

Homologous Series

The Structural Blueprint of Organic Families

Discover how organic compounds are organized into logical, predictable families based on shared functional groups and mathematical progressions.

Exam Focus: Section 8.4.2

The 3 Pillars of a Homologous Series

A homologous series is a family of organic compounds that share a common structure. Every valid series must satisfy these three absolute conditions:



Same Functional Group

Members share the exact same reactive center (e.g., -OH or -COOH), which dictates their characteristic chemical properties.



General Formula

The entire family can be represented by a single mathematical formula (e.g., Alkanes are defined by $\text{C}_n\text{H}_{2n+2}$).

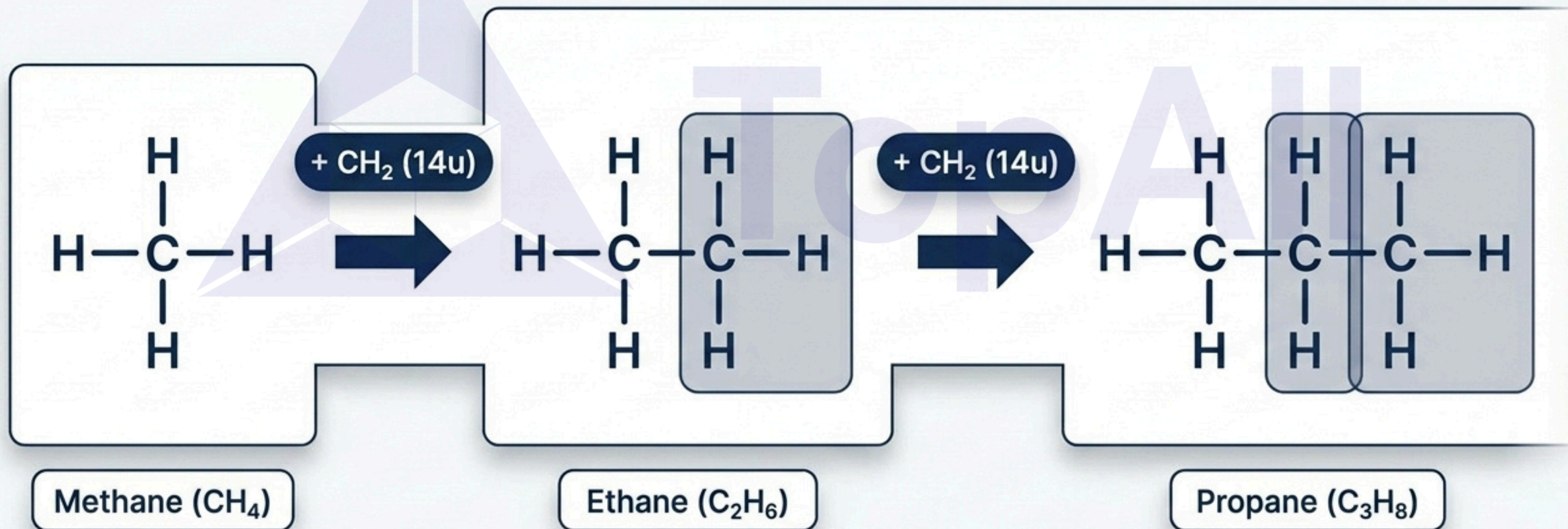


Successive -CH_2 Difference

Each consecutive member in the series increases by exactly one carbon and two hydrogens (14 atomic mass units).

The Successive Addition of $-\text{CH}_2$

Notice how the core structure remains intact while the carbon chain simply elongates by one methylene unit ($-\text{CH}_2$) per step.





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Hydrocarbons & Halogens

The foundational series built on carbon-carbon bonds and simple halogen substitutions.

Family	Functional Group	General Formula	Successive Examples
Alkanes	Single Bond	C_nH_{2n+2}	CH_4, C_2H_6, C_3H_8
Alkenes	Double Bond ($>C=C<$)	C_nH_{2n}	C_2H_4, C_3H_6, C_4H_8
Alkynes	Triple Bond ($-C\equiv C-$)	C_nH_{2n-2}	C_2H_2, C_3H_4, C_4H_6
Haloalkanes	Halogen ($-X$)	$C_nH_{2n+1}X$	$CH_3Cl, C_2H_5Cl, C_3H_7Cl$

Oxygen & Nitrogen Based Families

Series defined by the presence of oxygen or nitrogen heteroatoms, which fundamentally alter their chemical behavior.

Family	Functional Group	General Formula	Successive Examples
Alkanols (Alcohols)	Hydroxyl ($-\text{OH}$)	$\text{C}_n\text{H}_{2n+1}\text{OH}$	CH_3OH , $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_3\text{H}_7\text{OH}$
Alkanals (Aldehydes)	Formyl ($-\text{CHO}$)	$\text{C}_n\text{H}_{2n+1}\text{CHO}$	HCHO , CH_3CHO , $\text{C}_2\text{H}_5\text{CHO}$
Alkanones (Ketones)	Carbonyl ($>\text{C}=\text{O}$)	$\text{C}_n\text{H}_{2n}\text{O}$	CH_3COCH_3 , $\text{CH}_3\text{COC}_2\text{H}_5$
Alkanoic Acids	Carboxyl ($-\text{COOH}$)	$\text{C}_n\text{H}_{2n+1}\text{COOH}$	HCOOH , CH_3COOH , $\text{C}_2\text{H}_5\text{COOH}$
Amines	Amino ($-\text{NH}_2$)	$\text{C}_n\text{H}_{2n+1}\text{NH}_2$	CH_3NH_2 , $\text{C}_2\text{H}_5\text{NH}_2$, $\text{C}_3\text{H}_7\text{NH}_2$

Essential Takeaways

Mastering homologous series provides the foundational logic for predicting organic behavior without memorizing every individual molecule.



Predictable Chemistry

Because members share the same functional group, they exhibit virtually identical chemical properties and reactions.



Gradual Physical Shifts

As the molecular mass increases by successive -CH_2 units, physical properties (like boiling point and solubility) change in a smooth, predictable gradation.



Nomenclature Logic

Knowing the general formula and functional group prefix/suffix allows you to accurately name any molecule in the series instantly.



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