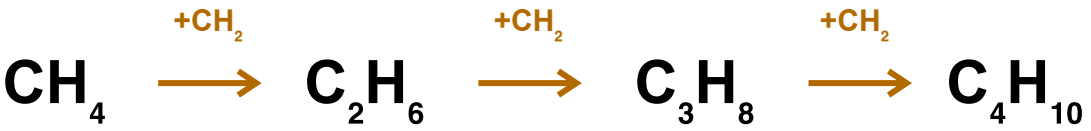
▶ Video explanation (YouTube Short)

Homologous Series

Methane, ethane, propane and butane look like four separate compounds. Line them up and a pattern appears: each one is the previous one plus a single CH_2 unit.



each step: one C and two H more, molar mass +14 u

1. Definition

A **homologous series** is a series of organic compounds in which all members have

- the **same functional group** (for the alkanes: only C–C and C–H single bonds),
- the **same general formula**, and
- successive members differing by a **–CH_2–** unit, that is, by **14 u** in molar mass.

Each member is called a **homologue**.

2. Three common series

Series	General formula	First three members
Alkanes	C_nH_{2n+2}	CH_4, C_2H_6, C_3H_8
Alcohols	$C_nH_{2n+1}OH$	CH_3OH, C_2H_5OH, C_3H_7OH
Carboxylic acids	$C_nH_{2n+1}COOH$ (n = 0, 1, 2 …)	HCOOH, CH_3COOH, C_2H_5COOH

3. Properties: similar chemistry, gradual physical change

Alkane	Formula	Molar mass (u)	Boiling point (°C, 1 atm)
Methane	CH_4	16	−161.5
Ethane	C_2H_6	30	−88.6
Propane	C_3H_8	44	−42.1
Butane	C_4H_{10}	58	−0.5
Pentane	C_5H_{12}	72	36.1

- **Chemical properties are similar** (not identical): all alkanes burn to CO_2 and H_2O, and all undergo substitution with chlorine in light.
- **Physical properties change gradually**: as the chain grows, the boiling point rises, because larger molecules attract one another more strongly.

Solved example

Q. Write the next two members after C_3H_7OH, and find the molar mass difference between C_3H_7OH and the second of them.
A. Add CH_2 each time: C_4H_9OH, then $C_5H_{11}OH$. They are 2 CH_2 apart, so the difference is 2 × 14 = 28 u (60 u → 88 u).

Key takeaways

- One family, one pattern: each next member = previous + CH_2 (14 u).
- Same functional group, same general formula.
- Similar chemical properties; physical properties change gradually.

Practice questions

1. (MCQ) Successive members of a homologous series differ by (a) CH (b) CH_2 (c) CH_3 (d) C_2H_4
2. (MCQ) Which is not an alkane? (a) C_3H_8 (b) C_5H_{12} (c) C_4H_8 (d) C_6H_{14}
3. (Very short) Define a homologous series.
4. (Very short) Write the general formula of the alkanes.
5. (Short) Are CH_4 and C_2H_4 members of the same homologous series? Give a reason.
6. (Short) Why do members of a homologous series have similar chemical properties?
7. (Application) Which has the higher boiling point, propane or pentane? Explain.
8. (Numerical) Find the molar mass of the sixth member of the alkane series (C = 12, H = 1).

Answer key

1. (b) $–CH_2–$.
2. (c) C_4H_8 does not fit C_nH_{2n+2} (it would need 10 H).
3. A series of organic compounds with the same functional group and general formula, in which successive members differ by $–CH_2–$.
4. C_nH_{2n+2}.
5. No. C_2H_4 is an alkene (C_nH_{2n}, with a C=C bond); the two differ by one C, not by CH_2.
6. They have the same functional group, which decides how they react.
7. Pentane (36.1 °C against −42.1 °C): its longer chain gives stronger attractions between molecules.
8. C_6H_{14}: 6 × 12 + 14 × 1 = 86 u.

▶ Watch the video explanation