LIPIDS

Lipid may be regarded as organic substances relatively insoluble in water, soluble in organic solvents (alcohol, ether etc.) actually or potentially related to fatty acid and utilized by the living cells.

In biology and biochemistry, a lipid is a macrobiomolecule that is soluble in nonpolar solvents. Non-polar solvents are typically hydrocarbons used to dissolve other naturally occurring hydrocarbon lipid molecules that do not (or do not easily) dissolve in water, including fatty acids, waxes, sterols, fat-soluble vitamins (such as vitamins A, D, E, and K), monoglycerides, diglycerides, triglycerides, and phospholipids.

MAJOR CLASSES OF STORAGE LIPIDS

Fatty acids

Fatty acids are comprised of a polar head (a carboxyl group) and a nonpolar aliphatic tail. They span a length of between 4 and 36 carbons in length. The exhibition of both polar and non-polar properties is described as amphipathy. Within a cell, they are associated with other biological molecules.

Fatty acids can be broadly classified as **saturated or unsaturated**. The physical properties of fatty acids depend on length and degree of unsaturation of their aliphatic chains. In their fully **saturated** forms, the most stable conformation is the fully extended form, in which steric hindrance of neighboring atoms is minimized. This allows ordering into crystalline arrays with the aliphatic tails associating through *van der waals* forces.

In **unsaturated fatty acids**, double bonds cause kinks to appear in the chain; this prevents tight packing of fatty acids and alters the properties of the arrays they form. This affects membrane properties as fatty acids are important constituents of phospholipids, which comprise many membranes.

In the body, fatty acids are released from triacylglycerols during fasting to provide a source of energy. They circulate in the blood by binding to a protein carrier, serum albumin where they travel to the tissue for use in metabolism or biosynthetic pathways.

Saturated	Unsaturated
H H | | -C-C- | | H H	H H | | -C=C-
Carbon-Carbon Single Bond	**Carbon-Carbon Double Bond**

Difference Between Saturated Fat and Unsaturated Fat

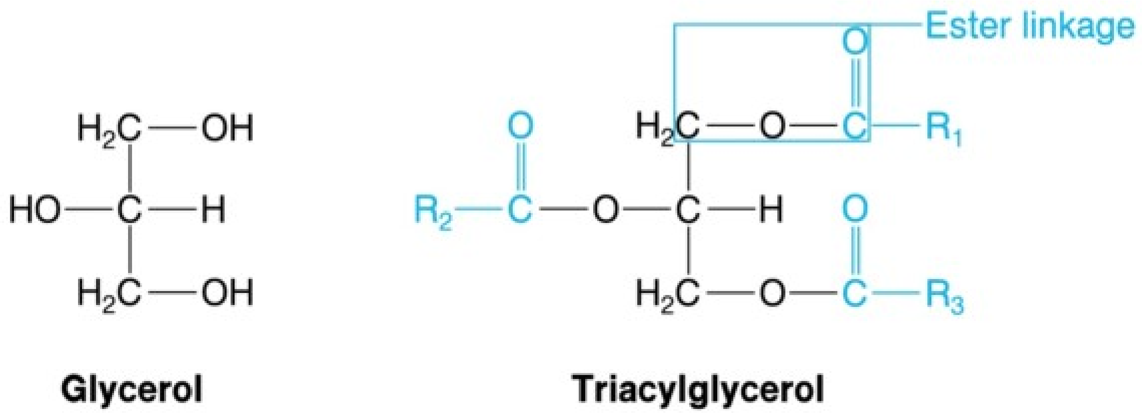
Saturated Fats	Unsaturated Fats
Consist of saturated fatty acids. Saturated fatty acids have **no double bonds** between the carbon atoms of the fatty acid chains.	Consist of unsaturated fatty acids, which contain **one or more than one double bond** in the fatty acid chains.
Higher melting point.	Lower melting point.
Exist as solid at room temperature.	Exist as liquid at room temperature.
Cannot be hydrogenated.	Can be hydrogenated.
High cholesterol content	No cholesterol content

Triacylglycerols

Triacylglycerols are the primary storage form of long-chain fatty acids, which are broken down for energy and used in the structural formation of cells. Triacylglycerols are composed of glycerol (1,2,3-trihydroxypropane) and 3 fatty acids to form a triester.

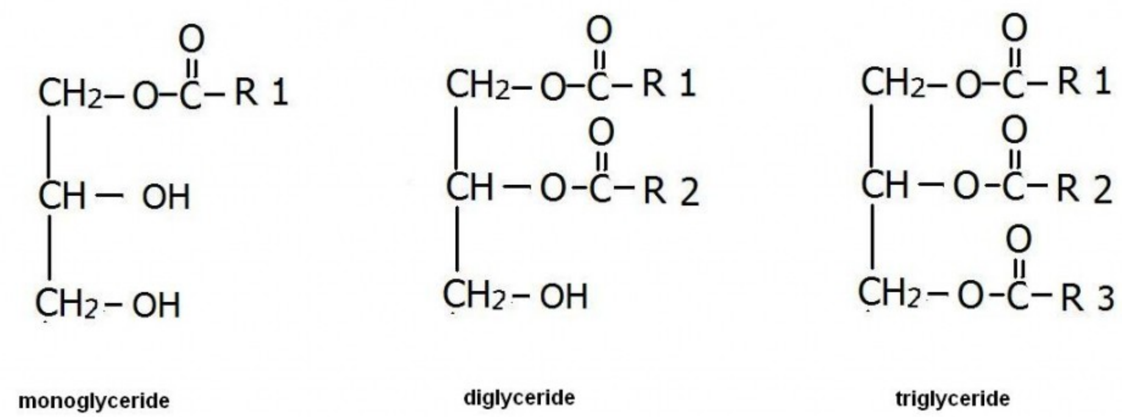
Simple triacylglycerols contain identical fatty acids; however, most naturally occurring fatty acids are mixed. Triacylglycerols are stored in adipocytes in vertebrates or as soils in the seed of plants. Both adipocytes and seeds contain lipase enzymes to liberate fatty acids for export when they are required for fuel or biosynthetic purposes.

In some animals, triacylglycerols provide a means of insulation; this is particularly notable in arctic-dwelling mammals such as walruses, polar bears, and penguins. Polyunsaturated fatty acids are important as constituents of the phospholipids and form the membranes of the cells.



Tri- Di- and Monoacylglycerols

Triacylglycerol, diacylglycerol, and monoacylglycerol contain three, two, or one fatty acid(s) respectively, which are esterified to trihydroxy-alcohol glycerol. While triacylglycerol functions predominantly as an energy storage molecule, diacylglycerol and monoacylglycerol species perform signaling roles as secondary messengers or ligands for signaling proteins such as protein kinases. These proteins are implicated in diverse pathways including cell proliferation, growth and protein transport.



Sterols

Sterols are comprised of tetracyclic rings, a feature common to human sex pheromones. Sterols can be conjugated to fatty acids, fatty acid esters, and sugars. Sterols have a fundamental effect in membrane properties, affecting fluidity, membrane transport and function of membrane proteins.

Sterols interact with phospholipids to stiffen and impermeabilize the membrane. They work specifically to alter the dynamics of a process known as phase transition. This describes the transition of a membrane from the solid phase (gel phase) to liquid at a defined temperature.

Specifically, sterols may eliminate this ability of membranes to transition. Alongside sphingolipids, sterols may form structures called lipid rafts which are implicated in signaling and membrane trafficking. Outside of the cell membrane, sterols, particularly cholesterols, are precursor of bile acids, vitamin D and steroidal hormones.

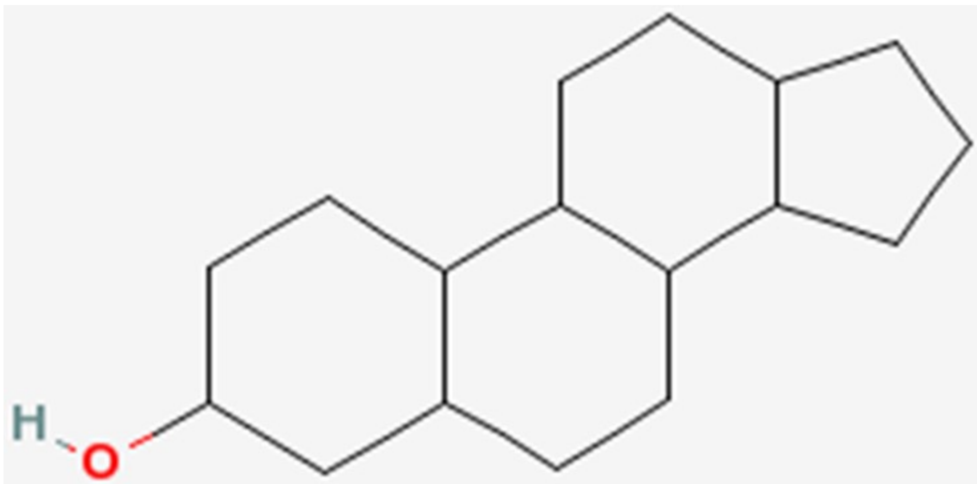
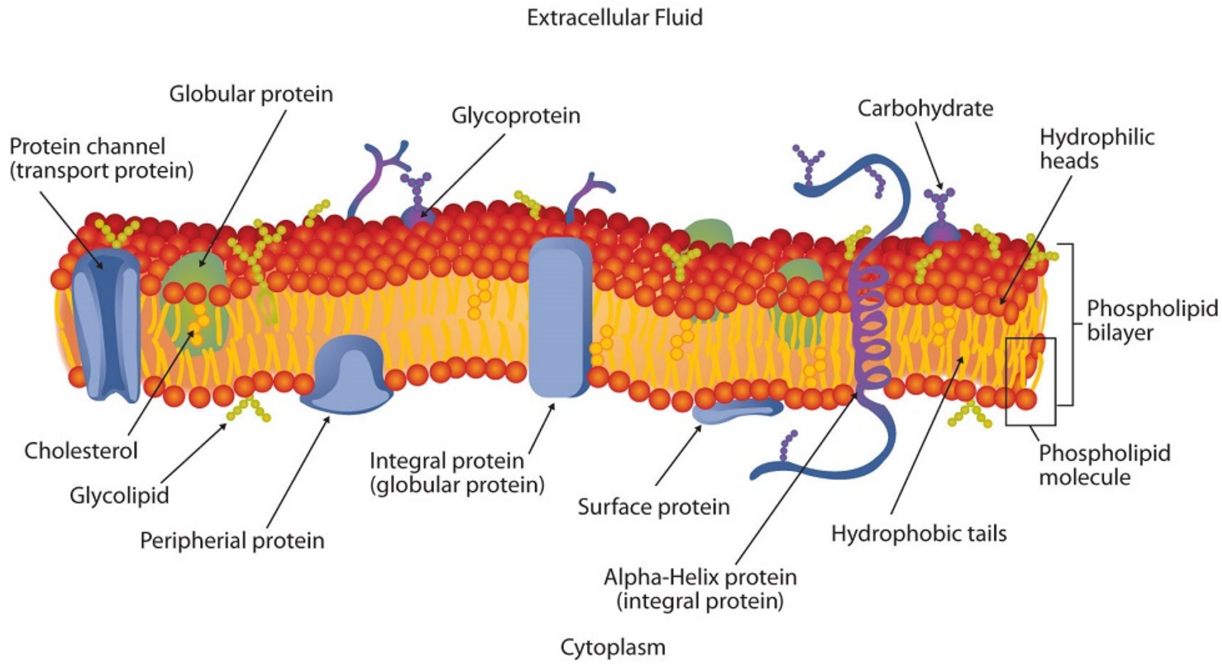


FIG: Sterol

MAJOR TYPES OF STRUCTURAL LIPIDS

Complex cell membrane lipids

Cellular membranes control the transport of materials, including signaling molecules and can change in form to enable budding, fission, and fusion. The cell membranes have a hydrophilic (water-loving) constituent and a hydrophobic (water repelling) constituent, making them amphiphilic.

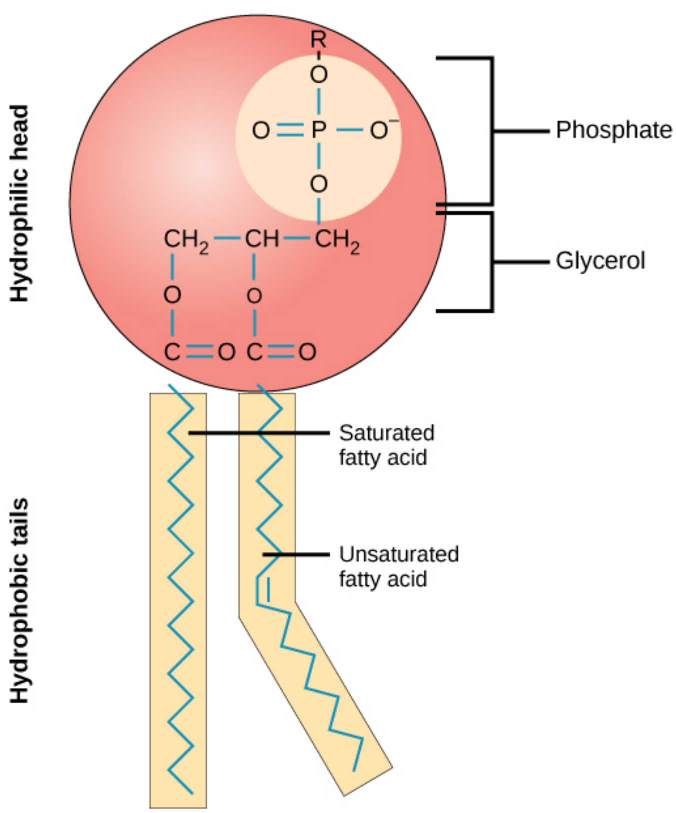


Phospholipids

There are two classes of phospholipids. The first, glycerophospholipids, are comprised of glycerol fatty acid esters, phosphatidic acids, and alcohols. Three alcohols that form phosphatides are choline, ethanolamine, and serine.

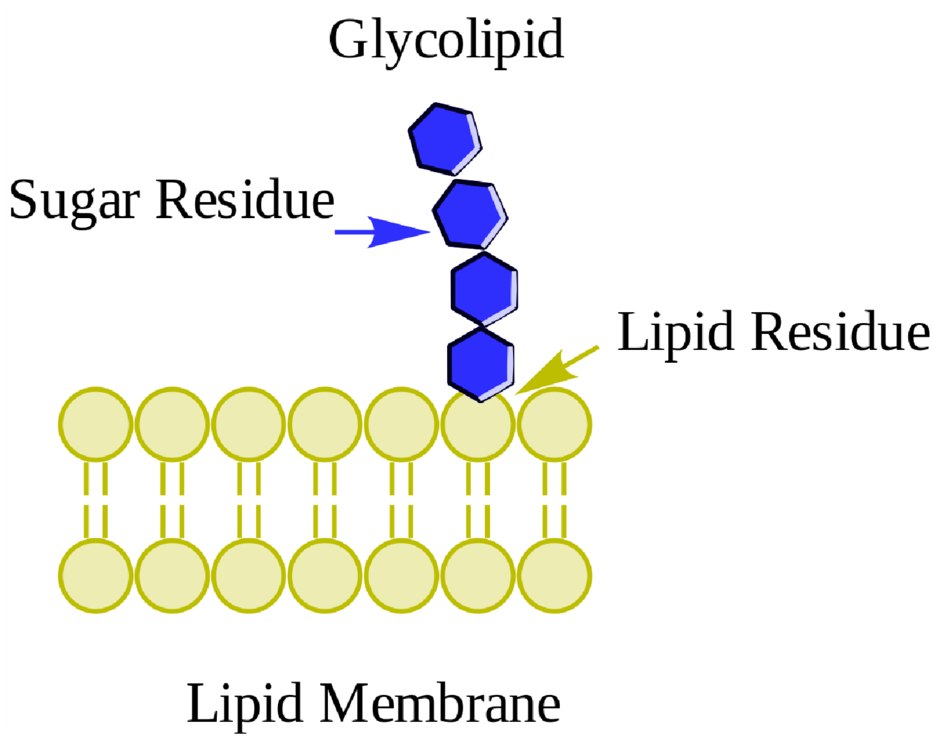
Phospholipids differ from triglycerides in their ability to act at the cell membrane as well as functioning as emulsifiers in food products. This latter function exploits their ability to reduce the interfacial tension between oil and water. Consequently, they are useful for purposes of emulsification, solubilization, or dispersion.

The second are sphingolipids. Sphingolipids have a long-chain or sphingoid base, such as sphingosine, to which a fatty acid is linked by an amide bond. The simplest sphingolipid is ceramide. They have high phase transition temperatures, and as such, form lipid rafts along with cholesterols. They, therefore, play an important role in cell signaling processes.



Glycolipids

Glycolipids are acylglycerols, ceramides, and prenols that are attached to one or more monosaccharide residues. They are crucial during cell development as they affect cell-cell interactions, immune responses and cell proliferation.



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