

LIPIDS

What are they?

- Are naturally occurring compounds that are generally insoluble in water but readily soluble in non-polar organic solvents such as acetone, chloroform and benzene
- Examples of lipids include fats & oils, waxes, sterols, carotenoid pigments and fat soluble vitamins e.g. A, D, E and K
- Fats are usually semi-solid/liquid, whereas oils are liquid at room temperature.

Functions

- Serve as concentrated energy reservoirs of the body
- Act as cushions/shock absorbers to vital body organs e.g. liver, spleen, lungs, kidneys and heart.
- Are important component of cell membrane e.g. phospholipids.
- Act as hormones e.g. steroid hormones, sex hormones.

Functions elaborated

Type	function
Fatty acids	Used to synthesize triglycerides and phospholipids or catabolized to generate adenosine triphosphate (ATP).
Triglycerides (fats and oils)	Protection, insulation, energy storage.
Phospholipids	Major lipid component of cell membranes.
Steroids	
<i>Cholesterol</i>	Minor component of all animal cell membranes; precursor of bile salts, vitamin D, and steroid hormones.
<i>Bile salts</i>	Needed for digestion and absorption of dietary lipids.
<i>Vitamin D</i>	Helps regulate calcium level in body; needed for bone growth and repair.

Type	function
<i>Adrenocortical hormones</i>	Help regulate metabolism, resistance to stress, and salt and water balance.
<i>Sex hormones</i>	Stimulate reproductive functions and sexual characteristics.
Eicosanoids (<i>prostaglandins and leukotrienes</i>)	Have diverse effects on modifying responses to hormones, blood clotting, inflammation, immunity, stomach acid secretion, airway diameter, lipid breakdown, and smooth muscle contraction.
Other lipids	
<i>Carotenes</i>	Needed for synthesis of vitamin A (used to make visual pigments in eye); function as antioxidants.
<i>Vitamin E</i>	Promotes wound healing, prevents tissue scarring, contributes to normal structure and function of nervous system, and functions as antioxidant.
<i>Vitamin K</i>	Required for synthesis of blood-clotting proteins.
<i>Lipoproteins</i>	Transport lipids in blood, carry triglycerides and cholesterol to tissues, and remove excess cholesterol from blood.

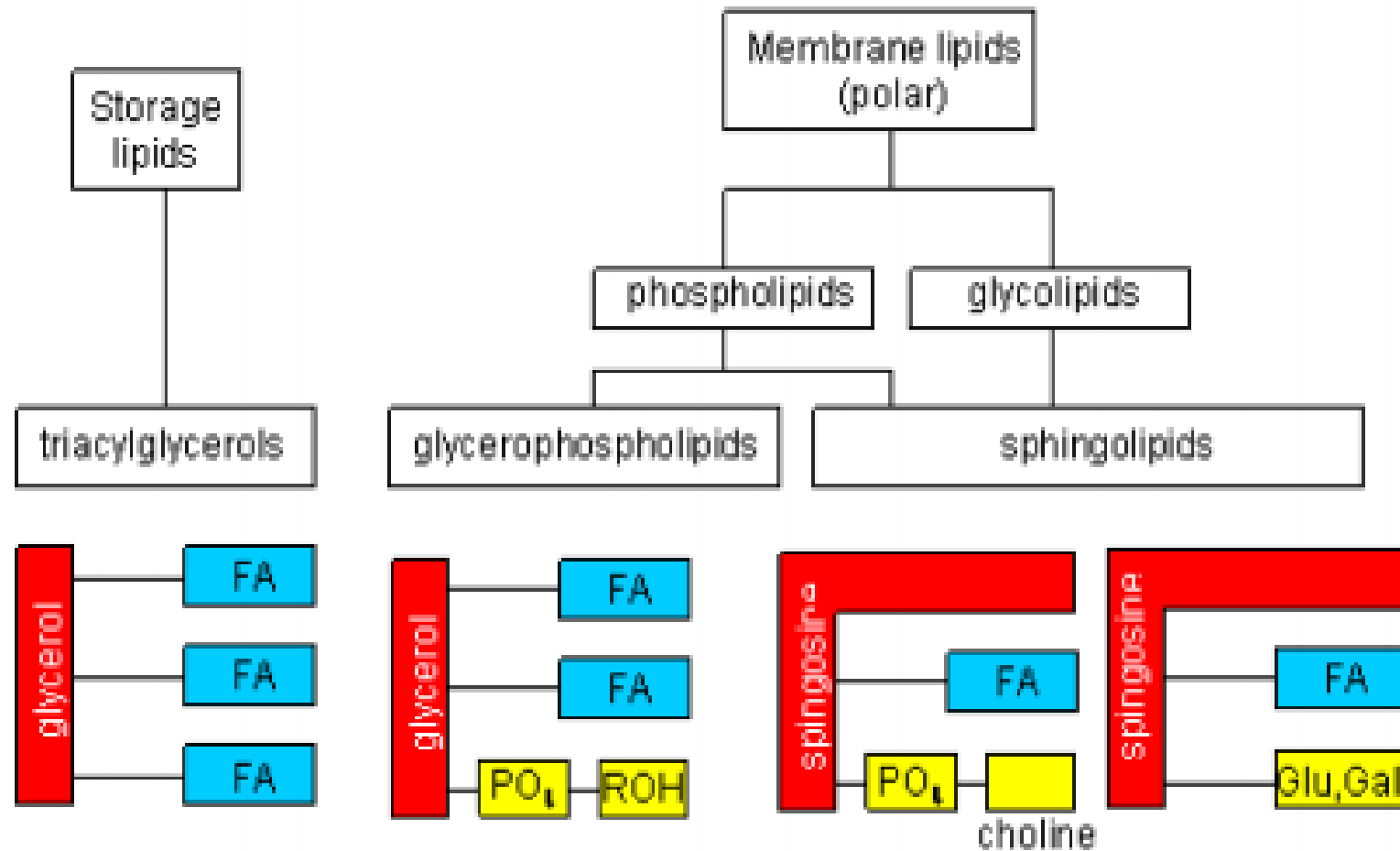
Fats form of energy storage

- Animals in general use fat for energy storage because fat stores **9 Kcal/g** of energy in anhydrous water free state.
- Plants, which don't move around, store food (starch) for energy in a less compact but more easily accessible form, so they carbohydrates and proteins store only **4 Kcal/g** of energy, thus, fats store about twice as much energy/gram as carbohydrates or proteins.

Classification of Lipids

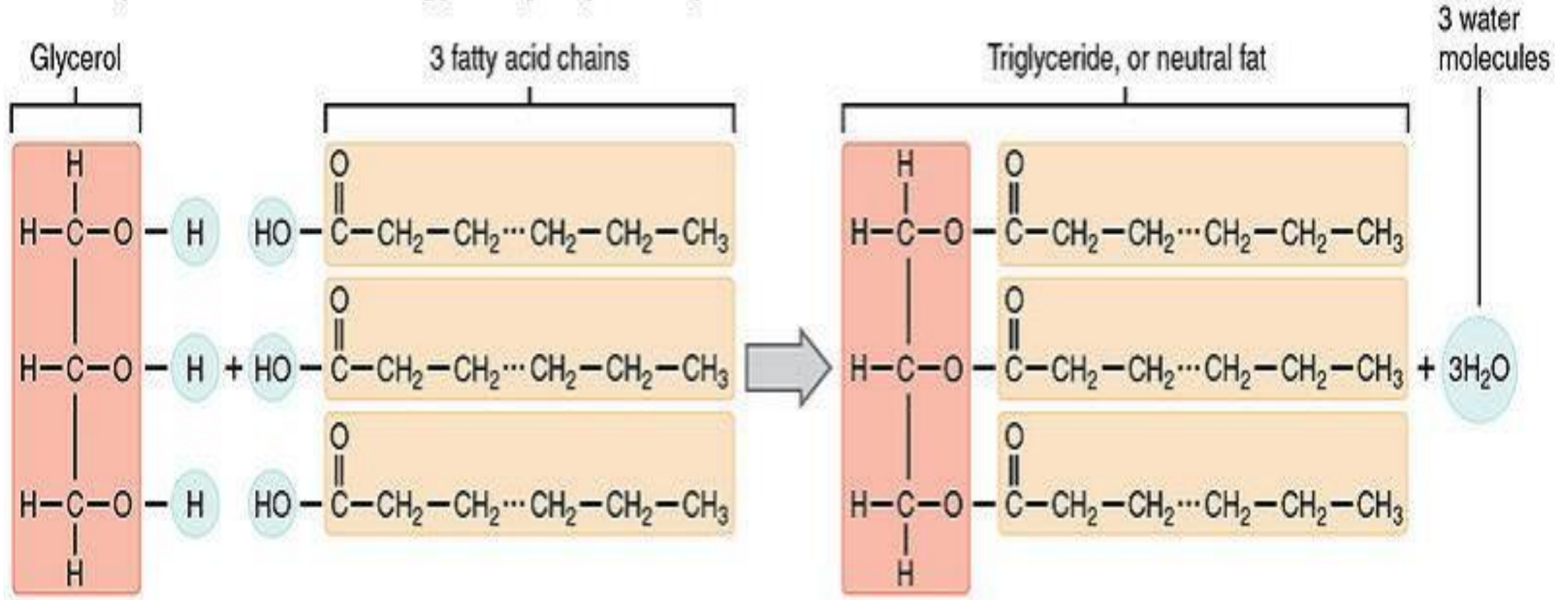
- **Simple lipids**- consist of triglyceride or triacylglycerols e.g. TAG in adipose tissues.
- **Compound lipids**- consists of conjugated lipids e.g. phospholipids, sphingolipids and glycolipids.
- **Derived lipids**- derived from either simple lipids or compound lipids. Include waxes e.g. beeswax, steroid compounds e.g. cholesterol and steroid hormones), prostaglandins, isoprenoids and fat soluble vitamins (A, D, E and K

Classification of lipids



Triacylglycerol (TAG)

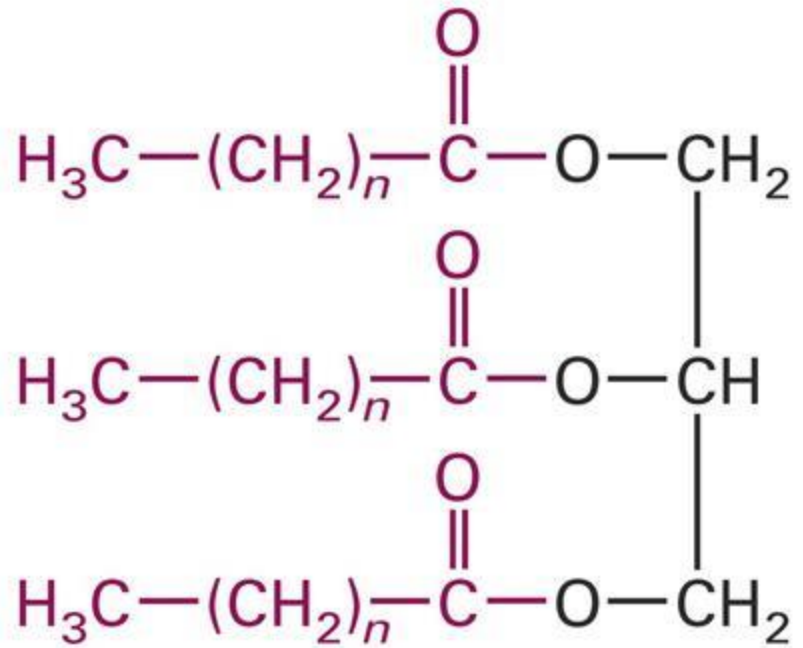
Three fatty acid chains are bound to glycerol by dehydration synthesis.



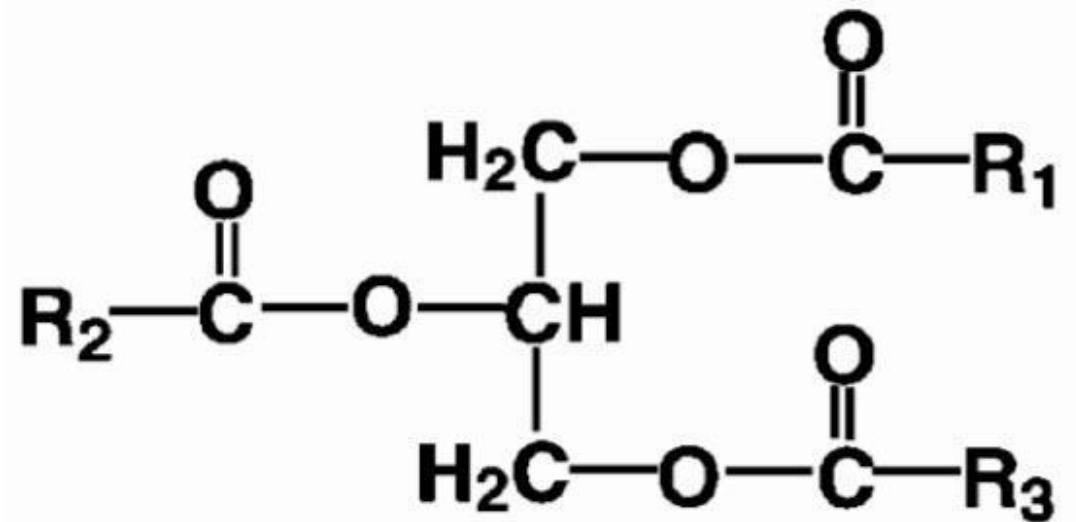
- Glycerol contains 3 carbon atoms and 3 hydroxyl groups. It reacts with 3 fatty acids to form a **triacylglycerol** or **TAG** (fat molecule).

Storage Lipid/Energy Reserve

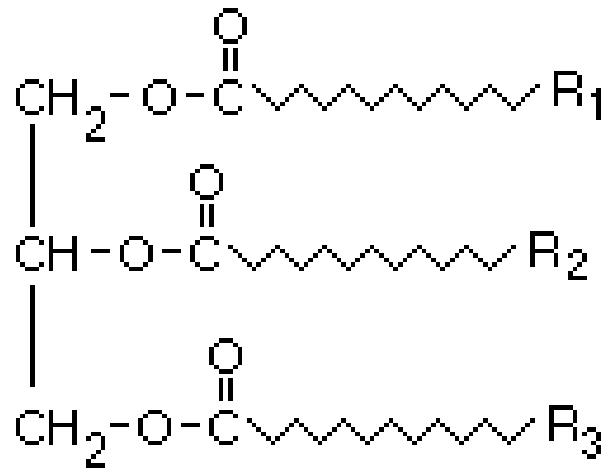
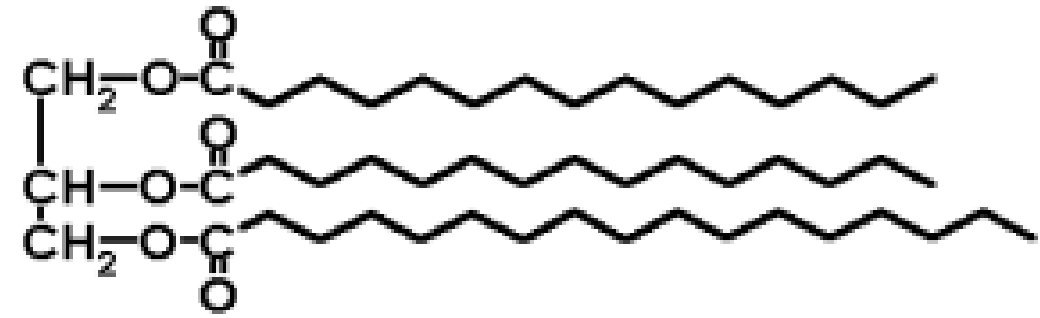
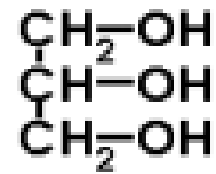
Triacylglycerols or TAGs are the main storage lipids/energy reserve usually stored in adipose tissues (fat cells).



Triacylglycerol



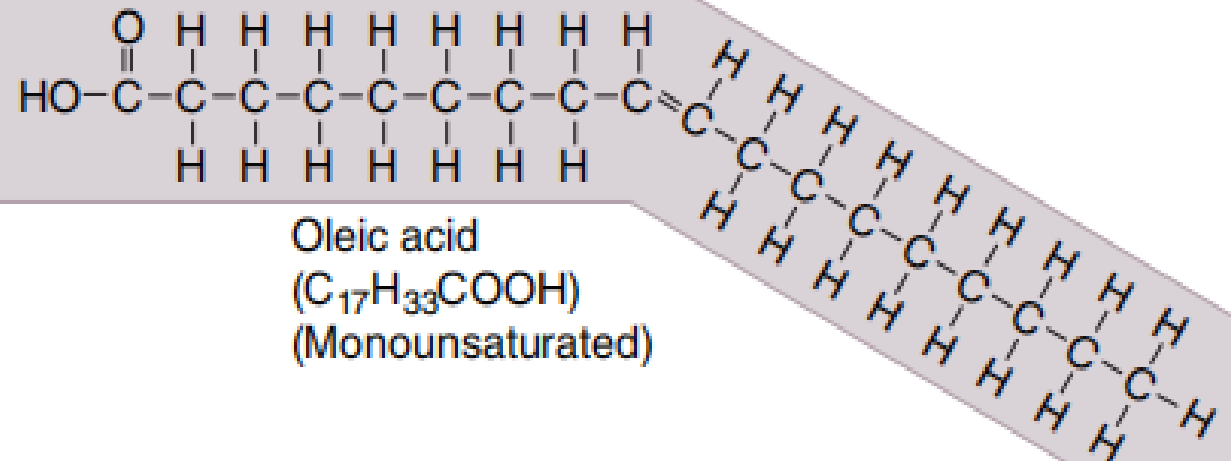
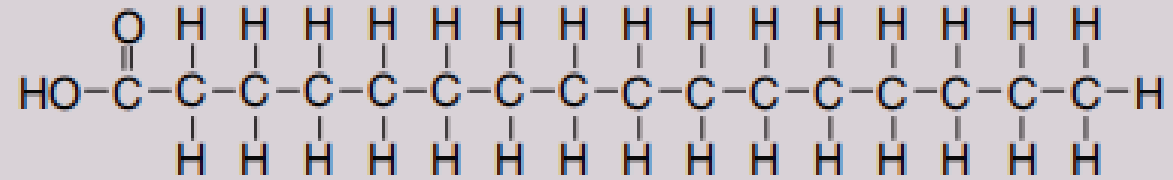
Look at this!!!!!!



A triacylglycerol

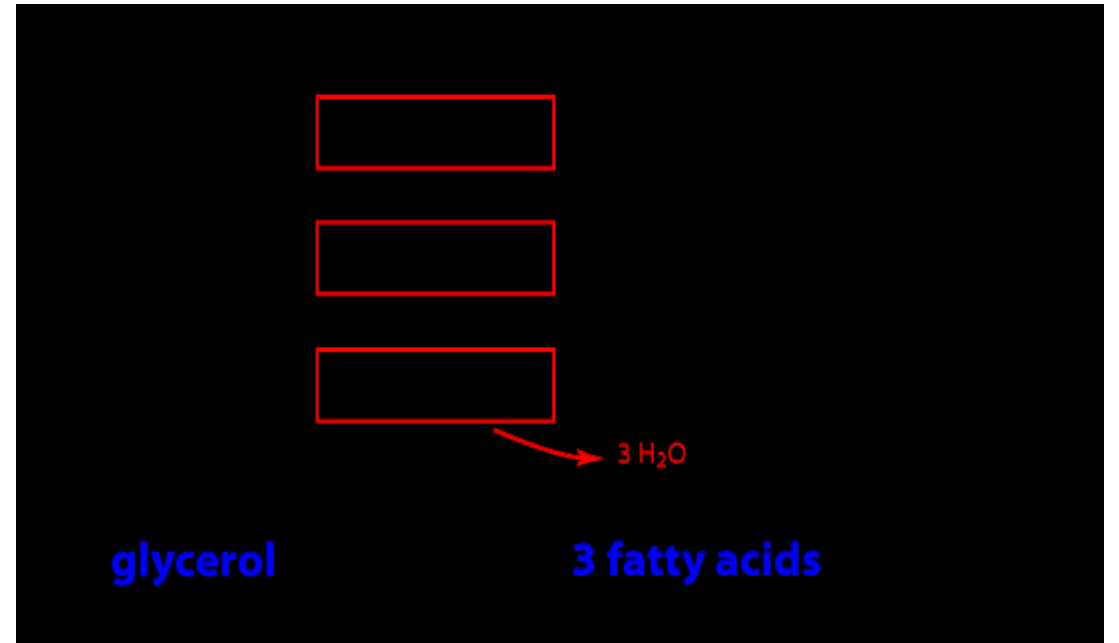
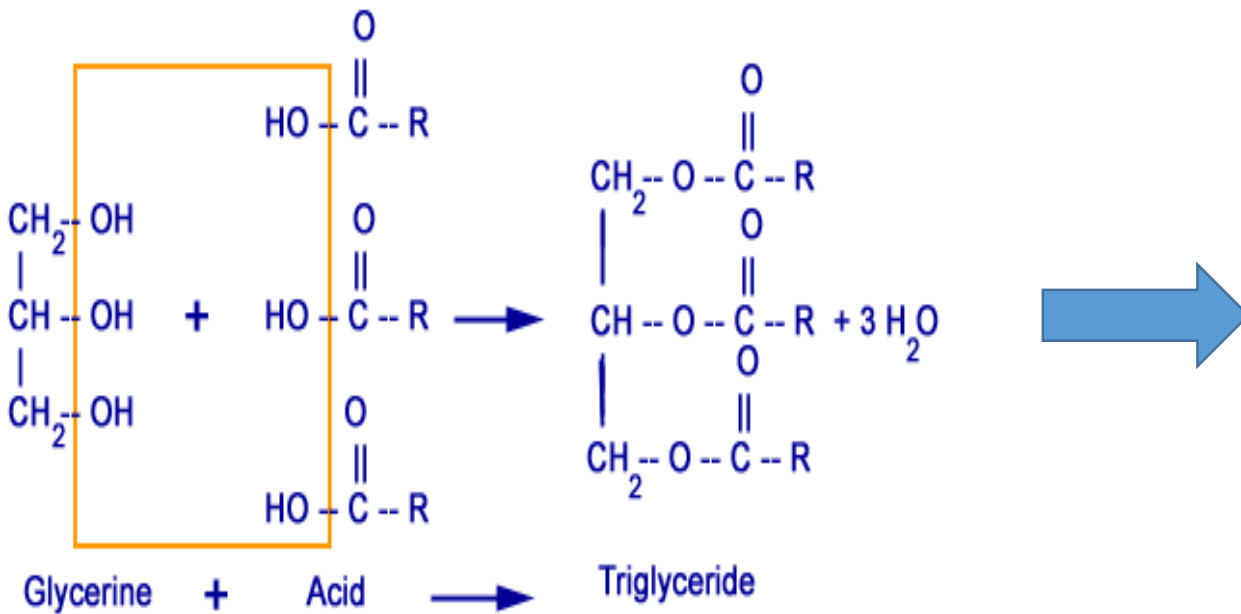
R₁ is often palmitate.
R₂ is often oleate.
R₃ is often oleate or a polyunsaturated fatty acyl group.

Palmitic acid (C₁₅H₃₁COOH) (Saturated)



Oleic acid
(C₁₇H₃₃COOH)
(Monounsaturated)

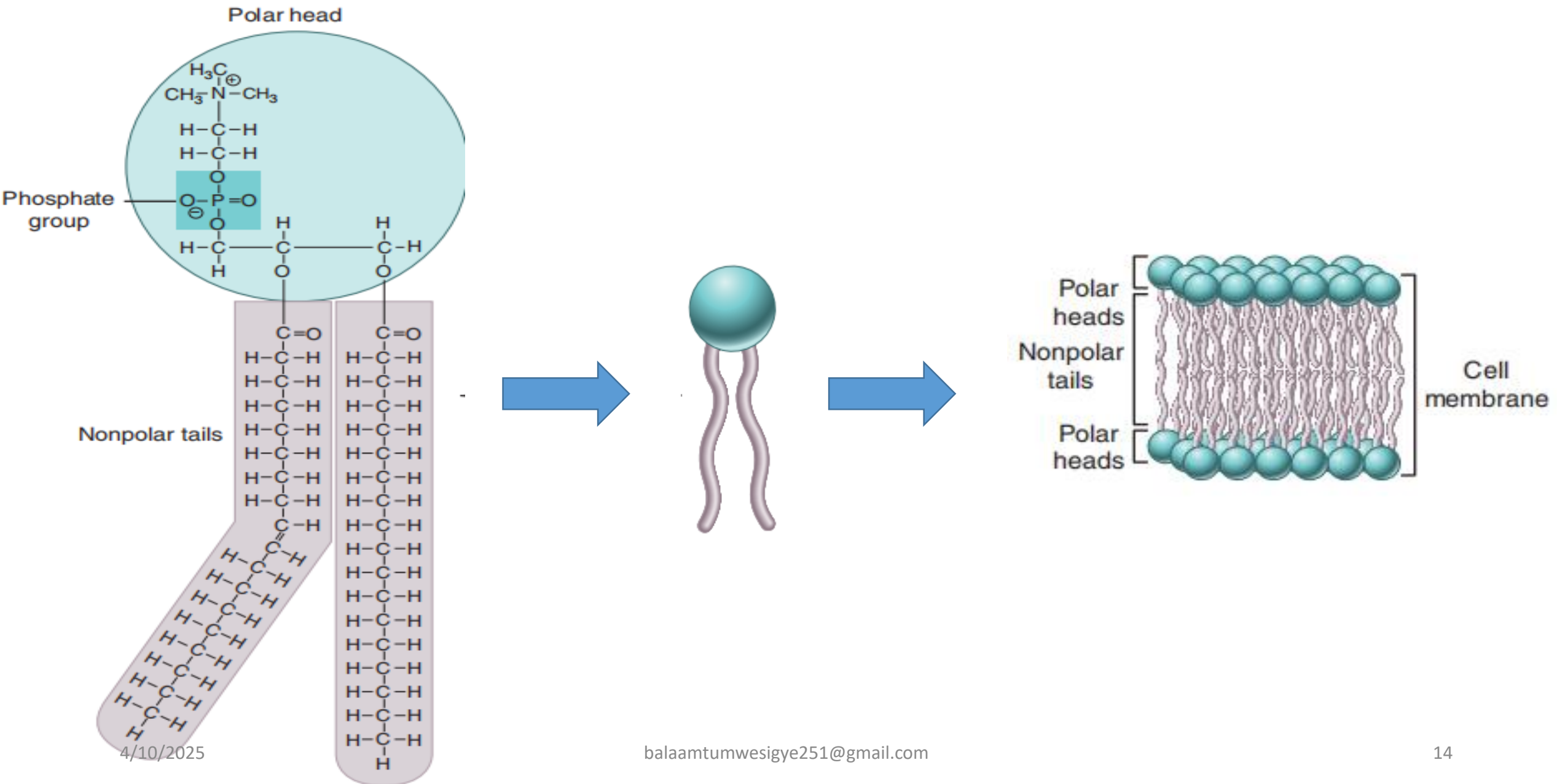
Formation of TAG



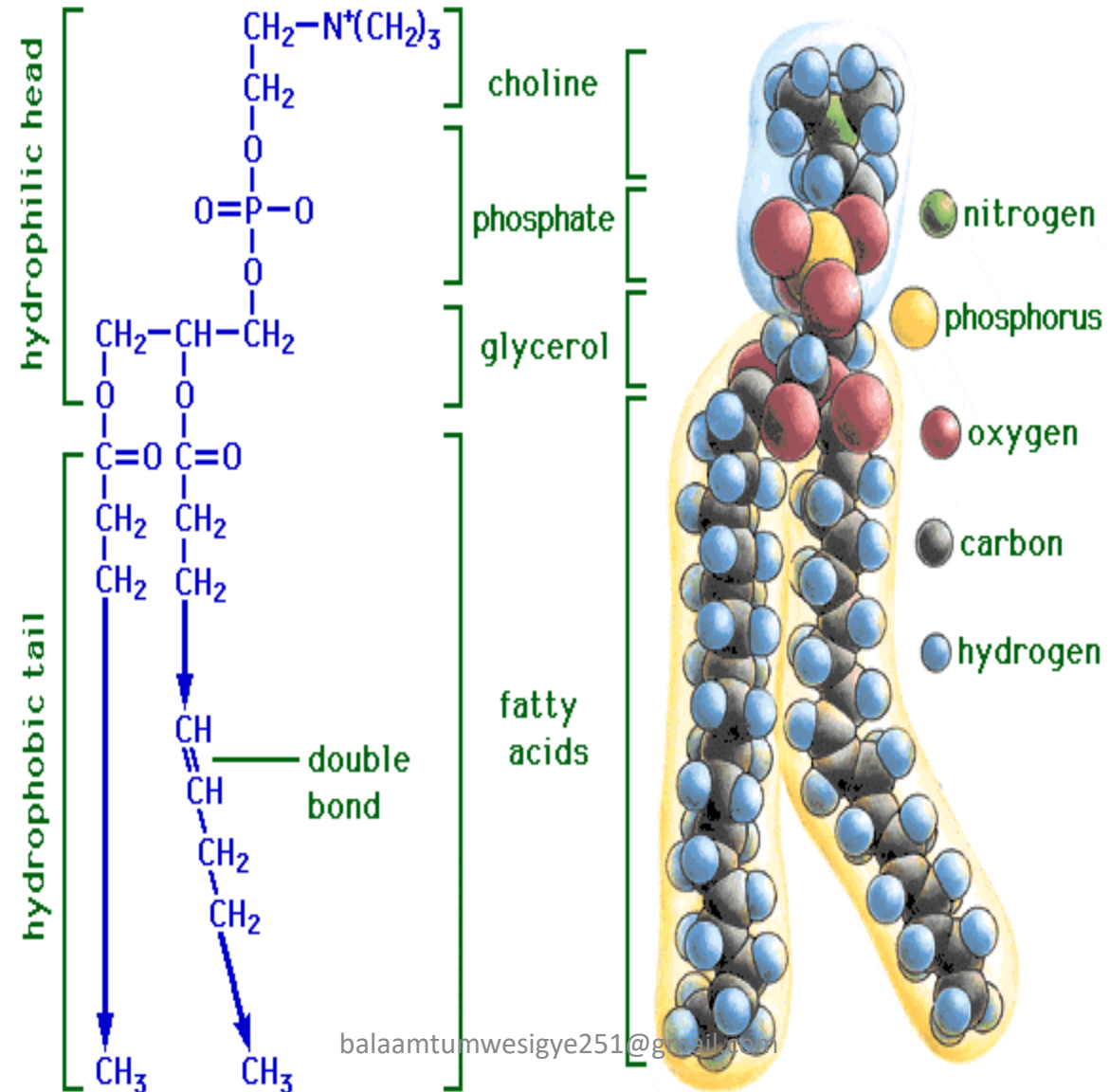
PHOSPHOLIPIDS

- Are structural membrane lipids usually found in membranes.
- Phospholipids are synthesized by esterification of an alcohol to the phosphate of phosphatidic acid or **1,2-diacylglycerol 3-phosphate**.

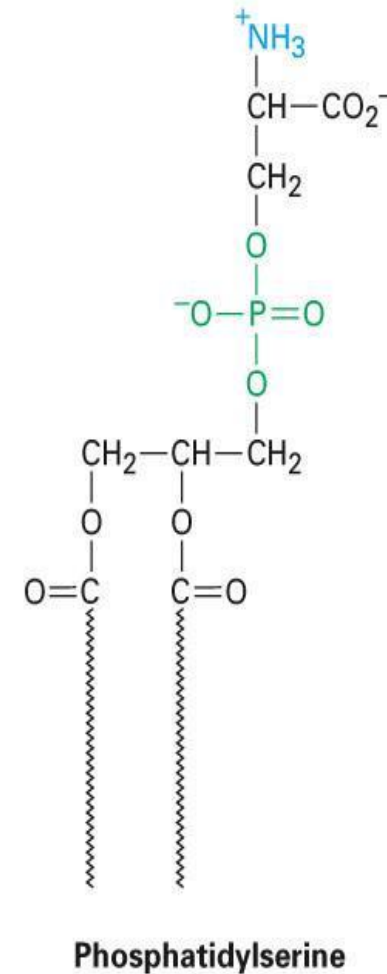
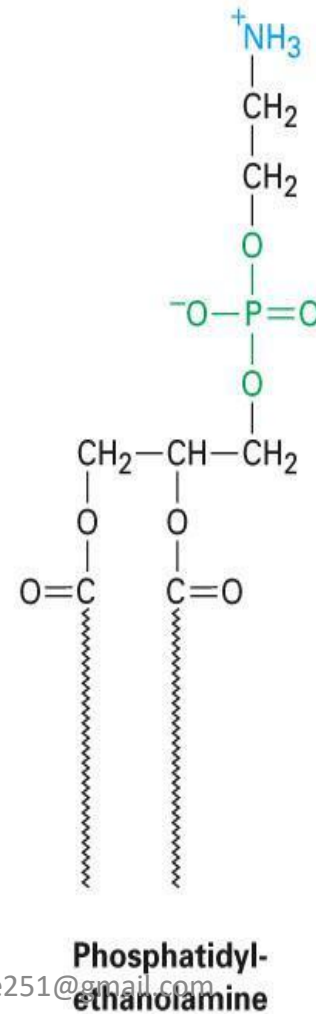
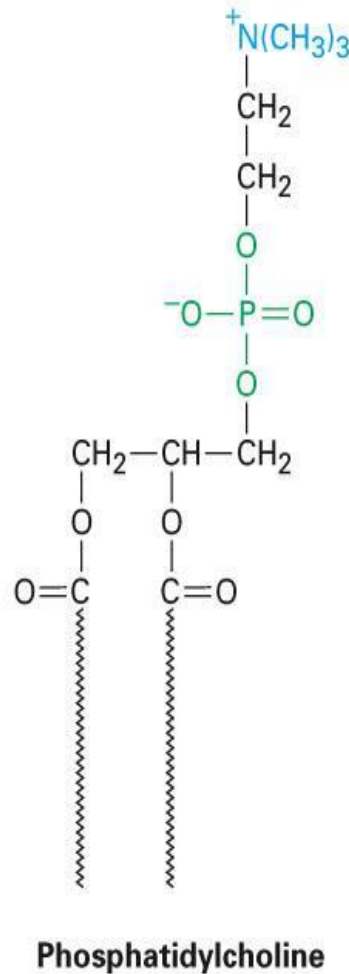
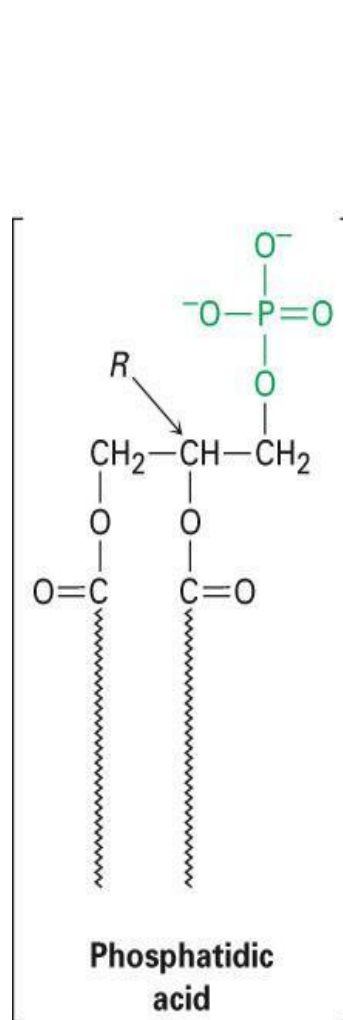
Look at this



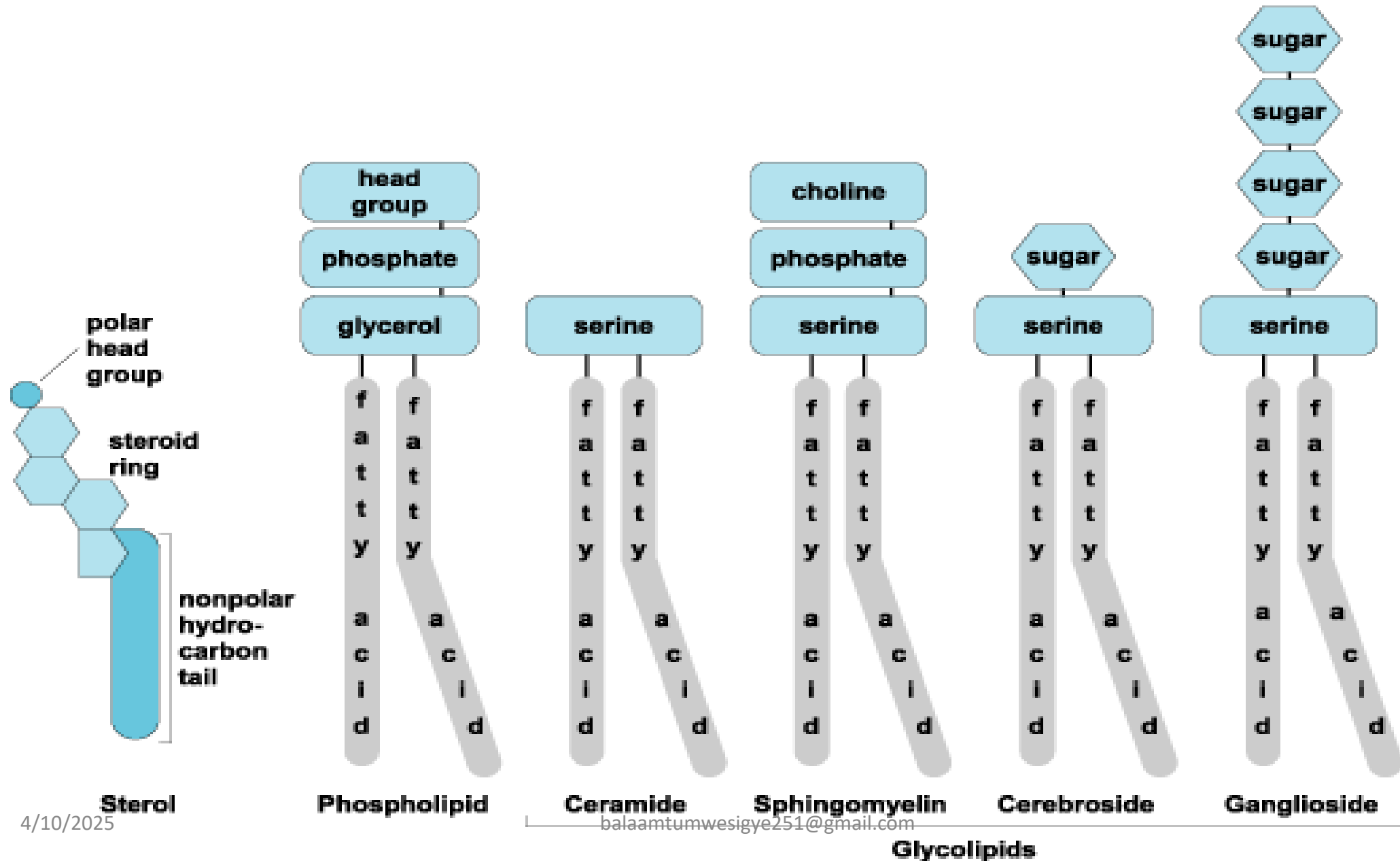
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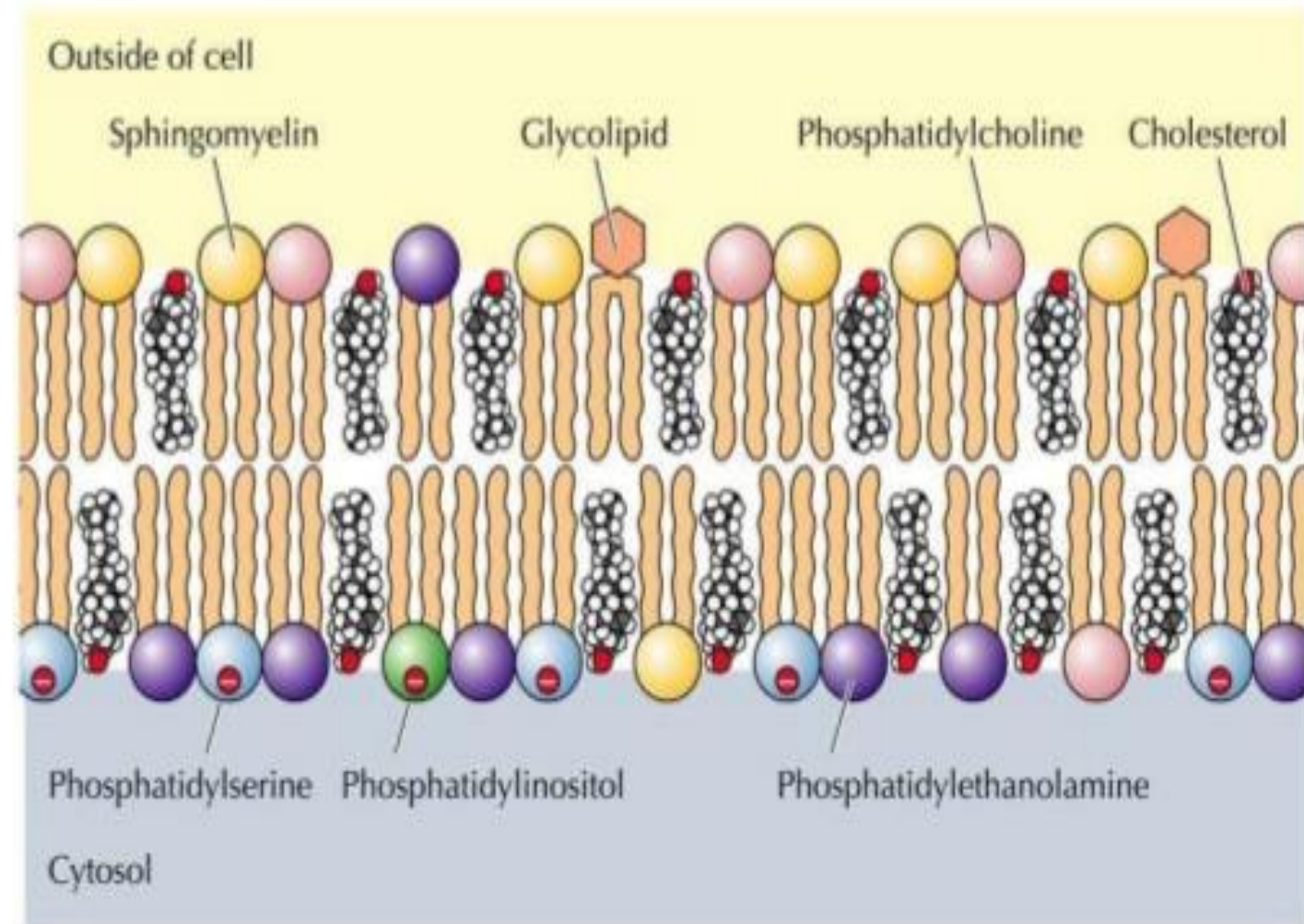
Examples of phospholipids



Lipids found in the cell membrane



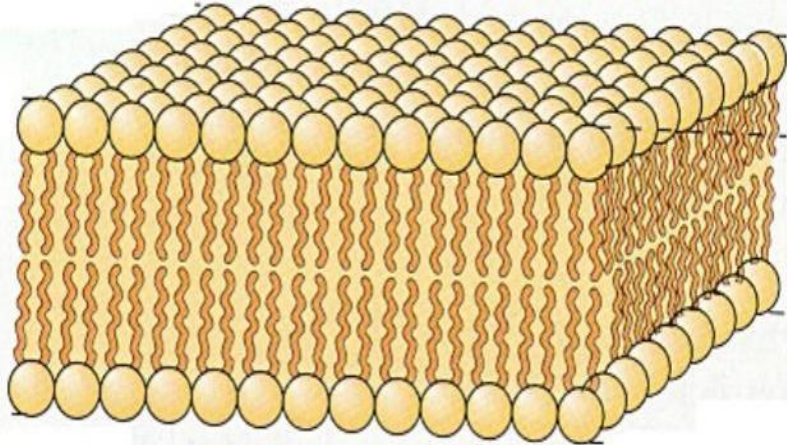
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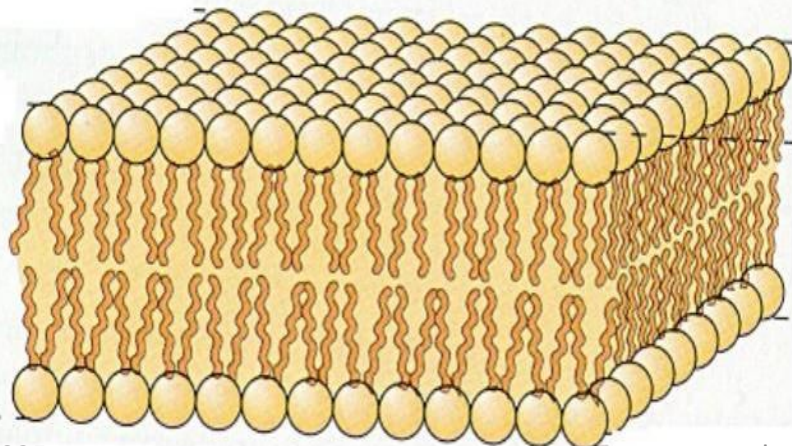
The membrane

gel phase--low temperatures

hydrocarbons are tightly packed



at higher temperatures--moves to fluid phase



bilayer "melts", movement is allowed

- Effect of temp on packing of hydrocarbons.
- The lipid bilayer gives the membranes its fluid characteristics.
- At low temperatures, the bilayer is in a gel state and tightly packed. At higher (body) temperatures, the bilayer actually "melts" and the interior is fluid allowing the lipid molecules to move around, rotate, exchange places.
- This also allows movement of other components of the membrane.
- Reference: Wolfe S.L., Molecular and Cellular
- Biology, Wadsworth Publishing Company,

1993.

What do you see??

