Ionic bonds

Student activity • desk activity

YEAR 10 / LESSON 16 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

How does electron transfer produce ions, and how do their charges determine a formula?

Build outer-electron models, then use charge balance to write formulae. An optional recorded demonstration shows magnesium burning to form magnesium oxide; the metal burns, not magnesium oxide. The recording illustrates a reaction, while the electron model explains the resulting ions. This lesson does not include a live flame demonstration.

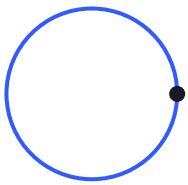
Equipment

- Student booklet, periodic table, pencil and two distinguishable dot/cross symbols
- Per pair: paper ion cards and up to 24 counters, or pencil marks instead
- Optional teacher screen and internet for the linked RSC magnesium recording

Desk activity only. No chemical samples or live reactions. Keep counters out of mouths and return loose pieces; use pencil symbols instead if preferred.

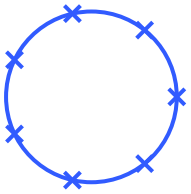
Course coverage: 1.39–1.41: ionic formulae, outer-electron dot-and-cross diagrams and electrostatic attraction between oppositely charged ions.

Model key • count every electron



Na: 2,8,1

One outer electron



Cl: 2,8,7

Seven outer electrons

Starting atoms, outer electrons only. Redraw after electron transfer; include ion brackets and charges.

Method and reasoning

Read the whole sequence before starting

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1. Use the supplied ion-charge reference. Build each formula in the table by choosing the smallest whole-number ratio giving total charge zero. Keep a polyatomic ion together and use brackets if more than one is needed.

2. Model sodium and chlorine using outer electrons only. Transfer one electron; redraw the ions in separate square brackets, showing charges and a full outer shell for chloride.

3. Repeat for magnesium oxide and magnesium chloride. Account for both electrons lost by each magnesium atom. Distinguish a 1:1 ratio from a 1:2 ratio.

4. Check an aluminium oxide model: two aluminium atoms lose six electrons in total and three oxygen atoms gain them. Write the simplest formula.

5. If the teacher shows the RSC recording, watch only the magnesium-and-oxygen section. Record visible changes as video observations; if it is not shown, write “not observed”. Do not substitute expected changes for observations.

6. Explain what holds an ionic solid together. Electron transfer forms ions; electrostatic attraction between positive and negative ions is the ionic bonding.

7. Compare the particle model with the real substance. Formula units give ratios in an extended structure, not separate NaCl molecules.

Cleanup

• Keep evidence and corrections together. Return shared cards/counters and equipment; close the recording or reference pages. No chemical waste is generated.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Charge reference: Group 1 +1; Group 2 +2; Al^{3+}; Group 6 −2; Group 7 −1; Ag^{+}, Zn^{2+}, Cu^{2+}, Fe^{2+}/Fe^{3+}, Pb^{2+} (use the named oxidation state). H^{+}, OH^{-}, NH_4^{+}, CO_3^{2-}, NO_3^{-}, SO_4^{2-}. Dots and crosses track electron origin, not different kinds of electron. Show outer electrons, brackets and charges; inner shells may be omitted.

Ions / substance	Smallest ion ratio	Neutral formula
Na^{+} and Cl^{-}		
Mg^{2+} and O^{2-}		
Mg^{2+} and Cl^{-}		
Al^{3+} and O^{2-}		
Ca^{2+} and NO_3^{-}		
NH_4^{+} and SO_4^{2-}		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Explain the difference between electron transfer and ionic bonding.

2. Draw outer-electron dot-and-cross diagrams for NaCl and MgO, including brackets and charges.

3. Draw $MgCl_2$ and explain why two chloride ions are needed.

4. Use charge balance to derive Al_2O_3 and $Ca(NO_3)_2$.

5. Write formulae for silver nitrate, zinc carbonate and iron(III) oxide.

6. Explain why NaCl is a ratio, not a discrete molecule. If you saw the magnesium video, separate one observation from one explanation.