



Biochemistry I

Lipids Metabolism I

Sawa University

جامعة ساوة الاهلية

College of health and medical techniques

كلية التقنيات الصحية والطبية

Department of Medical Laboratories

قسم تقنيات المختبرات الطبية

2nd Stage

المرحلة الثانية

محاضرة رقم 8

الجانب النظري

Lecture No. 8

Theoretical

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Topic

S

□ Lipids Metabolism I:

□ Subtopics:

□ Lipids

- Definition
- Function of Lipids
- Fatty Acid
- Classification of Lipids

LIPIDS

- ❑ **Definition**: Organic molecule of biological origin that is insoluble in water and soluble in nonpolar solvents like **ether** and **chloroform**
- ❑ **Solubility Explained**: Lipids do have both **nonpolar** and **polar** regions; however, the majority of the molecule is nonpolar (**due to large nonpolar tails**). Since "**like dissolves like**", lipids are soluble in nonpolar solvents.

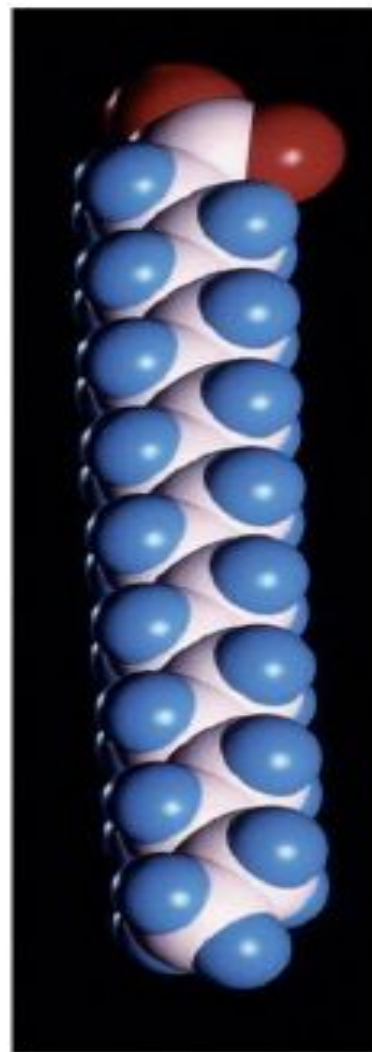
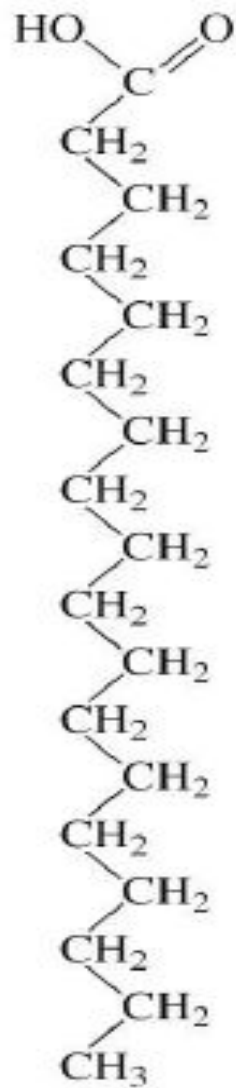
❑ **FUNCTIONS OF LIPIDS**

- 1) **Storage molecules for energy (fats and oils).**
 - 1) Can get lots of energy from a fat.
 - 2) Stored in adipose tissue.
- 3) **Structural components of cellular membranes.**
- 4) **Protective molecules (waxes).**
- 5) **Hormones and vitamins.**
- 6) **Intracellular messengers.**
- 7) **Pigments.**
- 8) **Insulation.**

Fatty Acid

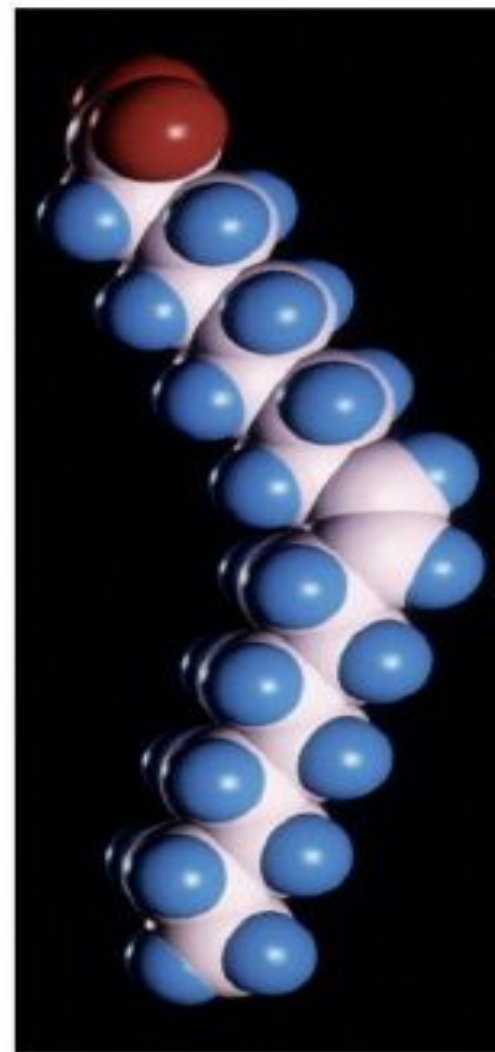
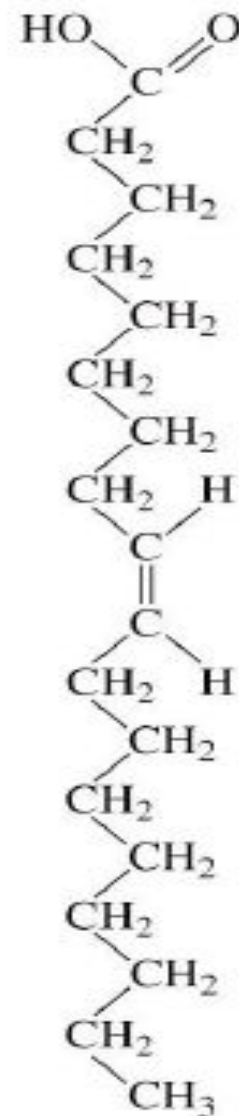
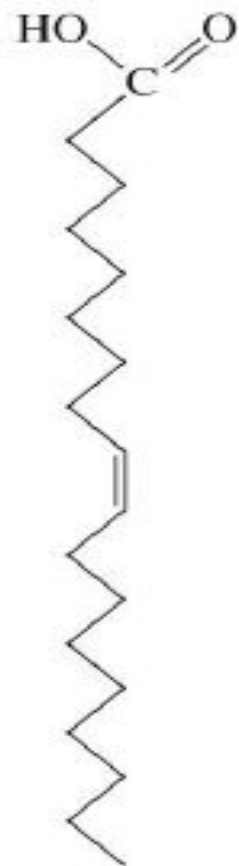
- ❑ **Fatty acid** is a molecule characterized by the presence of a **carboxyl group (or head)** attached to a **long hydrocarbon chain (tail)**. Therefore these are molecules with a formula **R-COOH** where **R** is a hydrocarbon chain.
- ❑ **Fatty acids** can be said to be carboxylic acids, and come in two major varieties:
 - **Saturated fatty acids** do not have any double bonds or are long-chain carboxylic acid containing only carbon-carbon single bonds. Saturated fatty acids are solids at room temperature. Animal fats are a source of saturated fatty acids.
 - **Unsaturated fatty acids** can have one or more double bonds along its hydrocarbon chain. A fatty acid with one double bond is called **monounsaturated**. If it contains two or more double bonds, we say that the fatty acid is **polyunsaturated**. Plants are the source of unsaturated fatty acids .

Carboxyl
group



(a)

Saturated

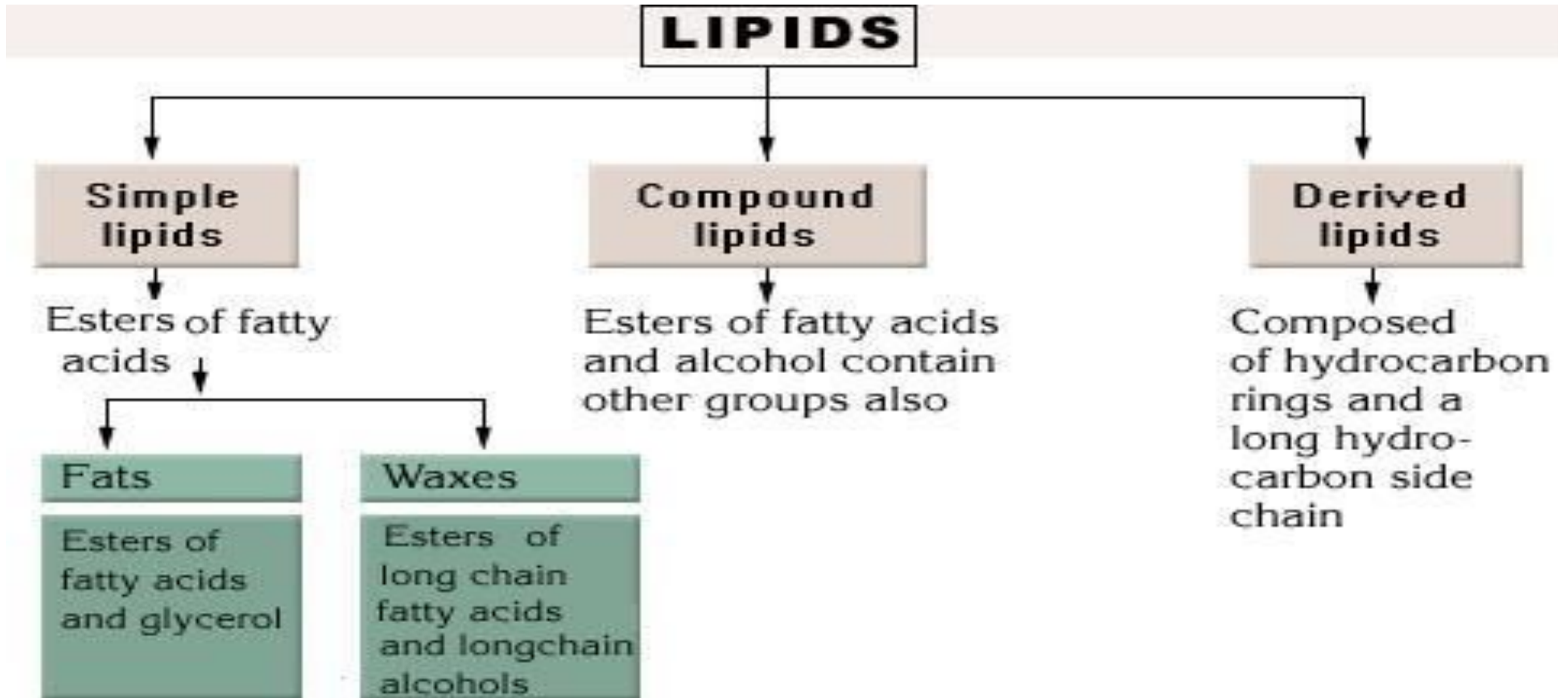


(b)

Unsaturated

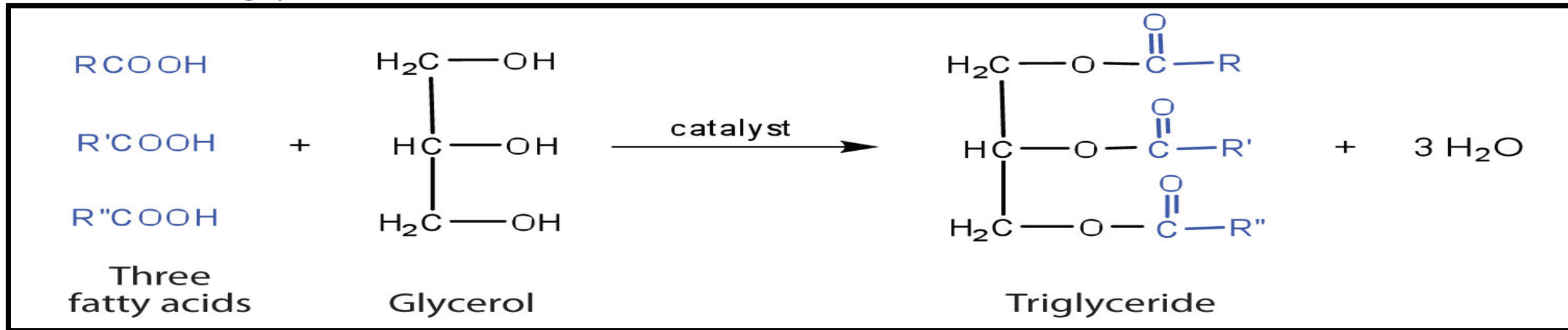
FATTY ACIDS

Classification of Lipids

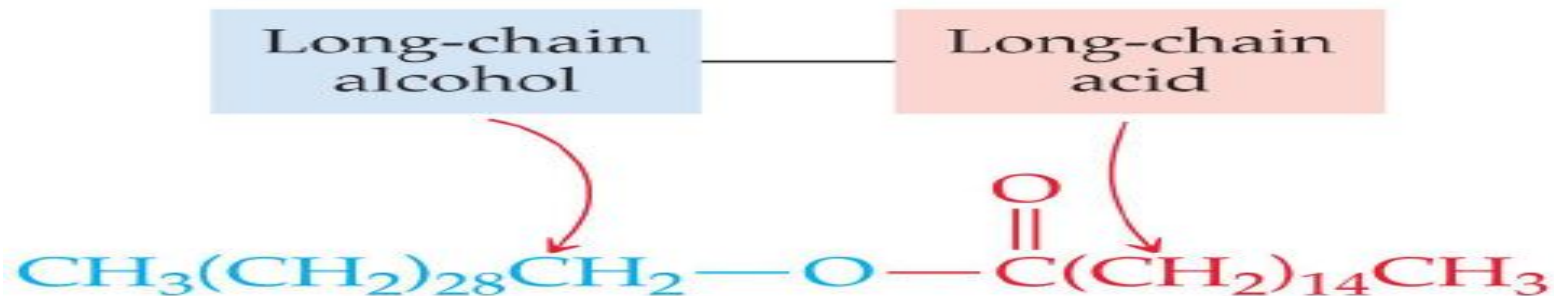


A. Simple Lipids or Homolipids

- Simple lipids are **the esters of fatty acids with various alcohols**.
- They are found as biological food stores and protective coatings.
- **Fats** and **Oils** (**triglycerides** and **triacylglycerols**) - These are esters of fatty acids with glycerol.



- Waxes

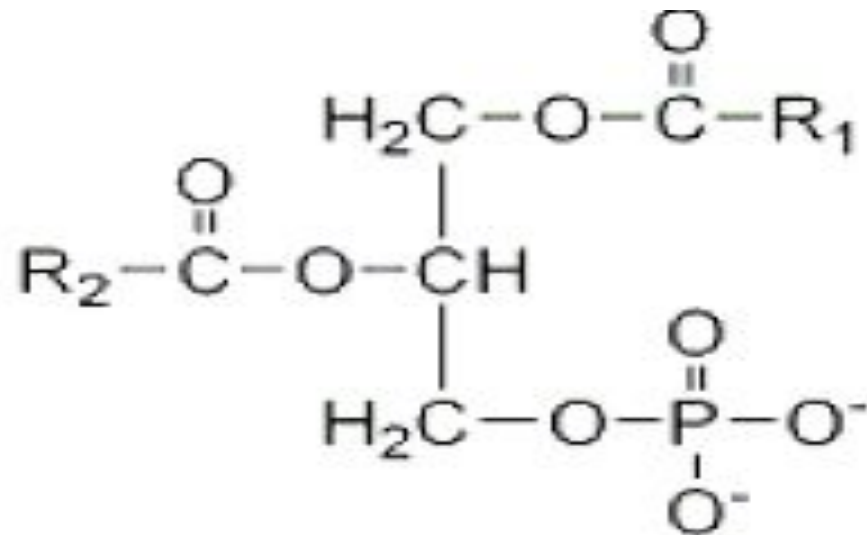


Beeswax

B- Compound Lipids or Heterolipids

— **Heterolipids** are esters of fatty acids with alcohol and possess additional groups also.

- I. **Phospholipids** are very similar in structure to triacylglycerols except one of the alcohols of glycerol is esterified by phosphoric acid instead of a fatty acid = phosphatidic acid (PA). They usually possess **one hydrophilic head** and **two non-polar tails**. They are called **polar lipids** and are **amphipathic** in nature.

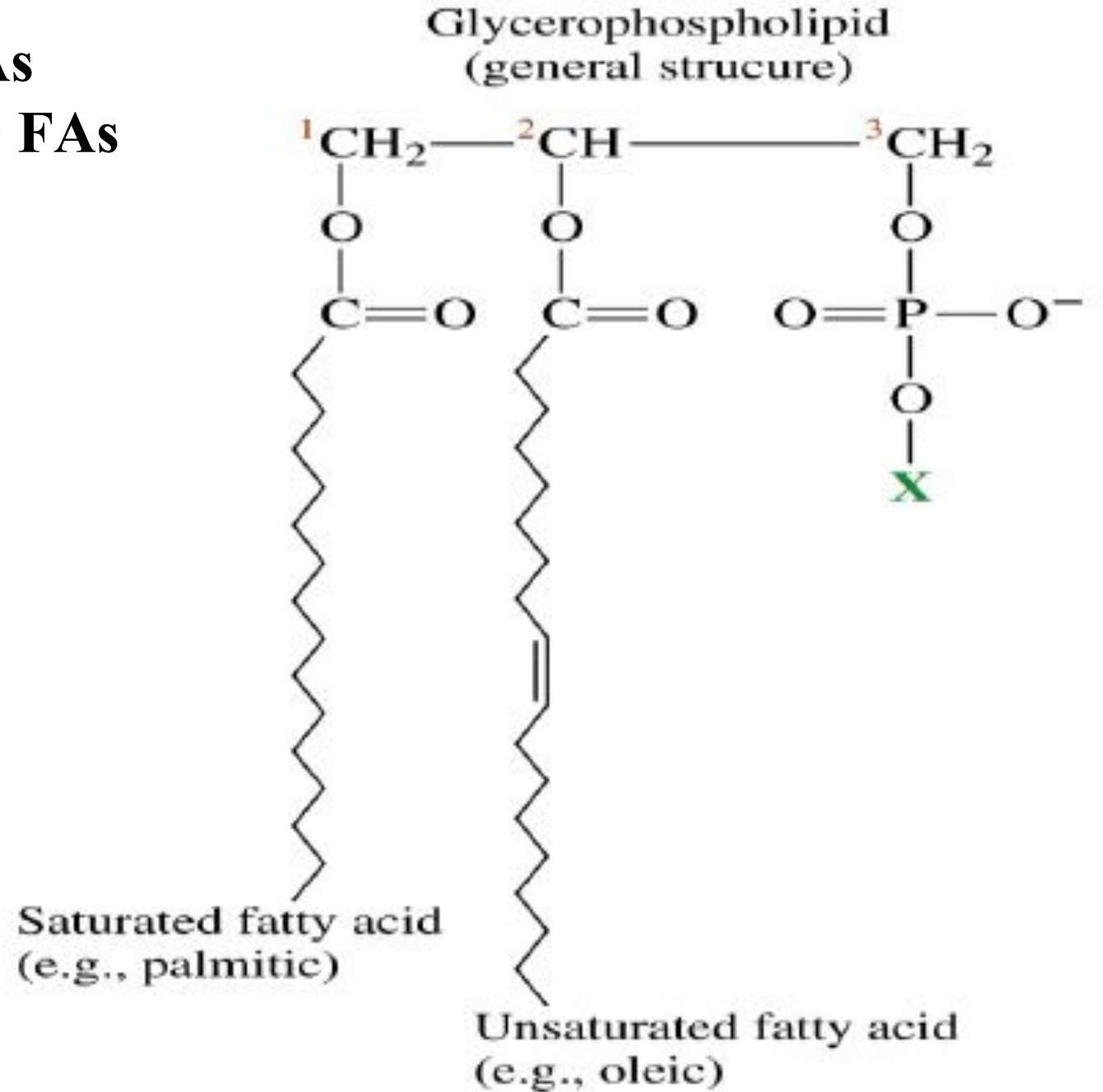


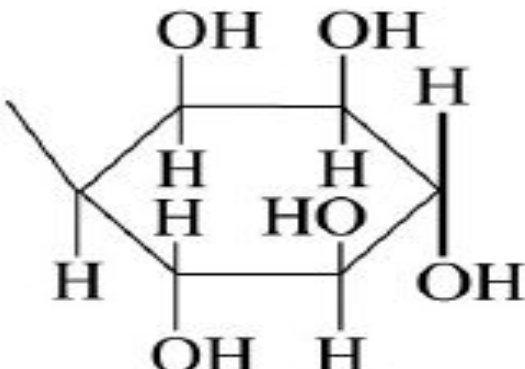
Phospholipids

16-18 FAs most common

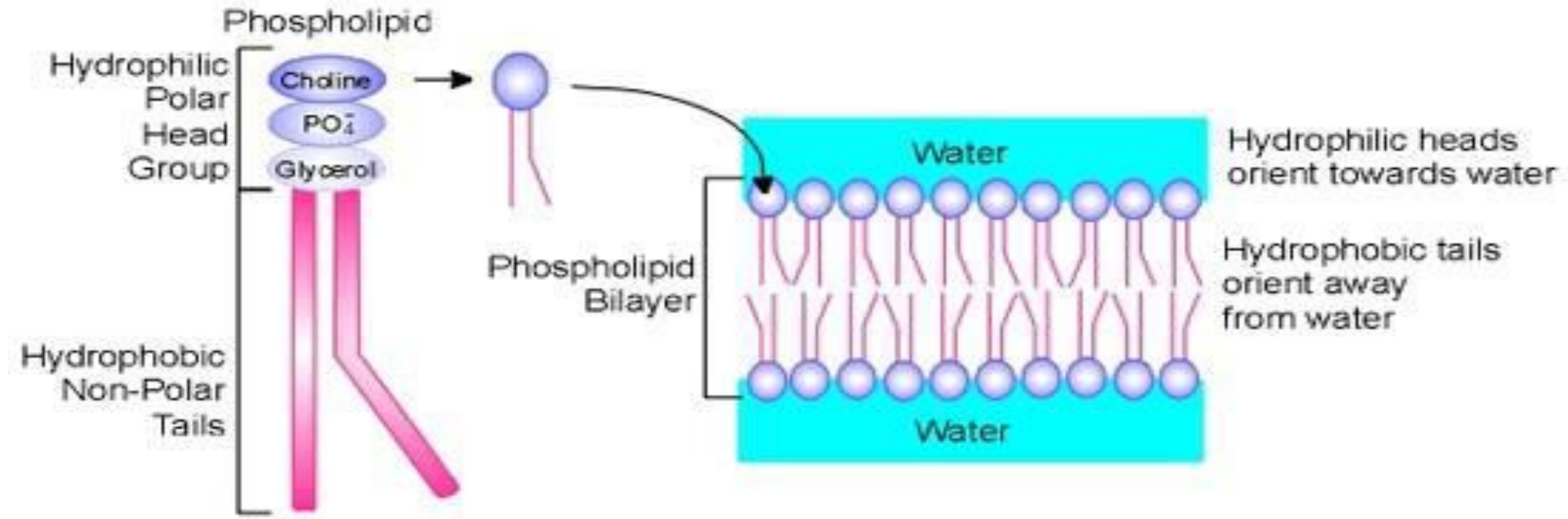
Position 1 favors **SATURATED** FAs

Position 2 favors **UNSATURATED** FAs



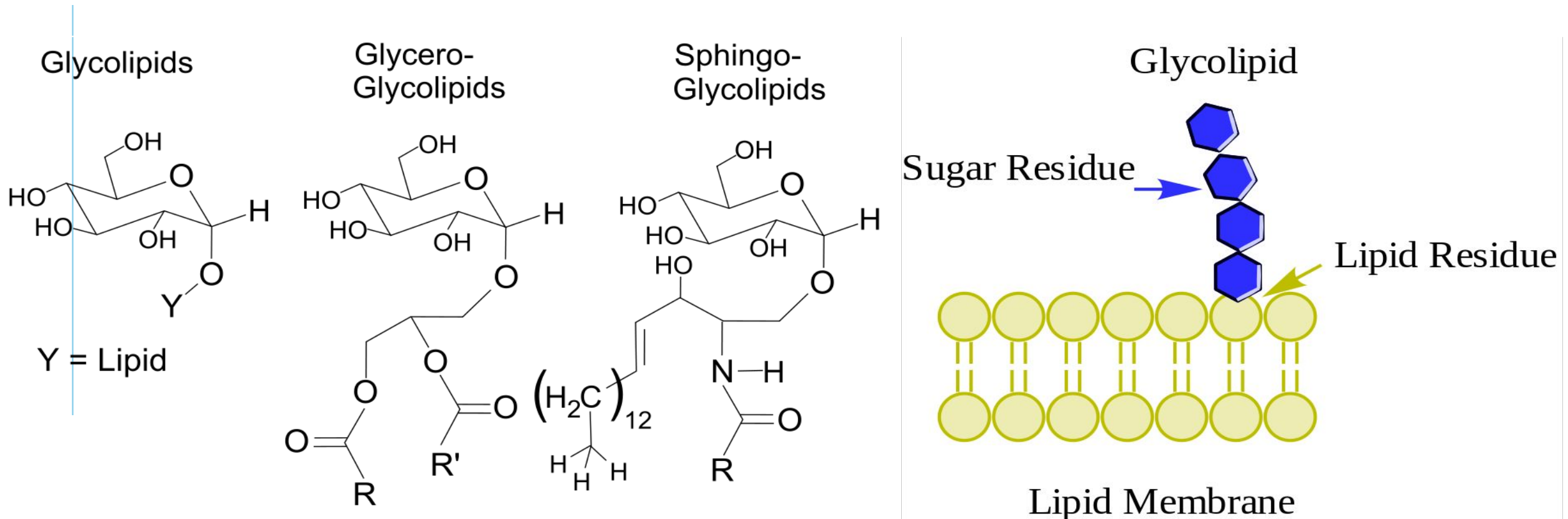
Name of X	Structure of X	Name of Glycerophospholipids
(a) Hydrogen	—H	Phosphatidic acid
(b) Ethanolamine	$\text{—CH}_2\text{—CH}_2\text{—}\overset{+}{\text{N}}\text{H}_3$	Phosphatidylethanolamine
(c) Choline	$\text{—CH}_2\text{—CH}_2\text{—}\overset{+}{\text{N}}(\text{CH}_3)_3$	Phosphatidylcholine
(d) Serine	$\text{—CH}_2\text{—CH—}\overset{+}{\text{N}}\text{H}_3$ COO^-	Phosphatidylserine
(e) Inositol	 The structure shows a six-membered carbon ring in a chair-like conformation. Each carbon atom is bonded to a hydroxyl group (OH) and a hydrogen atom (H). The hydroxyl groups are positioned at the top and bottom of the ring, while the hydrogen atoms are on the sides. The structure is labeled as Inositol.	Phosphatidylinositol

- ✓ **Phospholipids** has both **hydrophilic** and **hydrophobic** regions.
- ✓ **Phospholipids** have **one polar** head and **two non-polar** tails.
- ✓ **Phospholipids** form self-sealing lipid **bilayers** that are the basis for all **cellular membranes**.



II. Glycolipids [Glycerolipids and Sphingolipids (Cerebrosides or Glycosphingosides)]

- **Glycolipids** are lipids with a carbohydrate (**monosaccharide** or **oligosaccharide**) attached by a glycosidic (covalent) bond.



III. Derived Lipids

Derived lipids are the substances derived from simple and compound lipids by hydrolysis. These includes **fatty acids, alcohols, prostaglandins , steroids, terpenes, carotenoids.**

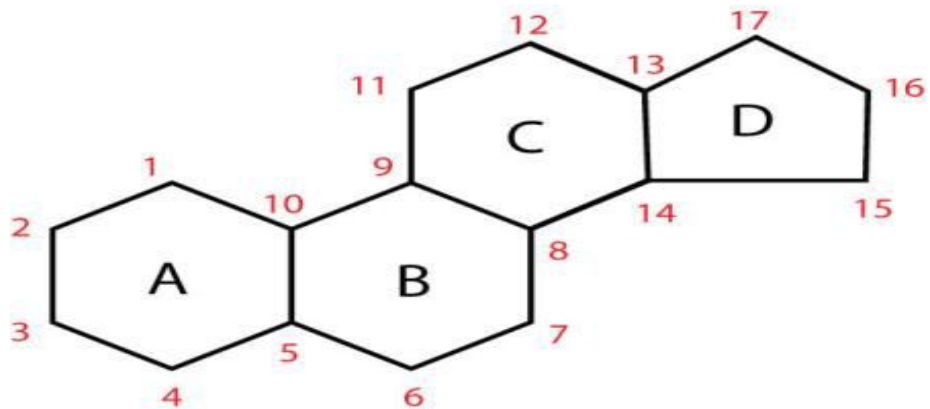
The most common derived lipids are **steroids, terpenes.**

1. Steroids

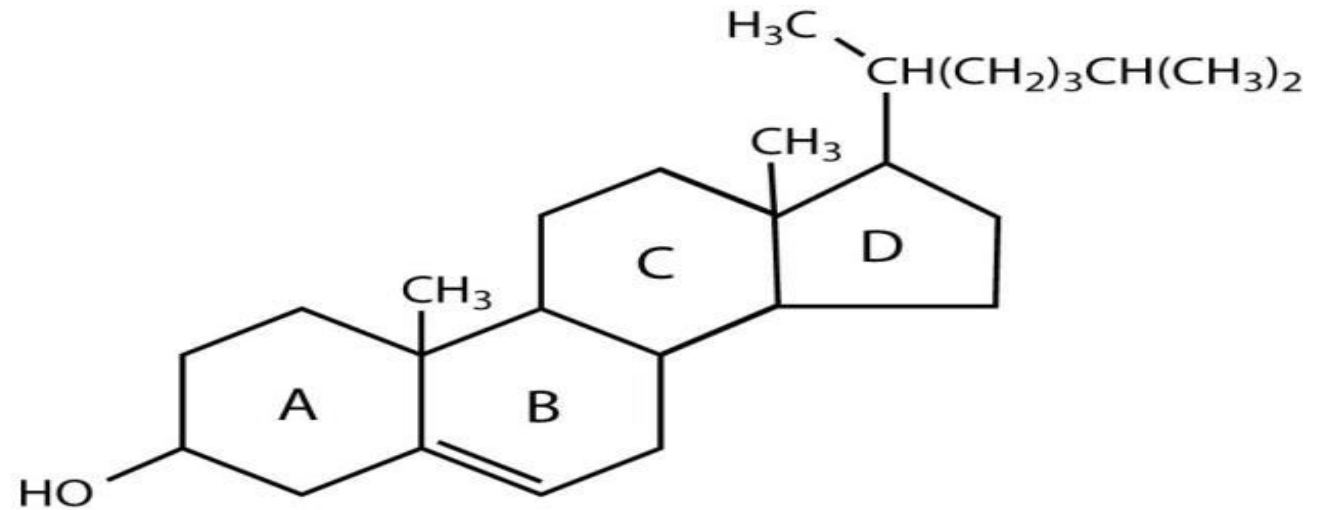
- **Steroids** do not contain **fatty acids**. They are widely distributed in animals, where they are associated with physiological processes.
- All **steroids** may be considered as derivatives of a fused and fully saturated ring system called **cyclopentanoperhydrophenanthrene** or **sterane**. This system consists of **3 cyclohexane** rings (**A, B** and **C**) fused in nonlinear or phenanthrene manner and a terminal **cyclopentane ring (D)**.

Function of Steroids :

- Source of some important biological molecules (**Cholesterol, bile acids, vit. D, and sex hormones**).
- Components of **cell membranes**.
- Energy storage



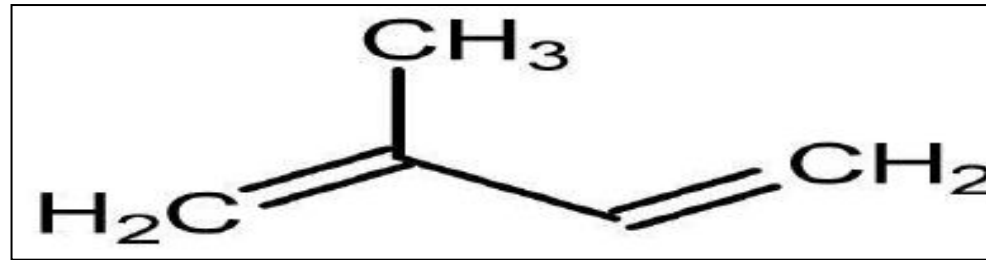
(a) Steroid skeleton



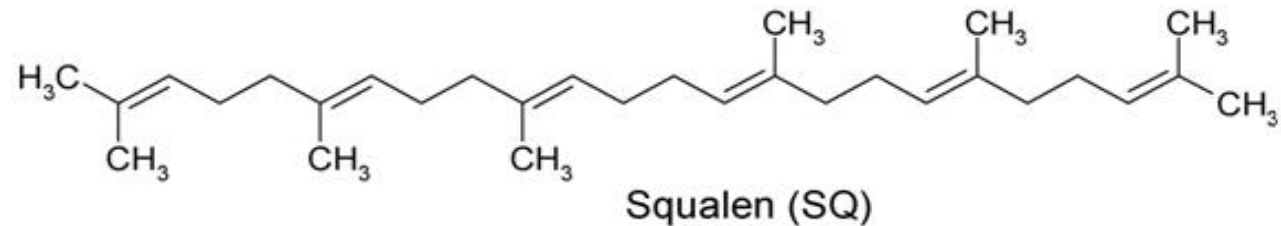
(b) Cholesterol

2- Terpenes

- Terpenes in majority are found in plants. Example: **Natural rubber**. **Geranoil**, **Camphor**, etc.
- It is built up from **isoprene**, a **hydrocarbon(diene)** consisting of five carbon atoms attached to eight hydrogen atoms (C_5H_8).



- The term is often extended to the terpenoids, which are oxygenated derivatives of these hydrocarbons.
- The true terpenes are usually grouped according to the number of **isoprene** (C_5H_8) units in the molecule: monoterpenes ($\text{C}_{10}\text{H}_{16}$) contain two such units;
 - **diterpenes** ($\text{C}_{20}\text{H}_{32}$),
 - **triterpenes** ($\text{C}_{30}\text{H}_{48}$),
 - **tetraterpenes** ($\text{C}_{40}\text{H}_{64}$),.



Any questions?

*Thank
You*