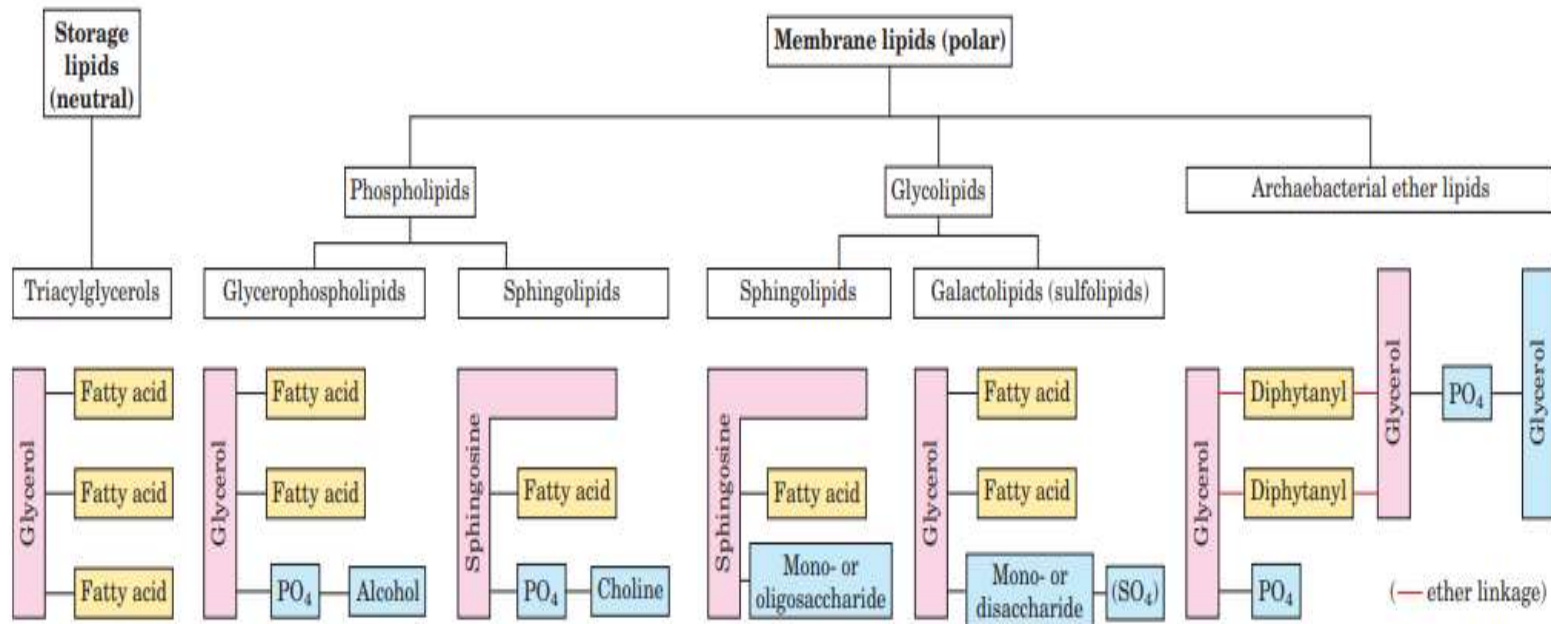




- Lipids are organic compounds that are found in living organisms.
- They have variety of structures and functions, and soluble in organic solvents due to their hydrocarbon component.





Structural Lipids in Membranes

- Central architectural feature of biological membranes is a double layer of lipids, which acts as a barrier to the passage of polar molecules and ions.
- Membrane lipids are amphipathic: one end of the molecule is hydrophobic, the other hydrophilic.

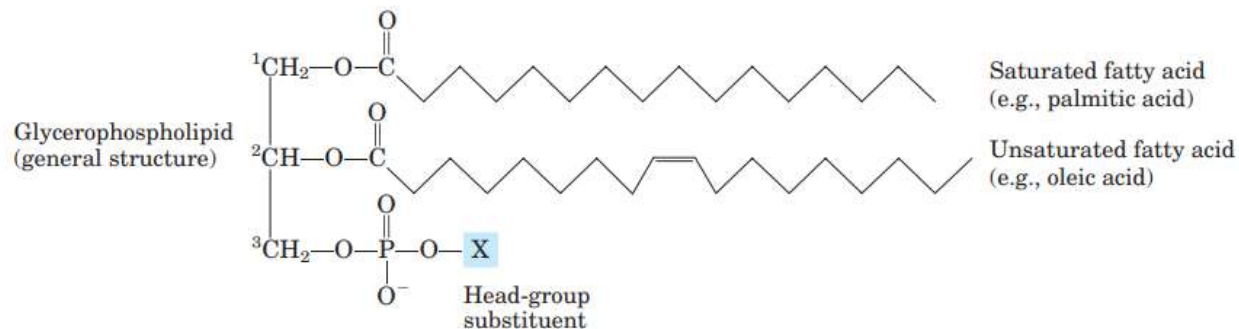
Types of membrane lipids

1. **Phospholipids** In glycerophospholipids and some sphingolipids, a polar head group is joined to the hydrophobic moiety by a phosphodiester linkage
2. **Glycolipids**, which also contain two fatty acids esterified to glycerol, have a simple sugar or complex oligosaccharide at their polar ends
3. **Ether lipids**, in which two very long alkyl chains are ether-linked to glycerol at both ends
4. **Sphingolipids**, in which a single fatty acid is joined to a fatty amine, sphingosine
5. **Sterols**, compounds characterized by a rigid system of four fused hydrocarbon rings.



Phospholipids

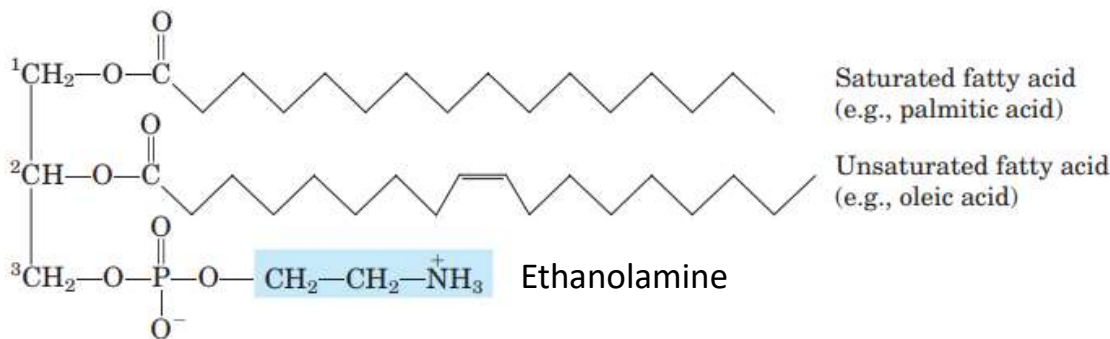
- **Phospholipids**, are a class of lipids whose molecule has a hydrophilic "head" containing a phosphate group and two hydrophobic "tails" derived from fatty acids, joined by an alcohol residue (usually a glycerol molecule).
- Marine phospholipids typically have omega-3 fatty acids EPA and DHA integrated as part of the phospholipid molecule.
- The phosphate group can be modified with simple organic molecules such as choline, ethanolamine, or serine.
- Phospholipids are a key component of all cell membranes
- The first phospholipid identified in 1847 as such in biological tissues was lecithin, or phosphatidylcholine, in the egg yolk of chickens by the French chemist and pharmacist



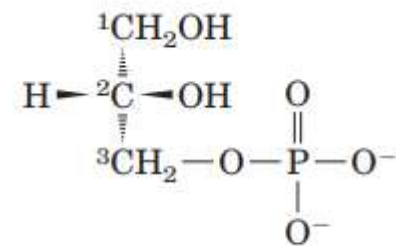


Phospholipids

- Glycerophospholipids, also called phosphoglycerides, are membrane lipids in which two fatty acids are attached in ester linkage to the first and second carbons of glycerol, and a highly polar or charged group is attached through a phosphodiester linkage to the third carbon.
- Glycerol is prochiral; it has no asymmetric carbons, but attachment of phosphate at one end converts it into a chiral compound, which can be correctly named either L-glycerol 3-phosphate, D-glycerol 1-phosphate
- Phosphatidylcholine and phosphatidylethanolamine have choline and ethanolamine in their polar head groups respectively.



Phosphatidylethanolamine

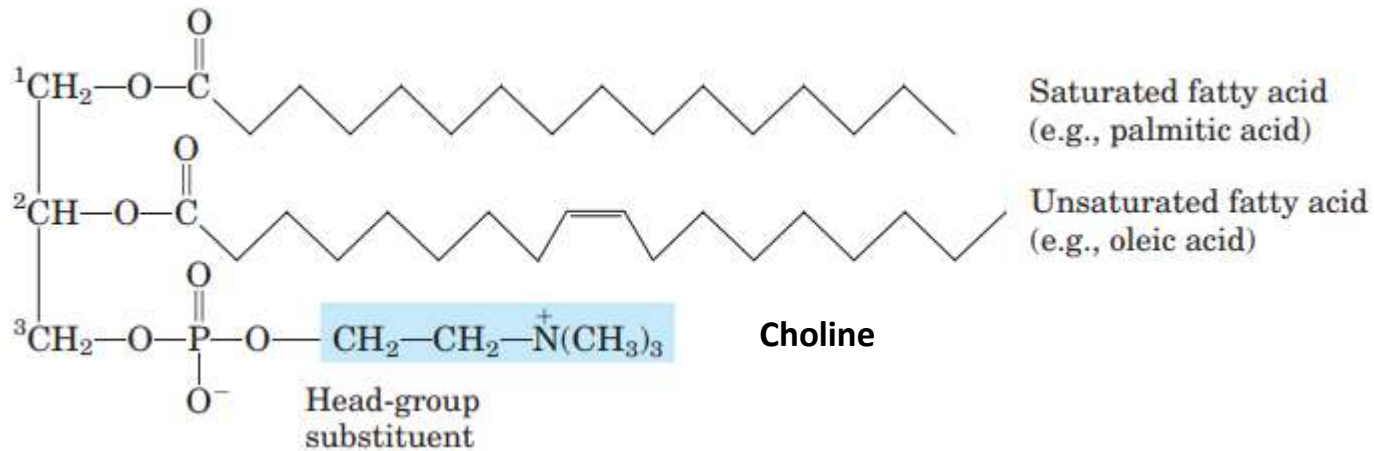


L-Glycerol 3-phosphate
(sn-glycerol 3-phosphate)

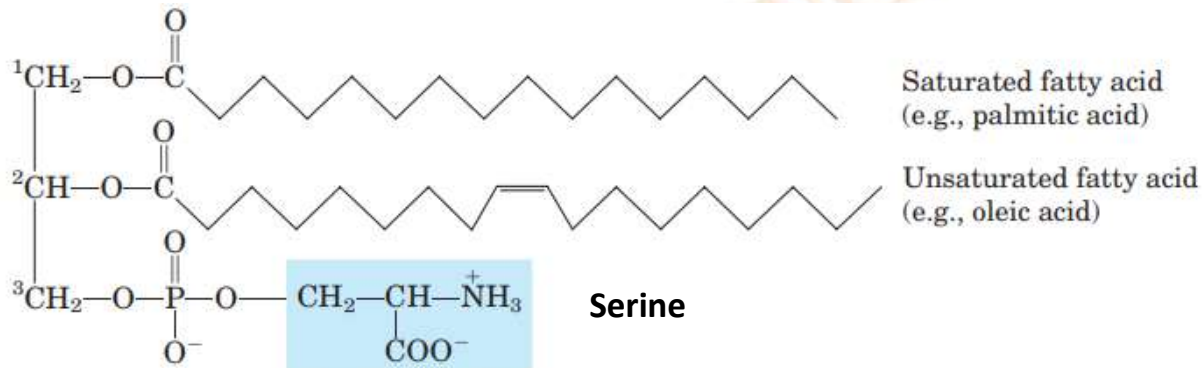
Parent compound, phosphatidic acid



Phospholipids



Phosphatidylcholine



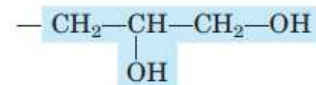
Phosphatidylserine



Phospholipids

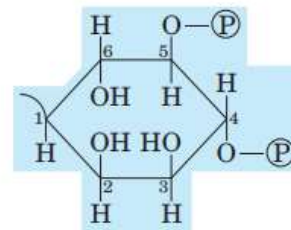
Phosphatidylglycerol

Glycerol



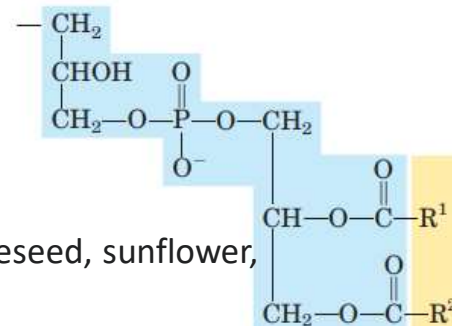
Phosphatidylinositol
4,5-bisphosphate

myo-Inositol 4,5-
bisphosphate



Cardiolipin

Phosphatidyl-
glycerol

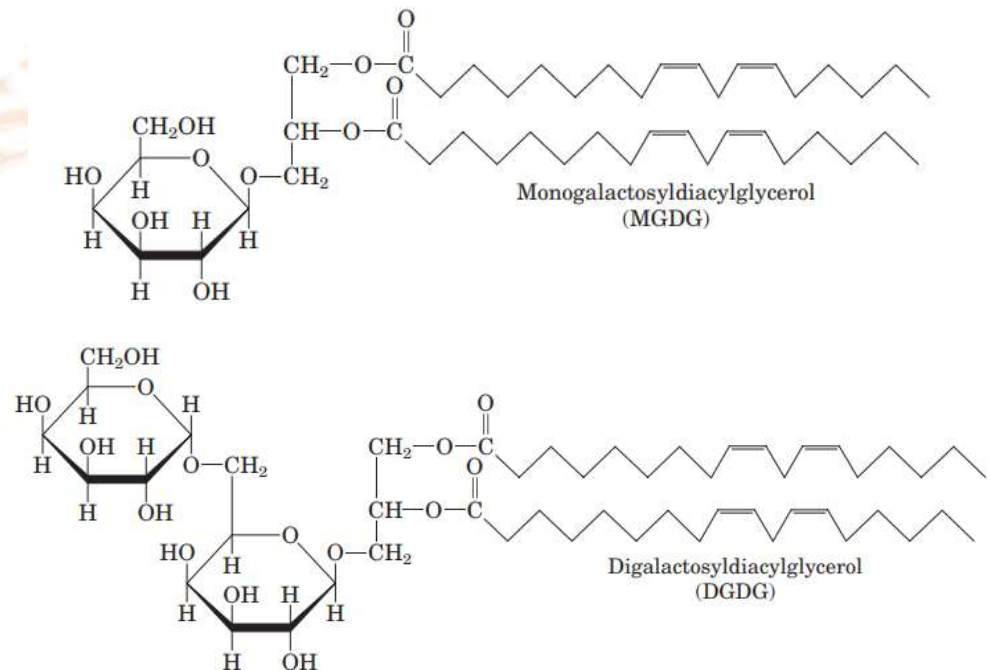
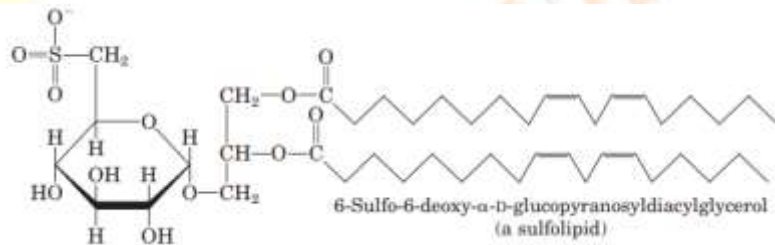


- Common sources of industrially produced phospholipids are soya, rapeseed, sunflower, chicken eggs, bovine milk, fish eggs
- Phospholipids have been widely used to prepare liposomal, ethosomal and other nanoformulations of topical, oral and **parenteral** drugs for differing reasons like improved bio-availability, reduced toxicity and increased permeability across membranes.
- Liposomes are often composed of **phosphatidylcholine**-enriched phospholipids and may also contain mixed phospholipid chains with **surfactant** properties.
- Advances in phospholipid research lead to exploring these biomolecules and their conformations using lipidomics.



Galactolipids

- Galactolipids are localized in the thylakoid membranes (internal membranes) of chloroplasts; they make up 70% to 80% of the total membrane lipids of a vascular plant, in which one or two galactose residues are connected by a glycosidic linkage to C-3 of a 1,2-diacylglycerol.
- They are probably the most abundant membrane lipids in the biosphere.
- Phosphate is often the limiting plant nutrient in soil, and perhaps the evolutionary pressure to conserve phosphate for more critical roles favored plants that made phosphate free lipids.
- Plant membranes also contain sulfolipids, in which a sulfonated glucose residue is joined to a diacylglycerol in glycosidic linkage.





Ether Lipids

- Ether lipids, in which one of the two acyl chains is attached to glycerol in ether, rather than ester, linkage.
- The ether-linked chain may be saturated, as in the alkyl ether lipids, or may contain a double bond between C-1 and C-2, as in **Plasmalogens**
- Platelet-activating factor (ether lipids), is a potent molecular signal.
- It is released from leukocytes called basophils and stimulates platelet aggregation and the release of serotonin (a vasoconstrictor) from platelets.
- It also exerts a variety of effects on liver, smooth muscle, heart, uterine, and lung tissues and plays an important role in inflammation and the allergic response.

