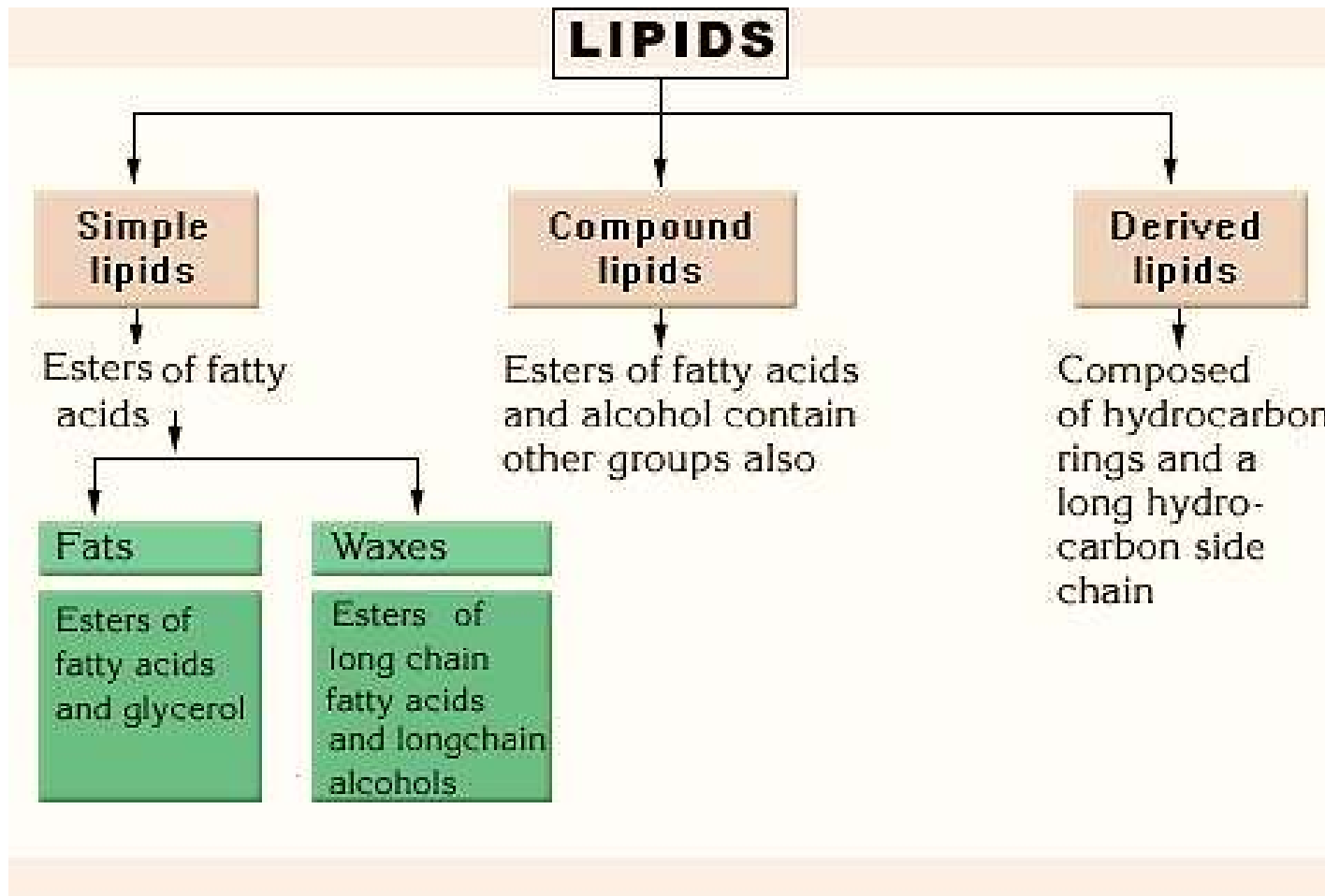
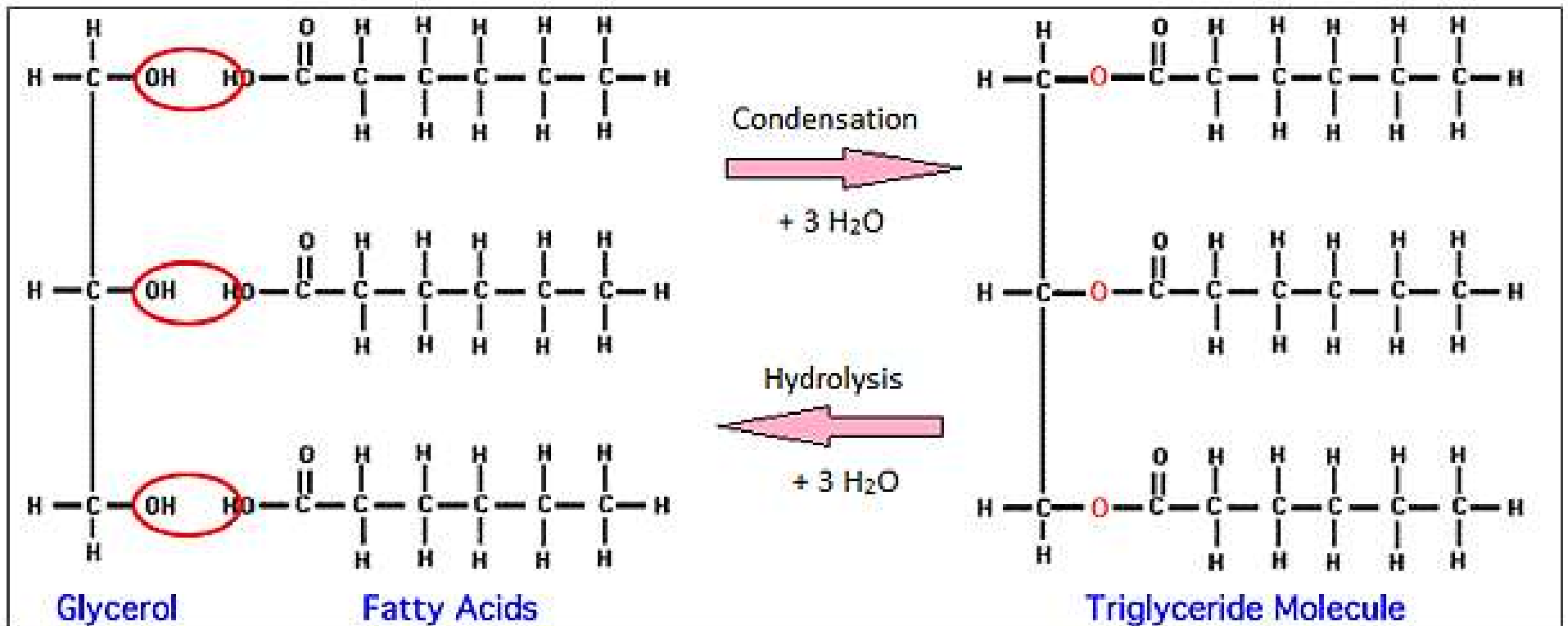
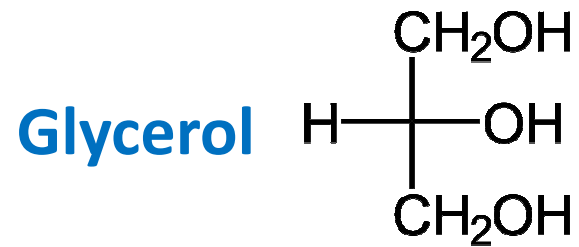
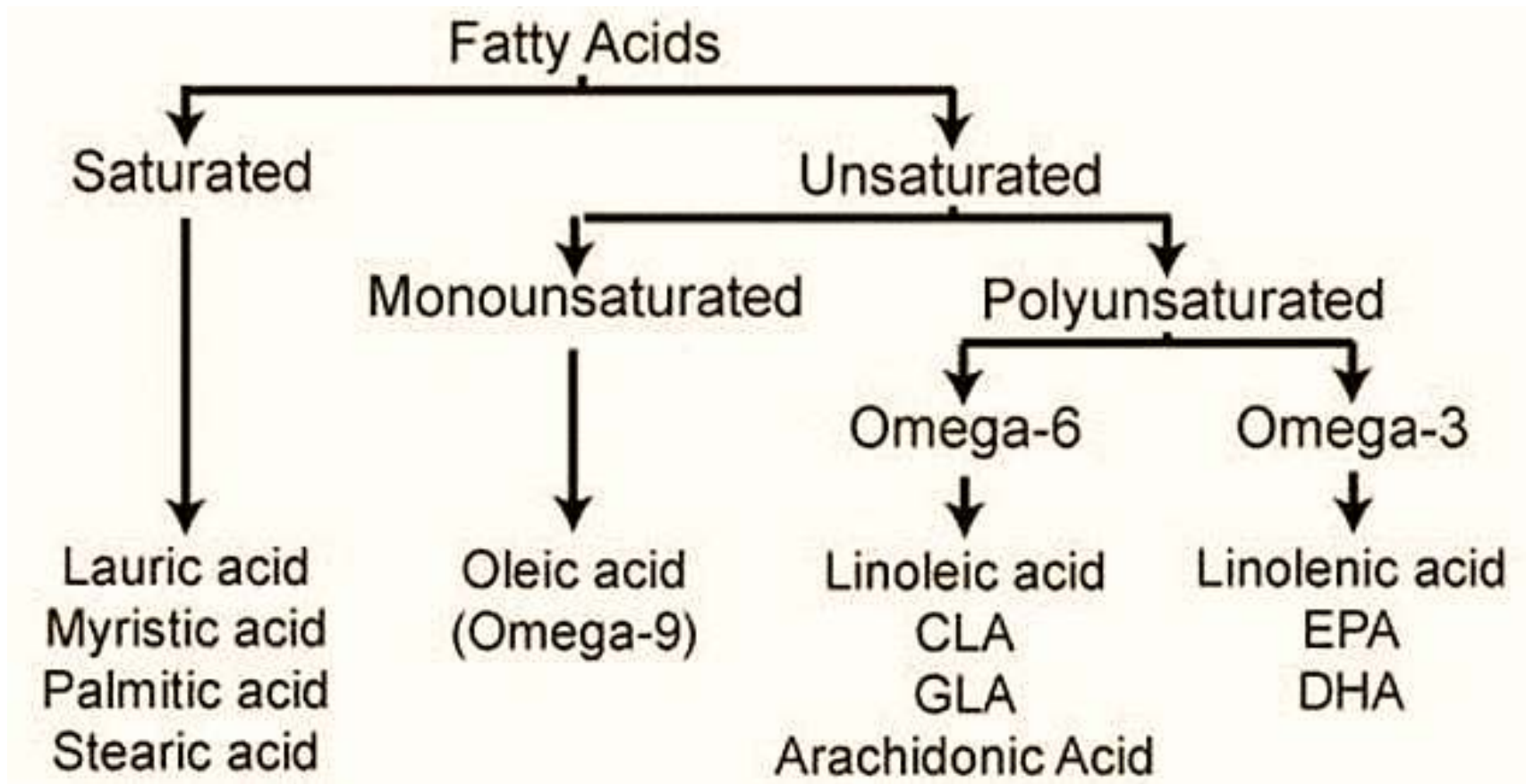


# Structure and Significance of Lipid



Type	Function
Bile acids	Steroids that aid in fat digestion and nutrient absorption
Cholesterol	Component of cell membranes; precursor of other steroids
Eicosanoids	Chemical messengers between cells
Fat-soluble vitamins (A, D, E, and K)	Involved in a variety of functions including blood clotting, wound healing, vision, and calcium absorption
Fatty acids	Precursor of triglycerides; source of energy
Phospholipids	Major component of cell membranes; aid in fat digestion
Steroid hormones	Chemical messengers between cells
Triglycerides	Energy storage; thermal insulation; filling space; binding organs together; cushioning organs





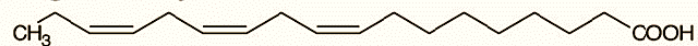
**GLA (Gamma linoleic)**

**CLA (Conjugated linoleic acid)**

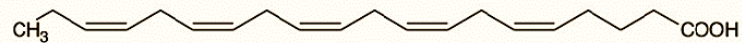
**DHA (Docosahexanoic acid)**

**EPA (Eicosapentaenoic acid)**

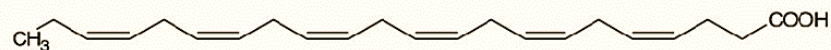
### Omega-3 fatty acids



ALA:  $\alpha$ -Linolenic acid      C18:3 n-3

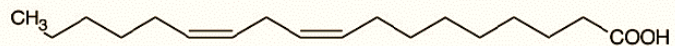


EPA: Eicosapentanoic acid      C20:5 n-3

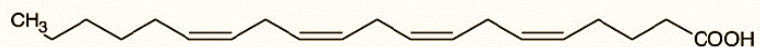


DHA: Docosahexanoic acid      C22:6 n-3

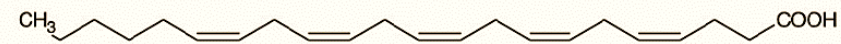
### Omega-6 fatty acids



LA: Linoleic acid      C18:2 n-6



AA: Arachidonic acid      C20:4 n-6



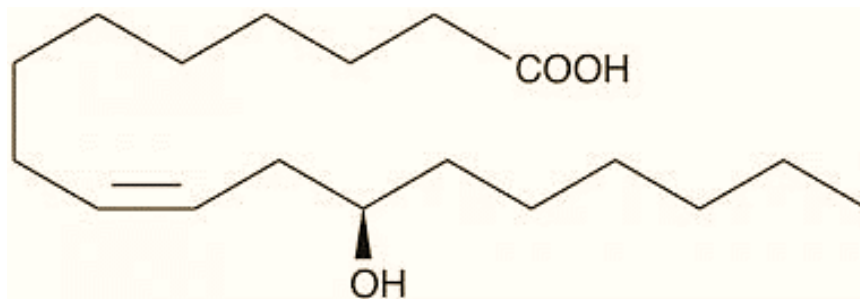
DPA: Docosapentanoic acid      C22:5 n-6

## NAMES AND CHEMICAL DESCRIPTIONS OF SOME COMMON FATTY ACIDS

LIPID COMMON NAME	CHAIN LENGTH # (# of carbons)	# DOUBLE BONDS	OMEGA # (double bond position)	SCIENTIFIC NAME
Lauric Acid -----	12	0	none	dodecanoic acid
Myristic Acid -----	14	0	none	tetradecanoic acid
Palmitic Acid -----	16	0	none	hexadecanoic acid
Stearic Acid -----	18	0	none	octadecanoic acid
Oleic Acid -----	18	1	omega-9	9-octadecanoic acid
Linoleic Acid -----	18	2	omega-6	9,12-octadecadienoic acid
Conjugated Linoleic Acid (CLA) -----	18	2	omega-6	9,11-octadecadienoic acid(*)
Alpha-Linolenic Acid -----	18	3	omega-3	9,12,15-octadecatrienoic
Gamma-Linolenic Acid (GLA)-----	18	3	omega-6	6,9,12-octadecatrienoic
Dihomo-Gamma-Linolenic Acid (DGLA) -----	20	3	omega-6	8,11,14-eicosatetranoic acid
Arachidonic Acid -----	20	4	omega-6	5,8,11,14-eicosatetranoic acid
EicosaPentanoic Acid (EPA) -----	20	5	omega-3	5,8,11,14,17-eicosapentaenoic acid
DocosaHexaenoic Acid (DHA) -----	22	6	omega-3	4,7,10,13,16,19-docosahexaenoic acid

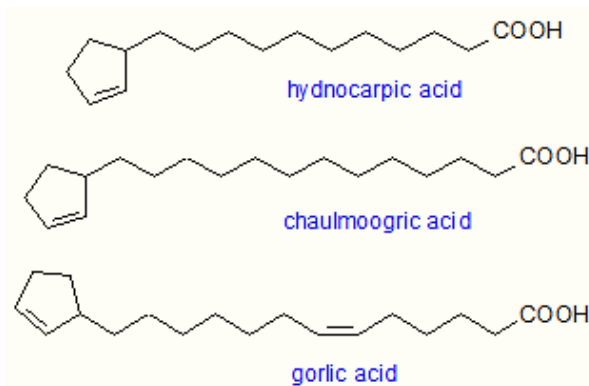
(\*) Some 10,12 CLA also occurs, but the 9,11 form greatly predominates in ruminant foods.

## Substituted fatty acid

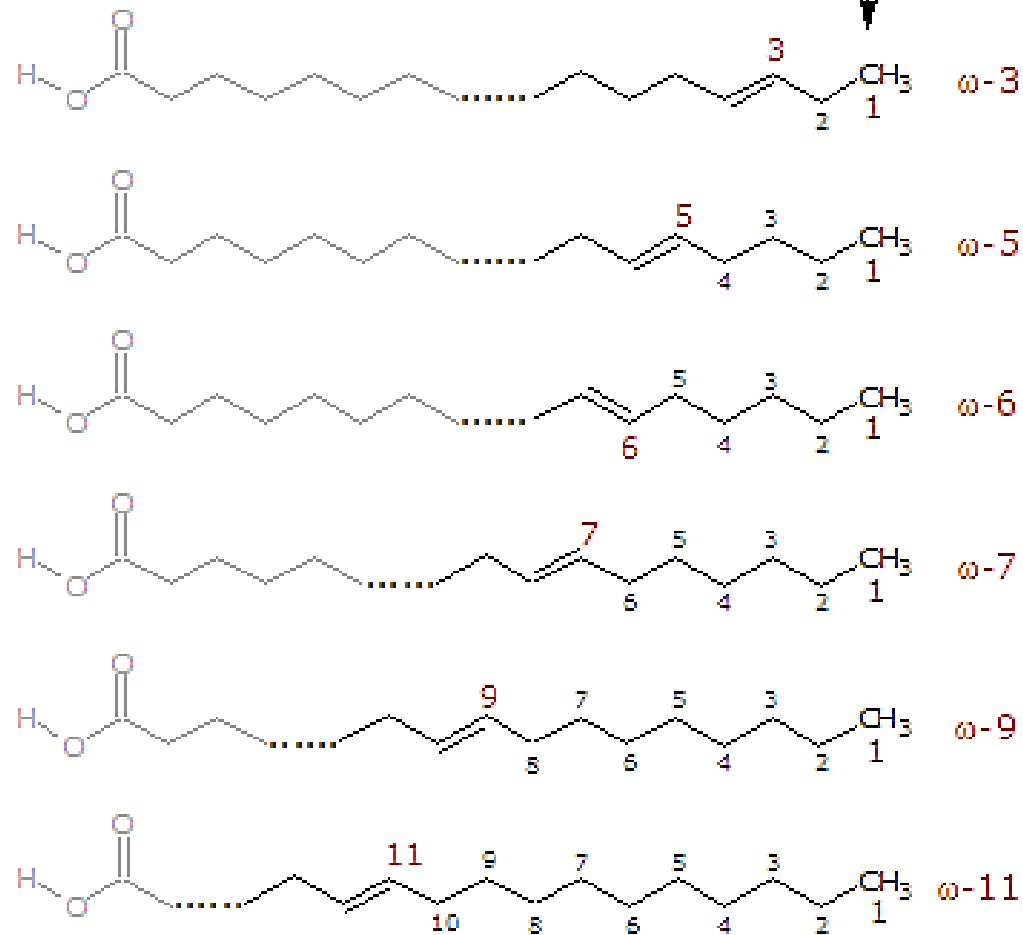


Ricinoleic acid

## Cyclic fatty acid



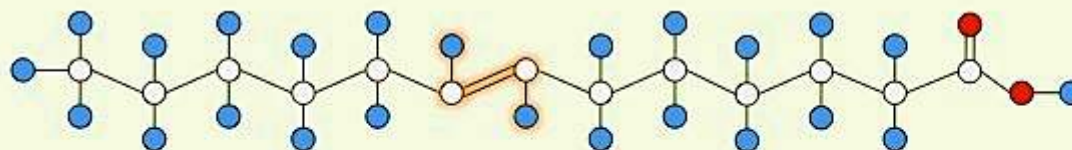
Position of the double bond closest to the methyl end of the fatty acid



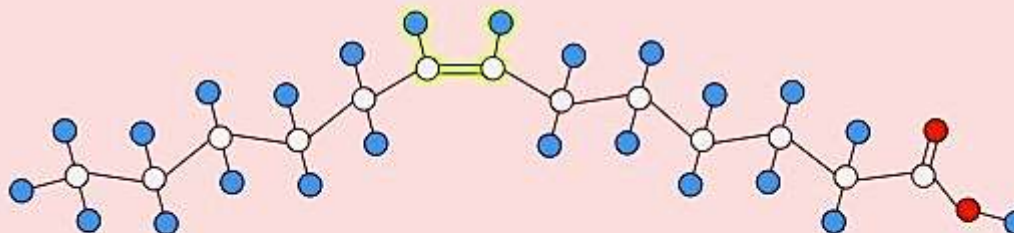
Saturated fatty acid  
(*no* double bonds)



Unsaturated – *trans*  
(H atoms opposite)



Unsaturated – *cis*  
(H atoms same side)  
⇒ *bent configuration*



**SATURATED FATTY ACIDS**

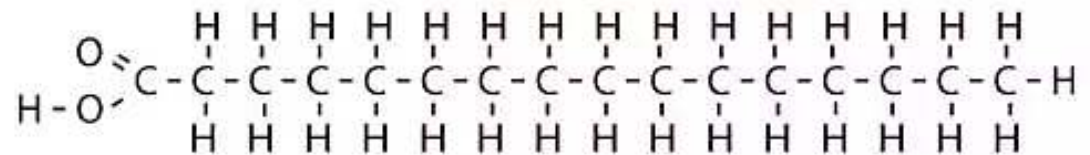
**VERSUS**

**UNSATURATED FATTY ACIDS**

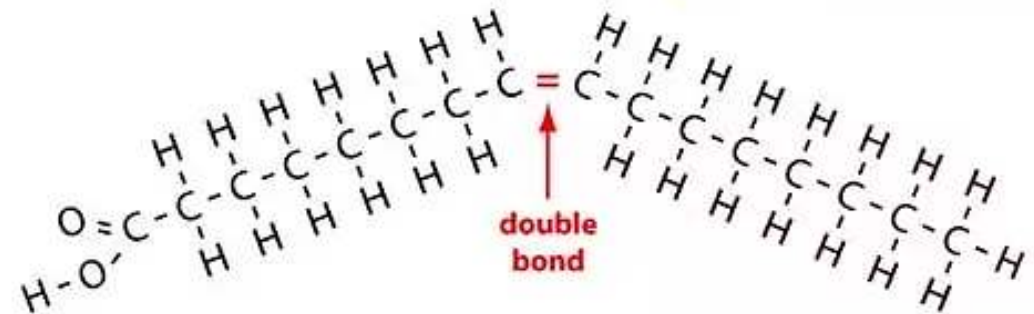
SATURATED FATTY ACIDS	UNSATURATED FATTY ACIDS
Fatty acids such as stearic acid, whose carbon chain contains no unsaturated linkages between carbon atoms and cannot incorporate any more hydrogen atoms	Fatty acids such as oleic acid, whose carbon chain possesses one or more double or triple bonds and, can incorporate additional hydrogen atoms
Can be found in coconut oil, vegetable oils, butter, whole milk, margarine, meat, and peanut	Can be found in avocado, olive oil, canola oil, sunflower oil, fish oil, and red meat
Include myristic, stearic, palmitic acids	Include linoleic, oleic, stearidonic acids
Hydrocarbon chain only contains single bonds	Hydrocarbon chain contains at least one double bond
Hydrocarbon chain is a straight chain	Hydrocarbon chain is bent
Have a high melting point	Have a low melting point
Solids at room temperature	Liquids
Make up the fat	Make up the oil
Rancidity is low	Rancidity is high
Shelf life is high	Shelf life is low
Increase the LDL	Decrease the LDL
10% of calories should come from saturated fatty acids	30% of calories should come from unsaturated fatty acids
Excessive consumption can lead to atherosclerosis and heart disease	Excessive consumption can reduce cholesterol levels in the body

Visit [www.FEDDAA.com](http://www.FEDDAA.com)

**saturated fatty acid**



**unsaturated fatty acid**

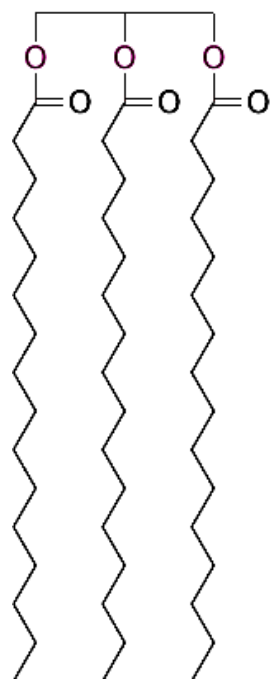


## Importance of fatty acids

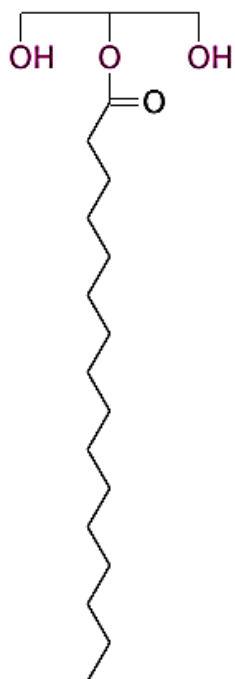
- Every human cell is formed by a **membrane and is formed of a bilayer of lipids** with role in the passive transport and proteins with role in the active transport.
- This double layer of lipids, which assures the **main structure of the cell membrane**, is formed of two layers of **phospholipids**. In this case, the phosphoric acid is esterified with a diacylglycerol, which can contain the same or different fatty acid residues.
- The type of fatty acids found in the structure of the cell membrane can affect its **fluidity, its stability and its functions**.
- Different **fluidity of cell membranes depending on the saturation of fatty acids**: saturated fatty acids forming viscous membrane (up), unsaturated cis fatty acids forming fluid membrane.
- **Hyperfluidity** of membranes is obtained in bilayers **rich in docosahexaenoic acid (DHA)** and it influence the **activity of the Na<sup>+</sup>-K<sup>+</sup>-ATPase pump in the same membrane**.
- High content of polyunsaturated fatty acids in cell membranes could expose them to oxidative stress and, consequently, to lipid oxidation and peroxidation.
- **Membrane protein activity can be affected** by external fatty acids released by other cells activity or by exogenous source (**syntaxin-3** activity is dependent on the presence of omega-6 arachidonic acid).
- **The arachidonic acid (AA)** can be also released from cell membranes through the action of phospholipase A<sub>2</sub> and serves as precursor for the **synthesis of the biologically active eicosanoids**. These eicosanoids are the prostaglandins (PG), thromboxanes and leukotrienes.
- **Saturated and trans fatty acids increase Coronary Heart Disease risk** is through an adverse influence on blood lipid levels.

# Triacylglycerol

Triacylglycerol



Monoacylglycerol

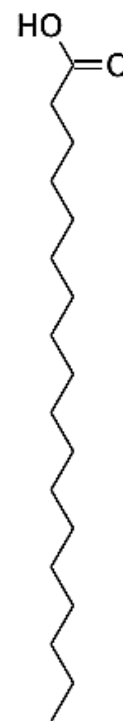


Fatty acids

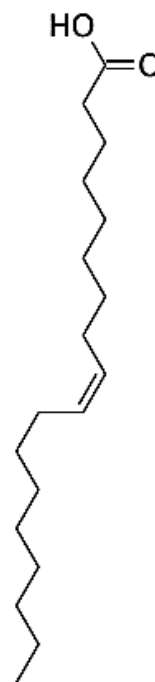
C16:0



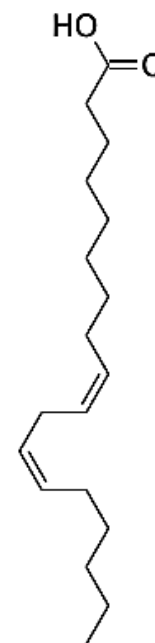
C18:0



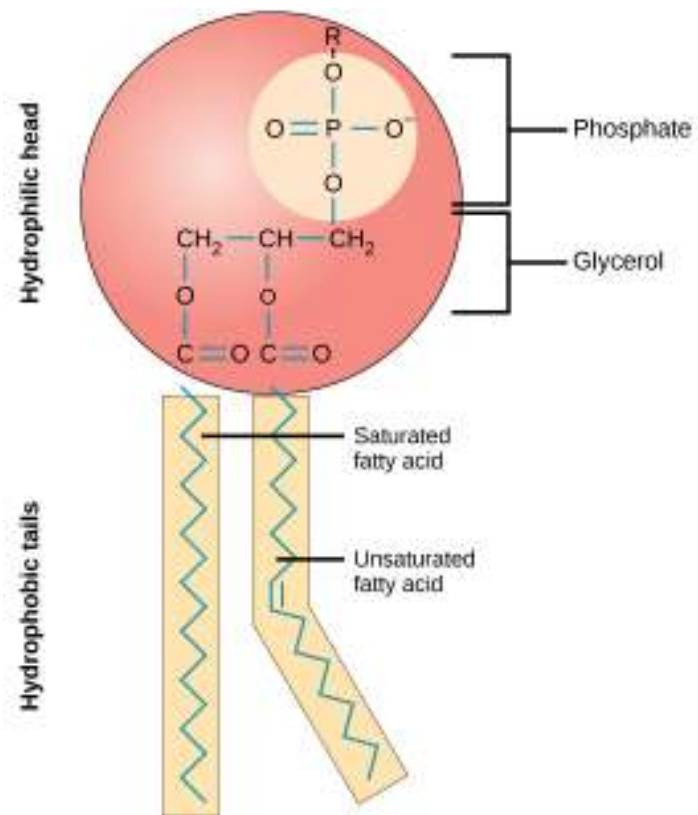
C18:1



C18:2

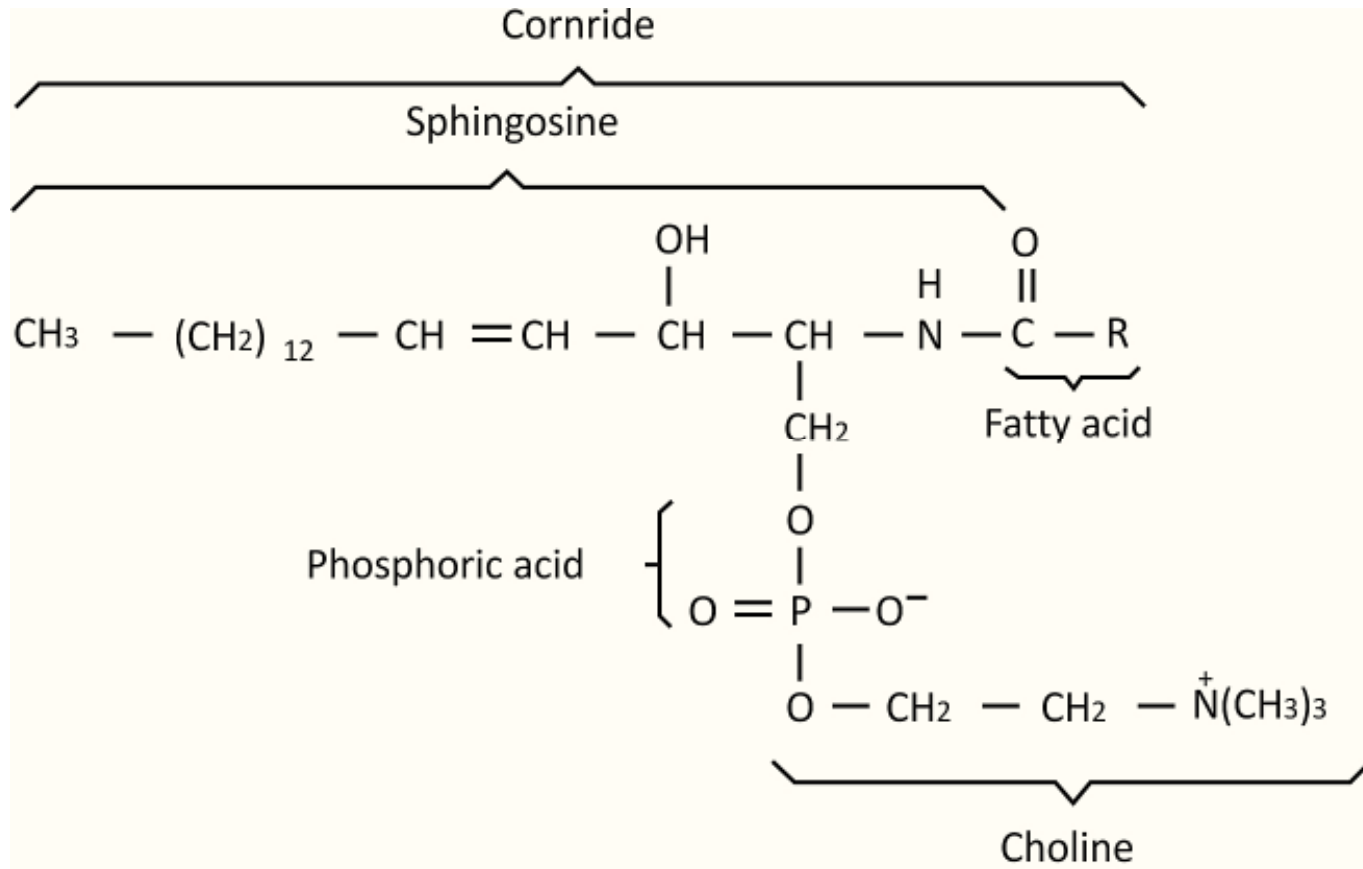


# Phospholipid



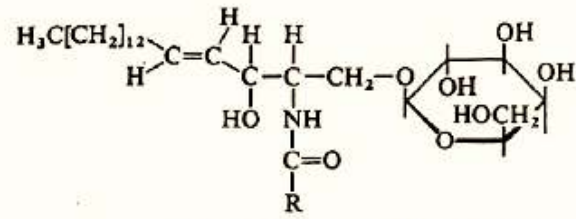
# Sphingolipid

Subhadipa 2020

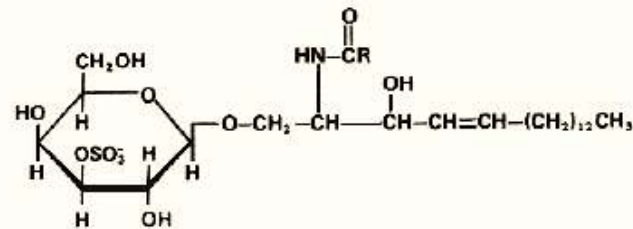


# Glycolipid

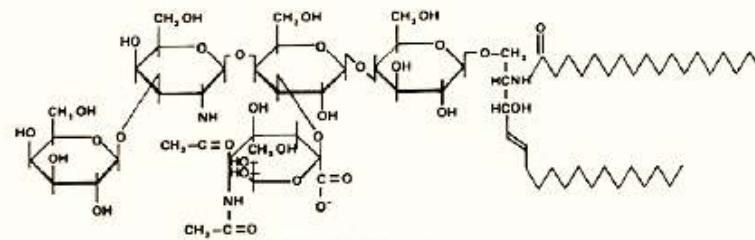
Subhadipa 2020



Neutral Glycosphingolipid  
(monoglycosylceramide)

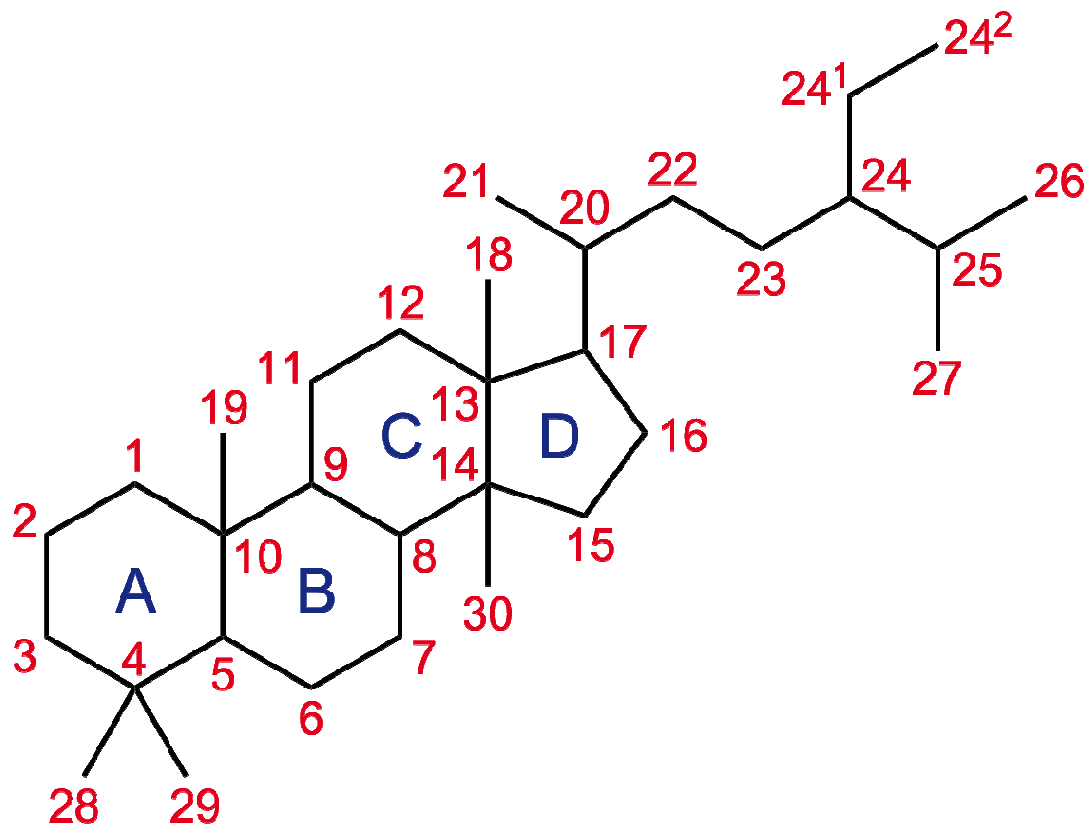


Sulfatide



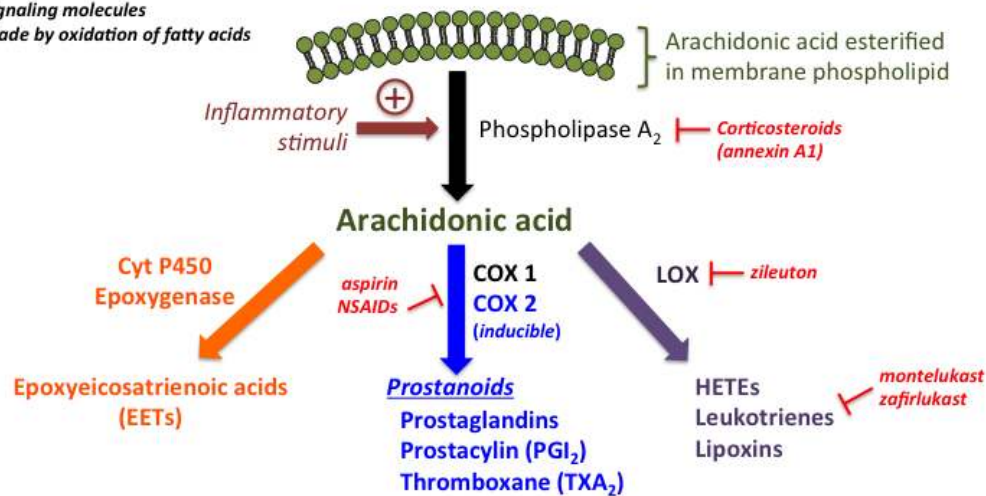
Ganglioside

# Steroids



## Eicosanoids

signaling molecules  
made by oxidation of fatty acids



- Eicosanoids are signaling molecules made by the enzymatic or non-enzymatic oxidation of arachidonic acid or other polyunsaturated fatty acids (PUFAs) that are, similar to arachidonic acid, 20 carbon units in length. Eicosanoids are a sub-category of oxylipins, i.e. oxidized fatty acids of diverse carbon units in length, and are distinguished from other oxylipins by their overwhelming importance as cell signaling molecules.
- They are produced by three primary enzymatic pathways: cyclooxygenase (COX), lipoxygenase (LOX) and cytochrome P450 (CYP).
- There are multiple subfamilies of eicosanoids, including most prominently the prostaglandins, thromboxanes, leukotrienes, lipoxins, resolvins, and eoxins.

# Terpenoids

Subhadipa 2020

The terpenoids (aka isoprenoids) are a large (estimated 60% of known natural products ) and diverse group of lipids derived from five-carbon isoprene units assembled in thousands of combinations. Technically a terpenoid contains oxygen, while a [terpene](#) is a hydrocarbon. Often the two terms are used to refer collectively to both groups.

