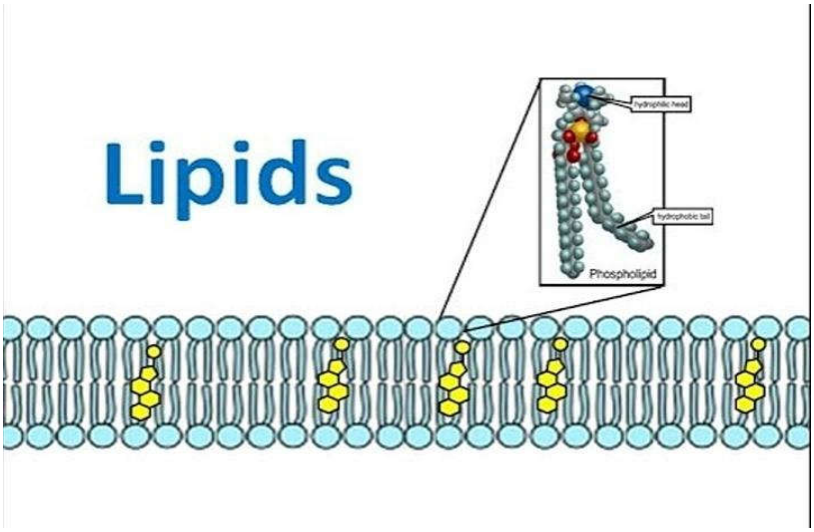
LIPIDS

Definition : regarded as organic substance relatively insoluble in water, soluble in organic solvents, actually or potentially related to fatty acids and utilized by living cells.

Classification of lipids:



1-Simple lipids divided into two types :

- Fats and oils : fat is solid at room temperature but oil is liquid at room temperature
- Waxes: esters of fatty acids used in preparation of candles, lubricants, cosmetics, oinments and polishes e. t.

2-Complex lipids: contain additional group such as phosphate, nitrogenous base, carbohydrate, protein

a-Phospholipids : contain phosphoric acid and nitrogenous base

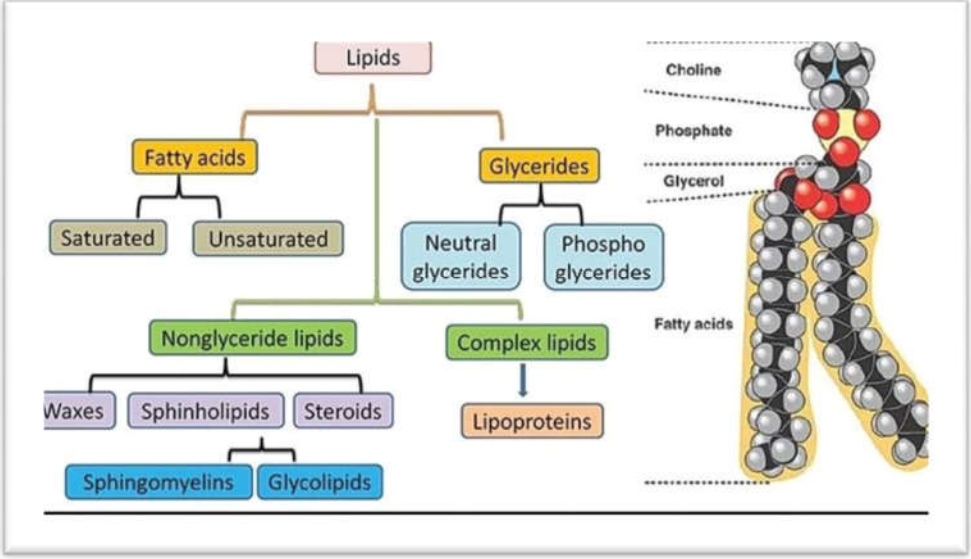
- Glycerophospholipids
- Sphingophospholipids

b- Glycolipids: contain fatty acid, carbohydrate and nitrogenous base.

c- Lipoprotiens: Macromolecules complexes of lipid with proteins.

d-Other complex lipids: such as sulpholipids amino- lipids

3-Derived lipids

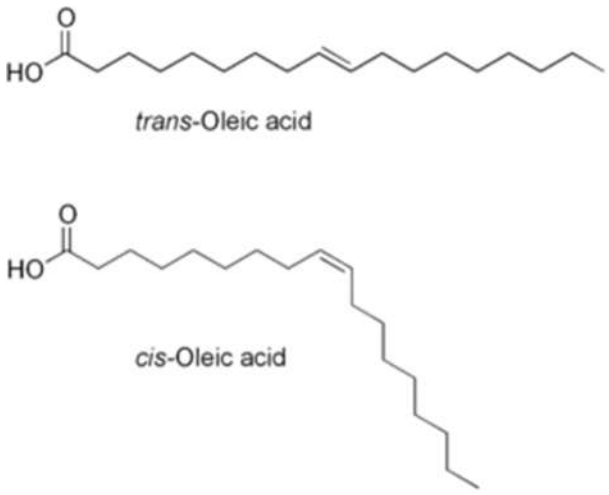


4-Miscellaneous lipids

Neutral lipids

Fatty acids: In chemistry, particularly in biochemistry, a fatty acid is a carboxylic acid with a long aliphatic chain, which is either saturated or unsaturated. Most naturally occurring fatty acids have an unbranched chain of an even number of carbon atoms, from 4 to 28.[1] Fatty acids are usually not found in organisms, but instead as three main classes of esters: triglycerides, phospholipids, and cholesteryl esters. In any of these forms, fatty acids are both important dietary sources of fuel for animals and they are important structural components for cells.

Types:



Comparison of the trans isomer trans fatty acid (top) and therefore the cis isomer monounsaturated fatty acid (bottom).

Fatty acids are classified in many ways: by length, by saturation vs unsaturation, by even vs odd carbon content, and by linear vs branched.

Length of fatty acidsEdit

• Short-chain fatty acids (SCFA) are fatty acids with aliphatic tails of 5 or fewer carbons (e.g. butyric acid).[6]

• Medium-chain fatty acids (MCFA) are fatty acids with aliphatic tails of 6 to 12[7] carbons, which may form medium-chain triglycerides.

• Long-chain fatty acids (LCFA) are fatty acids with aliphatic tails of 13 to 21 carbons.[8]

• Very long chain fatty acids (VLCFA) are fatty acids with aliphatic tails of twenty-two or more carbons.

Saturated fatty acids

Main article: Saturated fat

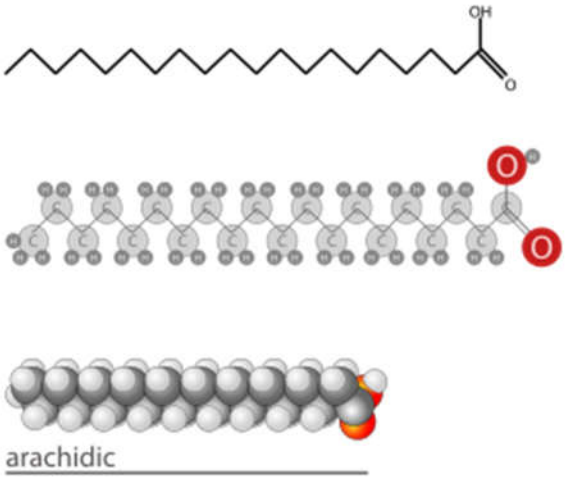
For a more comprehensive list, see List of saturated fatty acids.

Saturated fatty acids haven't any C=C double bonds. they need the

identical formula CH3(CH2)nCOOH, with variations in "n". a vital saturated carboxylic acid is octadecanoic acid (n = 16), which when neutralized with lye is that the most typical variety of soap.

Arachidic acid, a saturated carboxylic acid.

Examples of saturated fatty acids



Examples of saturated fatty acids

Common name	**Chemical structure**	***C*:*D***[9]
Caprylic acid	$CH_3(CH_2)_6COOH$	8:0
Capric acid	$CH_3(CH_2)_8COOH$	10:0
Lauric acid	$CH_3(CH_2)_{10}COOH$	12:0

Stearic acid	$CH_3(CH_2)_{16}COOH$	18:0
Arachidic acid	$CH_3(CH_2)_{18}COOH$	20:0
Behenic acid	$CH_3(CH_2)_{20}COOH$	22:0
Lignoceric acid	$CH_3(CH_2)_{22}COOH$	24:0
Cerotic acid	$CH_3(CH_2)_{24}COOH$	26:0

Unsaturated fatty acids:

Unsaturated fatty acids have one or more C=C double bonds. The C=C double bonds can give either cis or trans isomers. cis A cis configuration means the 2 hydrogen atoms adjacent to the covalent bond stick out on the identical side of the chain. The rigidity of the covalent bond freezes its conformation and, within the case of the cis isomer, causes the chain to bend and restricts the conformational freedom of the carboxylic acid. The more double bonds the chain has within the cis configuration, the less flexibility it's. When a series has many cis bonds, it becomes quite curved in its most accessible conformations. for instance, oleic acid, with one covalent bond, contains a "kink" in it, whereas polyunsaturated fatty acid, with two double bonds, contains a more pronounced bend. α-Linolenic acid, with three double bonds, favors a hooked shape.

effect of this can be that, in restricted environments, like when fatty acids are a part of a phospholipid during a lipid bilayer, or triglycerides in lipid droplets, cis bonds limit the flexibility of fatty acids to be closely packed, and thus can affect the melting temperature of the membrane or of the fat.

trans fats

A trans configuration, in contrast, means the adjacent two hydrogen atoms lie on opposite sides of the chain. As a result, they are doing not cause the chain to bend much, and their shape is analogous to straight saturated fatty acids. In most present unsaturated fatty acids, each covalent bond has three (n-3), six (n-6), or nine (n-9) carbon atoms after it, and every one double bonds have a cis configuration. Most fatty acids within the trans configuration (trans fats) don't seem to be found in nature and are the results of human processing (e.g., hydrogenation). Some trans fatty acids also occur naturally within the milk and meat of ruminants (such as cattle and sheep). they're produced, by fermentation, within the rumen of those animals. they're also found in dairy products from milk of ruminants, and will be also found in breast milk of girls who obtained them from their diet.

The geometric differences between the assorted varieties of unsaturated fatty acids, still as between saturated and unsaturated fatty acids, play a vital role in biological processes, and within the construction of biological structures (such as cell membranes).

Even- vs odd-chained fatty acids: Most fatty acids are even-chained, e.g. stearic (C16) and oleic (C18),

meaning that **a** good number of carbon atoms comprise them. Some fatty acids have odd numbers of carbon; they're spoken as odd-chained fatty acids (OCFA). the foremost common OCFA are the saturated C15 and C17 derivatives, respectively pentadecanoic acid and saturated fatty acid, which are found in dairy products.[13][14] On a molecular level, OCFAs are biosynthesized and metabolized slightly differently from the even-chained relatives

Essential fatty acids: Essential fatty acids, or EFAs, are fatty acids that humans and other animals must ingest because the body requires them permanently health but cannot synthesize them.[1]
The term "essential fatty acid" refers to fatty acids required for biological processes but doesn't include the fats that only act as fuel. Essential fatty acids mustn't be confused with essential oils, which are "essential" within the sense of being a concentrated essence.
Only two fatty acids are known to be essential for humans: omega-3 (an omega-3 fatty acid) and linolic acid (an omega-6 fatty acid).[2] another fatty acids are sometimes classified as "conditionally essential", meaning that they will become essential under some developmental or disease conditions; examples include omega-3 fatty acid (an omega-3 fatty acid) and gamma-linolenic acid (an omega-6 fatty acid).

When the 2 EFAs were discovered in 1923, they were designated "vitamin F", but in 1929, research on rats showed that the 2 EFAs are better classified as fats instead of vitamins

Triglycerides : A triglyceride (TG, triacylglycerol, TAG, or triacylglyceride) is

an ester derived from glycerol and three fatty acids (from tri- and glyceride).[1] Triglycerides are the most constituents of body fat in humans and other vertebrates, moreover as vegetable fat.[2] they're also present within the blood to enable the bidirectional transference of adipose fat and blood sugar from the liver, and are a significant component of human skin oils.[3]

There are many various styles of triglyceride, with the most division between saturated and unsaturated types. Saturated fats are "saturated" with hydrogen—all available places where hydrogen atoms can be bonded to carbon atoms are occupied. These have the next freezing point and are more likely to be solid at temperature. Unsaturated fats have double bonds between a number of the carbon atoms, reducing the quantity of places where hydrogen atoms can bond to carbon atoms. These have a lower freezing point and are more likely to be liquid at temperature

Properties :

• Triglycerides store unused calories and supply your body with energy.
• Cholesterol is employed to make cells and certain hormones.
• Linseed oil and related oils are important components of useful products employed in oil paints and related coatings. flaxseed oil is rich in di- and tri-unsaturated carboxylic acid components, which tend to harden within the presence of oxygen. This heat-producing hardening process is peculiar to those so-called drying oils. it's caused by a polymerization process that begins with oxygen molecules attacking the carbon backbone.
• Triglycerides are split into their components via transesterification during the manufacture of biodiesel. The resulting carboxylic acid esters will be used as

fuel in diesel engines. The glycerin has many uses, like within the manufacture of food and within the production of pharmaceuticals.

Phospholipids :

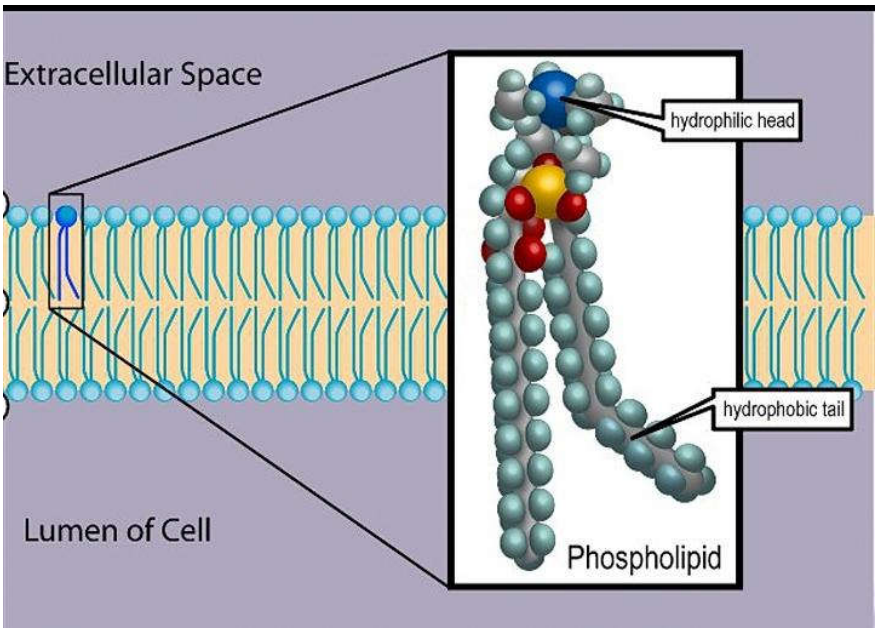
Phospholipids are a category of lipids that are a serious component of all cell membranes. they'll form lipid bilayers thanks to their amphiphilic characteristic. The structure of the phospholipid molecule generally consists of two hydrophobic carboxylic acid "tails" and a hydrophilic "head" consisting of a phosphate group.

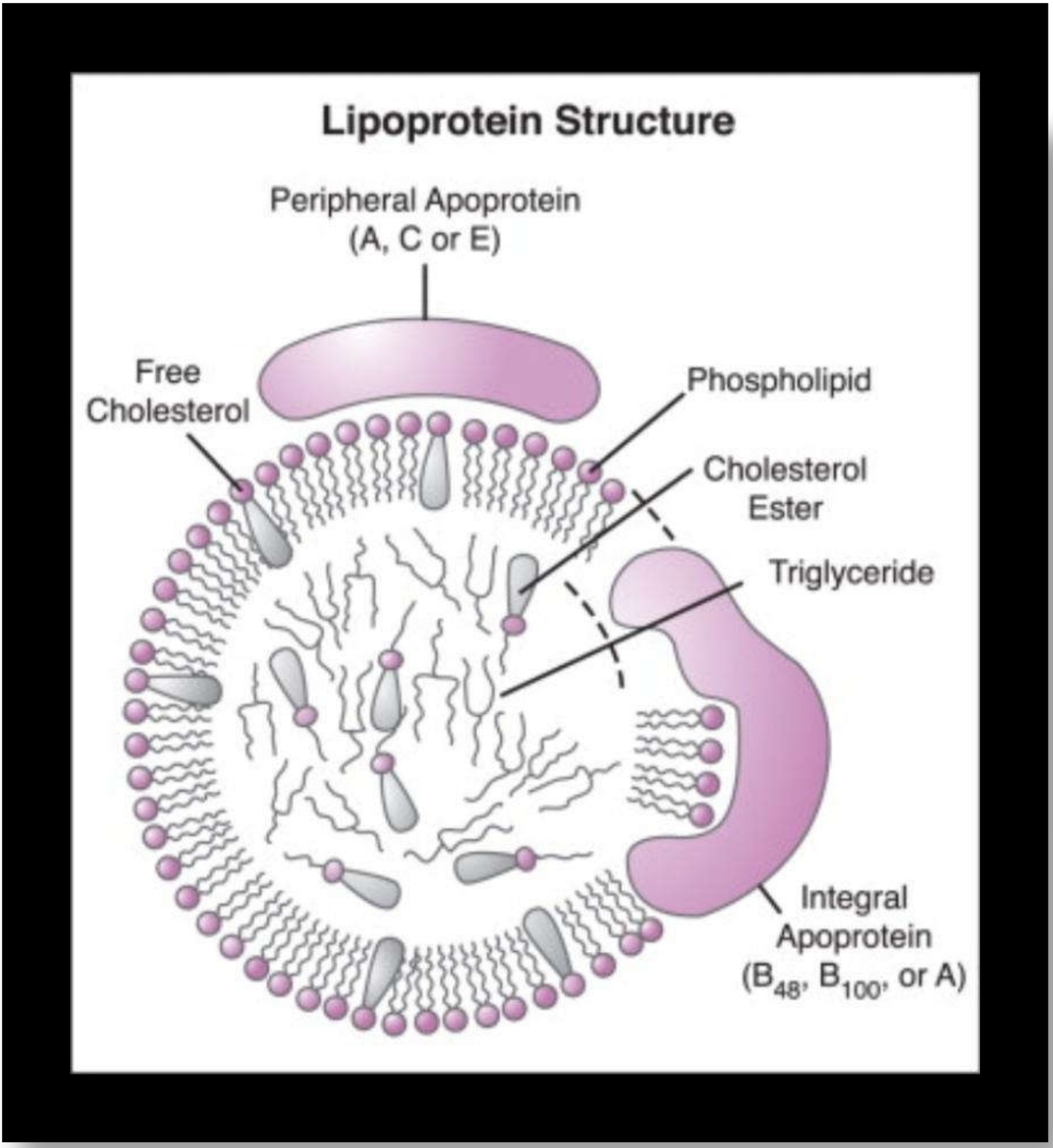
Glycolipids : Glycolipids are lipids with a carbohydrate attached by a glycosidic (covalent) bond. Their role is to keep up the soundness of the semipermeable membrane and to facilitate cellular recognition, which is crucial to the response and within the connections that allow cells to attach to 1 another to make tissues.

Lipoproteins :

A lipoprotein could be a biochemical assembly whose primary purpose is to move hydrophobic lipid molecules in water, as in plasma or other extracellular fluids.

Steroids: one in all an oversized group of chemical substances classified by a selected carbon structure. Steroids include drugs accustomed relieve swelling and inflammation, like prednisone and cortisone; vitamin D; and a few sex hormones, like testosterone and estradiol


Extracellular Space
hydrophilic head
hydrophobic tail
Lumen of Cell
Phospholipid


Lipoprotein Structure
Peripheral Apoprotein
(A, C or E)
Free
Cholesterol
Phospholipid
Cholesterol
Ester
Triglyceride
Integral
Apoprotein
(B_{48}, B_{100}, or A)

Amphiphatic lipids:

An amphiphile (from the Greek αμφις, amphis: both and φιλία, philia: love, friendship) could be a substance possessing both hydrophilic (water-loving, polar) and lipophilic (fat-loving) properties. Such a compound is termed amphiphilic or amphipathic. This forms the premise for variety of areas of research in chemistry and biochemistry, notably that of lipid polymorphism. Organic compounds containing hydrophilic groups at both ends of a prolate (in the aggregate) molecule are called bolaamphiphilic. Common amphiphilic substances are soaps, detergents, and lipoproteins.

Examples :

There are several samples of molecules that present amphiphilic properties:

Hydrocarbon-based surfactants are an example group of amphiphilic compounds. Their polar region will be either ionic, or non-ionic. Some typical members of this group are: sodium dodecyl sulfate (anionic), benzalkonium chloride (cationic), cocamidopropyl betaine (zwitterionic), and 1-octanol (long-chain alcohol, non-ionic). Many biological compounds are amphiphilic: phospholipids, cholesterol, glycolipids, fatty acids, bile acids, saponins, local anaesthetics, etc.
Soap could be a common household amphiphilic compound. Soap mixed with water (polar, hydrophilic) is helpful for cleaning oils and fats (non-polar, lipiphillic) from kitchenware, dishes, skin, clothing, etc.