# Simple covalent molecules

Student activity • desk activity

YEAR 10 / LESSON 23 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

## The question

**When a molecular substance boils, which attractions are overcome?**

Compare attractions inside a molecule with those between molecules. Use the halogen reference data from Lesson 20 to connect molecular size and phase-change temperatures, then explain the limits of that trend. This is a paper-model and data activity, not an alkane-heating experiment.

## Equipment

- Student booklet, pencil, ruler and periodic table
- Per pair: six pre-drawn diatomic molecule cards and blank paper
- Calculator optional; no alkanes, water baths, burners or thermometers

Desk activity only. Use pre-cut blunt modelling pieces and keep small parts out of mouths. Keep the workspace clear; no chemicals, flames or electrical supply are required.

Course coverage: 1.47–1.48: simple molecular structures, relatively low melting/boiling points and the general relationship with relative molecular mass. Consolidates non-conduction in simple molecular substances.

## Inside a molecule ≠ between molecules



**Solid: covalent bond inside each molecule**

Dashed: attraction between molecules

# Method and reasoning

Read the whole sequence before starting

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**1.** Draw six identical diatomic molecules on separate cards. Use a solid line for the covalent bond within each molecule; do not connect all six into one giant chain.

**2.** Arrange the cards close together and add dashed lines between neighbouring cards to represent intermolecular attractions. Label the two kinds of line explicitly.

**3.** Model boiling by spreading intact molecule cards apart. Explain why this represents overcoming attractions between molecules without breaking their internal covalent bonds.

**4.** Use the supplied relative atomic masses to calculate $M_r$ for $Cl_2$, $Br_2$ and $I_2$. Copy the sourced melting and boiling points into a comparison or use the supplied table.

**5.** Describe the melting-point and boiling-point trends across these three comparable molecules. Link the larger electron clouds to stronger attractions between molecules and more energy needed to separate them.

**6.** Evaluate the statement “a bigger $M_r$ always means a higher boiling point”. Treat this as a general pattern for comparable molecules, not a universal rule; molecular shape and other interactions can matter.

**7.** Explain why a pure simple molecular substance usually does not conduct electricity. Distinguish neutral molecules from mobile charged particles. Complete the questions and correct your model labels.

## Cleanup

• Keep your evidence and corrections. Count and return reusable model pieces; recycle unwanted paper. No chemical waste is produced.

# Record your evidence

Blank spaces are for your own work

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## Reference and task data

Use $A_r$: Cl 35.45, Br 79.90, I 126.90 (rounded reference values); $M_r$ is the sum for one molecule and has no unit. Phase-change data are RSC reference values at approximately standard pressure, reused from Lesson 20, not class measurements. All three are comparable diatomic halogen molecules. The general $M_r$ trend is not sufficient to predict every unrelated substance.

| Molecule / reference mp, bp (°C) | Calculate $M_r$ | Explain the comparison |
|---|---|---|
| $Cl_2$: −101.5, −34.04 | | |
| $Br_2$: −7.2, 58.8 | | |
| $I_2$: 113.7, 184.4 | | |

**Show your calculations, labelled model or correction here.**

# Explain and evaluate

Use evidence and show calculation steps where relevant

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**1.** Label a covalent bond and an intermolecular attraction on a diagram of two $Cl_2$ molecules.

**2.** Explain why boiling chlorine does not turn $Cl_2$ into separate chlorine atoms.

**3.** Calculate $M_r$ for $Cl_2$, $Br_2$ and $I_2$, showing your sums.

**4.** Explain the boiling-point trend in these three comparable molecules.

**5.** Correct: “Simple molecular substances have low boiling points because their covalent bonds are weak.”

**6.** Explain why a pure simple molecular liquid usually does not conduct electricity, and give one limit of the $M_r$ trend.