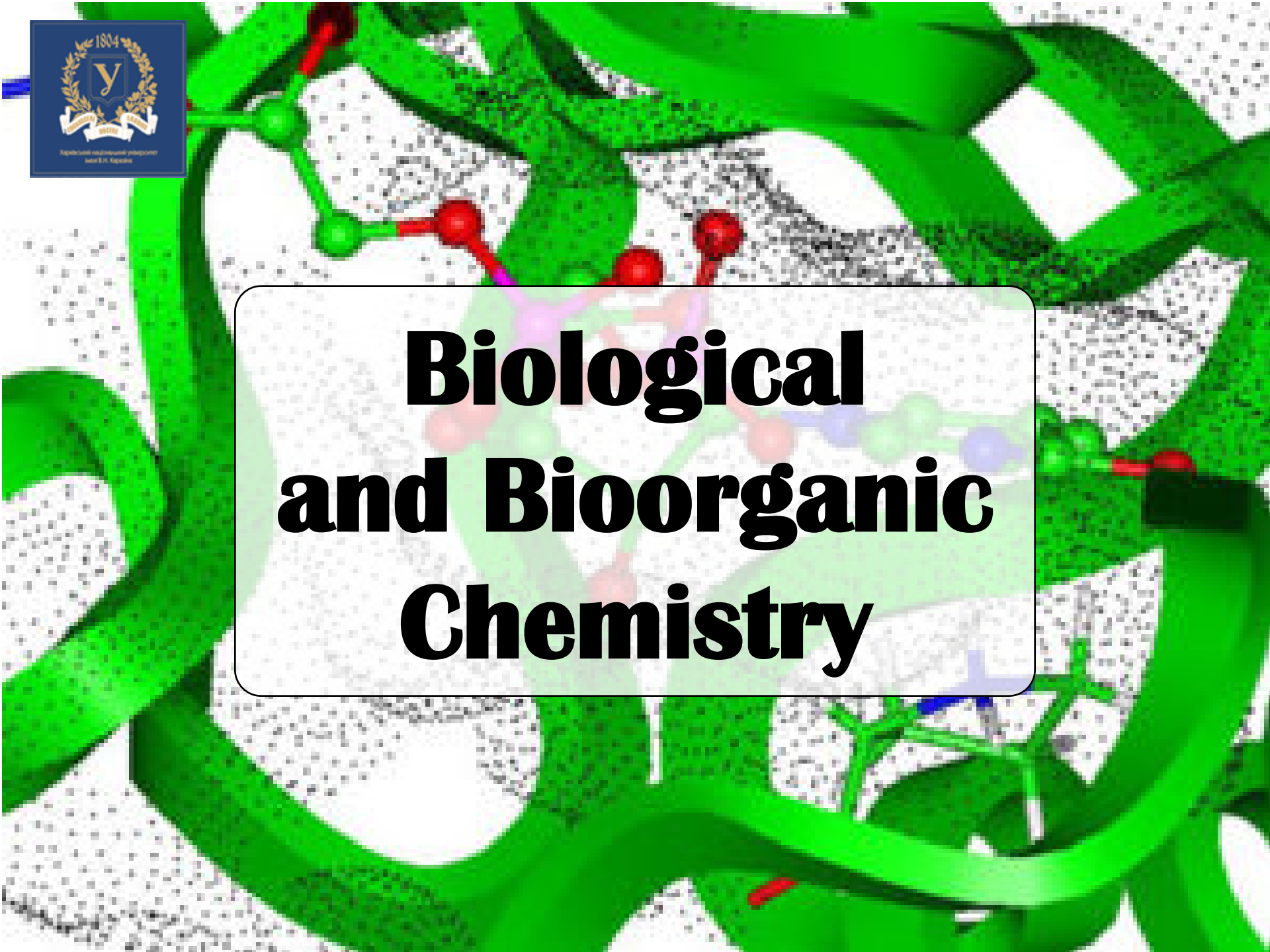
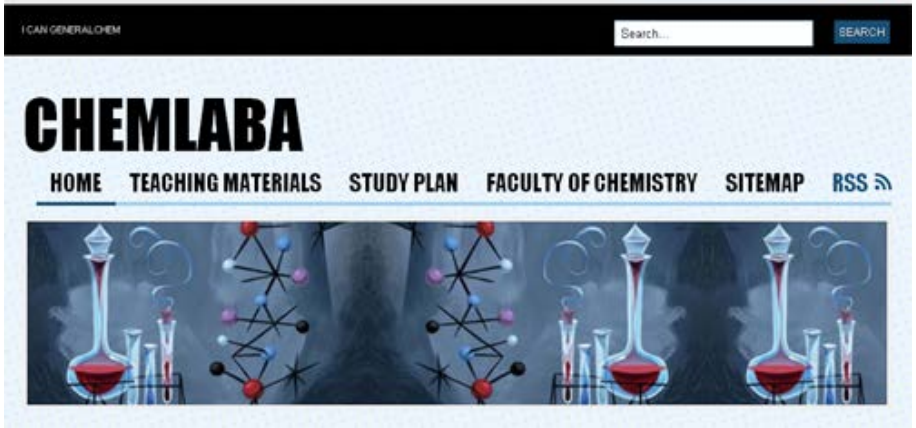
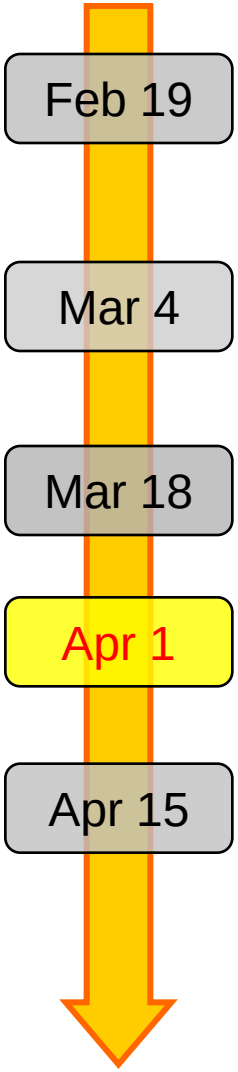

Biological
and Bioorganic
Chemistry

Some useful material



will be announced ...

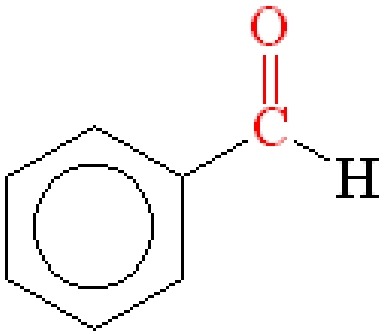
What shall we do?



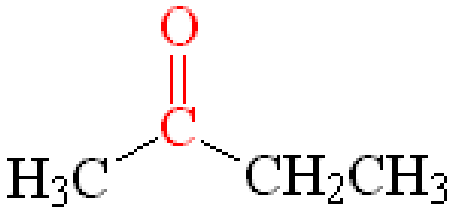
Feb 19	Introduction to organic and biological chemistry. Classes and nomenclature of organic compounds. Saturated and unsaturated hydrocarbons. S_R and Ad_E reactions.
Mar 4	Aromatic hydrocarbons. Orientation in the aromatic ring. Halogen derivatives of hydrocarbons. S_N reacions. Alcohols, ethers. Polyhydric alcohols.
Mar 18	Carbonyl compounds – aldehydes and ketones. Carbohydrates.
Apr 1	Carboxylic acids and their derivatives: amides, nitriles, anhydrides. Esters, fats, lipids.
Apr 15	Amines, aminoacids, peptides. Heterocyclic compounds and their biological activity.

Carboxylic acids

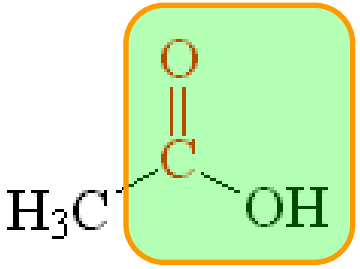
The carboxylic group



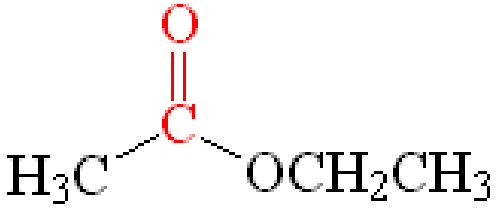
benzaldehyde



methyl ethyl ketone

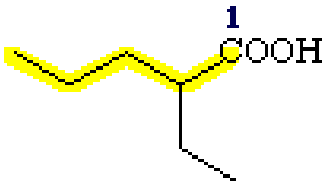


acetic acid

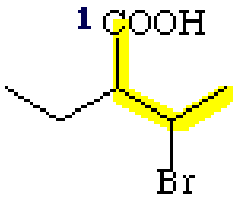


ethyl acetate

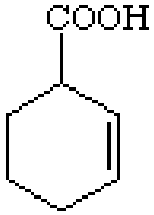
Naming carboxylic acids



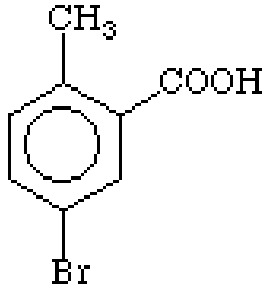
2-ethylpentanoic acid



3-bromo-2-ethylbutanoic acid



2-cyclohexenecarboxylic acid

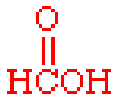


5-bromo-2-methylbenzoic acid

Simple carboxylic acids are named as derivatives of the parent alkane, using the suffix *-oic acid:*

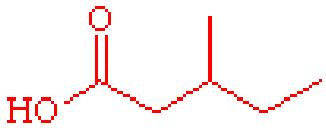
1. Select the longest continuous carbon chain, containing the carboxylic acid group, and derive the parent name by replacing the **-e** ending with **-oic acid**.
2. Number the carbon chain, beginning at the end nearest to the carboxylic acid group.
3. Number the substituents and write the name, listing substituents alphabetically.
4. Carboxylic acid substituents attached to rings are named using the suffix **-carboxylic acid**.

Naming carboxylic acids

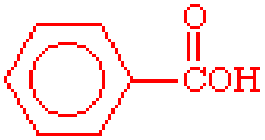


methanoic acid
(common name: formic acid)

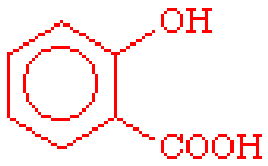
ethanoic acid
(common name: acetic acid)



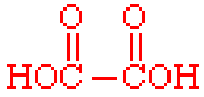
3-methylpentanoic acid



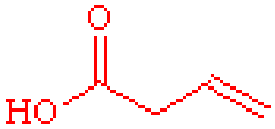
benzoic acid



salicylic acid
(common name)

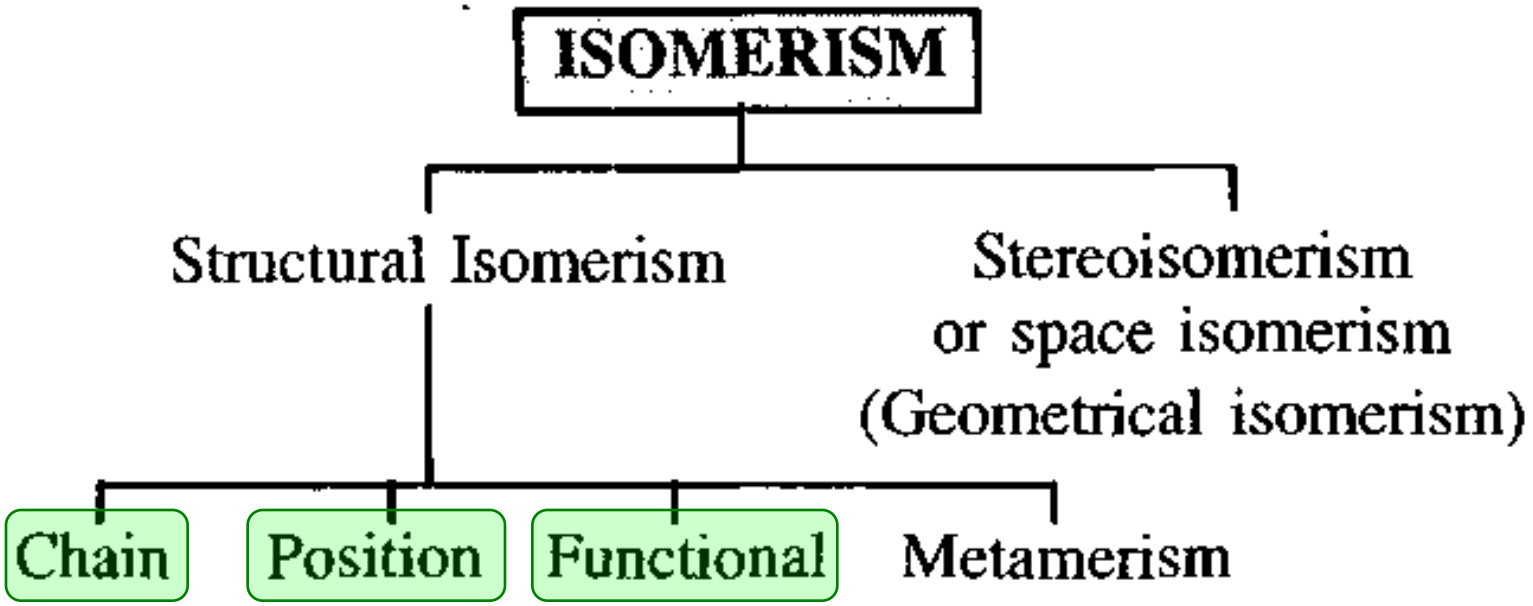


ethanedioic acid
(common name: oxalic acid)

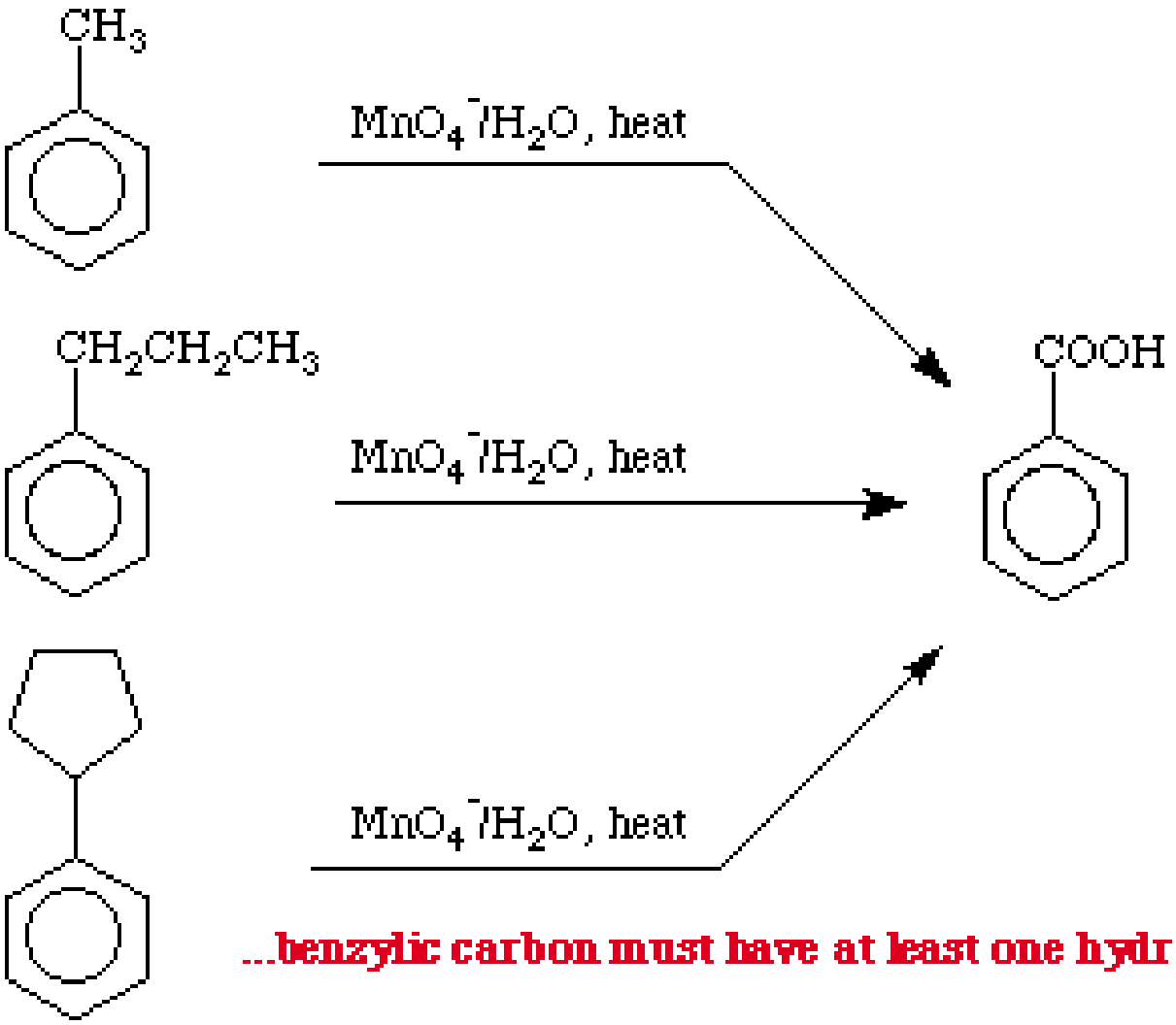


3-butenoic acid

Isomerism of carboxylic acids

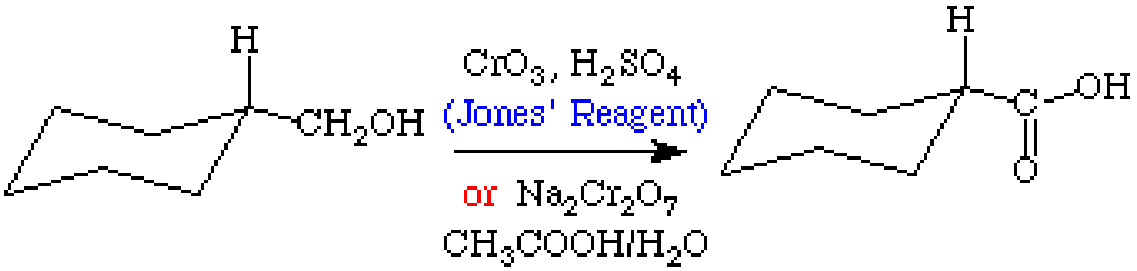


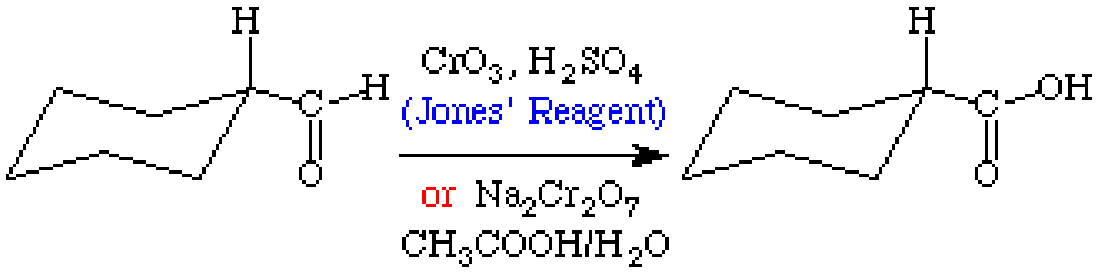
Synthesis of carboxylic acids

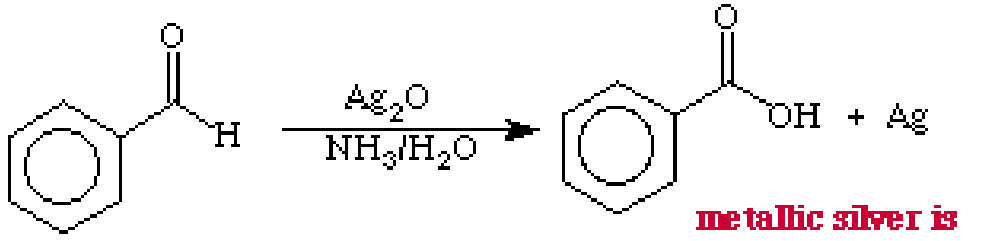


...benzylic carbon must have at least one hydrogen.

Synthesis of carboxylic acids

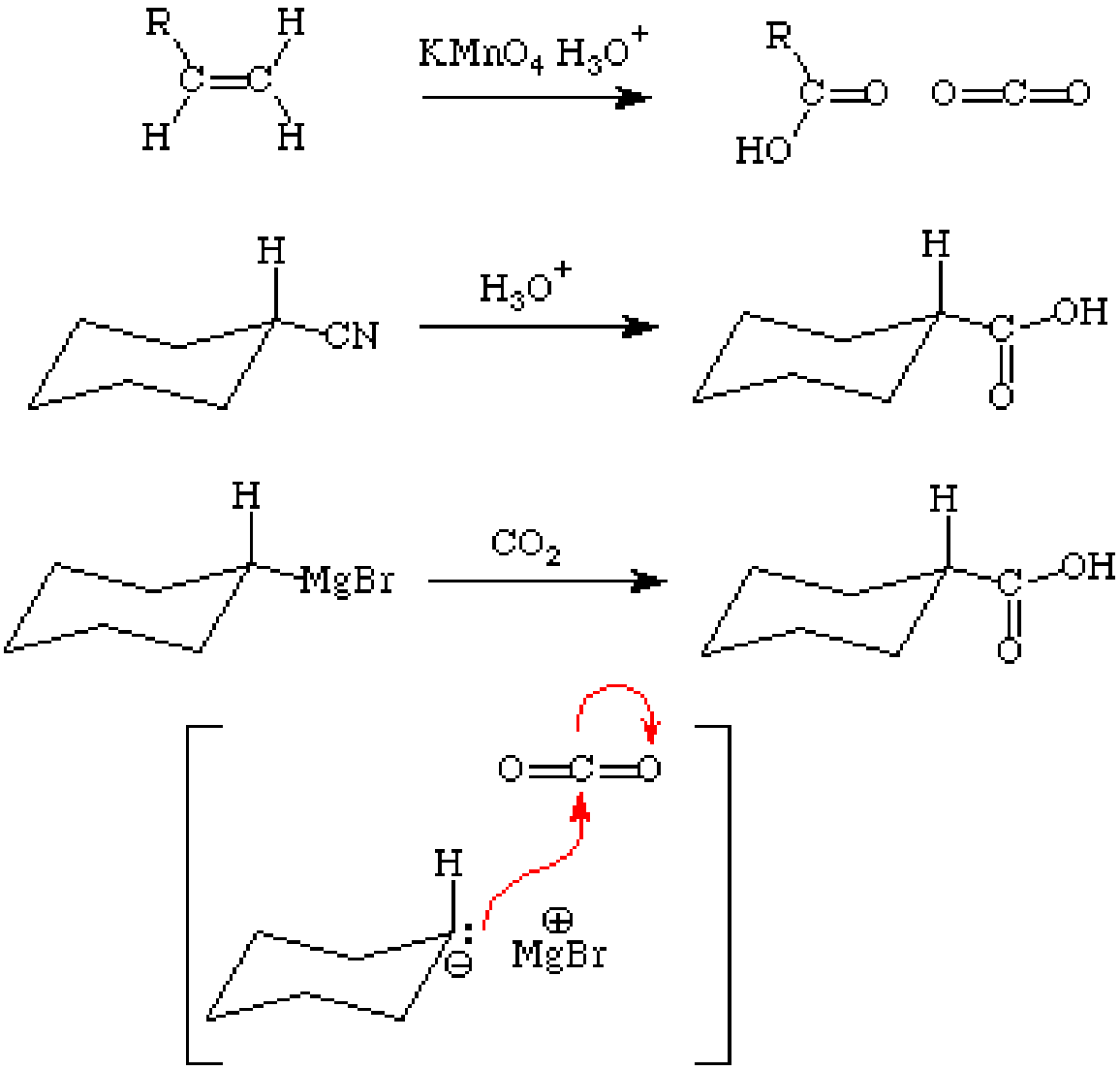






metallic silver is deposited in a thin "mirror" coating

Synthesis of carboxylic acids

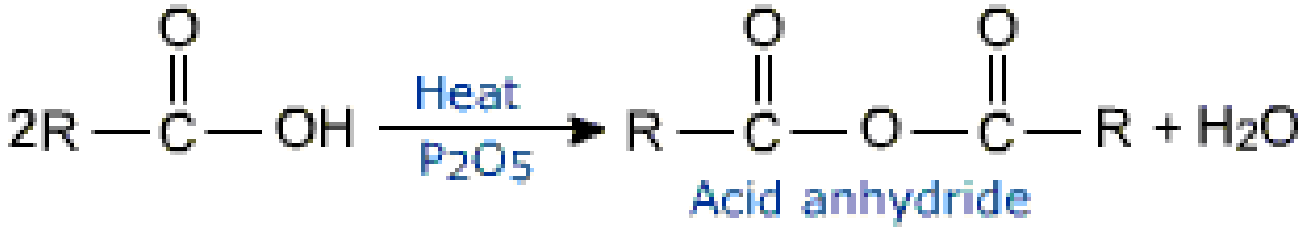


Reactions of carboxylic acids

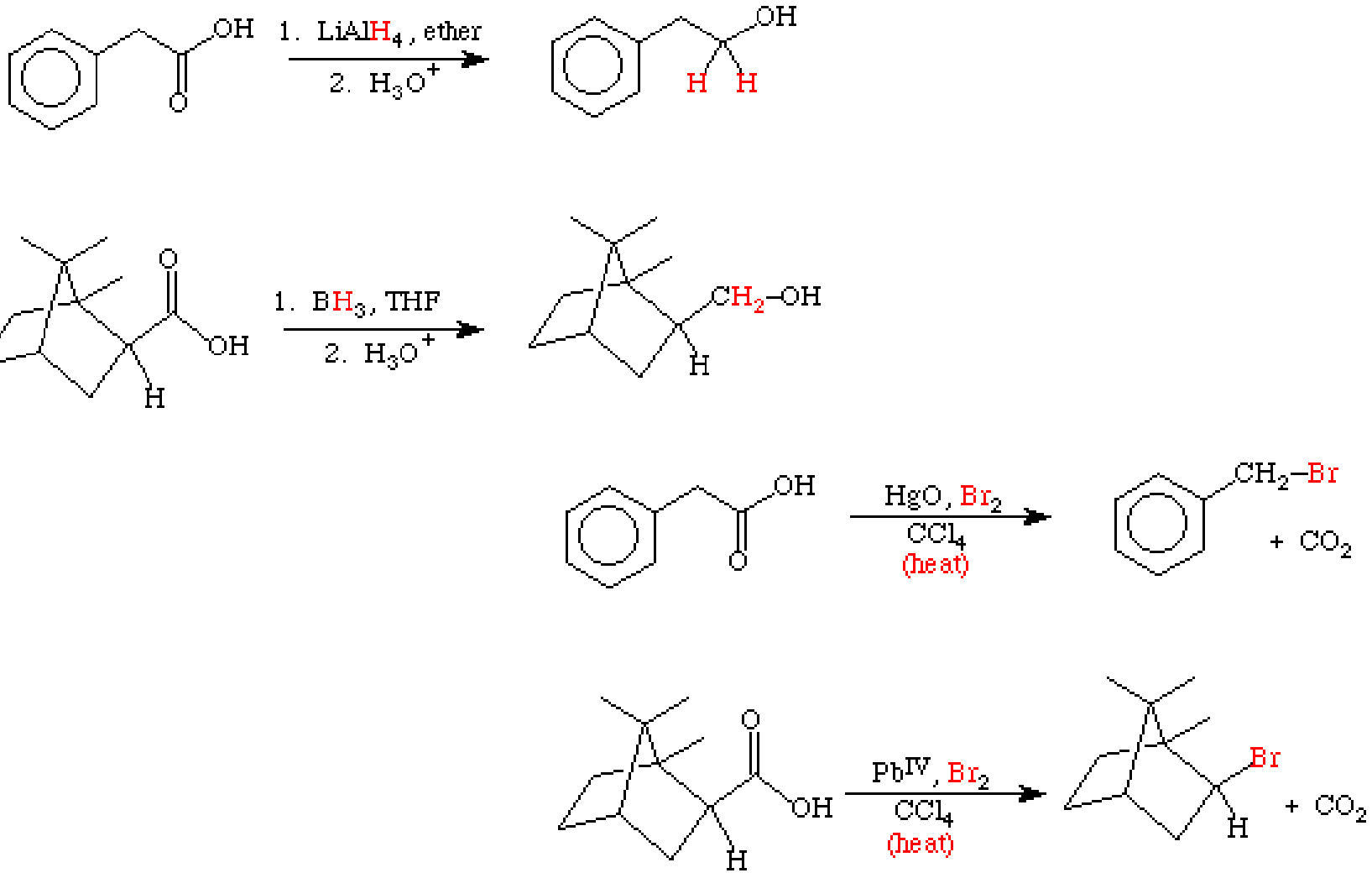
$$2RCOOH + Zn \longrightarrow (RCOO)_2\ Zn + H_2$$

$$RCOOH + NaOH \longrightarrow RCOONa + H_2O$$

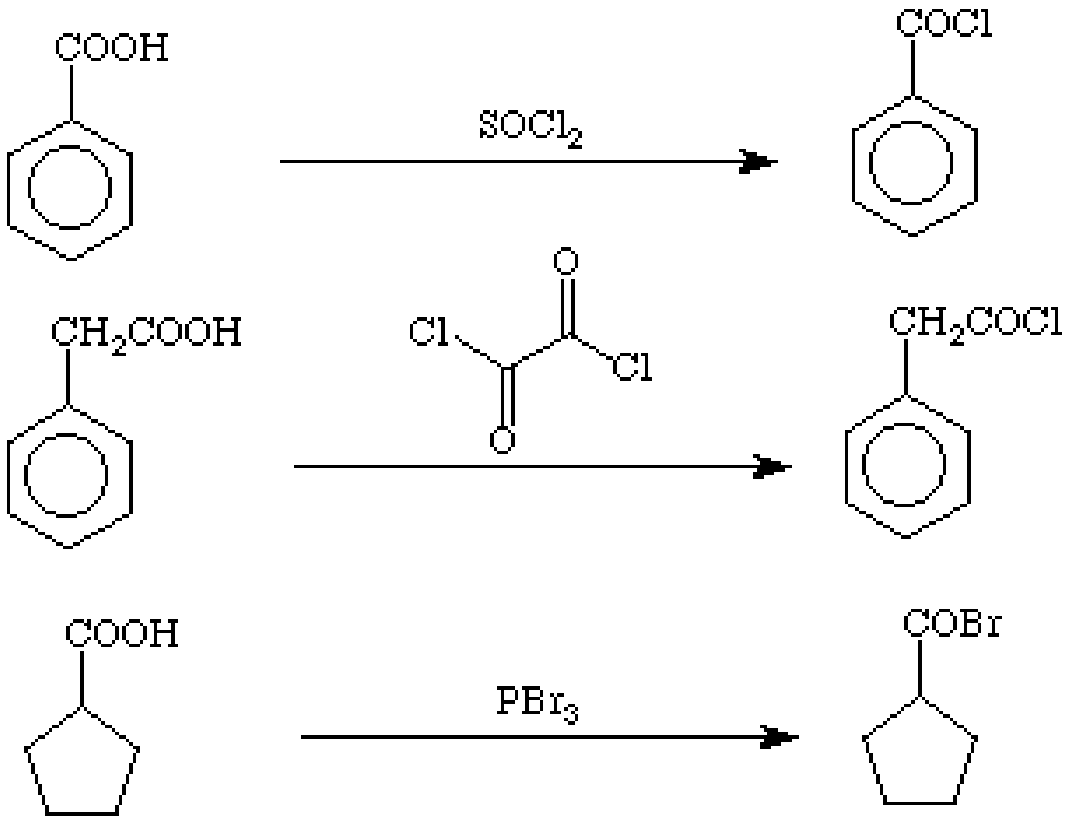
$$RCOOH + NaHCO_3 \longrightarrow RCOONa + CO_2 + H_2O$$



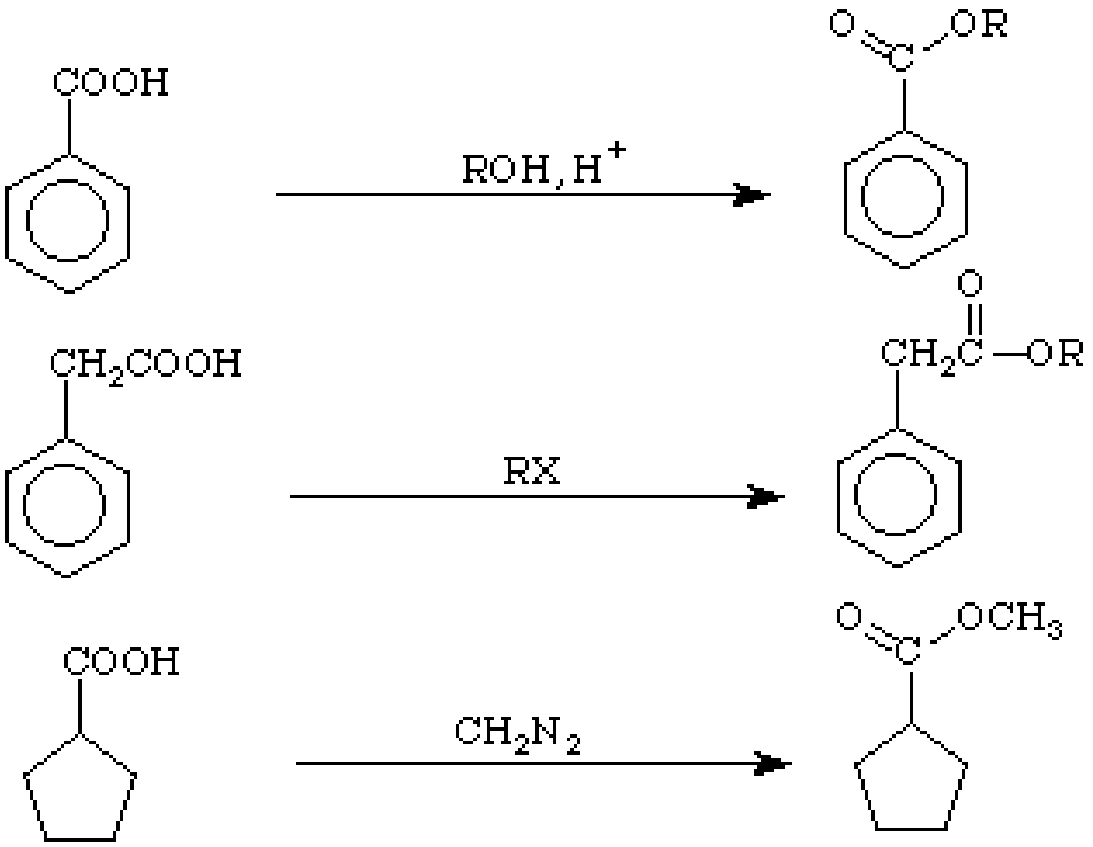
Reactions of carboxylic acids

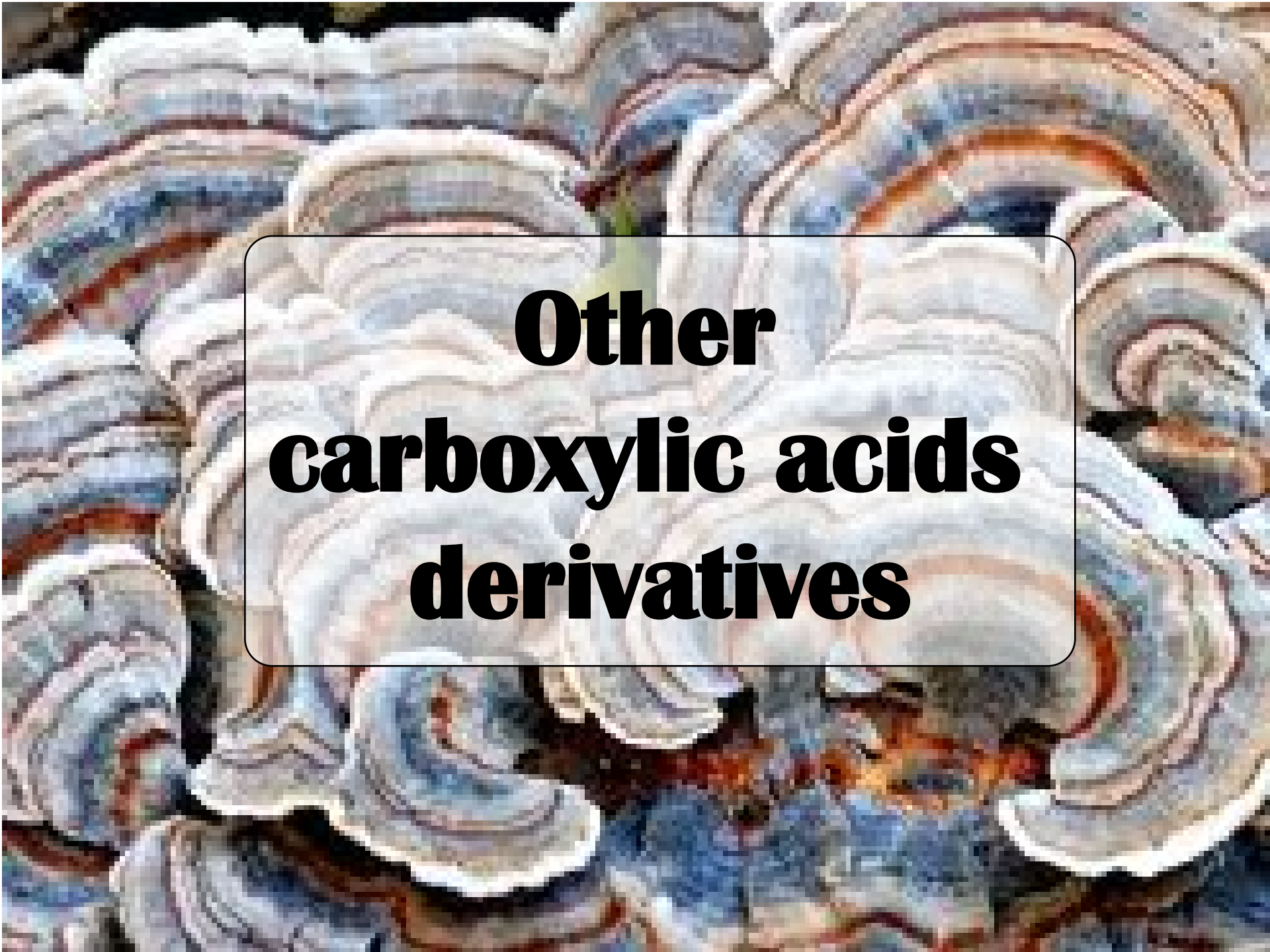


Reactions of carboxylic acids

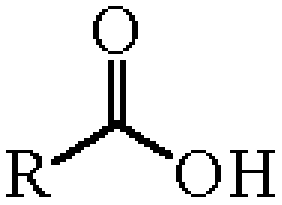


Reactions of carboxylic acids

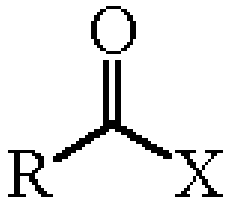



Other
carboxylic acids
derivatives

Carboxylic acids derivatives

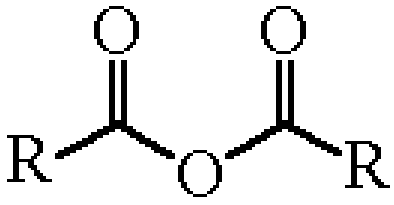


Carboxylic Acid

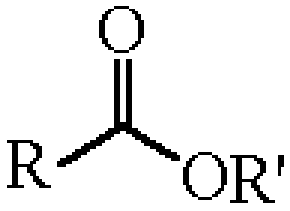


Acid Halide

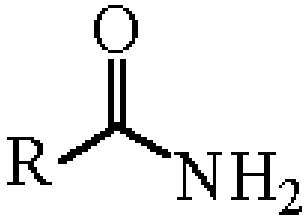
(X=F,Cl,Br,I)



Acid Anhydride



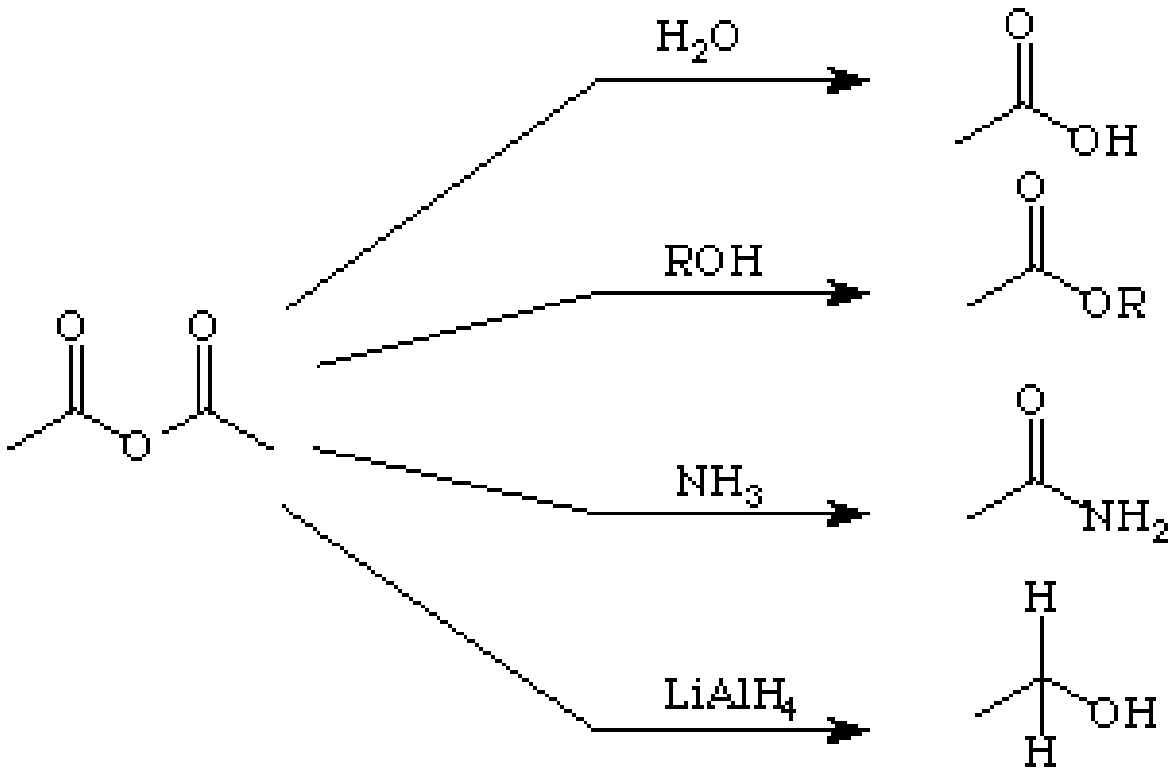
Ester



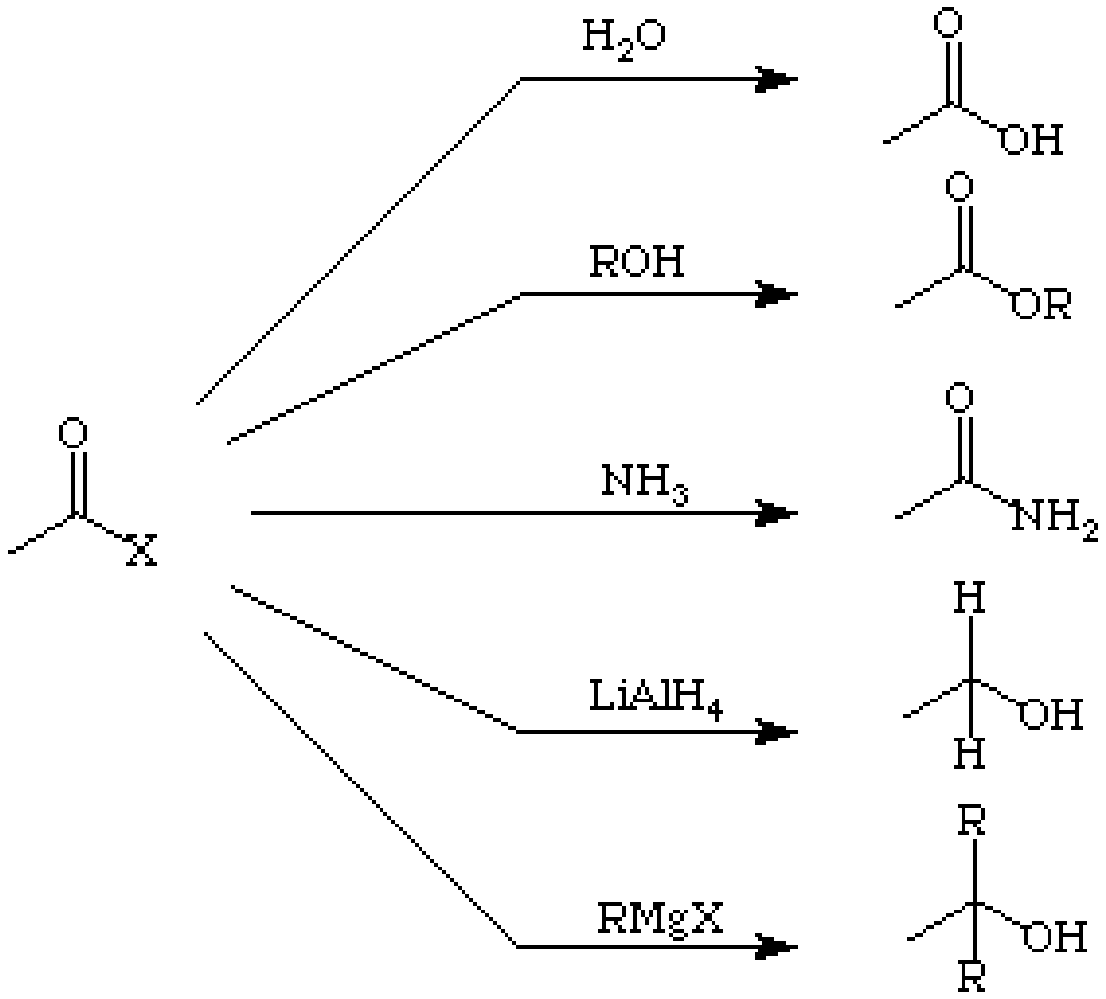
Amide

Nitrile

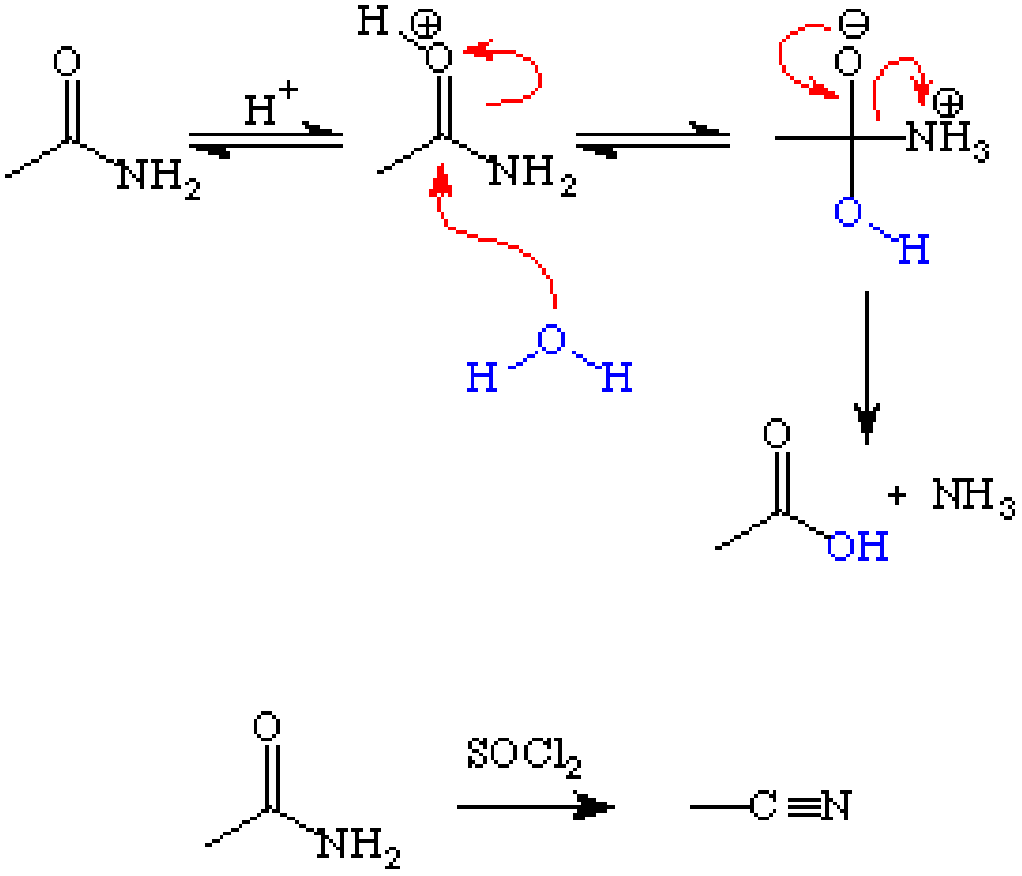
Acid anhydrides



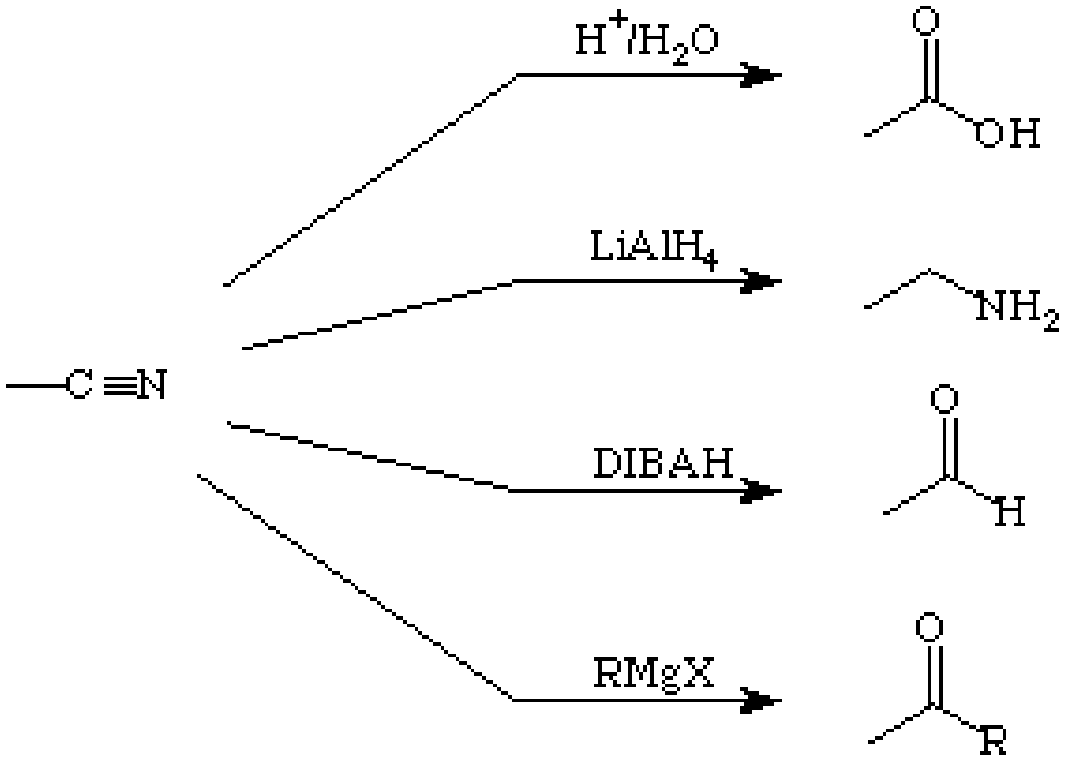
Acid halides (haloanhydrides)



Carboxylic acid amides

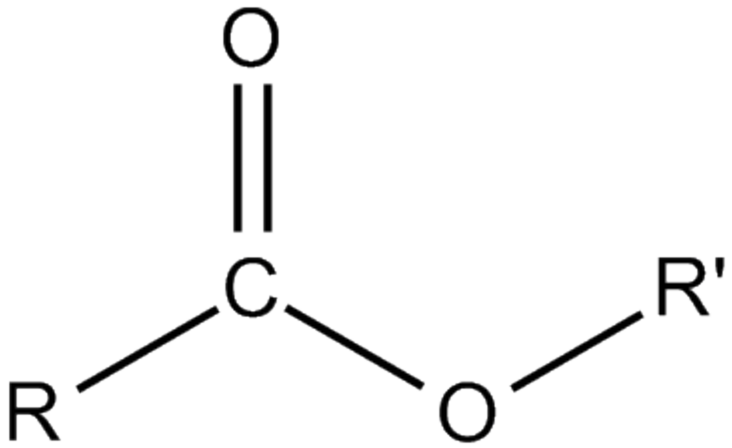


Nitriles



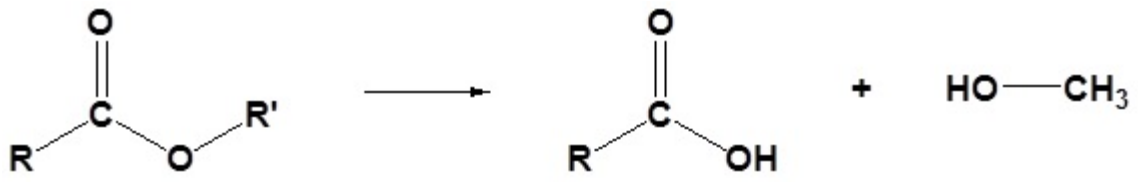
Esters and fats

Esters



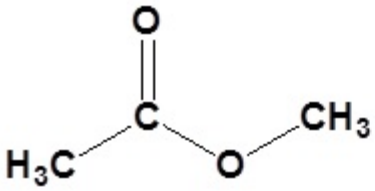
Esters are chemical compounds consisting of a carbonyl adjacent to an ether linkage. They are derived by reacting an oxoacid with a hydroxyl compound such as an alcohol or phenol.

Esterification Reaction

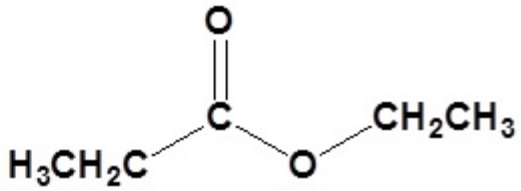


Ester **Carboxylic Acid** **Alcohol**

Esters are named as if the alkyl chain from the alcohol is a substituent.
No number is assigned to this alkyl chain.
This is followed by the name of the parent chain form
the carboxylic acid part of the ester with an **–e**
remove and replaced with the ending **–oate**.



Methyl ethanoate



Ethyl propanoate

Nomenclature of Esters

Esters are named as if the alkyl chain from the alcohol is a substituent.
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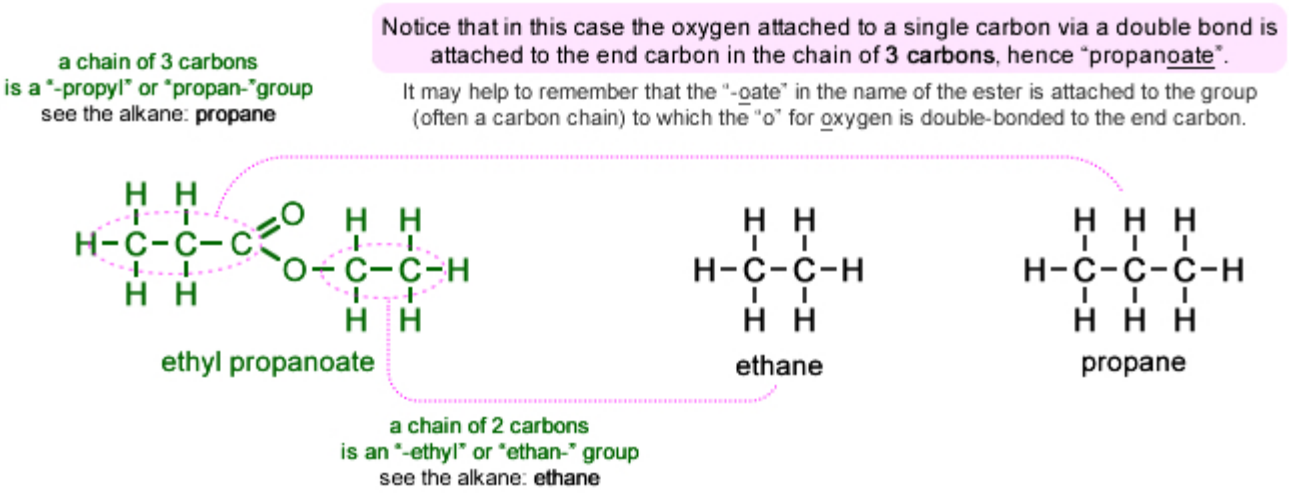
This is followed by the name of the parent chain form
the carboxylic acid part of the ester with an **–e**
remove and replaced with the ending **–oate**.



Nomenclature of Esters

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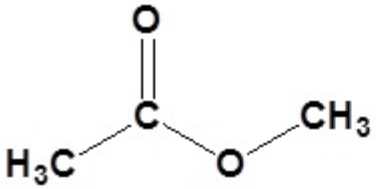
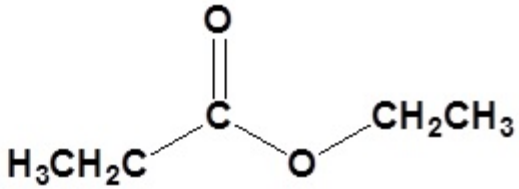
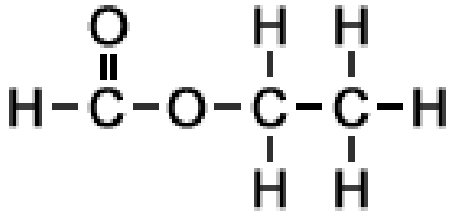


Methyl ethanoate

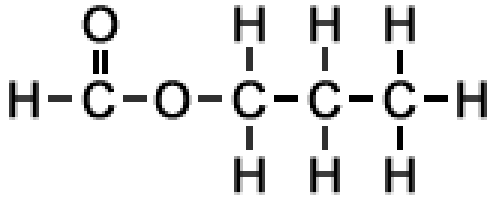


Ethyl propanoate

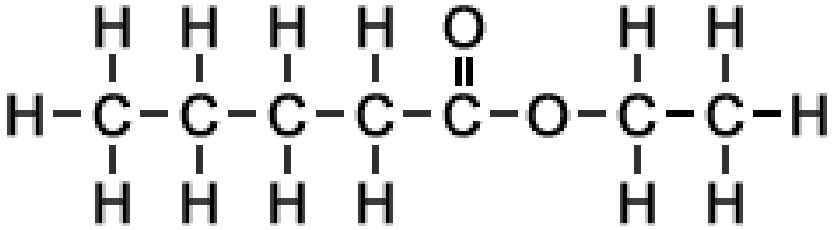
Nomenclature of Esters



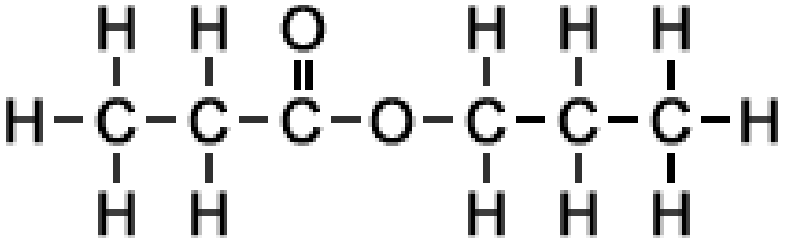
ethyl formoate



propyl formoate

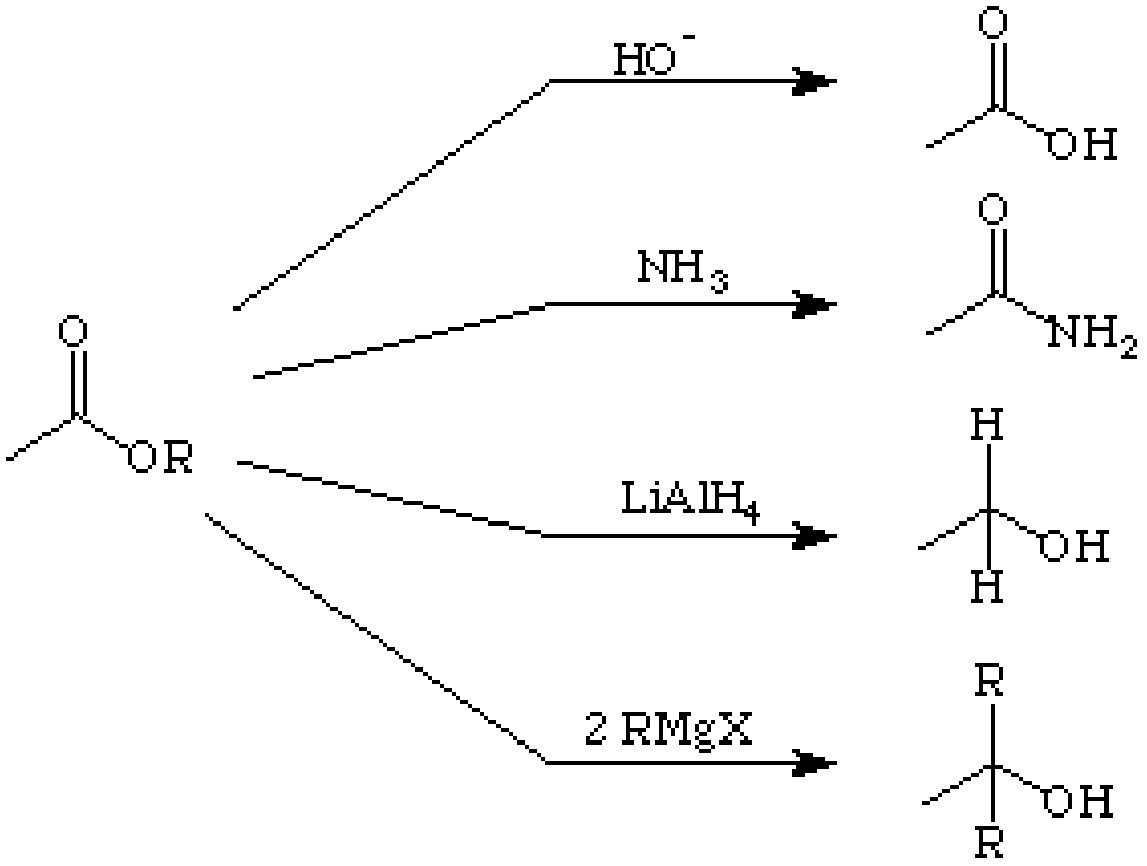


ethyl pentanoate

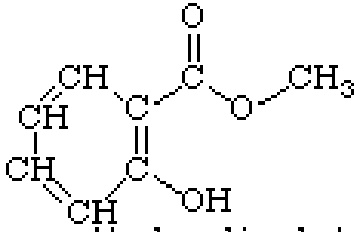


propyl propanoate

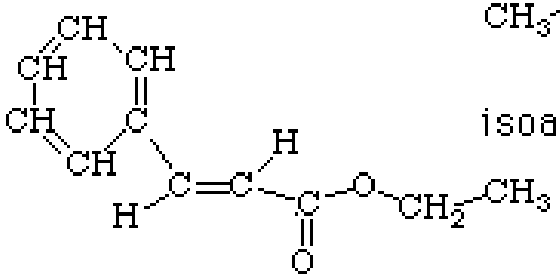
Reactions of Esters



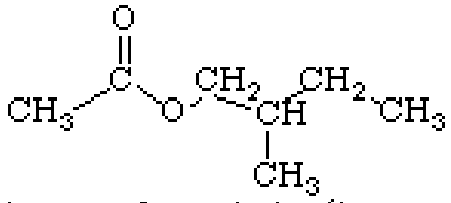
Esters as odorants



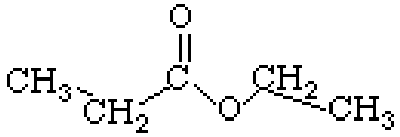
methyl salicylate
(winter-green)



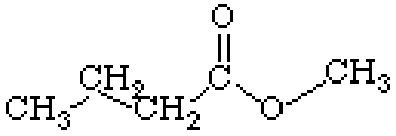
ethyl cinnamate (cinnamon)



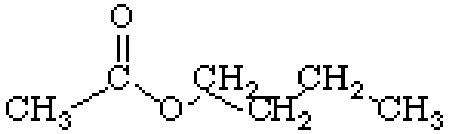
isoamyl acetate (banana)



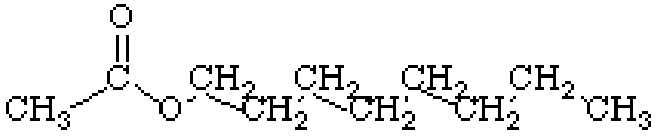
ethyl propionate (fruity)



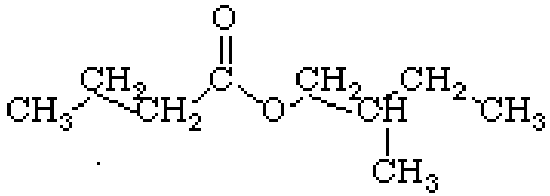
methyl butyrate
(pineapple)



n-butyl acetate (banana)

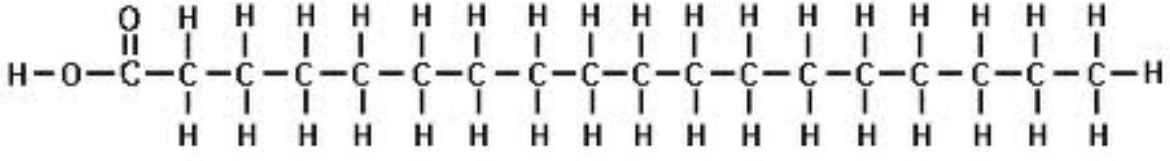


octyl acetate (orange-like)



isoamyl butyrate (pear)

Fatty carboxylic acids



Stearic Acid

Fatty carboxylic acids

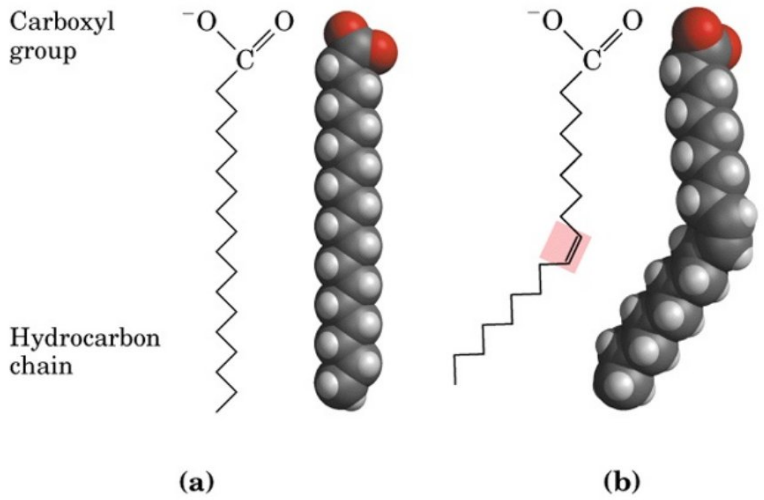
FATTY ACIDS

Saturated		
Formula	**Common Name**	**Melting Point**
$CH_3(CH_2)_{10}CO_2H$	lauric acid	45 °C
$CH_3(CH_2)_{12}CO_2H$	myristic acid	55 °C
$CH_3(CH_2)_{14}CO_2H$	palmitic acid	63 °C
$CH_3(CH_2)_{16}CO_2H$	stearic acid	69 °C
$CH_3(CH_2)_{18}CO_2H$	arachidic acid	76 °C

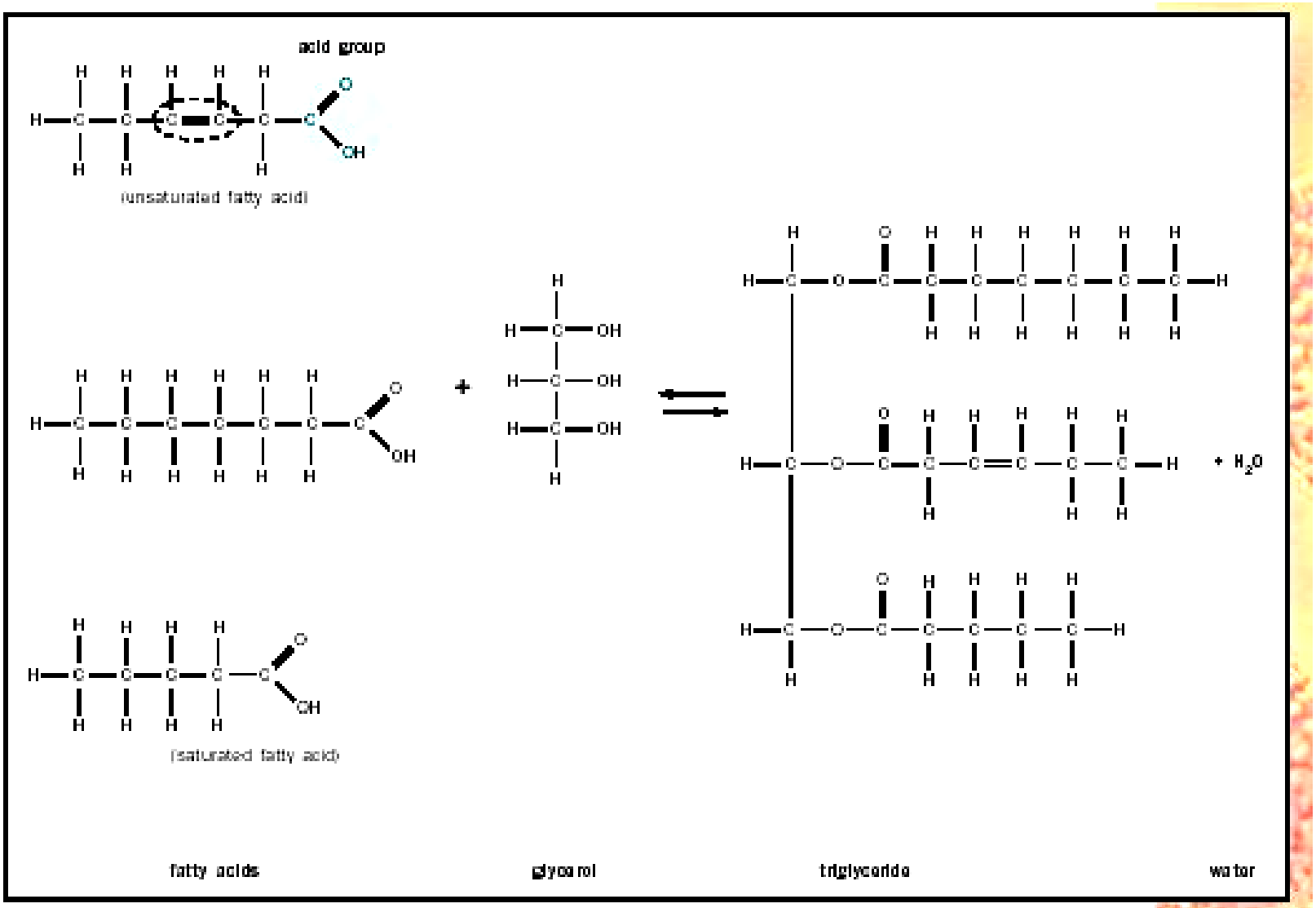
Unsaturated		
Formula	**Common Name**	**Melting Point**
$CH_3(CH_2)_5CH=CH(CH_2)_7CO_2H$	palmitoleic acid	0 °C
$CH_3(CH_2)_7CH=CH(CH_2)_7CO_2H$	oleic acid	13 °C
$CH_3(CH_2)_4CH=CHCH_2CH=CH(CH_2)_7CO_2H$	linoleic acid	-5 °C
$CH_3CH_2CH=CHCH_2CH=CHCH_2CH=CH(CH_2)_7CO_2H$	linolenic acid	-11 °C
$CH_3(CH_2)_4(CH=CHCH_2)_4(CH_2)_2CO_2H$	arachidonic acid	-49 °C

Fatty carboxylic acids

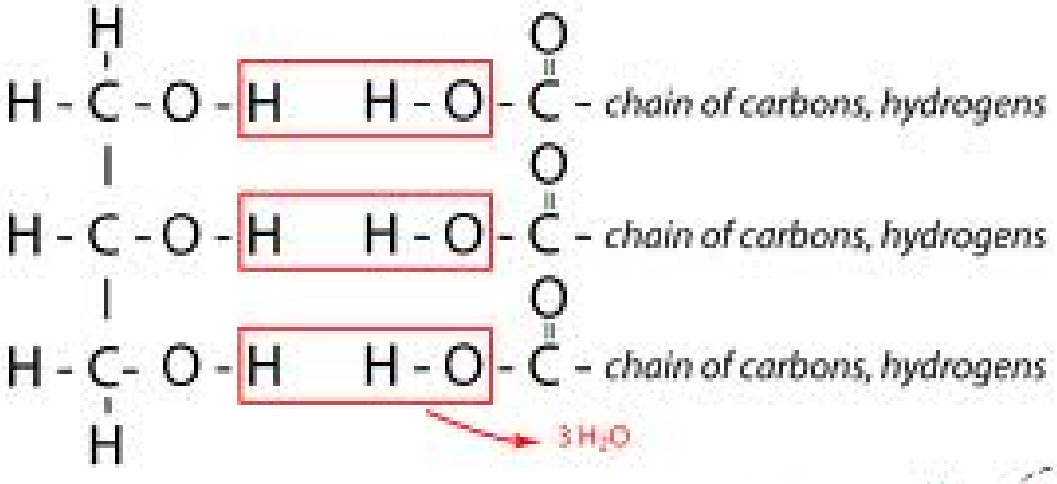
Fatty Acid Structure



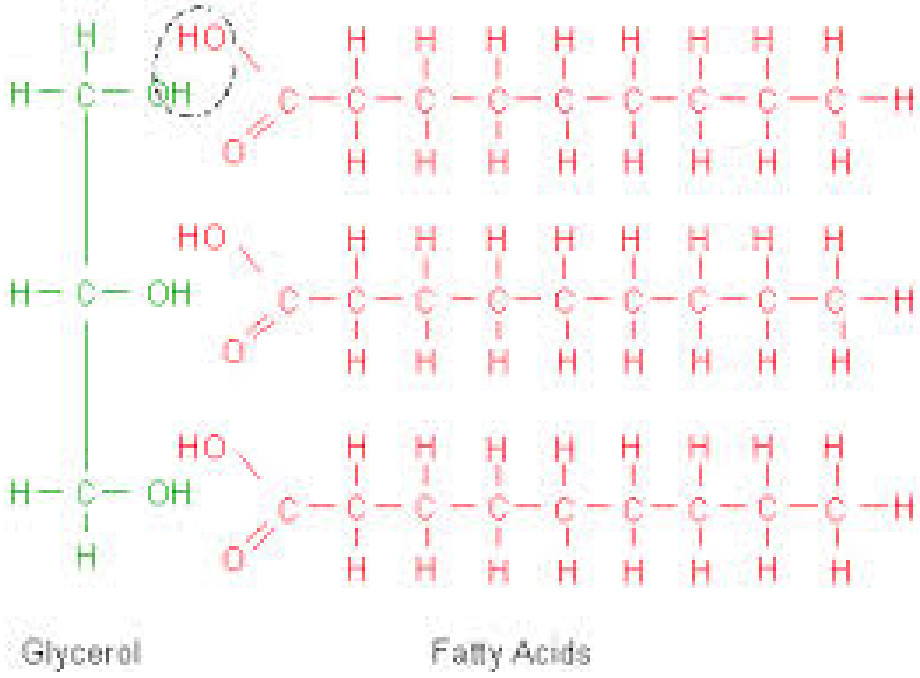
Reactions of esterification



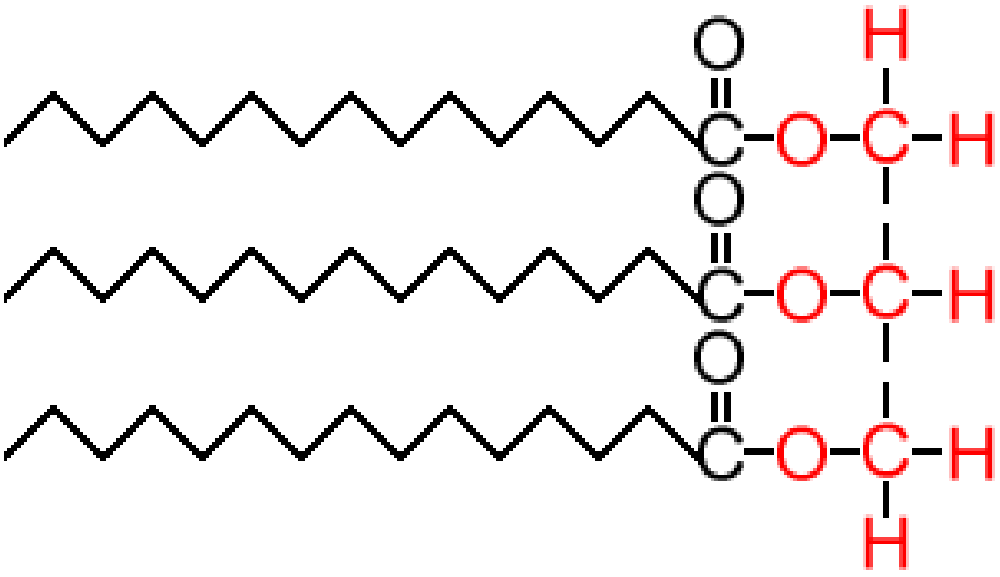
Reactions of esterification



glycerol **3 fatty acids**



Reactions of esterification



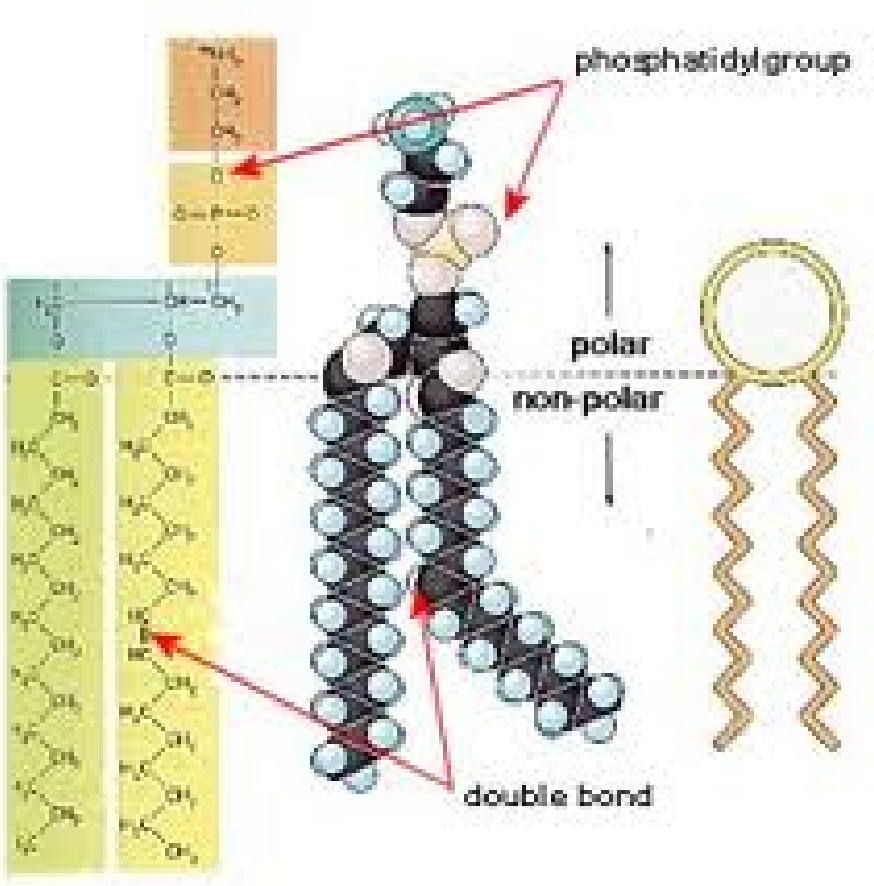
Physiological role of fats

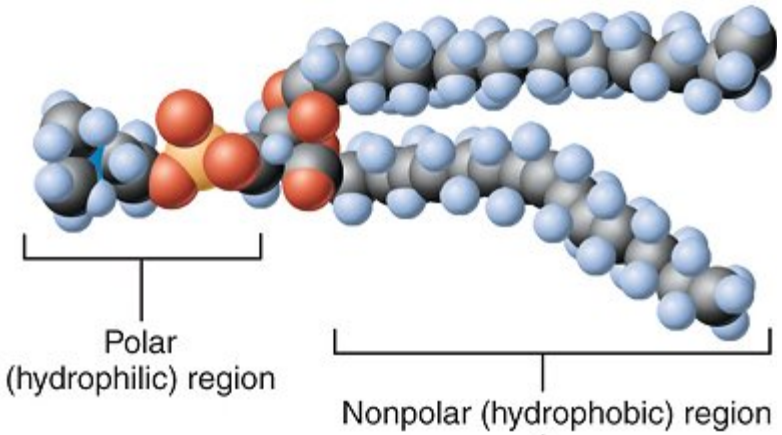
Vitamins A, D, E, and K are fat-soluble, meaning they can only be digested, absorbed, and transported in conjunction with fats. Fats are also sources of essential fatty acids, an important dietary requirement.

Fats play a vital role in maintaining healthy skin and hair, insulating body organs against shock, maintaining body temperature, and promoting healthy cell function.

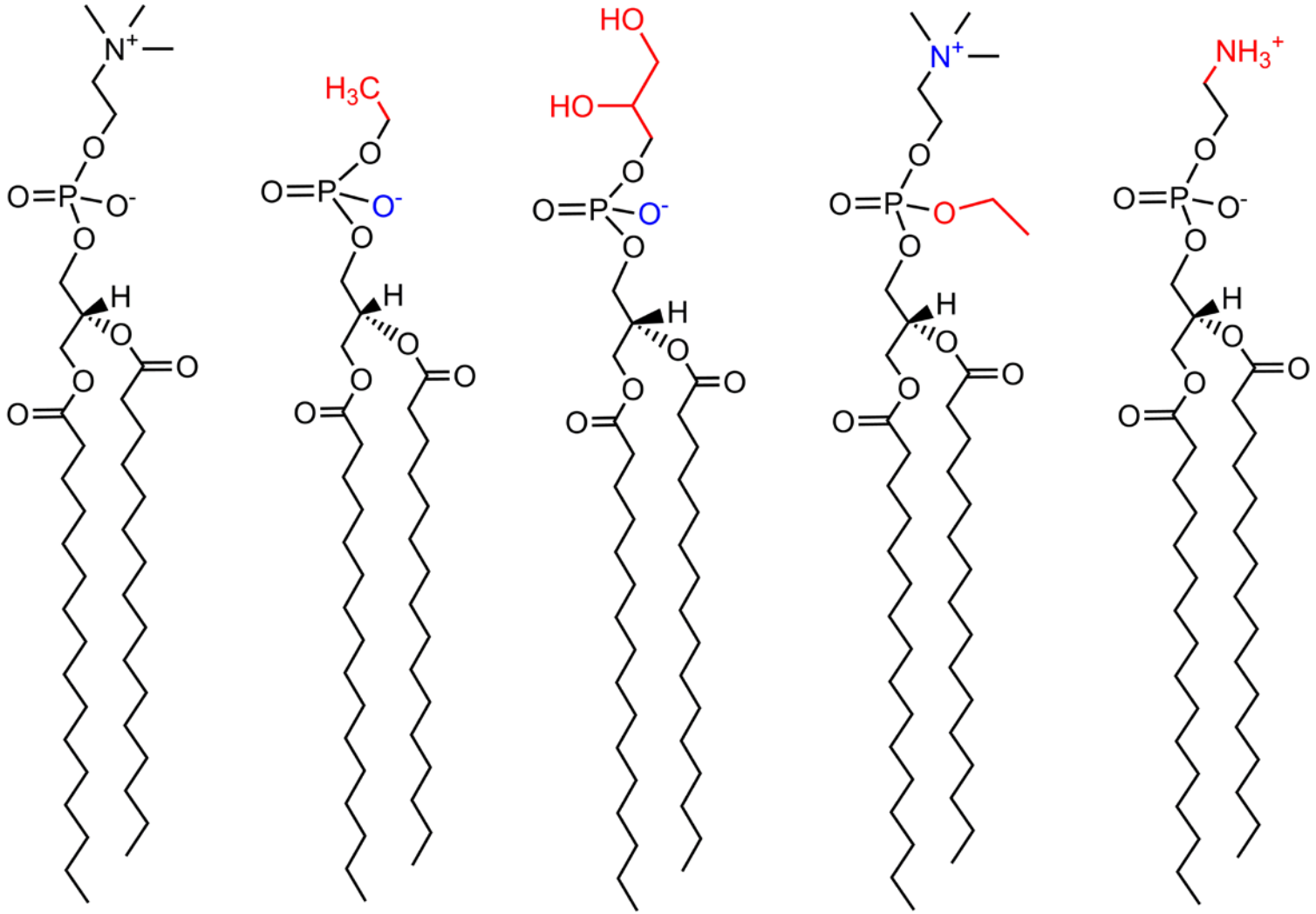
Fats also serve as energy stores for the body, containing about 37.8 kJ (9 cal) per gram of fat. They are broken down in the body to release glycerol and free fatty acids. The glycerol can be converted to glucose by the liver and thus used as a source of energy.

Lipids

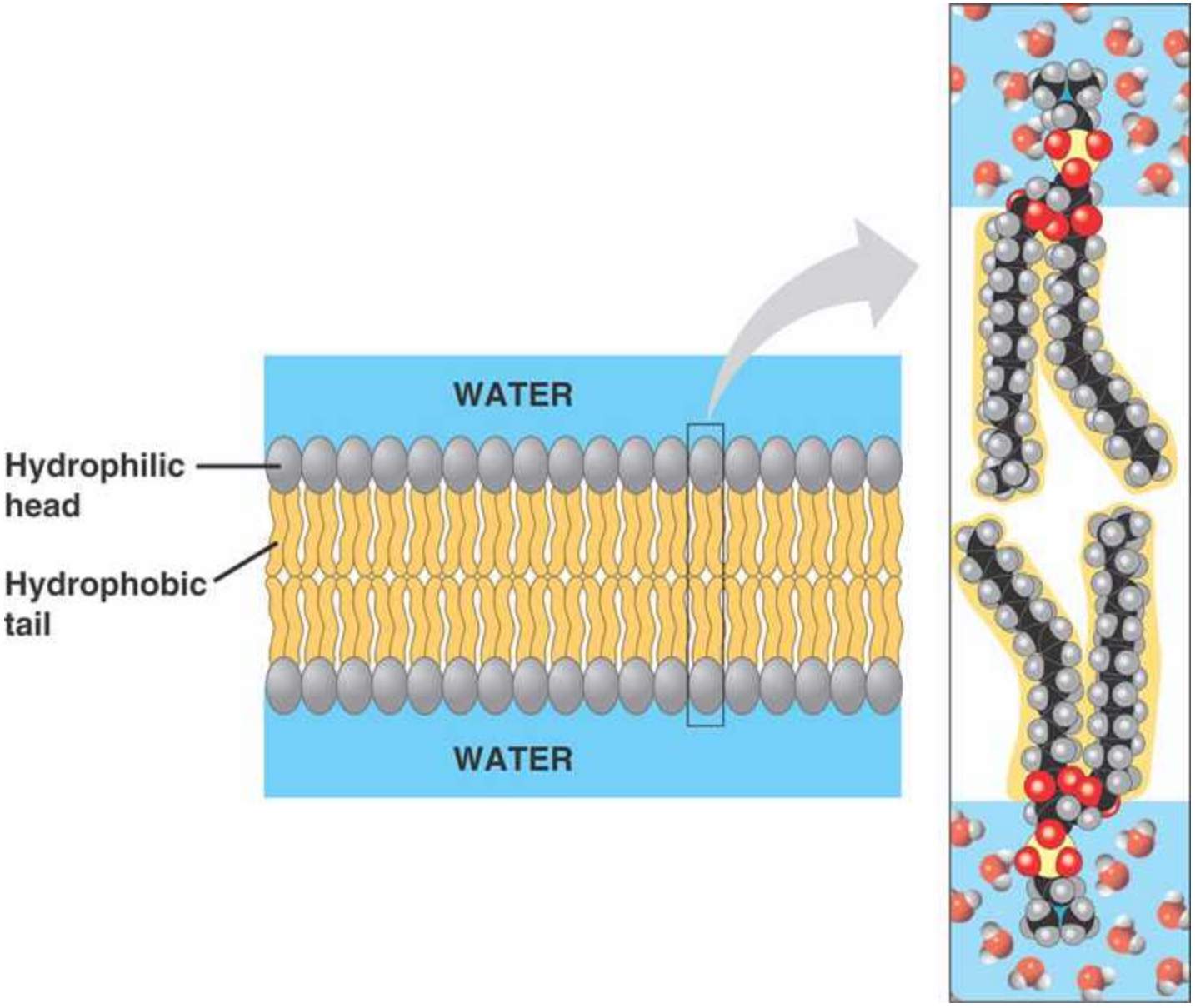

phosphatidyl group
polar
non-polar
double bond


Polar
(hydrophilic) region
Nonpolar (hydrophobic) region

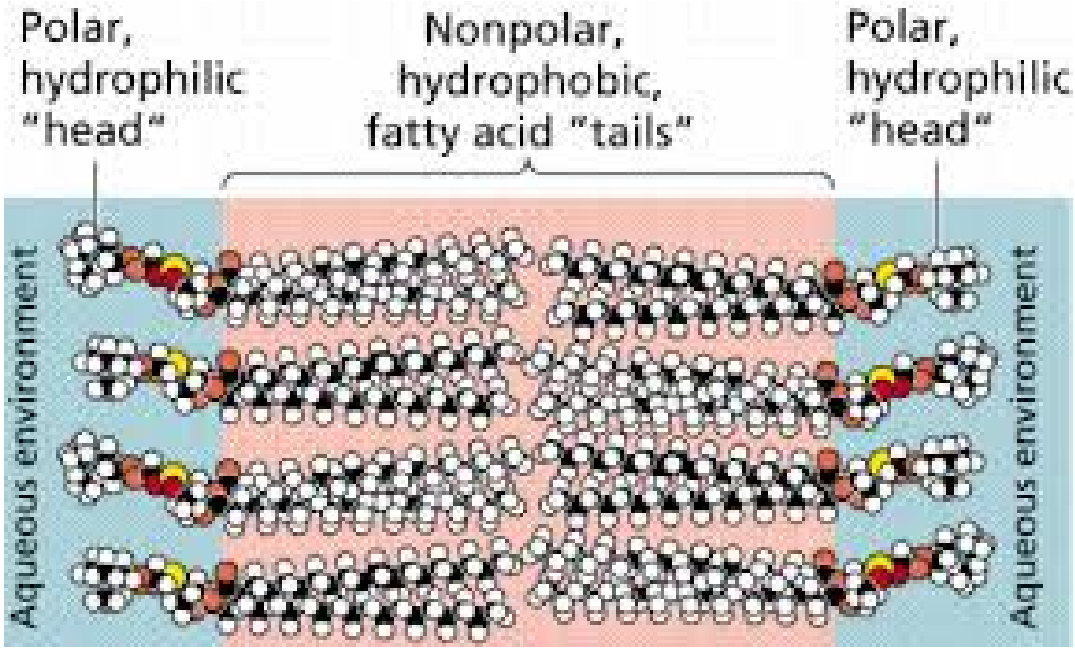
Phospholipids

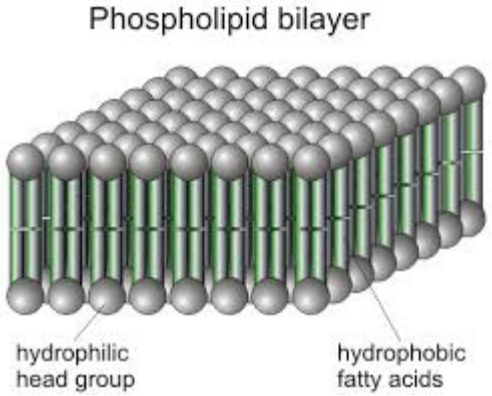


Lipids

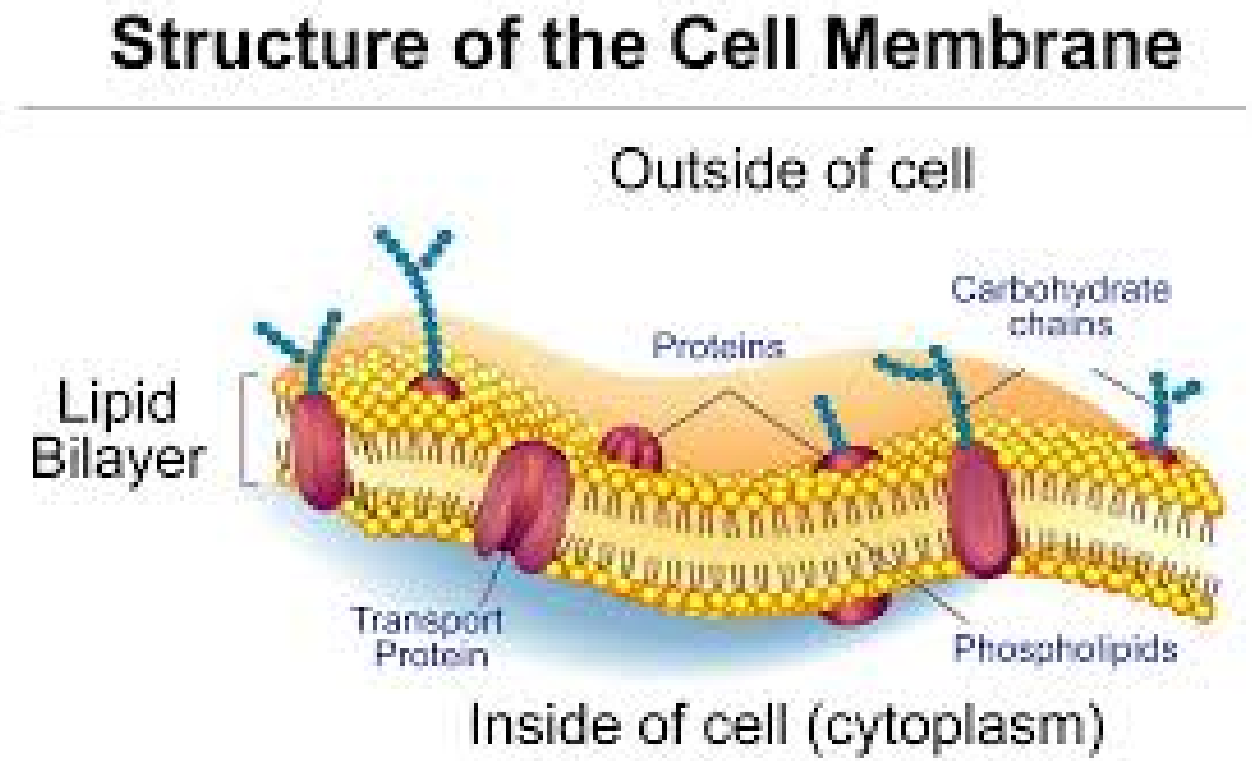


Lipid Bilayer

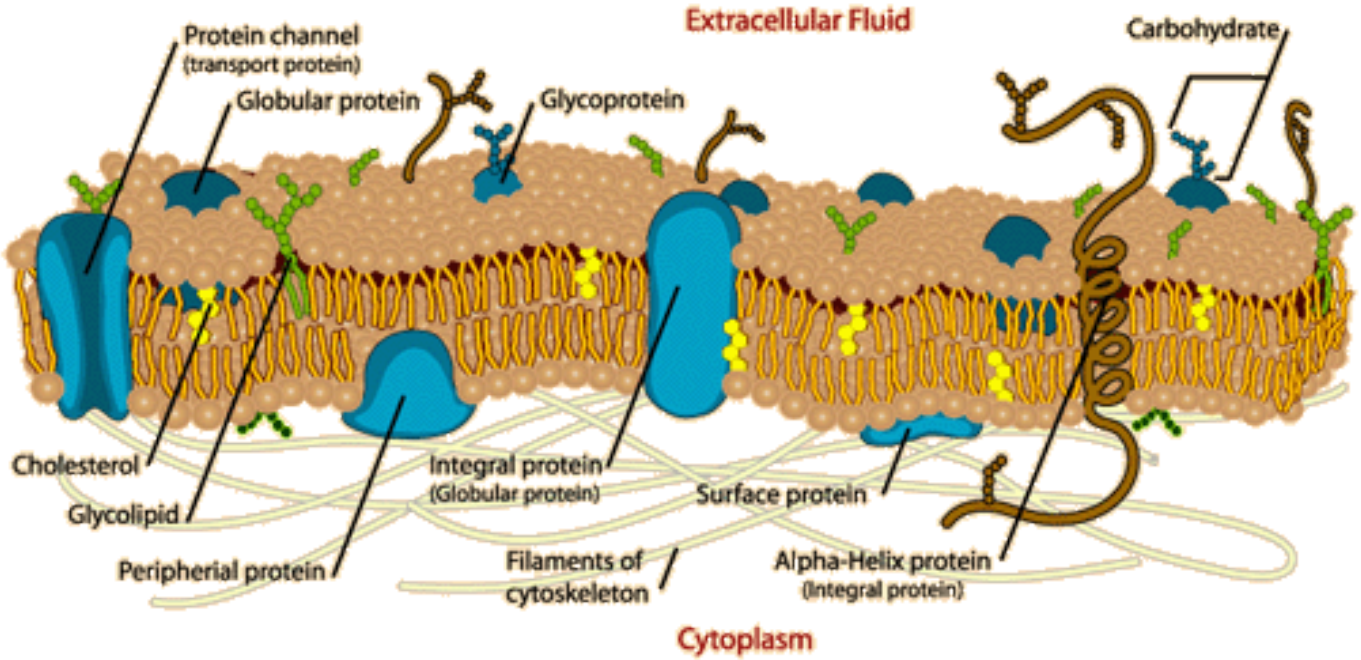




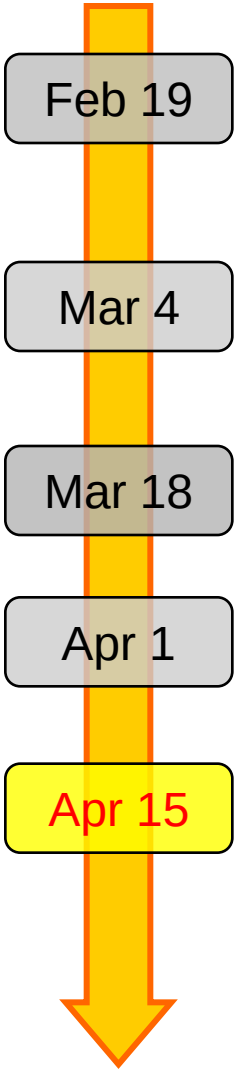
Cell Membrane



Cell Membrane



What shall we do next?



Feb 19	Introduction to organic and biological chemistry. Classes and nomenclature of organic compounds. Saturated and unsaturated hydrocarbons. S_R and Ad_E reactions.
Mar 4	Aromatic hydrocarbons. Orientation in the aromatic ring. Halogen derivatives of hydrocarbons. S_N reacions. Alcohols, ethers. Polyhydric alcohols.
Mar 18	Carbonyl compounds – aldehydes and ketones. Carbohydrates.
Apr 1	Carboxylic acids and their derivatives: amides, nitriles, anhydrides. Esters, fats, lipids.
Apr 15	Amines, aminoacids, peptides. Heterocyclic compounds and their biological activity.