# Extraction of iron on a match head

The investigation is part of the **Nuffield practical collection**, developed by the Nuffield Foundation and the Royal Society of Chemistry. Delve into a wide range of chemical concepts and processes with this collection of over 200 step-by-step practicals: rsc.li/43bjGql

This practical is relevant for age ranges 11–14 as well as 14–16. There are separate learning objectives, follow up questions and answers for each age range.

## Learning objectives 11–14

1 Safely investigate heating iron oxide on a match head to reduce iron.

2 Explain why metals need to be extracted from their ores.

3 State that the method of extraction depends on the reactivity of the metal being extracted.

## Learning objectives 14–16

1 Safely investigate heating iron oxide on a match head to reduce iron.

2 Explain why metals need to be extracted from their ores.

3 Explain the process of extracting metals using reduction with carbon.

4 Identify which species are oxidised and which are reduced.

By carrying out the practical method to extract iron, learners will develop their understanding of how metals are extracted by reduction with carbon. The questions that follow consolidate their understanding of which metals can be extracted by reduction with carbon and why this is possible, and build skills in identifying which species have been oxidised and which have been reduced during the process.

## Introduction

In this experiment, learners reduce iron(III) oxide with carbon on a match head to produce iron. The experiment provides a small-scale example of metal extraction and can be used to highlight aspects of the reactivity series.

This practical can easily be carried out individually by learners. The experiment is very quick to do provided that the apparatus and chemicals are already set out around the laboratory.

© 2026 Royal Society of Chemistry

## Teaching notes

A simple equation for the reaction is

**Iron(III) oxide + carbon → iron + carbon dioxide**

The sodium carbonate fuses easily and brings the iron oxide into close contact with the carbon.

## Scaffolding

Two versions of the worksheet are available: scaffolded (✪) and unscaffolded (✪✪). The scaffolded sheet offers more support to allow learners to access the questions. The answers to the worksheets are at the end of this document.

You may wish to discuss as a class how to write the formula of iron(III) oxide unless learners have already covered both ionic formulas and the use of roman numerals when giving the ion charge of transition metals.

You could direct learners towards using a reactivity series to scaffold their understanding of which metals can be obtained from their ores by reduction.

Integrated instructions are provided in the lesson slides (rsc.li/4cCNsdA) as an alternative to the full written method, designed to reduce cognitive load, read more at rsc.li/47bIKi5.

## Technician notes

Read our standard health and safety guidance (rsc.li/3zyJLkx) and carry out a risk assessment before running any live practical.

### Equipment

*Apparatus*

- Safety glasses
- Match (non-safety)
- Tongs (crucible tongs)
- Weighing boat (small white plastic ones are ideal)
- Spatula
- Bunsen burner
- Heat resistant mat
- Magnet (e.g. bar magnet)

*Chemicals*

Small amounts of the following:

- Iron(III) oxide powder 
- Sodium carbonate powder (IRRITANT) 
- Water

### Preparation

This experiment works best with non-safety/strike anywhere matches with a pinkish-read head.

© 2026 Royal Society of Chemistry

You may wish to provide small amounts (a few spatula measures) of each of the powders in Petri dishes or watch classes for groups of learners to share. You can provide the water in a small beaker.

### Safety and hazards

- Wear safety glasses throughout.
- Iron(III) oxide powder, $Fe_2O_3(s)$ is FLAMMABLE. See CLEAPSS Hazcard HC055A, refer to SSERC or contact your local safety advisory body.



- Sodium carbonate powder, $Na_2CO_3(s)$ is IRRITANT. See CLEAPSS Hazcard HC095A, refer to SSERC or contact your local safety advisory body.



## Method

*The method also appears in the lesson slides (rsc.li/4cCNsdA), alongside integrated instructions.*

1. Dip the head of a match in water to moisten it.
2. Roll the damp match head first in sodium carbonate powder, and then in iron(III) oxide powder.
3. Hold the match in a pair of tongs. Put the head of the match into a blue Bunsen flame (air-hole open). The match will flare and burn. Do not allow the match to burn more than halfway along its length.
4. Allow the match to cool for about 30 seconds.
5. Use a spatula to crush the charred part of the match into a small plastic weighing boat.
6. Move a magnet around under the weighing boat - some of the small particles will move around in the weighing boat following the track of the magnet. Do not dip the magnet into the particles directly unless you have first wrapped the magnet in cling film - any pieces of iron will stick to the magnet and will be difficult to clean off.

## Answers to the follow-up questions (11–14)

1. *Scaffolded and unscaffolded*

(a) Iron and oxygen
(b) Iron oxide + carbon → iron + carbon dioxide

2. *Scaffolded*
Zinc

*Unscaffolded*
Zinc, tin, lead or copper

3. *Scaffolded*

(a) Gold

© 2026 Royal Society of Chemistry

*Unscaffolded*

(a) Gold or platinum

*Scaffolded*

(b) crust, metal, profitable

*Unscaffolded*

(b) Ores are rocks that are found naturally in the Earth's crust. They contain enough metal to make it profitable to extract.

*Scaffolded and unscaffolded*

(c) Lead sulfide + oxygen → lead oxide + sulfur dioxide

*Scaffolded and unscaffolded*

(d) Lead oxide + carbon → lead + carbon dioxide

## Answers to the follow-up questions (14–16)

**1.** *Scaffolded*

(a) $Fe_2O_3$

*Unscaffolded*

(a) Iron(III) oxide + carbon → iron + carbon dioxide

*Scaffolded and unscaffolded*

(b) $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$

*Scaffolded*

(c) Oxidation is the gain of oxygen **and** oxidation is the loss of electrons

*Unscaffolded*

(c) The iron in iron(III) oxide has been reduced - it has gained electrons and lost oxygen.

$Fe^{3+} + 3\,e^- \rightarrow Fe$

*Scaffolded*

(d) Carbon has been oxidised
Iron has been reduced

© 2026 Royal Society of Chemistry

**2.** *Scaffolded and unscaffolded*

Carbon is more reactive than iron, so it can displace iron from its compounds.

*Unscaffolded only*
This method would not work for any metal above carbon in the reactivity series (e.g. potassium, sodium, lithium, calcium).

**3.** *Scaffolded and unscaffolded*

(a) Ores are rocks that are found naturally in the Earth's **crust**. They contain enough **metal** to make it **profitable** to extract.
(b) Lead sulfide + oxygen → lead oxide + sulfur dioxide
(c) $2PbO + C \rightarrow 2Pb + CO_2$
(d) Lead must be below carbon in the reactivity series as it is displaced from its compound, lead oxide, by carbon.

© 2026 Royal Society of Chemistry