▶ Video explanation (YouTube Short)

Functional Groups

Two molecules can have exactly the same carbon chain and still react very differently. The difference is one small part of the molecule: its functional group.

Carbon chain = body **Functional group = identity**

$CH_3CH_2–OH$ alcohol

$CH_3CH_2–COOH$ carboxylic acid

1. Definition

A **functional group** is an atom or a group of atoms, joined in a specific way, that largely decides the characteristic chemical properties and reactions of an organic compound.

- It can be **one atom** (for example –Cl) or a **group of atoms** (for example –COOH).
- Compounds with the same functional group react in similar ways, so they form a **family**.
- "Largely": the group decides chemical behaviour, but chain length still changes physical properties such as boiling point.

2. Five important functional groups

The chain is kept as $CH_3CH_2–$ in every example. The carbon of –CHO and –COOH is counted as part of the group.

Group	Family	Example	Name
–OH	Alcohol	$CH_3CH_2–OH$	Ethanol
–CHO	Aldehyde	$CH_3CH_2–CHO$	Propanal
>C=O (between two carbons)	Ketone	$CH_3CH_2–CO–CH_3$	Butanone
–COOH	Carboxylic acid	$CH_3CH_2–COOH$	Propanoic acid
$–NH_2$	Amine (primary)	$CH_3CH_2–NH_2$	Ethanamine

Careful: an aldehyde and a ketone both contain C=O (the carbonyl group). In an aldehyde it is at the end of the chain with an H on it (–CHO). In a ketone it sits between two carbon atoms.

3. Same chain, different chemistry

Test	$CH_3CH_2–OH$ (ethanol)	$CH_3CH_2–COOH$ (propanoic acid)
$NaHCO_3$ solution	No fizz	Fizzes: CO_2 is given off

Blue litmus	No change	Turns red

The chain is the same, so the difference comes from the functional group.

Solved example

Q. Name the functional group and family of (a) CH_3CHO (b) CH_3COCH_3 (c) CH_3COOH (d) CH_3NH_2.
A. (a) –CHO, aldehyde (ethanal). (b) C=O between two carbons, ketone (propanone). (c) –COOH, carboxylic acid (ethanoic acid). (d) $–NH_2$, amine (methanamine).

Key takeaways

- Carbon chain = body; functional group = chemical identity.
- –OH alcohol · –CHO aldehyde · C=O mid-chain ketone · –COOH carboxylic acid · $–NH_2$ amine.
- Learn the groups, and you know how whole families behave.

Practice questions

1. (MCQ) Which family does $CH_3CH_2CH_2–OH$ belong to? (a) aldehyde (b) alcohol (c) ketone (d) amine
2. (MCQ) Which compound gives CO_2 with $NaHCO_3$? (a) ethanol (b) propanone (c) ethanoic acid (d) ethanamine
3. (Very short) Define a functional group.
4. (Very short) Write the functional group of a carboxylic acid.
5. (Short) Both ethanal and propanone contain C=O. Why are they in different families?
6. (Short) Ethanol and propan-1-ol have the same functional group. Give one way they are alike and one way they differ.
7. (Application) A compound $C_2H_5–X$ turns red litmus blue. Which group is X?
8. (Numerical) How many carbon atoms are there in $CH_3CH_2–CO–CH_3$, and how many of them are in the chain on either side of C=O?

Answer key

1. (b) It carries –OH.
2. (c) Carboxylic acids are acidic enough to release CO_2.
3. An atom or group of atoms that largely decides a compound's characteristic chemical properties and reactions.
4. –COOH.
5. In ethanal, C=O is at the chain end with an H (–CHO, aldehyde). In propanone, C=O is between two carbons (ketone).
6. Alike: similar chemical reactions, since both have –OH. Differ: propan-1-ol has a longer chain and a higher boiling point (about 97 °C against 78 °C).
7. $–NH_2$ (an amine): amines are basic.
8. 4 carbons in all: the C of C=O, 2 on one side ($CH_3CH_2–$) and 1 on the other ($–CH_3$).

▶ Watch the video explanation