Organic molecules: five ways to represent them

Student activity • observation and reasoning

YEAR 10 / LESSON 67 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

How can different formulae describe the same molecule?

Build carbon/hydrogen models and compare molecular, empirical, structural, displayed and general formulae. Count bonds as well as atoms.

Equipment

• Booklet, pencil and molecular model kit per pair; no chemical samples

Keep small model pieces away from mouths; use links gently and keep the desk clear.

Course coverage: Shared core: 4.1–4.2. Alcohol examples are identification contrasts, not Chemistry-only reaction requirements.

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. Sort written examples CH_4, C_2H_6, C_2H_4, C_2H_5OH and CO_2 by whether they contain only carbon and hydrogen. Explain each exclusion.

2. Build ethane with two carbon atoms and sufficient hydrogen for four bonds at each carbon. Count the atoms and draw every bond.

3. Record molecular C_2H_6, simplest whole-number ratio CH_3 and structural $CH_3–CH_3$. Explain why CH_3 does not describe an ethane molecule by itself.

4. Build ethene with one C=C double bond. Count each carbon bond order to four, then compare molecular and empirical formulae with ethane.

5. Build propane and infer the general formula C_nH_{2n+2} for acyclic saturated hydrocarbons. State that a general formula describes a series, not one identified compound.

6. Swap displayed drawings with a partner. Check every atom, every C–H bond and each carbon valency; correct without changing the intended molecular formula.

Cleanup

- Count and return all model pieces and keep corrected drawings.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Carbon normally forms four covalent bonds and hydrogen one in these models. Molecular formula gives actual atom numbers; empirical formula gives the simplest integer ratio; displayed formula shows every bond. A condensed structural formula can group hydrogens. C_nH_{2n+2} applies here to acyclic saturated hydrocarbons.

Molecule	Molecular / empirical	Structural / displayed check
Ethane		
Ethene		
Propane		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Which of CH_4, C_2H_6, C_2H_4, C_2H_5OH and CO_2 are hydrocarbons?

2. Give molecular and empirical formulae of ethane.

3. Draw a displayed ethene molecule showing every C–H bond.

4. Give the empirical formula of propane and explain your choice.

5. What does a displayed formula show that a molecular formula does not?

6. Use the alkane general formula to predict the molecular formula for five carbons.