

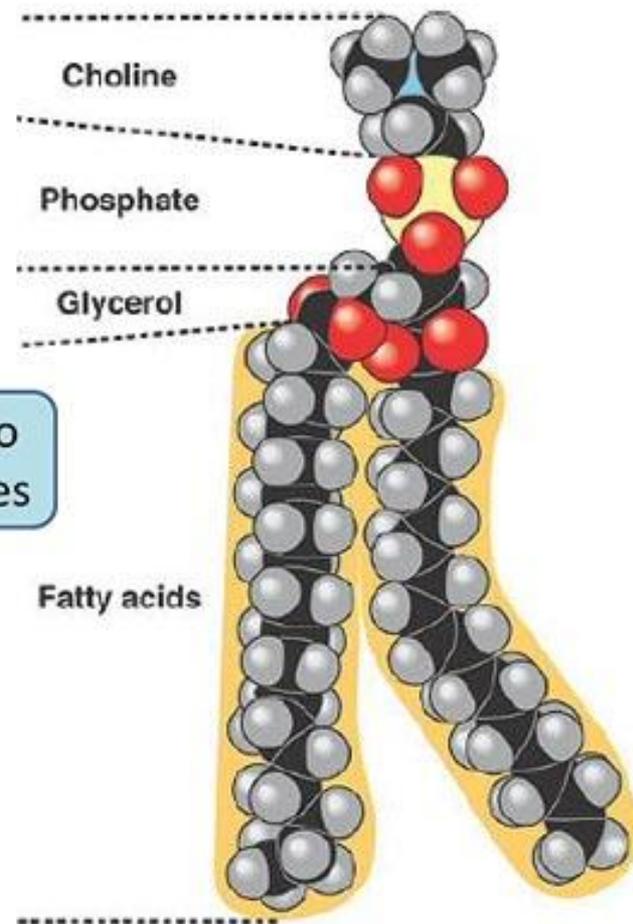
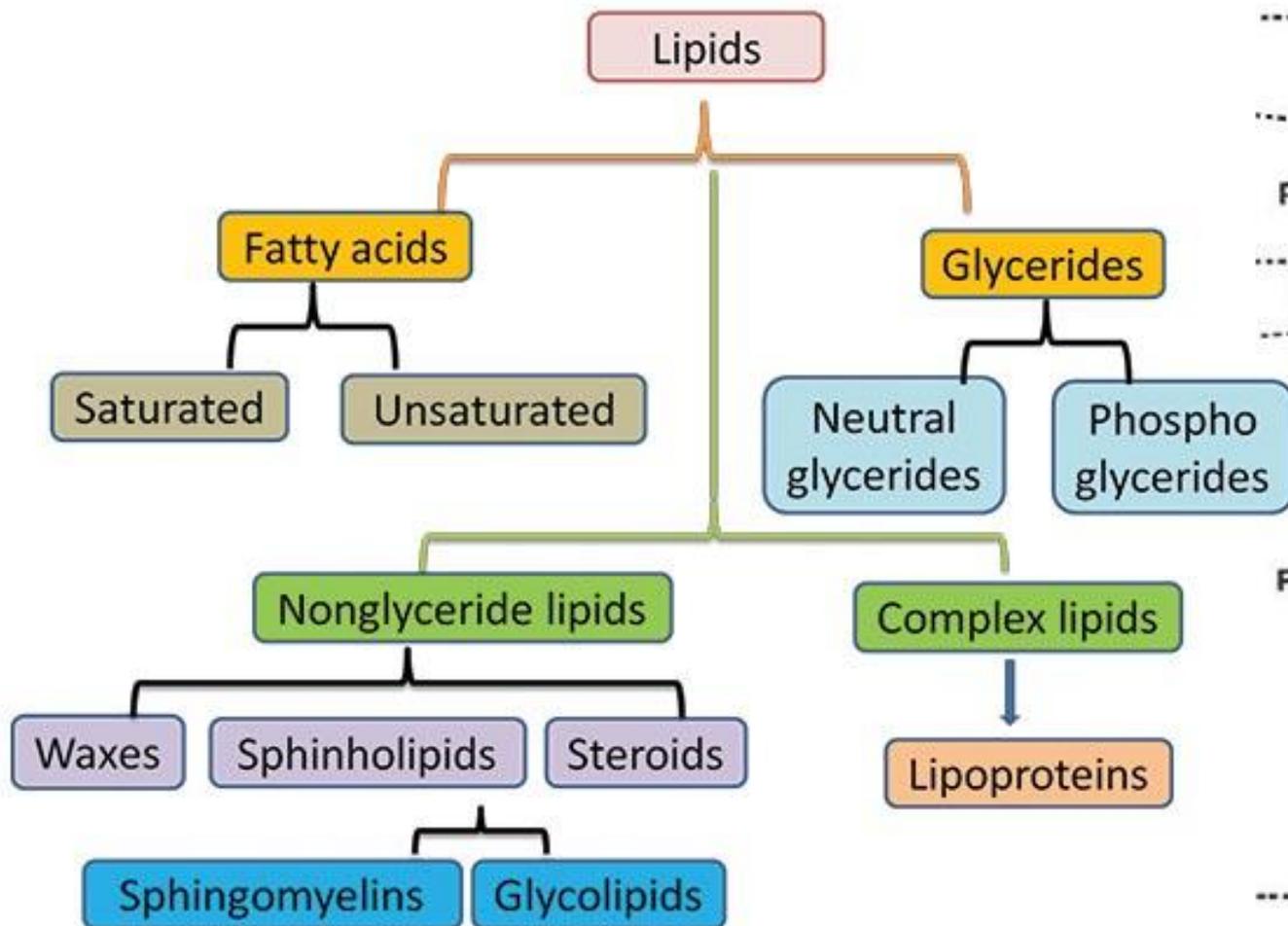
# Organic Chemistry IV

**Presented by:**

Dr. Neeraj Sharma

Assistant Professor

# Classification of Lipids



# Types of Lipids

- **1. Simple lipids**
- **2. Compound lipids**
- **3. Derived lipids:**

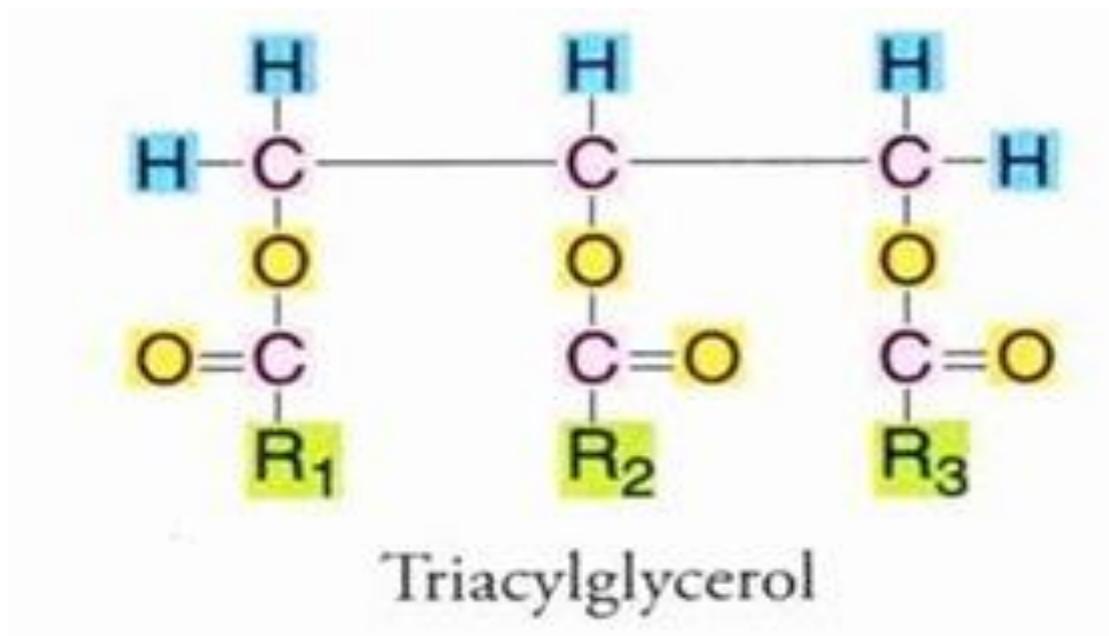
# 1. Simple lipids

**(a) Fats and oils** which yield fatty acids and glycerol upon hydrolysis.

- Both types of compounds are called triacylglycerols because they are esters composed of three fatty acids joined to glycerol, trihydroxy alcohol.
- The difference is on the basis of their physical states at room temperature. It is customary to call a lipid a fat if it is solid at 25°C, and oil if it is a liquid at the same temperature.
- These differences in melting points reflect differences in the degree of unsaturation of the constituent fatty acids.

# 1. Simple lipids

- These are esters of fatty acids with glycerol (a trihydric alcohol). These are known as triacylglycerol's (TAG) or triglycerides.



# 1. Simple lipids

- $R_1$ ,  $R_2$ , and  $R_3$  are the three fatty acids. All the three may be the same or different.
- If all the three Rs are the same, then it may be, Tripalmitin-3 palmitic acids esterified with glycerol.
- Tristearin-3 stearic acids esterified with glycerol.
- If the 'R' groups are different then it is spelled out as Palmito-stearo-olein indicating that glycerol is esterified with palmitic acid, stearic acid and oleic acid.



# 1. Simple lipids

(b) **Waxes**, which yield fatty acids and long-chain alcohols upon hydrolysis.

- Wax is an ester of long-chain alcohol (usually mono-hydroxy) and a fatty acid.
- The acids and alcohols normally found in waxes have chains of the order of 12-34 carbon atoms in length.

## 2. Compound lipids

- (A) **Phospholipids**, which yield fatty acids, glycerol, amino alcohol sphingosine, phosphoric acid and nitrogen-containing alcohol upon hydrolysis.
- They may be **glycerophospholipids** or **sphingophospholipid** depending upon the alcohol group present (glycerol or sphingosine).

## 2. Compound lipids

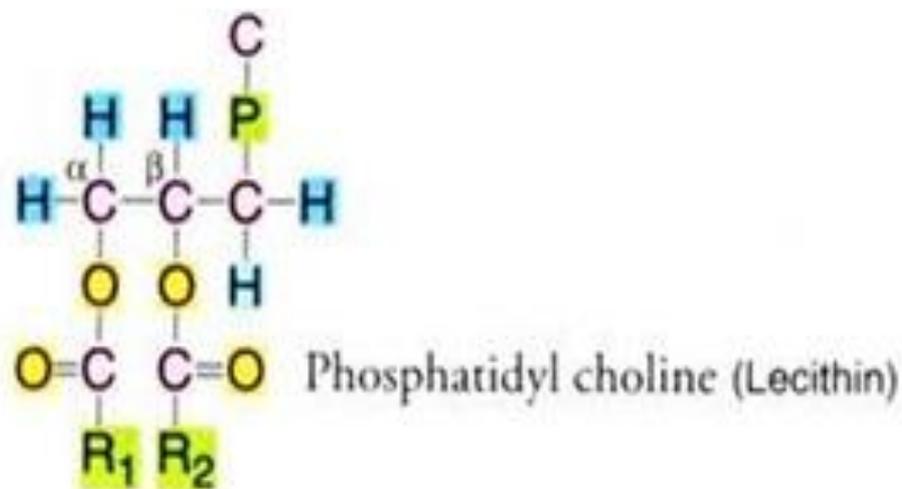
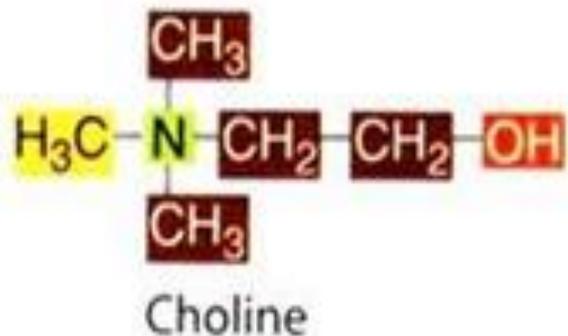
- Depending upon the alcohol present they are further classified as:

### (a) Glycerophospholipids:

- They contain the alcohol-glycerol.
- The components of glycerophospholipids are glycerol, two fatty acids (the one at  $\alpha$ -position is saturated fatty acid and the other at  $\beta$ -position is unsaturated), phosphoric acid and a base.
- Glycerol, fatty acids and phosphate together form a phosphatide to which a base is attached. Depending upon the base present there are various glycerophospholipids.

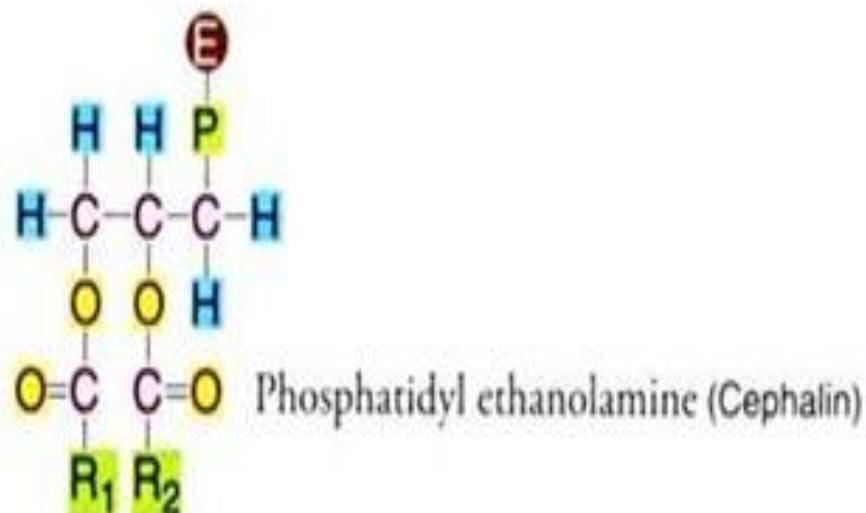
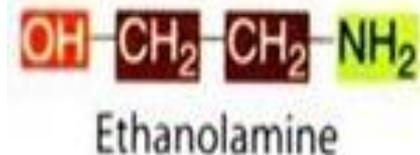
## 2. Compound lipids

- Phosphatidyl choline or lecithin:
- Here the base is choline



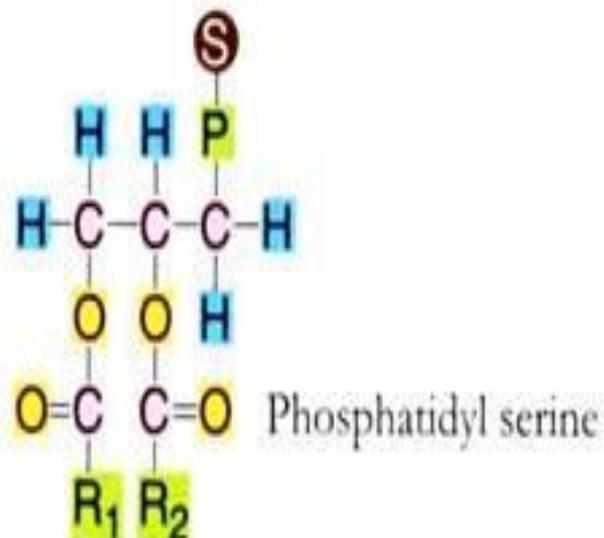
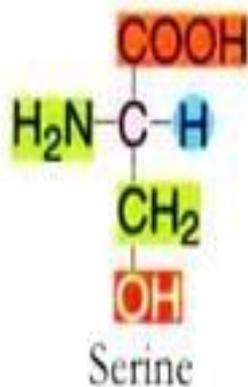
## 2. Compound lipids

- **Phosphatidyl ethanolamine or cephalin:**
- Here the base is ethanol amine, attached through — OH group.



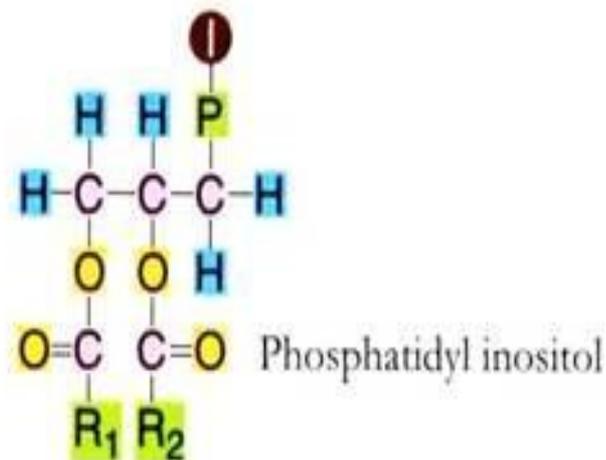
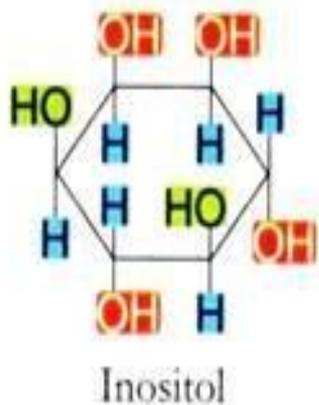
## 2. Compound lipids

- **Phosphatidyl serine:**
- Here the base is the amino acid serine.



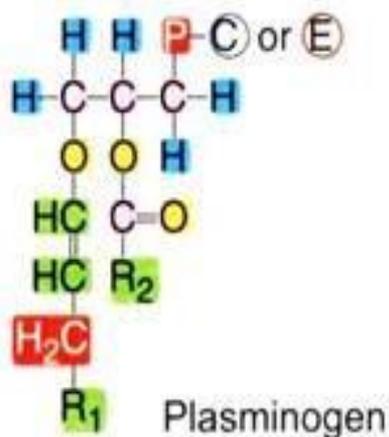
## 2. Compound lipids

- **Phosphatidyl inositol:**
- Here the base is inositol.



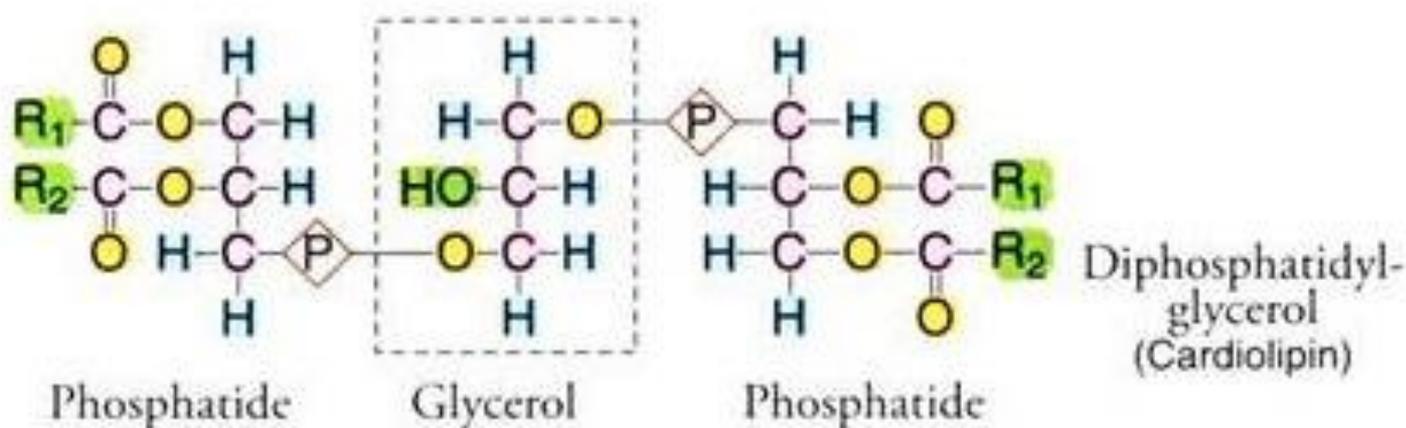
## 2. Compound lipids

- **Plasminogen:**
- Here one of the fatty acids of the phosphatide is replaced by a long chain aldehyde which is in an enolic form. The base may be choline or ethanolamine.



## 2. Compound lipids

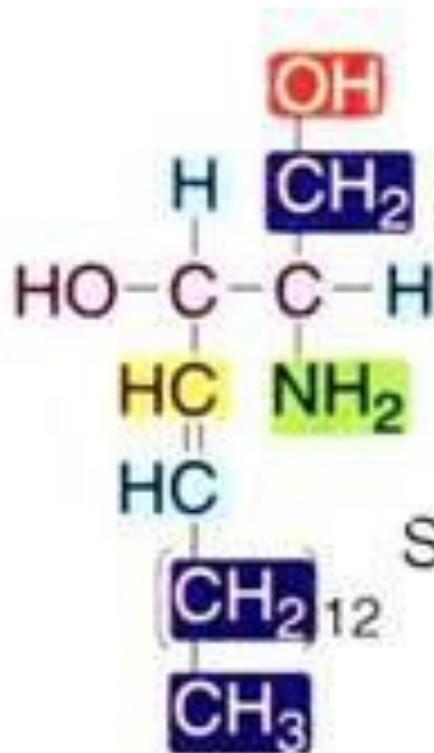
- **Cardiolipin or di-phosphatidyl glycerol:**
- Here two phosphatide groups are linked together through a glycerol.



## 2. Compound lipids

- **(b) Sphingophospholipids:**
- These phospholipids have sphingol as the alcohol. Sphingol is an amino alcohol with a chain length of 18 carbons having a double bond at trans delta 4 position.
- An example of sphingophospholipid or sphingolipid is sphingomyelin, which contains a fatty acid at the amino group (and this combination, i.e., sphingol and fatty acid is known as ceramide), a phosphoric acid at the primary alcohol and the base choline is attached to this phosphate group.

## 2. Compound lipids



Sphingophospholipid

## 2. Compound lipids

- (B) **Glycolipids**, which yield fatty acids, sphingosine or glycerol, and a carbohydrate upon hydrolysis.
- They may also be **glyceroglycolipids** or **sphingoglycolipid** depending upon the alcohol group present (glycerol or sphingosine).

## 2. Compound lipids

- **(a) Glucocerebrosides:**
- If the sugar is glucose, then they are called as glucocerebrosides.
  
- **(b) Galactocerebrosides:**
- If the sugar is galactose then they are called as galactocerebrosides.

## 2. Compound lipids

- **(c) Gangliosides:**
- These are complex sphingolipids made up of several sugar units, viz., glucose, galactose, galactosamine and N-acetyl-neuramic acid or sialic acid.

## 2. Compound lipids

### (C) Lipoproteins:

- These are lipids in conjugation with proteins. They mainly function for the transport of lipids (hydrophobic) through the blood (hydrophilic).

## 2. Compound lipids

Name of the lipoprotein	Composition					Function in the body
	Protein		Triacylglycerol (TAG)	Phospholipid (PL)	Cholesterol	
	Type	Percent				
Chylomicron	A,B,C,E	2	83	7	8	Transport digested lipids
Very low density lipoprotein (VLDL)	B,C,E	9	50	19	22	Transport TAG from liver to adipose tissue

Name of the lipoprotein	Composition					Function in the body
	Protein		Triacylglycerol (TAG)	Phospholipid (PL)	Cholesterol	
	Type	Percent				
Low density lipoprotein (LDL)	Apo B	21	10	22	47	Transport cholesterol from liver to kidney
High density lipoprotein (HDL)	A,C,D,E	33	8	29	30	Blood scavengers for cholesterol

## 2. Compound lipids

- These lipoproteins are classified depending upon their densities in water.
- The density of a lipoprotein depends upon the fat content of that lipoprotein, more the fat content lower the density and hence it floats on the surface of water (vice versa).
- The protein part in the lipoprotein is known as a apoprotein.
- The various types of apoproteins found in lipoproteins are apoprotein- A, B, C, D, E. Lipoproteins also constitute the combination of membrane proteins with membrane lipids..