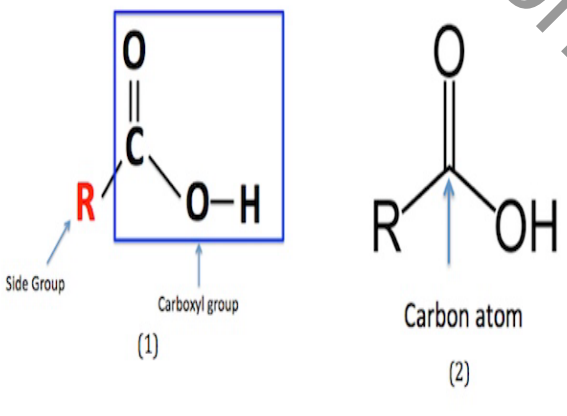
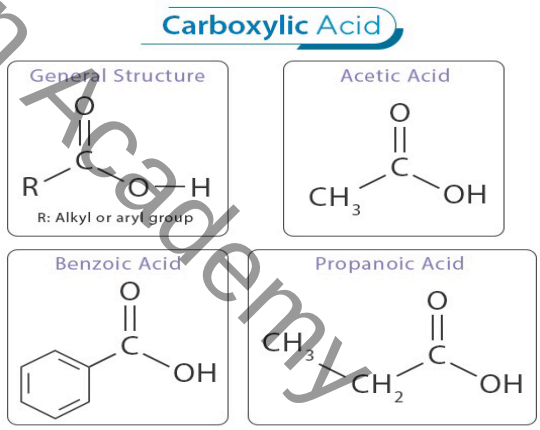
Carboxylic Acid

- **Carboxylic acids** are another **homologous series** of molecules.
- Carboxylic acids all contain the **carboxylic acid functional group**. This group is made up of a carbon atom that has a **double bond** to an **oxygen atom** and a **single bond** to an OHOH group.
- Due to the bonding present this functional group they will always be located at the **ends** of a hydrocarbon chain.

Molecular formulae of Carboxylic Acid:

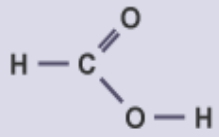
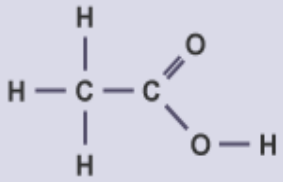
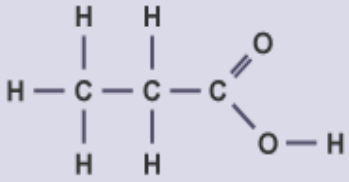
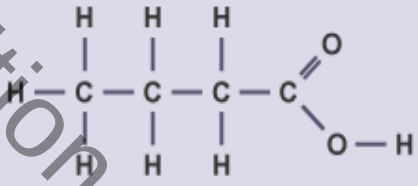
- Carboxylic acids consist of a carboxyl active group (-COOH) responsible for their distinctive properties and behavior.
- This functional group comprises a carbonyl group (C=O), where a carbon atom is double-bonded to an oxygen atom, and a hydroxyl group (OH), where an oxygen atom is bonded to a hydrogen atom, both of which are attached to the same carbon atom
- R is other group





Representation of Carboxylic Acid

Carboxylic acids follow the general pattern for **hydrocarbon molecules** in terms of their **nomenclature**. The first **four** acids in the series all have generic prefixes; **meth-**, **eth-**, **prop-**, and **but-**, with the rest having the **numerical prefixes**. Carboxylic acids are then give then suffix **-anoic acid**. For the molecule shown above, there are three carbon atoms in the chain so we use the prefix prop- and add the suffix -anoic acid, giving us the name **propanoic acid**.

Name	Formula	Structure (showing all the covalent bonds)
Methanoic acid	HCOOH	
Ethanoic acid	CH_3COOH	
Propanoic acid	C_2H_5COOH	
Butanoic acid	C_3H_7COOH	

Carboxylic Acid properties

➤ The carboxylic acids have the **typical properties of acids**. For example, they:

- dissolve in water to form acidic solutions with pH values less than 7
- react with metals to form a salt and hydrogen
- react with bases to form a salt and water
- react with carbonates to form a salt, water and carbon dioxide

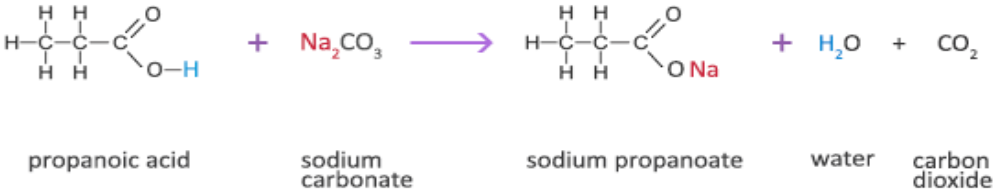
➤ These properties are due to the –COOH functional group.

Carboxylic Acid Reactions

1. Acid-Base Reaction

For example, propanoic acid will react with sodium carbonate to produce a sodium **salt** (sodium propanoate), **water**, and **carbon dioxide**:

Propanoic Acid+Sodium Carbonate → Sodium Propanoate+Water+Carbon Dioxide



2. Making esters

- Carboxylic acids can react with alcohols to make esters. Esters are organic compounds which all contain the functional group -COO-. Esters have fruity smells and can be used as solvents.
- The general equation for the formation of an ester is:

alcohol + carboxylic acid → ester + water

For example:

The Strength of Carboxylic Acids

- Carboxylic acids are typically **weak acids**. As such, solutions of weak acids tend to have a **higher** pH than those of ionic acids such as sulfuric or hydrochloric acid.

- The weakness of carboxylic acids is a result of the their behavior in solution. Unlike strong acids, carboxylic acids **do not** dissociate **completely** in solution. This means that only a **small proportion** of the acid molecules become ionised, producing a **low concentration** of H+ ions.

CH3 COOH(aq) ⇌CH3 COO(aq)− +H(aq)+