SAWA UNIVERSITY

Biochemistry I

Lipids Metabolism I

Sawa University — جامعـــــة ســـــــاوة الاهلية

College of health and medical techniques — كليـــــة التقنيـــات الصحيـة والطبيـة

Department of Medical Laboratories — قسم تقنيات المختبرات الطبية

2nd Stage — المرحلـــــــــــة الثانية

الجانب النظري محاضرة رقم 6

Theoretical Lecture No 6.

تدريسي المادة : م.د. عبدالرحمن يسر خلسفة

Topics

- **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

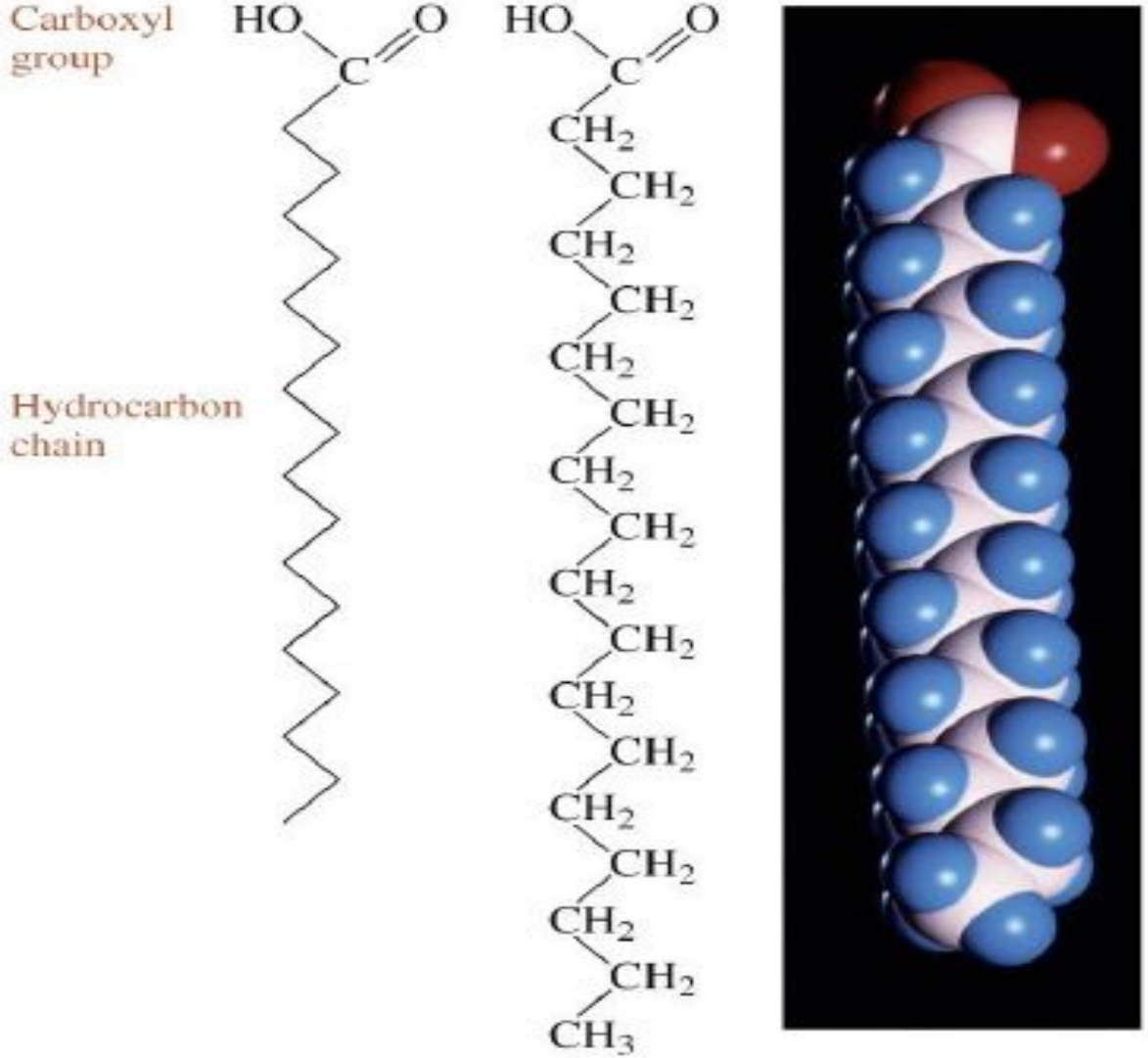
1) **Storage molecules for energy (fats and oils).**
   1) Can get lots of energy from a fat.
   2) Stored in adipose tissue.
3) **Structural components of cellular membranes.**
4) **Protective molecules (waxes).**
5) **Hormones and vitamins.**
6) **Intracellular messengers.**
7) **Pigments.**
8) **Insulation.**

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 .



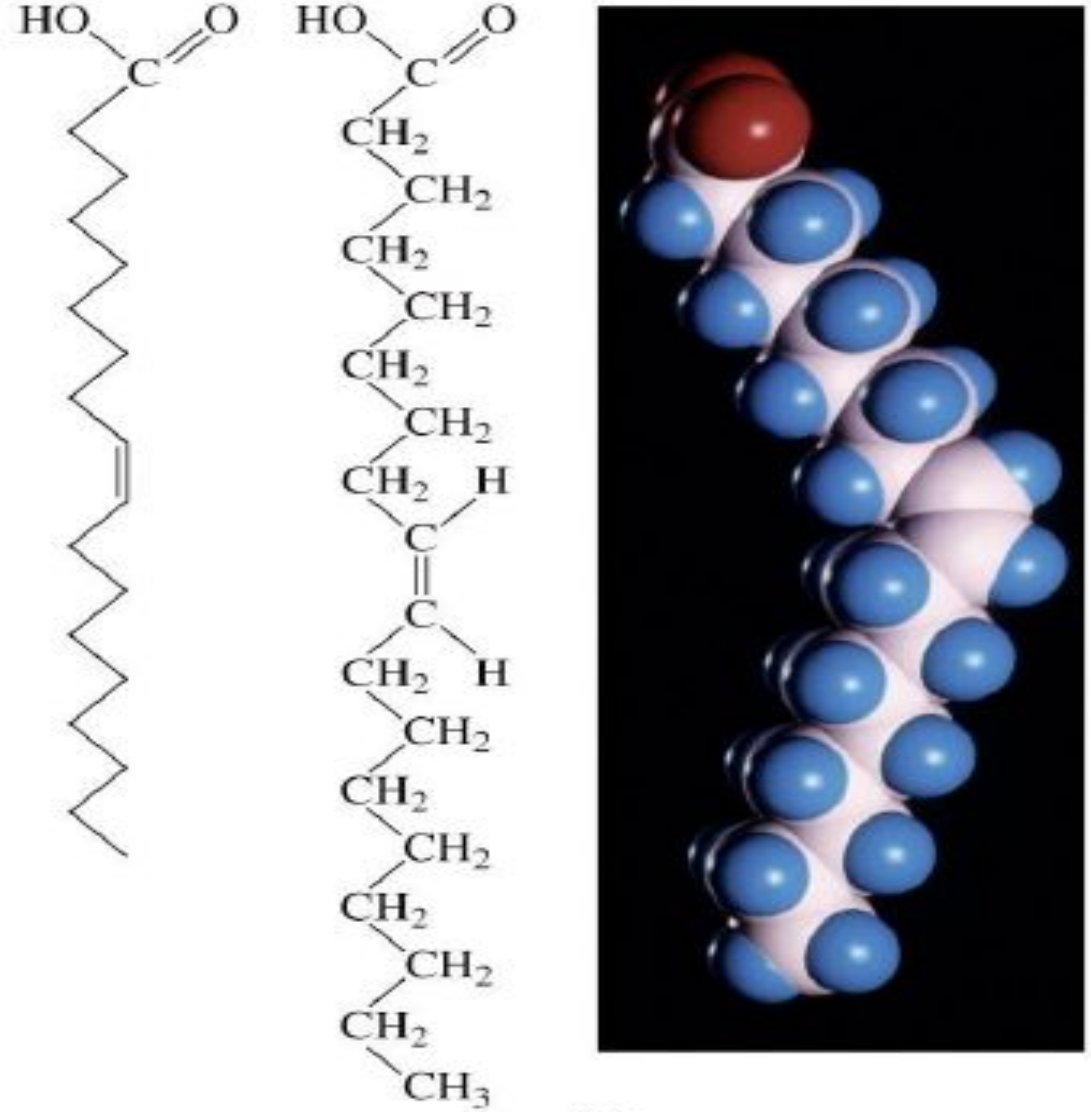


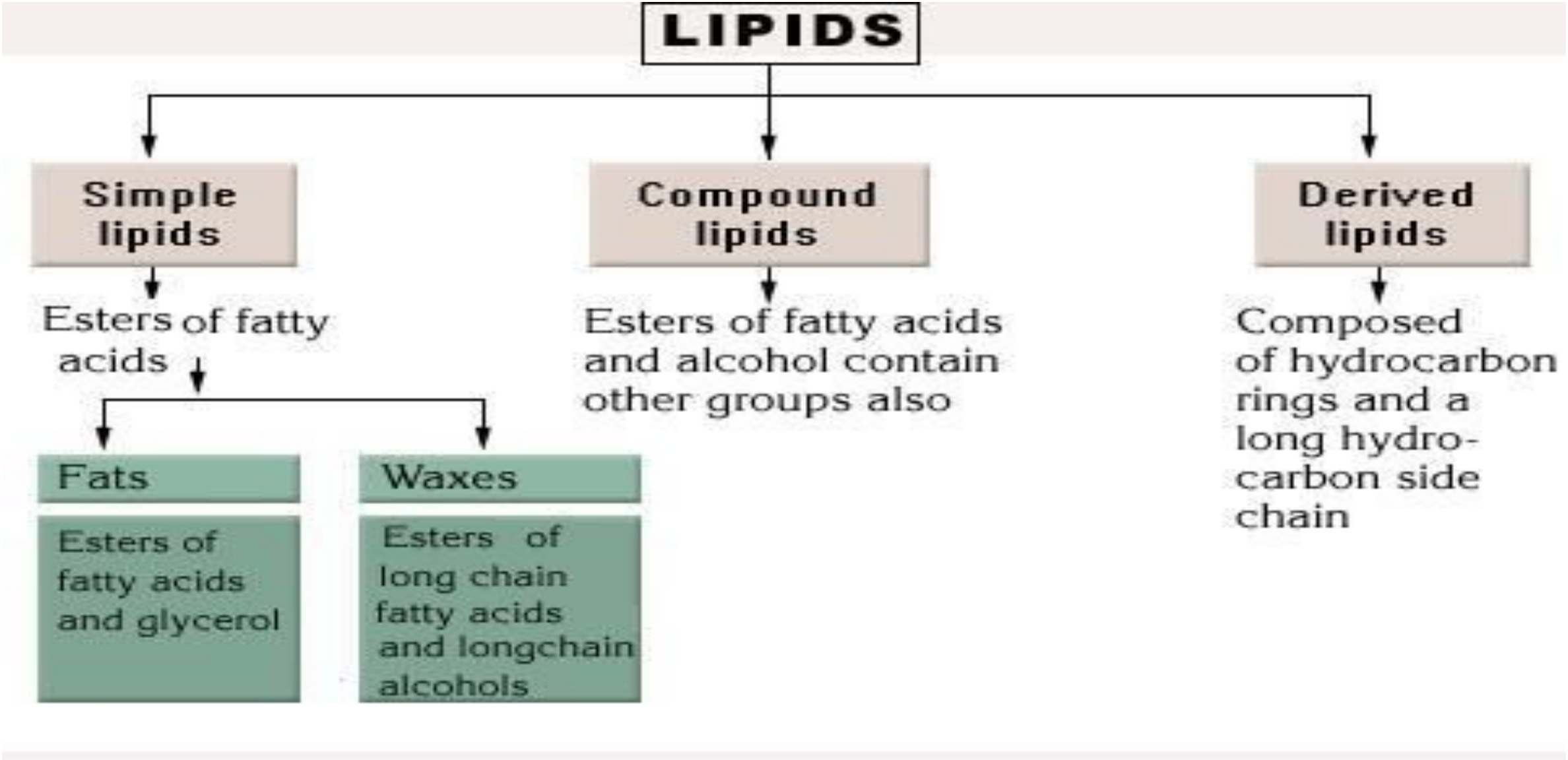
Figure 8-1 Concepts in Biochemistry, 3/e

Saturated

Unsaturated

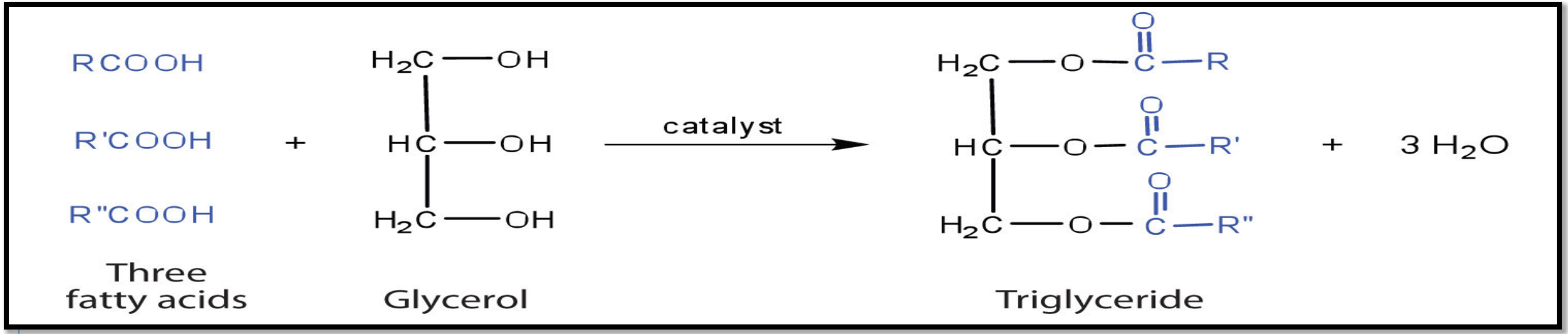
FATTY ACIDS

Classification of Lipids

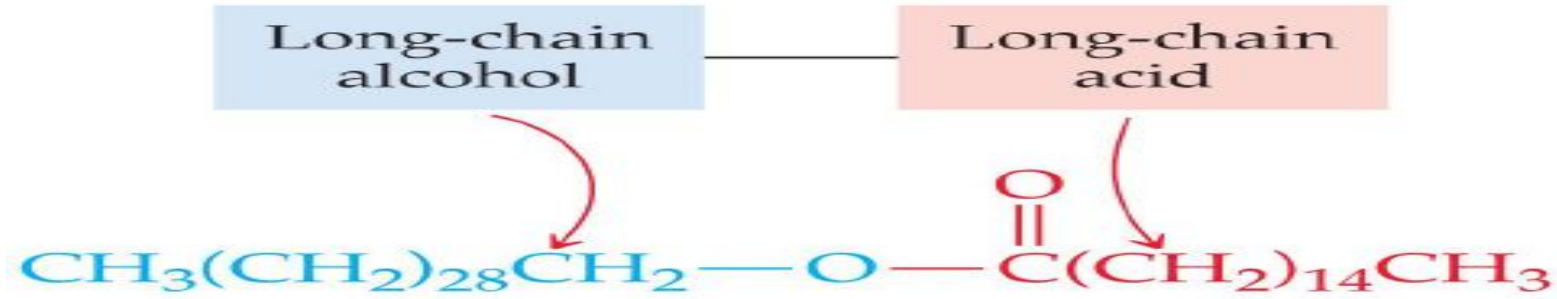


A. Simple Lipids or Homolipids

- 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**

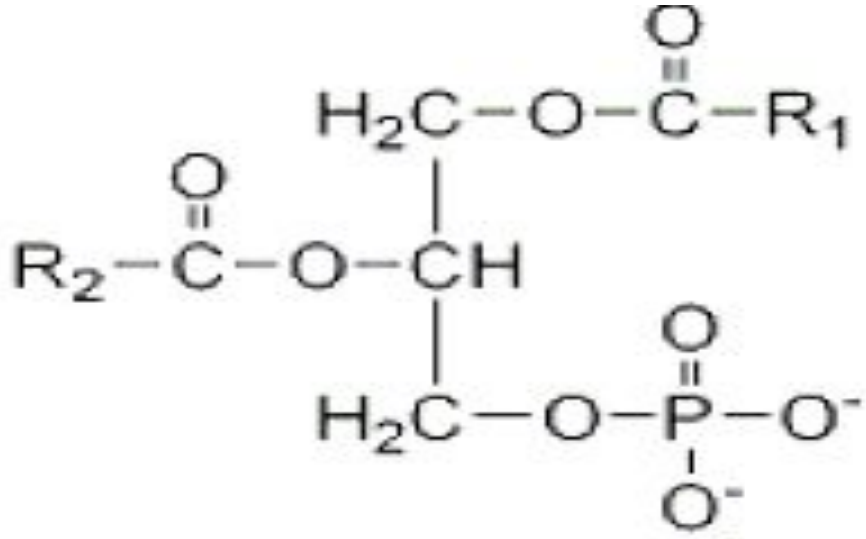


Beeswax

B- Compound Lipids or Heterolipids

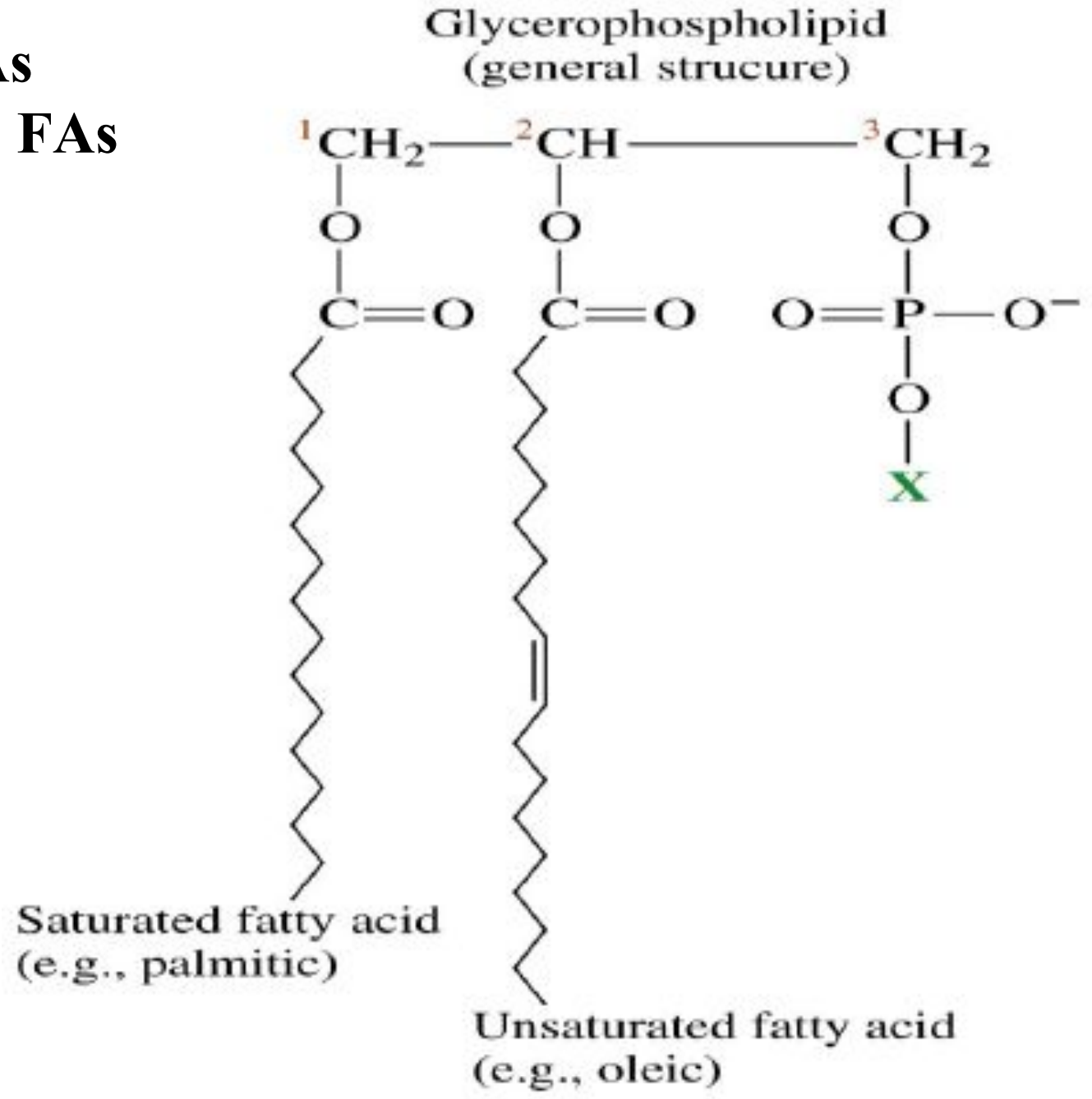
— **Heterolipids** are esters of fatty acids with alcohol and possess additional groups also.

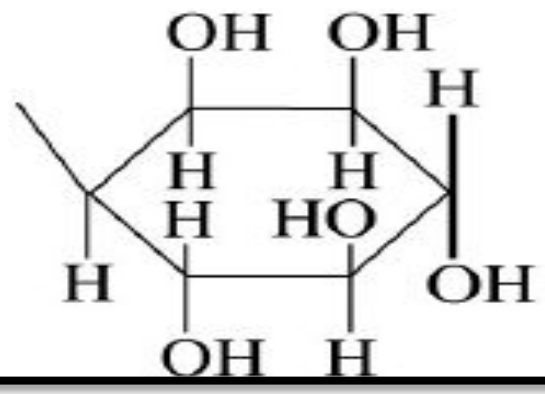
I. **Phospholipids** are very similar in structure to **triacylglycerols** except **one of the alcohols of glycerol is esterified by phosphoric acid instead of a fatty acid = phosphatidic acid (PA)**. They usually possess **one hydrophilic head** and **two non-polar tails**. They are called **polar lipids**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



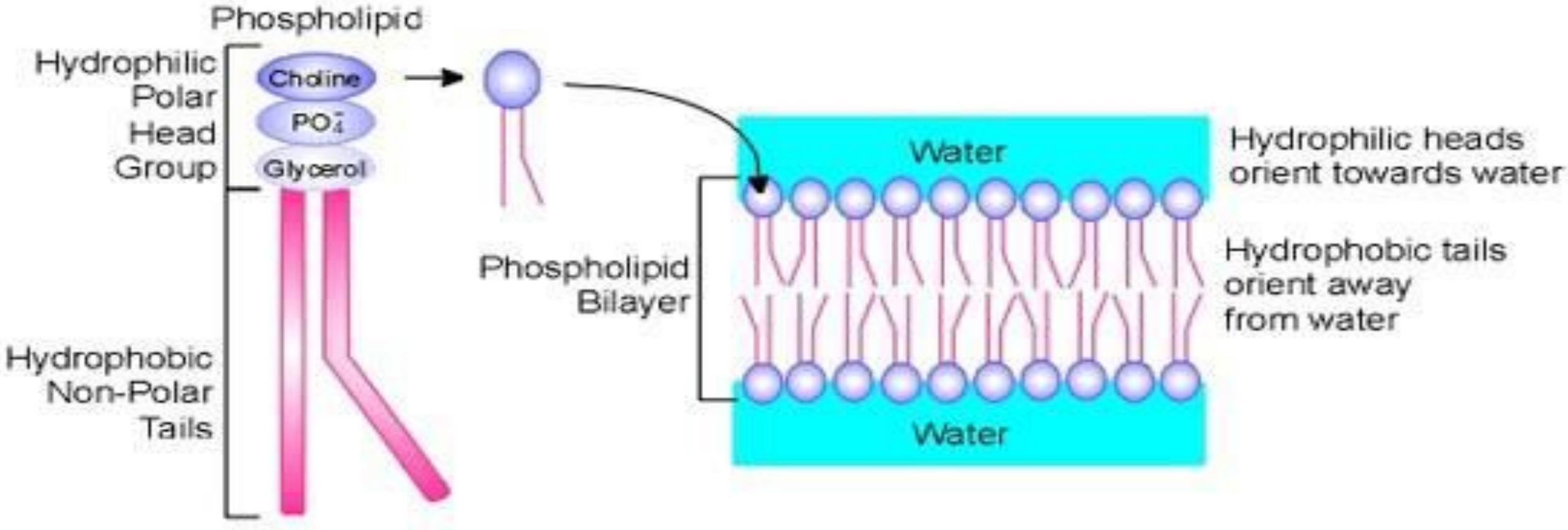
Phospholipids

16-18 FAs most common
Position 1 favors **SATURATED FAs**
Position 2 favors **UNSATURATED FAs**



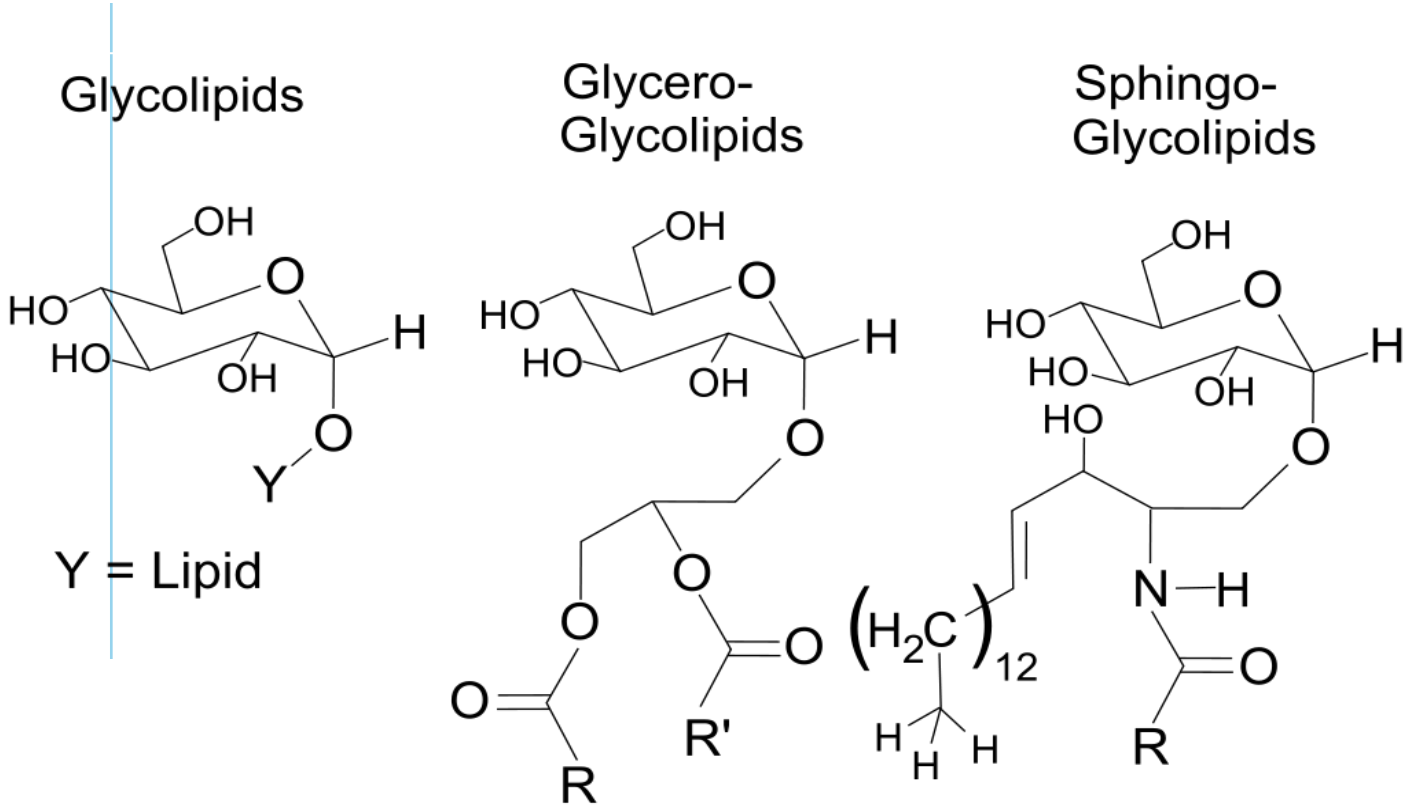
Name of **X**	Structure of **X**	Name of Glycerophospholipids
(a) Hydrogen	—H	Phosphatidic acid
(b) Ethanolamine	$-CH_2-CH_2-\overset{+}{N}H_3$	Phosphatidylethanolamine
(c) Choline	$-CH_2-CH_2-\overset{+}{N}(CH_3)_3$	Phosphatidylcholine
(d) Serine	$-CH_2-CH(COO^-)-\overset{+}{N}H_3$	Phosphatidylserine
(e) Inositol		Phosphatidylinositol

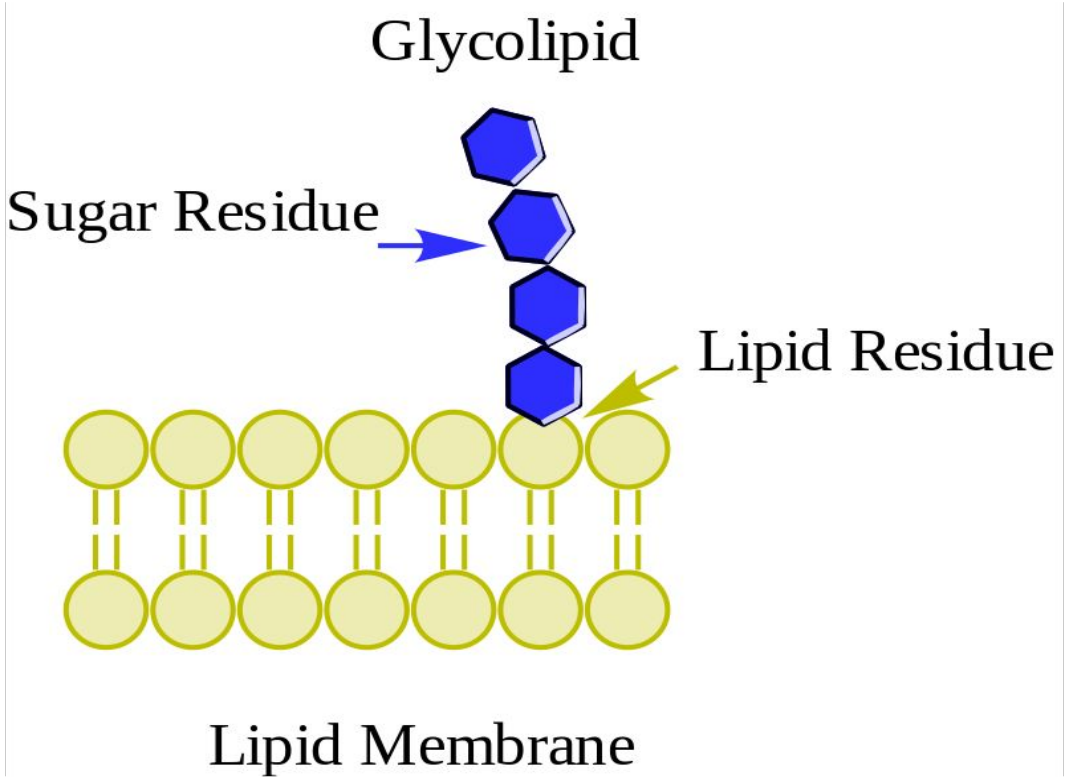
- ✔ **Phospholipids** has both **hydrophilic** and **hydrophobic** regions.
- ✔ **Phospholipids** have **one polar** head and **two non-polar** tails.
- ✔ **Phospholipids** form self-sealing lipid **bilayers** that are the basis for all **cellular membranes**.



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**.

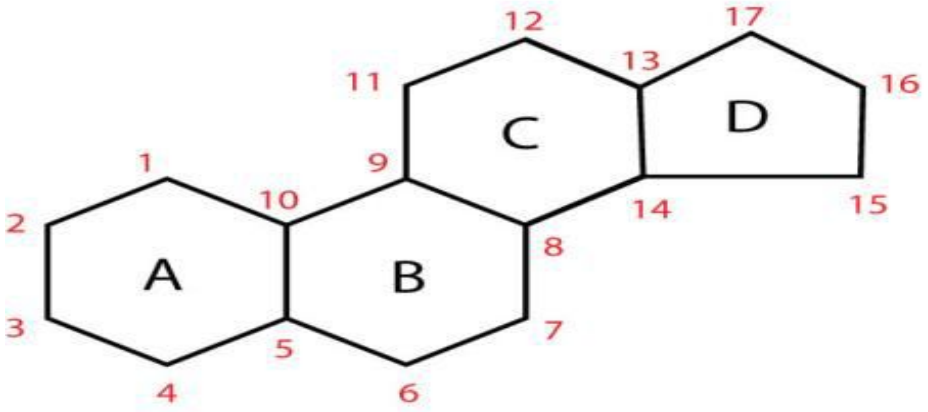
The most common derived lipids are **steroids**, **terpenes**.

1. Steroids

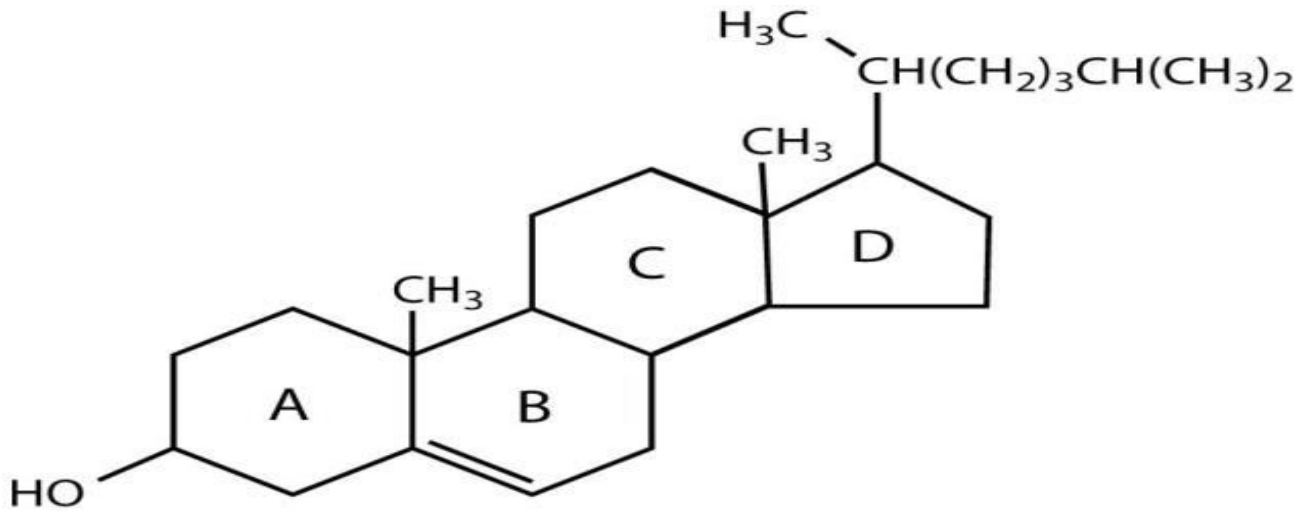
- **Steroids** do not contain **fatty acids**. They are widely distributed in animals, where they are associated with physiological processes.
- All **steroids** may be considered as derivatives of a fused and fully saturated ring system called cyclopentanoperhydrophenanthrene or **sterane**. This system 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



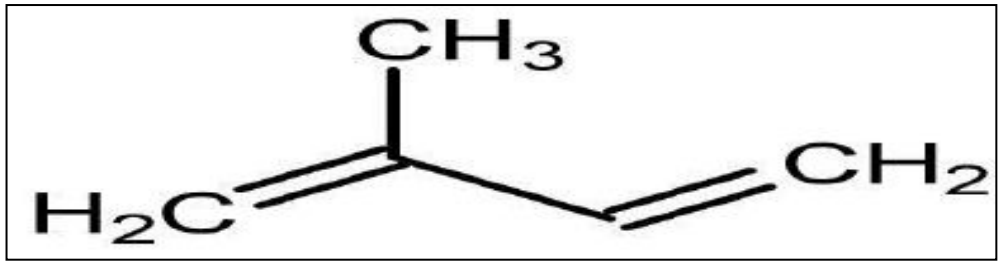
(a) Steroid skeleton



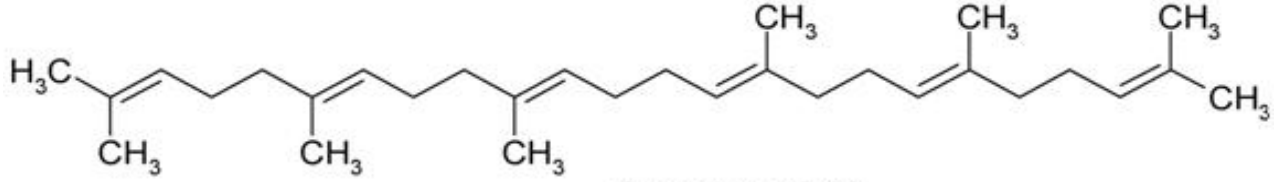
(b) Cholesterol

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 ($C_{10}H_{16}$) contain two such units;
  - **diterpenes ($C_{20}H_{32}$),**
  - **triterpenes ($C_{30}H_{48}$),**
  - **tetraterpenes ($C_{40}H_{64}$),.**



Squalen (SQ)

Any questions?