Homologous series: patterns and functional groups

Student activity • observation and reasoning

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The question

Which similarities identify a homologous series?

Sort written structures by functional group and use neighbouring members to explain the CH_2 increment. Distinguish chemical similarity from gradual physical-property change.

Equipment

• Booklet, pencil and optional molecular model kits; no reagents

No chemicals are used. Keep model components away from mouths.

Course coverage: Shared core: 4.3. Oxygen-containing functional groups are labelled extension recognition; their Chemistry-only reactions are not assessed here.

Plan, model or apparatus sketch

Draw and label the model or apparatus that explains the central idea of this lesson.

Method and reasoning

Read the whole sequence before starting

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1. List methane, ethane, propane and butane with their formulae. Identify the increment between consecutive members.

2. Use C_nH_{2n+2} to predict pentane and hexane and check carbon valencies with models or displayed formulae.

3. Compare ethene and propene: identify a C=C functional group and describe how it changes the classification from saturated to unsaturated.

4. Sort supplied written structures CH_3CH_3, $CH_2=CH_2$, CH_3CH_2OH and CH_3COOH. Label the last two as extension recognition examples, not hydrocarbon members.

5. Explain why similar chemical reactions do not mean identical boiling points. Suggest why physical properties can change gradually along a series.

6. Audit the statement that any compound with formula C_nH_{2n} must be an alkene. State the open-chain one-double-bond restriction used at this level.

Cleanup

- Return models and retain the corrected classification table.

Record your evidence

Blank spaces are for your own work

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Reference and task data

For the series studied here, successive members differ by CH_2 and share a general formula and similar chemical reactions. Acyclic alkanes: C_nH_{2n+2}. Acyclic alkenes with one double bond: C_nH_{2n} ($n \geq 2$). Functional-group recognition extension: alcohol –OH attached to carbon; carboxylic acid –COOH. The acid OH is part of –COOH, not an alcohol group.

Example / series	Functional feature	Formula / reasoning
Alkanes		
Alkenes		
Extension: alcohol		
Extension: carboxylic acid		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. State three features of a homologous series.

2. Give pentane and hexane molecular formulae.

3. Identify the alkene functional group and explain unsaturation.

4. Why is ethanol not a hydrocarbon?

5. Explain why boiling points need not be identical within one series.

6. Why is C_nH_{2n} alone insufficient to prove an alkene structure?