

Topic 10.1: Organic chemistry – Fundamentals of organic chemistry

Organic chemistry focuses on the chemistry of compounds containing carbon.

• **Understanding:** A homologous series is a series of compounds of the same family, with the same general formula, which differ from each other by a common structural unit.

- **Homologous series:** series of compound of the same family, with the same general formula, which differ by a common structural unit
 - Common structural unit: often CH_2 (methylene) group
 - Same family: has the same functional group
 - Properties: homologous series has similar physical and chemical properties

• **Understanding:** Structural formulas can be represented in full and condensed format.

	Full structural formula	Condensed structural formula	Skeletal structural formula
Example		$\text{CH}_3\text{—CH}_2\text{—CH}_2\text{—CH}_3$ $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$	
Description	Two-dimensional representation showing all atoms, their relative positions and bonds	Two-dimensional representation showing all atoms and their relative position	Two dimensional representation of a compound where each vertex and end of line represent a carbon atom, and functional group is added

• **Understanding:** Structural isomers are compounds with the same molecular formula but different arrangements of atoms.

- **Structural isomers:** compounds with same molecular formula with different arrangement of atoms
 - Properties: structural isomers have different chemical and physical properties (melting point, boiling point etc.)

• **Understanding:** Functional groups are the reactive parts of molecules.

- **Functional groups:** reactive parts of a molecule that is responsible for the molecule's chemical property
 - Naming: the position of the function group is identified by the number of carbon to which it is attached

• **Understanding:** Saturated compounds contain single bonds only and unsaturated compounds contain double or triple bonds.

- **Saturated compounds:** organic compounds in which all the carbon-carbon bonds are single (e.g., *alkanes*)
- **Unsaturated compounds:** organic compound in which there is at least one carbon-carbon bond that is double or triple (e.g., *alkenes*)

• **Understanding:** Benzene is an aromatic, unsaturated hydrocarbon.

- **Aliphatic:** characterized by a straight, branched or cyclic structure
- **Aromatic:** characterized by presence of benzene ring
- **Benzene:** aromatic, unsaturated hydrocarbon in which six carbons bonds into a ring
 - **Sigma (σ) bond in benzene:** benzene contains six sp^2 hybridized carbon atoms bond to one other by sigma bonds
 - **Pi (π) bond in benzene:** p-orbitals in carbon overlap to form a continuous π bond above and below the plane of carbons

• **Applications and skills:** Explanation of the trends in boiling points of members of a homologous series.

Name	Formula	Structural formula (condensed)	Boiling point ($^{\circ}\text{C}$)
Methane	CH_4	CH_4	-161
Ethane	C_2H_6	CH_3CH_3	-89
Propane	C_3H_8	$\text{CH}_3\text{CH}_2\text{CH}_3$	-42
Butane	C_4H_{10}	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$	-0.5
Pentane	C_5H_{12}	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	36
Hexane	C_6H_{14}	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	69

- Trend in boiling points: boiling points increases as the carbon chain increases by a common structural unit
 - Trends arise from increasing intermolecular (dispersion forces) with increased chain lengths

• **Applications and skills:** Distinction between empirical, molecular and structural formulas.

- **Empirical formula:** simplest ratio of atoms (of an element) in a molecule
- **Molecular formula:** actual number of atoms (of each element) in a molecule
- **Structural formula:** representation of the type of atom and their position relative to one other

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Wenbin Ji

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