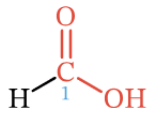
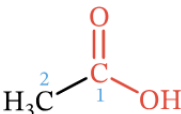
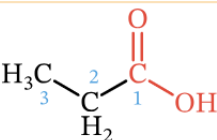
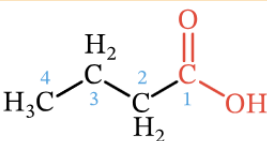
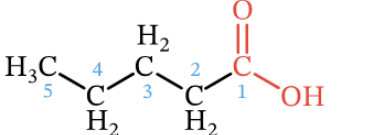
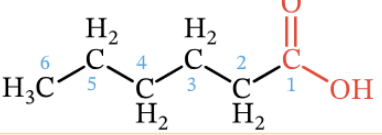
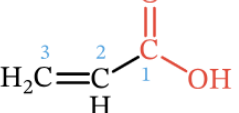
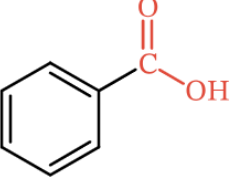


Lecture 6: Carboxylic acids

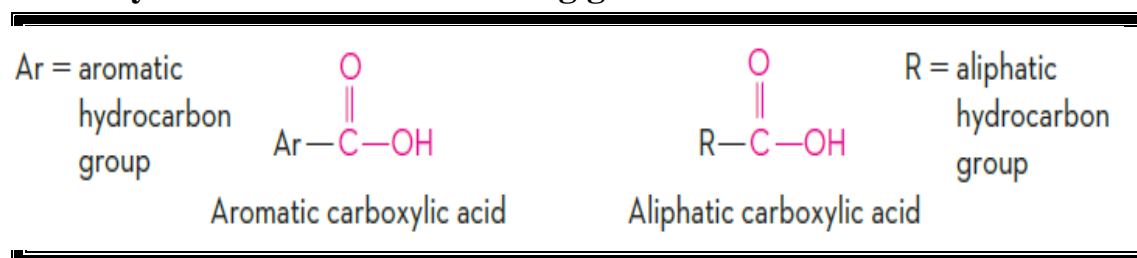
The functional group of the carboxylic acids is the carboxyl group (—COOH).

- Because the carboxyl group is extremely polar and carboxylic acids can form intermolecular hydrogen bonds with one another, they have higher boiling points and melting points than alcohols.
- The lower-molar-mass carboxylic acids are water-soluble and tend to taste sour and have unpleasant aromas.
- The longer-chain carboxylic acids are called fatty acids.
- In the IUPAC Nomenclature System, carboxylic acids are named by replacing the -e ending of the parent compound with -oic acid. When naming dicarboxylic acids, the -e is retained and the suffix -dioic is added. Often, common names are derived from the source of the carboxylic acid.

Molecular Structure	Common Name	IUPAC Name	Molecular Formula
	Formic acid	Methanoic acid	HCOOH
	Acetic acid	Ethanoic acid	CH ₃ COOH
	Propionic acid	Propanoic acid	CH ₃ CH ₂ COOH
	Butyric acid	Butanoic acid	CH ₃ CH ₂ CH ₂ COOH

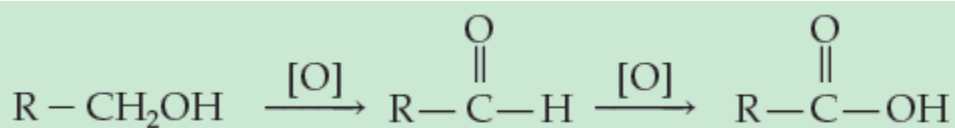
	Valeric acid	Pentanoic acid	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
	Caproic acid	Hexanoic acid	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
	Acrylic acid	Propenoic acid	$\text{C}_2\text{H}_3\text{COOH}$
	Benzoic acid	Benzenecarboxylic acid	$\text{C}_6\text{H}_5\text{COOH}$

Carboxylic acids have the following general structure:



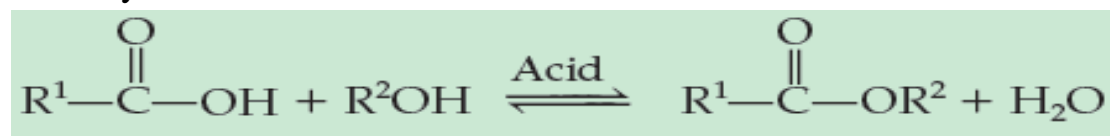
Preparation of Carboxylic Acids

Simple carboxylic acids can be made by **oxidation** of the appropriate primary alcohol or aldehyde.



Esterification

Carboxylic acids react with alcohols to form esters and water



- Carboxylic acids are weak acids and are neutralized by strong bases to form salts. Soaps are salts of long-chain carboxylic acids (fatty acids)

Carboxylic Acids Derivatives

Group replacing - OH	Name	Structure	Example
-Cl	Acid chloride	$\text{R} - \overset{\text{O}}{\parallel} - \text{C} - \text{Cl}$	$\text{CH}_3 - \overset{\text{O}}{\parallel} - \text{C} - \text{Cl}$ Acetyl chloride
-NH ₂	Acid amide	$\text{R} - \overset{\text{O}}{\parallel} - \text{C} - \text{NH}_2$	$\text{CH}_3 - \overset{\text{O}}{\parallel} - \text{C} - \text{NH}_2$ Acetamide
-OR'	ester	$\text{R} - \overset{\text{O}}{\parallel} - \text{C} - \text{OR}'$	$\text{CH}_3 - \overset{\text{O}}{\parallel} - \text{C} - \text{OCH}_3$ Methyl acetate
-OOCR	Acid anhydride	$\text{R} - \overset{\text{O}}{\parallel} - \text{C} - \text{O} - \overset{\text{O}}{\parallel} - \text{C} - \text{R}$	$\text{CH}_3 - \overset{\text{O}}{\parallel} - \text{C} - \text{O} - \overset{\text{O}}{\parallel} - \text{C} - \text{R}$ Acetic anhydride

Some Important Carboxylic Acids

- Many carboxylic acids occur in nature. **Ethanoic** (acetic) acid provides the acidic zip to vinegars. **Propanoic** (propionic) acid is the product of bacterial fermentation of milk products.
- Fatty acids are **long-chain monocarboxylic acids** and can be isolated from a variety of sources including palm oil, coconut oil, butter, milk, lard, and animal fat.
- Human kidney stones are often formed from the calcium salt of **oxalic acid**.
- **Salicylic acid** is used as a disinfectant, Acetylsalicylic acid is aspirin association as a preventive measure against heart attacks and strokes caused by blood clots.
- The hormone ghrelin, produced in the stomach, is sometimes called the “hunger hormone” because it stimulates the hypothalamus of the brain to signal that the body is hungry. However, the hormone alone does not

have this effect. Ghrelin must be covalently bonded to a molecule of **octanoic acid** in order to have the hunger-stimulating effect on the hypothalamus.

- **Metabolic carboxylic acid**

Carboxylic Acid	Pathway / Role	Clinical Relevance
Pyruvate (α -keto acid)	Glycolysis \rightarrow TCA cycle	\uparrow in pyruvate dehydrogenase deficiency, lactic acidosis
Lactic acid	Anaerobic glycolysis	\uparrow in shock, sepsis, hypoxia
Acetoacetic acid & β -Hydroxybutyric acid	Ketone bodies	\uparrow in diabetic ketoacidosis, starvation
Citrate, α -Ketoglutarate, Succinic acid, Malate, Oxaloacetate	TCA cycle intermediates	\downarrow in mitochondrial disorders
Formic acid	Methanol metabolism	Toxic metabolite \rightarrow metabolic acidosis

Clinical case: Lactic acidosis

