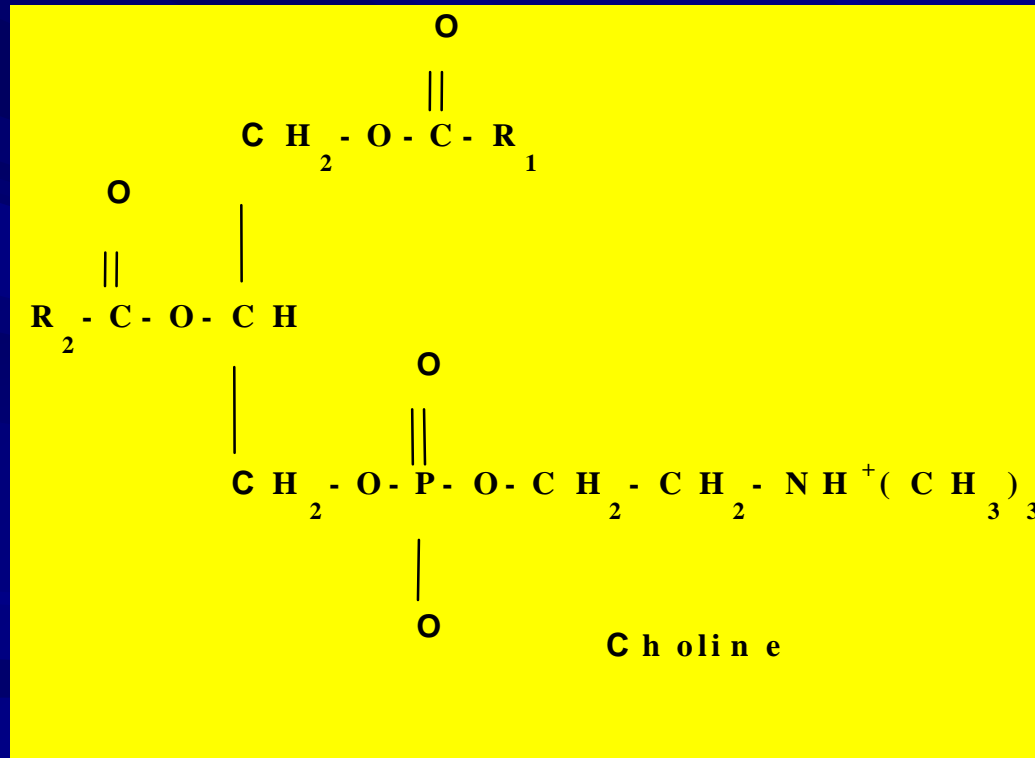
# **a- phosphoglycerides:-**

■ A structure of a phosphoglyceride can be represented as:

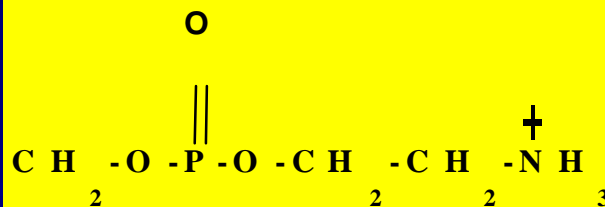


At C<sub>1</sub> and C<sub>2</sub> of glycerol there are esters of F.A. At C<sub>3</sub> there is a phosphate group (phosphatidic acid). Phosphate group can be bonded to a nitrogen compound. Like : choline, ethanolamin and serine.

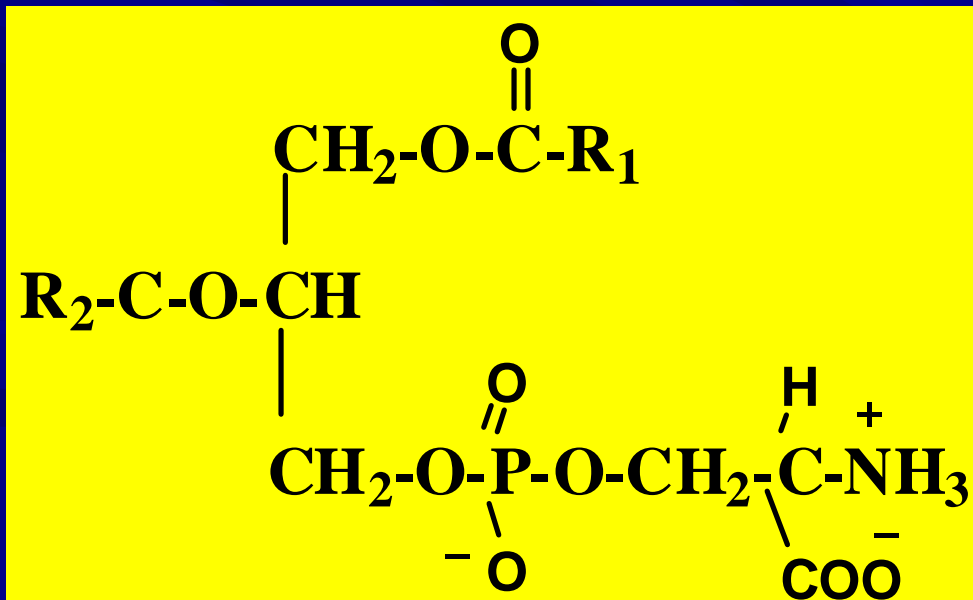
- \* If phosphatidic acid bonded with choline the product compound called : phosphatidyl choline (Lecithine)



- \* If phosphatidic acid bonded with ethanol amine the product compound is called : phosphatidyl ethanol amine (Cephalin)



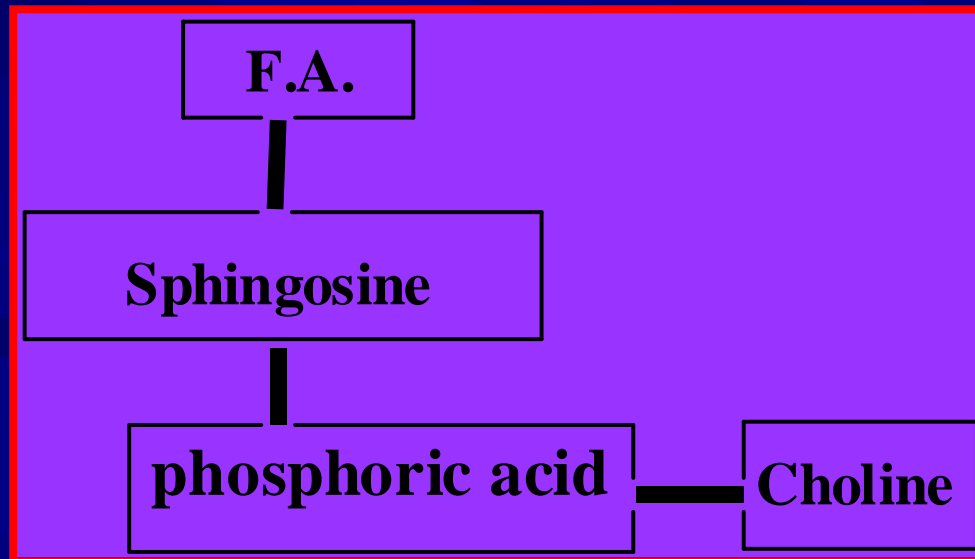
\* If phosphatidic acid bonded with serine the product compound is called phosphatidyl serine



# B-Phosphosphingosides:-

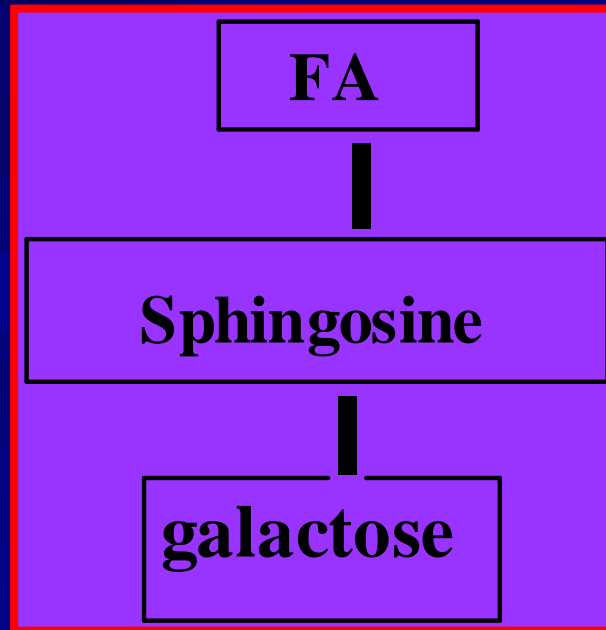
called *sphingolipids* differ from *phophoglycerides* in that they contain the alcohol sphingosine in place of glycerol.

One particular type of *sphingolipid* called *sphingomyelin* is present in large amount in brain and nerve tissue. The general formula for a shingolipid is



## Glycolipid:-

- Are similar to sphingomyolins except that they contain a carbohydrate often galactose in place of the choline and  $H_3PO_4$ . the general structure for a glycolipid is



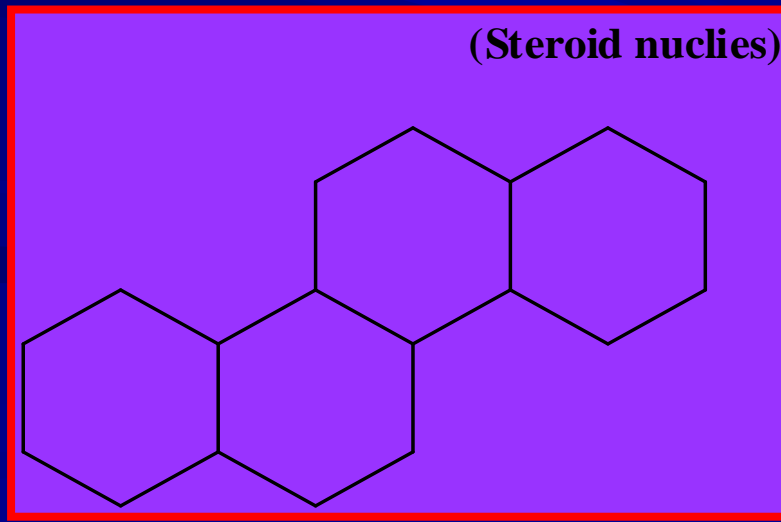
Glycolipid are also called cerebrosides because they are found in large amount in the brain tissue.

### 3-Derived lipids(steroids):-

- Are high molecular weight tetracyclic (four-ring) compounds. Those containing one or more hydroxyl group (-OH).

The nuclei for these compound called

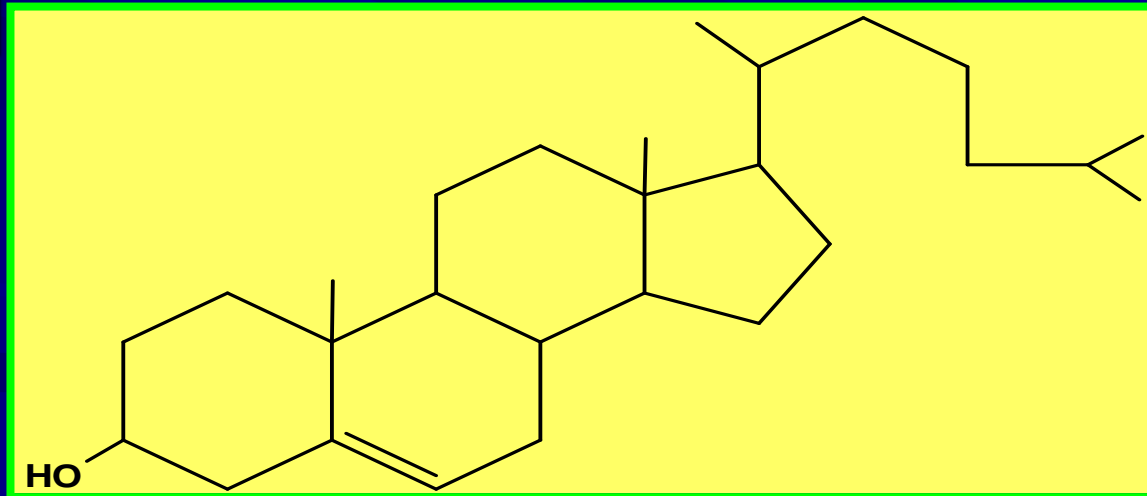
cyclopentano perhydro phenanthrene





# Cholesterol :-

- Is the most steroids found in animal fats but not in plant fats cholesterol is found in all animal tissues particularly in brain and nervous tissues in the blood stream.
- % of cholesterol in blood serum 140/260 mg/100ml



Other steroids: bile salts, sex hormones and cortisones.

## References:

Harper's Illustrated Biochemistry

Lippincott Biochemistry

Lehninger Principles of Biochemistry

Stryer Biochemistry