Metal oxides: displacement and redox

Student activity • evidence and modelling

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The question

How can one metal take oxygen from another metal's oxide?

Analyse a recorded thermite demonstration and use atom cards to follow oxygen transfer. Separate what the recording shows from what the chemical equation tells you. This lesson uses no live thermite mixture or heated metal powders.

Equipment

- Student booklet and periodic table
- Per pair: 2 aluminium, 2 iron and 3 oxygen atom cards
- Teacher display of the linked RSC recording; paper for equations

Desk activity. Keep small cards out of mouths. No chemicals or heating; do not attempt to reproduce the recorded reaction.

Course coverage: 2.16, 2.17 and 2.20: displacement involving metal oxides; reactivity order; oxidation, reduction and agents by oxygen transfer and electron transfer.

Plan, model or apparatus sketch

Track oxygen atoms from iron oxide to aluminium oxide.

Method and reasoning

Read the whole sequence before starting

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1. Before viewing, predict whether aluminium can displace iron from iron(III) oxide using the reactivity series. Label this a prediction.

2. Watch the teacher-selected RSC recording. Record only visible changes; identify any product name supplied by the narration separately.

3. Arrange cards for Fe_2O_3 and 2Al, then rearrange exactly the same atoms into Al_2O_3 and 2Fe. Check counts before writing the balanced equation.

4. Draw an arrow showing oxygen transfer from iron oxide to aluminium. Identify which substance gains oxygen and which loses it.

5. Write electron-transfer statements for Al becoming Al^{3+} and Fe^{3+} becoming Fe. Balance electrons across the two statements.

6. Predict whether copper could displace iron from iron oxide. Explain using relative reactivity; do not interpret failure to ignite as a measurement of reactivity.

7. Explain the oxidising and reducing agents and identify one limit of using a video as experimental evidence.

Cleanup

- Return cards and retain observations; recycle waste paper.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Reference reactivity order, most to least: K, Na, Li, Ca, Mg, Al, Zn, Fe, Cu, Ag, Au. A more reactive metal can remove oxygen from the oxide of a less reactive metal under suitable conditions. A model accounts for atoms; it does not measure temperature or reaction rate.

Case / condition	Evidence or prediction	Explanation / limitation
Recorded thermite demonstration		
Al with Fe_2O_3: atom model		
Cu with Fe_2O_3: prediction		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Balance $Fe_2O_3 + Al \rightarrow Al_2O_3 + Fe$.

2. Identify the oxidised and reduced substances using oxygen transfer.

3. Write the two balanced electron-transfer statements, using Al^{3+} and Fe^{3+}.

4. Identify the reducing agent and oxidising agent; explain each role.

5. Predict the result of Cu with Fe_2O_3 and justify it.

6. Give one directly observed feature and one inferred or supplied claim from the recording.