

# BIO-ORGANIC CHEMISTRY

## (Organic Chemistry for Biology Students)

### (SQBS 1603)

# Basic Compounds in Biomolecules:

## Lipids

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# Lipids

- Lipids
  - biomolecules that contain many nonpolar and C-H bonds.
  - Biomolecules that are soluble in organic solvents insoluble in water

Most important types of lipid in biological system

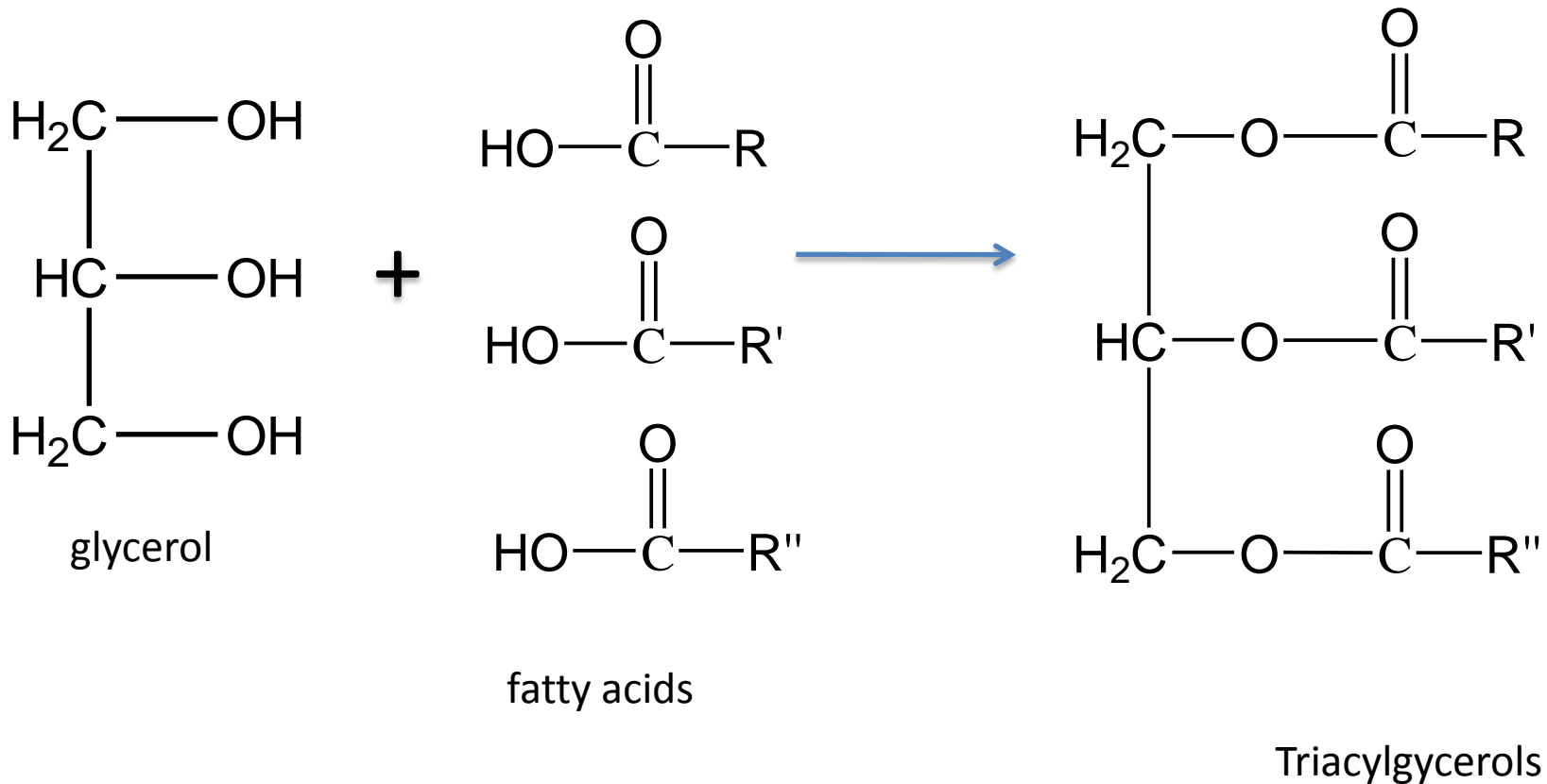
Triacylglycerols

Phospholipids

Steroids

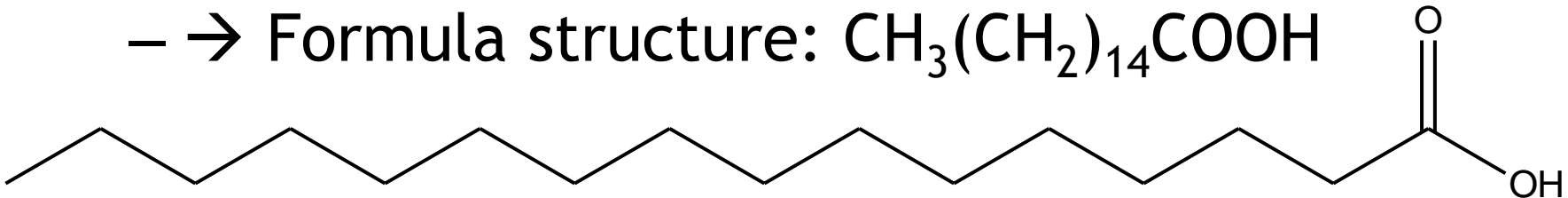
# Triacylglycerols

- Triesters formed from **glycerol** and three molecules of **fatty acids**



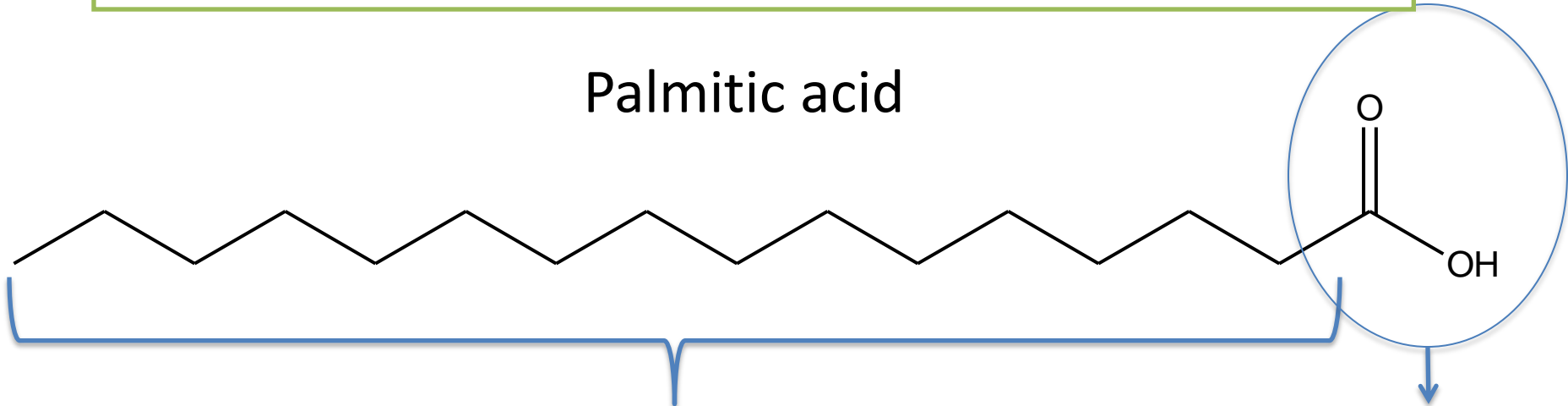
# Fatty Acids

- Fatty acids → carboxylic acids (RCOOH) with long carbon chain of 12-20 carbon atoms
- Physical property
  - Insoluble in water.
  - Soluble in organic solvents.
- Example: Palmitic acid
  - → Formula molecule:  $C_{16}H_{32}O_2$
  - → Formula structure:  $CH_3(CH_2)_{14}COOH$



# Fatty Acids

## Palmitic acid



Non-polar C-C and C-H bonds



Hydrophobic portion



Not attracted to water  
(water phobia or water fearing)

Polar C-O and O-H bonds



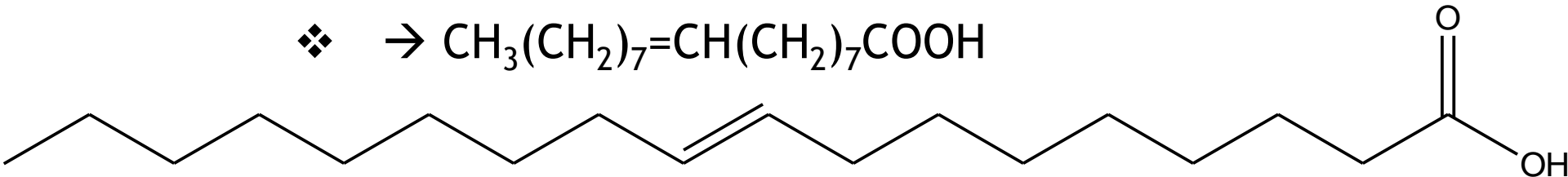
Hydrophilic portion



Attracted to water  
(water loving)

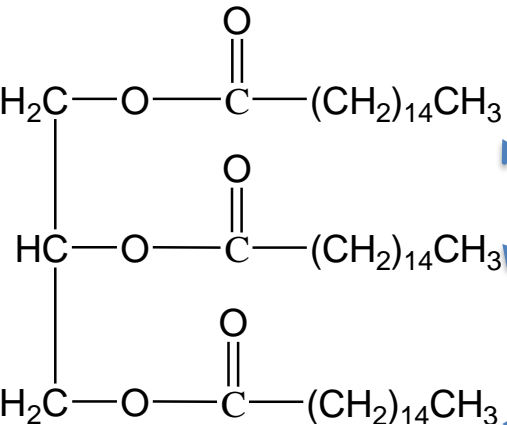
# Fatty Acids

- Two types of fatty acids
  1. Saturated fatty acids
    - ❖ No double bonds in their long hydrocarbon chain
    - ❖ E.g: Palmitic acid
  2. Unsaturated fatty acids
    - ❖ Have one or more double bonds in their long hydrocarbon chain
    - ❖ E.g: Oleic acid
    - ❖ →  $\text{CH}_3(\text{CH}_2)_7=\text{CH}(\text{CH}_2)_7\text{COOH}$



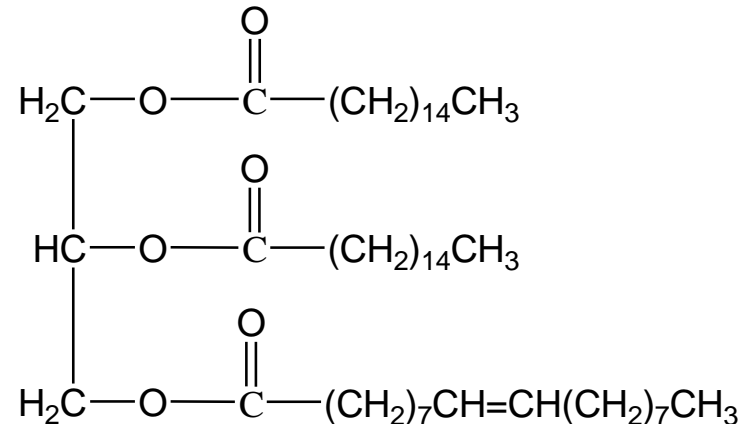
# Triacylglycerols

## Simple Triacylglycerols



Three identical  
saturated  
carbon chains

## Mixed Triacylglycerols



One  
unsaturated  
carbon chain

# Triacylglycerols

- **Simple triacylglycerols:**
  - Triacylglycerols composed of 3 identical fatty acid side chains.
- **Mixed triacylglycerols:**
  - Triacylglycerols composed of two or three different fatty acid.
- **Saturated:**
  - Alkyl chain contains only C-C bonds.
- **Monounsaturated:**
  - Alkyl chain contains one C=C bond.
- **Polyunsaturated:**
  - Alkyl chain contains more than one C=C bonds.



# Triacylglycerols

## Fats

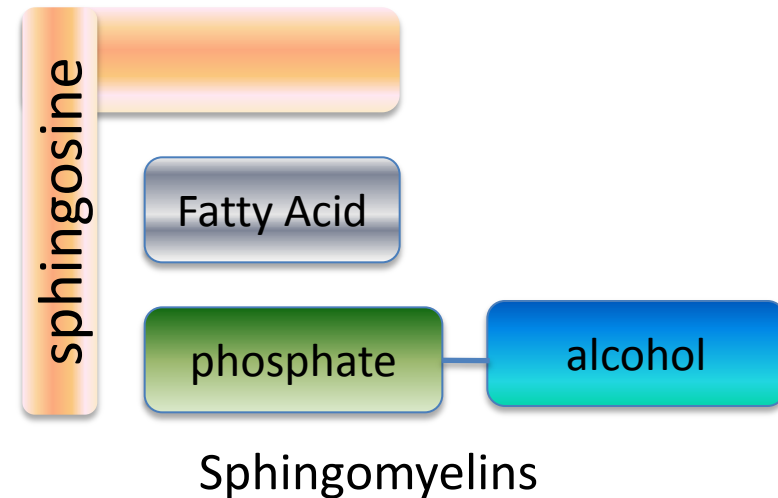
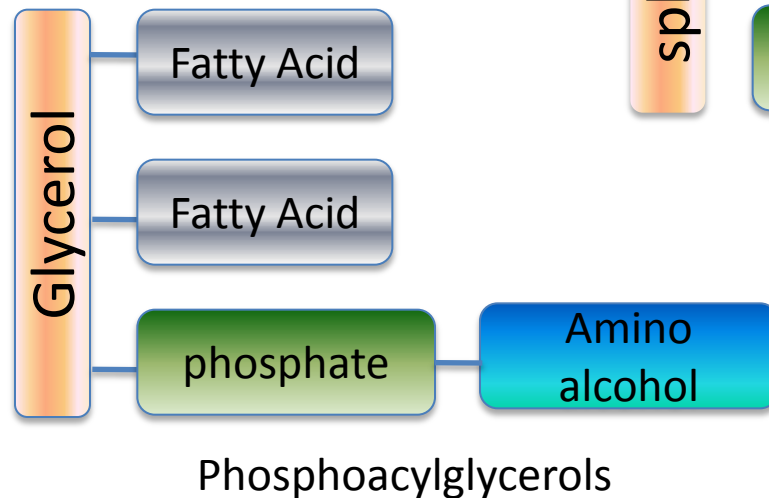
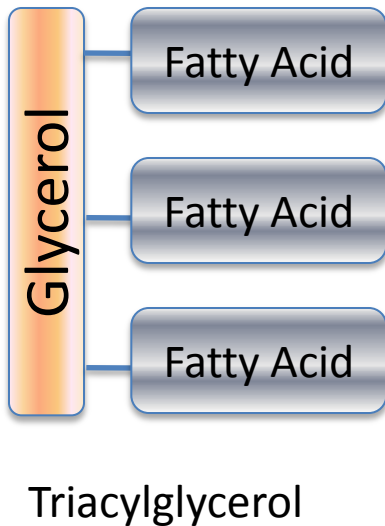
- Triacylglycerols with a **high saturated** fatty acids content.
- **Higher melting points**
- **Solids** at room temperature

## oils

- Triacylglycerols with a **high unsaturated** fatty acids content.
- **lower melting points**
- **liquids** at room temperature

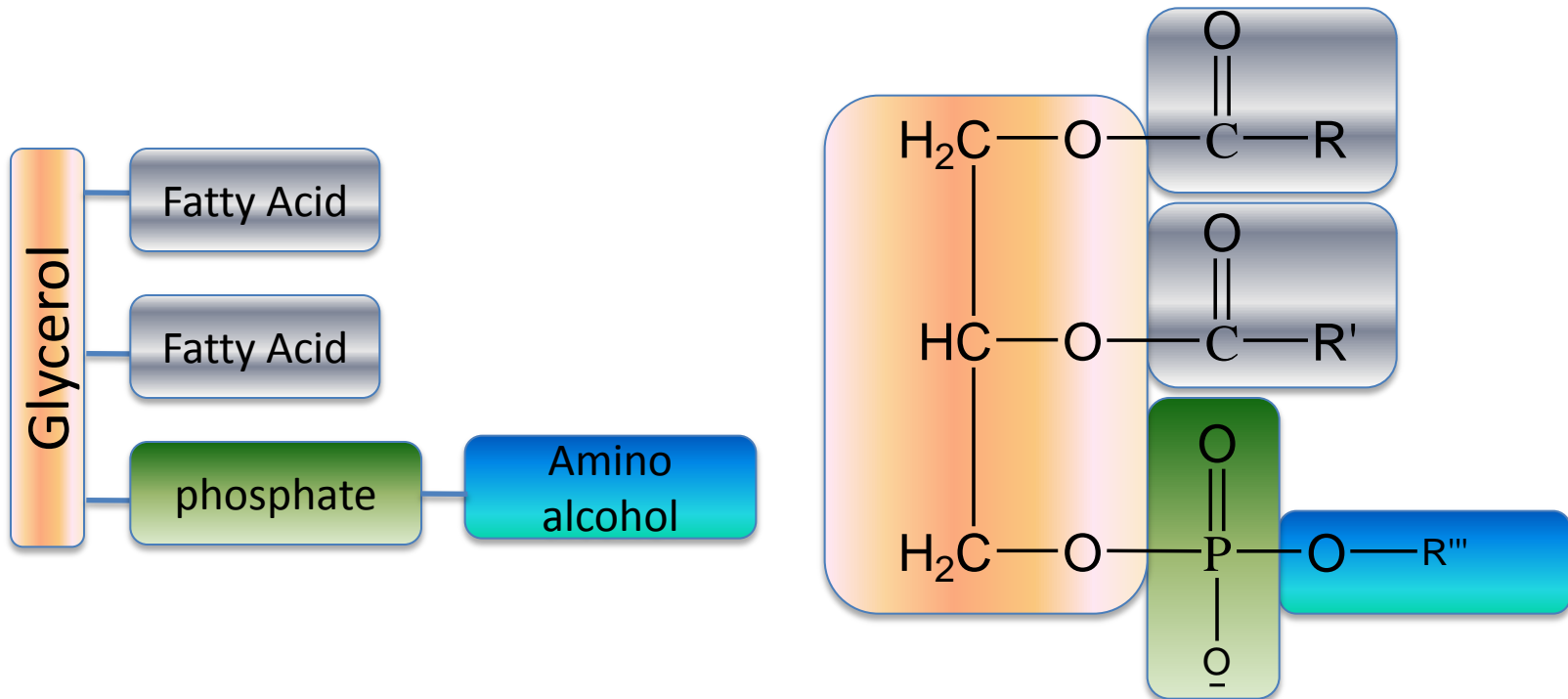
# Phospholipids

- Phospholipids
  - Lipids that contain a phosphorus atom.
  - Two common types:
    1. Phosphoacylglycerols
    2. Sphingomyelins

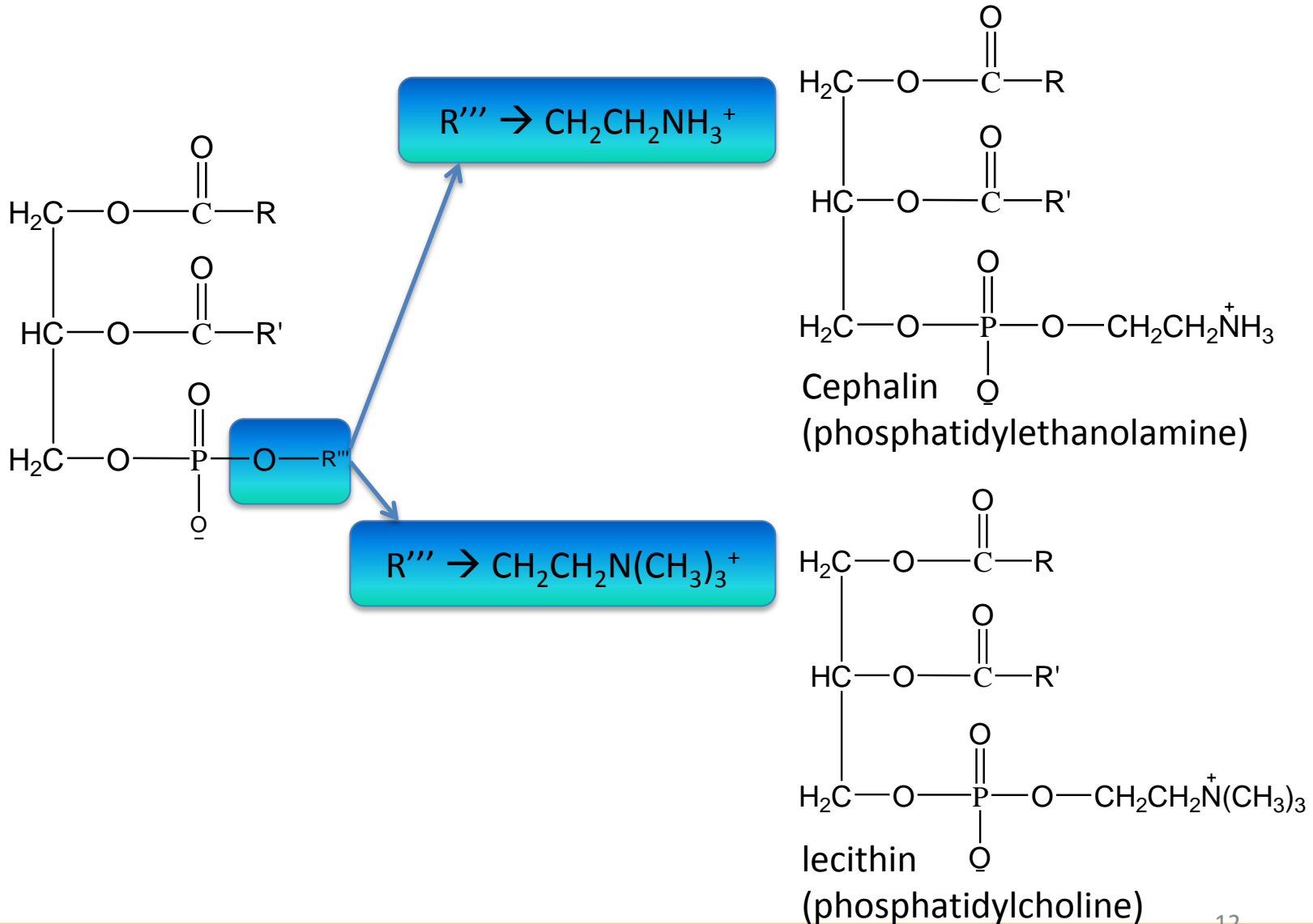


# Phosphoacylglycerols

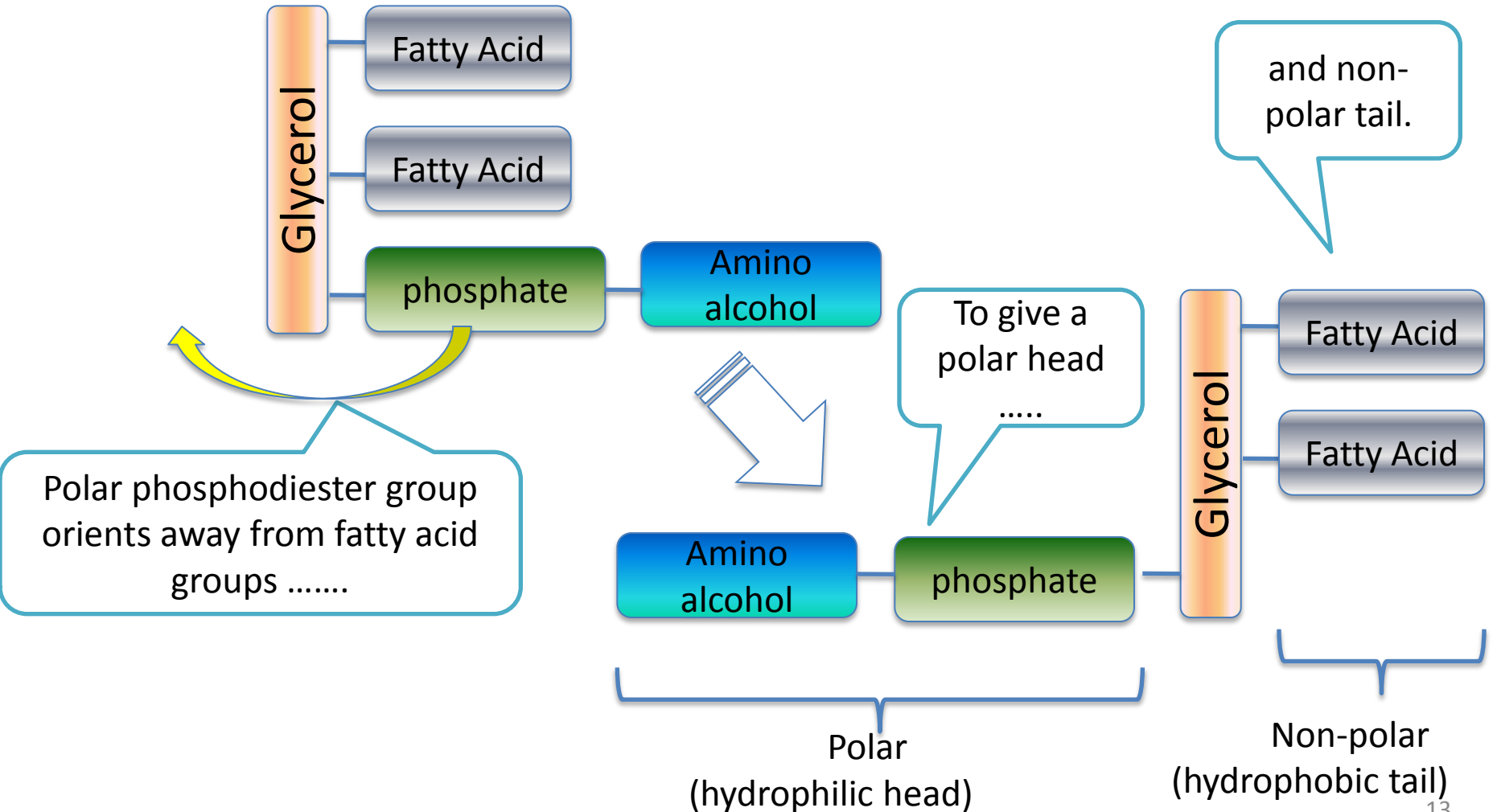
- The second most abundant type of lipid.
- They form the principal lipid component of most cell membranes.



# Phosphoacylglycerols



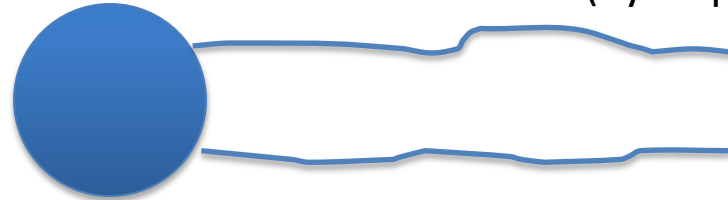
# Phosphoacylglycerols



# Phosphoacylglycerols

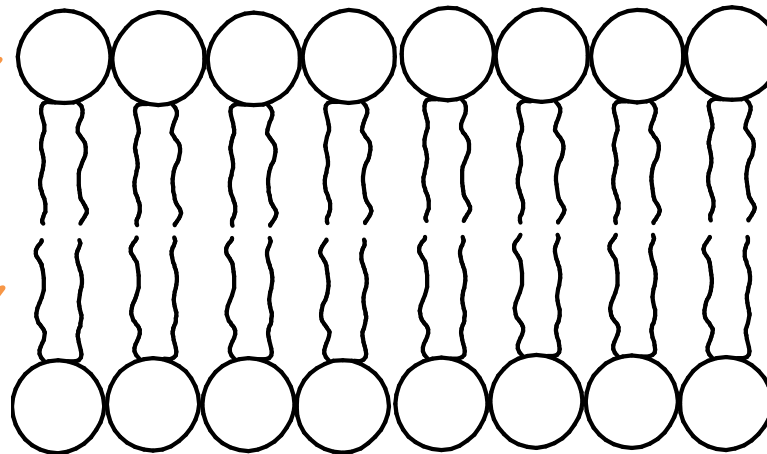
Polar  
(hydrophilic head)

Non-polar  
(hydrophobic tail)



Hydrophilic heads are  
exposed to water-  
based surroundings

Hydrophobic tails  
aggregate to form a  
sealed water-free layer



Lipid bilayer

# REFERENCES

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# MY PROFILE



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