Elements and mixtures • staff

Teacher / technician guide

YEAR 10 / LESSON 4 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

A modelling and data-interpretation lesson, not a wet practical. No chemicals, heating or flames are included. Keep this answer guidance separate from student copies.

Purpose and coverage

Covers 1.8 classification and 1.9 melting/boiling-point distinctions at fixed pressure. Evidence comes from particle cards and an explicitly invented melting dataset. No melting-point measurement is claimed. Revisit existing Lesson 1 cooling observations if useful; that lesson is unchanged.

Requisition

Item	Per pair	Class of 30 / 15 pairs
Card set A–F	1 printed set	15 sets
Counters labelled X	12	180
Counters labelled Y	12	180
Removable connectors	6	90
Pencil, ruler, paper	1 working set	15 sets
Student booklet	1 per student	30 copies

Use reusable modelling pieces or pre-cut labelled paper circles. Letters make the model accessible without relying on colour. Avoid edible sweets and sharp improvised connectors.

Suggested timing • 45–50 minutes

- 5 minutes: atom types, substances and purity.
- 10 minutes: classify cards independently, then compare pair reasoning.
- 10 minutes: conserved-atom model and separation analogy.
- 10 minutes: named examples and invented melting data.
- 10–15 minutes: explanations, misconceptions and exit check.

Safe delivery

Desk activity only: no chemicals, heating or flames are required. Keep counters and connectors out of mouths and count them back into their storage box. Use pre-cut paper pieces. Keep the working area clear.

Count and return the counters, connectors and cards. Keep your classifications, drawings and written explanations.

Particle-card answer guidance

Count chemical substances, not the number of drawn particles

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Card	Atom types	Substances	Classification	Evidence
A	1	1	Element	Separate X atoms only
B	1	1	Element	Identical X_2 molecules
C	2	1	Compound	Identical XY molecules
D	2	2	Mixture	Separate X and Y elements
E	2	2	Mixture	XY compound + X element
F	2	2	Mixture	XY and XY_2 compounds

Discussion points

• A molecule need not be a compound: X_2 contains only one atom type. A compound can be pure: every XY particle represents the same substance.

• Card F is not one compound merely because every atom belongs to a molecule. Two different molecular compositions represent two different compounds.

• The first construction uses four X and four Y atoms before and after. Only the represented connections change. The physical counters do not undergo a chemical reaction.

• In the second model, sorting unjoined X pieces from XY pairs represents separation without decomposing the compound. It does not show that real atoms can be separated by hand.

• Named examples: nitrogen = element; carbon dioxide and pure water = compounds; air, salt water and brass = mixtures. A uniform appearance does not establish purity.

Physical evidence and teaching notes

Melting data are invented and labelled as such

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Dataset answers

Range widths: sample 1 = 1.0 °C; sample 2 = 6.0 °C; sample 3 = 1.0 °C. Samples 1 and 3 have similarly narrow apparent ranges. Sample 2's broader range is consistent with a mixture or impurity. Neither a narrow range nor a higher melting temperature proves purity or tells whether a sample is an element or a compound.

Keep the distinction precise

• At fixed pressure, the ideal course model gives a pure substance a fixed melting and boiling point. In an experiment, thermal gradients, heating rate and instrument resolution can create an apparent interval.

• Say that mixtures may melt or boil over a range. Do not replace "may" with "always": the syllabus statement is not an absolute purity test.

• Introduce boiling-point behaviour through discussion of the same distinction. This lesson includes no boiling measurements.

• A pure compound has a fixed chemical composition; a mixture's components are not combined into one substance. Some compounds form extended lattices rather than individual molecules.

• An exit check: "Can a sample contain two elements but only one substance?" A correct explanation can use pure water or the XY card.

Sources and original material

Pearson 4CH1 specification: points 1.8 and 1.9

RSC: atoms, elements, molecules, compounds and mixtures

RSC: elements, compounds and mixtures — misconceptions

Reviewed 21 November 2026. The six X/Y diagrams, counter sequence and unnamed sample data are original teaching materials. They are not copied experimental results or a claim of a physical trial. The review-list suggestions for heated iron/sulfur and melting demonstrations were not adopted; the scheme already identifies this as a lesson without wet practical work.