Atoms and elements

Where this unit fits in

This unit builds on:
- unit 7G Particle model of solids, liquids and gases (in which the particle model is introduced and developed).
- However, if teachers wish to introduce the idea of particles through elements and compounds, it could be taught before these units.

The concepts in this unit are:

- All matter is created from a limited number of substances called elements.
- Elements themselves are composed of identical atoms which may exist singularly or as fixed arrangements of two or more identical atoms.
- Each element possesses unique physical properties.
- New material can be formed when two or more elements chemically combine.

This unit leads onto:

- unit 8F Compounds and mixtures
- unit 9E Reactions of metals and metal compounds
- unit 9F Patterns of reactivity

The historical impact of ideas about atoms is covered in unit 21.

This unit relates to:

- Scientific discoveries in the history scheme of work.

Framework yearly teaching objectives - Particles

The atom is the basic building block of matter:
- There is a relatively small number of different atoms.
- Elements consist of only one type of atom.
- Compounds consist of fixed combinations of different types of atoms that cannot be easily separated.

Expectations from QCA Scheme of Work

At the end of this unit...

...most pupils will ...

- Select information about elements and their properties from a range of secondary sources.
- Describe how to deal with hazards when preparing oxides.
- Identify an approach to finding out whether a material is an element or not and explain how their results provide appropriate evidence.

...some pupils will have made so much progress and will ...

- Find information from selected secondary sources about elements and their properties.
- Describe some hazards in preparing oxides and describe the results of their investigations.
- Select secondary sources to provide the information needed about elements and their properties.
- Identify limitations of evidence obtained about whether a substance is an element or not, where appropriate, suggesting alternative explanations.

...some pupils will not have made so much progress and will ...

- Recognise that there is a small number of elements and name some of these.
- Explain that compounds are made when atoms of different elements join together.
- Begin to use symbols for elements and to represent reactions in word equations.
- Distinguish between symbols for elements and formulae for compounds.
- Name some elements and represent these by symbols.
- Name a wide variety of materials.
- Identify elements whose properties do not fit the general pattern of metals and non-metals.
- Begin to represent compounds by formulae.

Suggested lesson allocation (see individual lesson planning guides)

Direct route

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>It's elementary</td>
<td>The elements</td>
<td>How elements differ</td>
<td>Getting it right - Think about classifying</td>
<td>Reacting elements</td>
</tr>
</tbody>
</table>

Extra lessons (not in pupil book)

Review and assess progress (distributed appropriately)

Misconceptions

Pupils think chemicals are different from materials and that chemicals are harmful. Pupils find it difficult to recognise living things are made out of materials and they don’t always recognise a different form of a material as being the same material, e.g. copper wire and copper turnings. Pupils tend to think that elements exist as solids only. Pupils have difficulty in accepting as an element those which exist as diatomic molecules, etc. Pupils don’t apply the term metal and non-metal only to elements as a scientist would (they will put wood or sugar with the non-metals).

Health and safety

See activity notes to inform risk assessment.

Risk assessments are required for any hazardous activity. Care should be taken when using copper turnings in Activity E5a as they can irritate the eyes. Safety goggles must be worn.

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Lesson planning
guide

It's elementary

Learning objectives
i. Understand that there is a huge variety of different materials that are mostly made from mixtures.
ii. There is a small number of elements from which all materials are made.
iii. Elements contain only one type of atom.
iv. Some elements are molecules.

Scientific enquiry
v. Appreciate that scientific ideas have changed over time. (Framework YTO Sc1 8a)
vi. Recognise that a range of sources is required and collect, store and present information in different ways. (Framework YTO 8 c, d)

Suggested alternative starter activities (5-10 minutes)

<table>
<thead>
<tr>
<th>Introduce the unit</th>
<th>Share learning objectives</th>
<th>Word game</th>
<th>Capture interest (1)</th>
<th>Capture interest (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit map for Atoms and elements.</td>
<td>• Learn how to distinguish between materials, mixtures, and pure substances, elements and particles, and atoms and molecules. • Find out how to use the terms material, mixture, pure substance, element, particle, atom, molecule, to classify matter. (Sc1)</td>
<td>Pupils evaluate recipes to make a range of materials including gold.</td>
<td>Show pupils a painting depicting an alchemist. Catalyst Interactive Presentations 2</td>
<td>Demonstration of the electrolysis of water.</td>
</tr>
</tbody>
</table>

Suggested alternative main activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objective see above</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook E1</td>
<td>i, iii, iv and v</td>
<td>Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows</td>
<td>20 min</td>
<td>R/G G K S</td>
</tr>
<tr>
<td>Activity E1a Practical</td>
<td>i, ii, v and vi</td>
<td>Grouping Pupils observe and describe a collection of elements and materials</td>
<td>20 min</td>
<td>✔ W</td>
</tr>
</tbody>
</table>

Suggested alternative plenary activities (5-10 minutes)

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils define what the terms material, element, pure substance and mixture mean to them.</td>
<td>In pairs pupils share responses to questions from Activity E1a.</td>
<td>In groups pupils feedback to the class their results from Activity E1a.</td>
<td>Pupils play odd man out. Pupils brainstorm: what information about these special materials called elements do you think we should collect?</td>
<td></td>
</tr>
</tbody>
</table>

Learning outcomes

Most pupils will ...
- know that elements contain only one type of atom
- understand that a single, pure element cannot be changed into any other material by physical or chemical changes
- be able to name three elements
- understand that ideas about materials have changed over time

Some pupils, making less progress will ...
- know that elements contain only one type of atom
- know that a single, pure element cannot be changed into any other material
- be able to name one element
- know that scientists didn't always know about elements.

Some pupils, making more progress will ...
- know that elements contain only one type of atom
- understand that a single, pure element cannot be changed into any other material by physical or chemical changes because only one type of atom is present
- be able to name six elements
- understand that scientists in the past thought transmutation was possible because they did not know about different types of atom.

Key words
element, mixture, pure, particle, atom, molecule, red only: alchemists

Out-of-lesson learning
Framework E1 Textbook E1 end-of-spread questions
**Lesson planning guide**

**E2 The elements**

### Learning objectives

i. Elements are represented by symbols.

ii. Elements are arranged in the Periodic Table.

iii. Elements can be classified into metals and non-metals.

iv. Use the Periodic Table and other secondary sources. (Framework YTO Sc1 8c)

### Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Recap last lesson</th>
<th>Share learning objectives</th>
<th>Problem solving</th>
<th>Capture interest (1)</th>
<th>Capture interest (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils match words to their definitions.</td>
<td>+ Be able to recognise and use symbols to represent elements.</td>
<td>Pupils decide which statements describe the characteristics of elements.</td>
<td>Show pupils video clips illustrating a range of properties of elements.</td>
<td>Pupils discuss or are shown old fashioned names for elements, e.g. oxygen, sulphur and alchemy symbols.</td>
</tr>
</tbody>
</table>

### Suggested alternative main activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objective</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook E2</td>
<td>i, iii and iv</td>
<td>Teacher-led explanation and questioning or pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.</td>
<td>20 min</td>
<td>C H E S R/G G R S ✔ ✔</td>
</tr>
<tr>
<td>Activity E2a</td>
<td>Practical</td>
<td>Which are elements? Pupils pick out elements from atomic models of different substances.</td>
<td>15 min</td>
<td>✔</td>
</tr>
<tr>
<td>Activity E2b</td>
<td>Paper (ICT)</td>
<td>What's in a name? Pupils use secondary sources to research why elements have been given the names they have.</td>
<td>20 min</td>
<td>✔</td>
</tr>
</tbody>
</table>

### Suggested alternative plenary activities (5–10 minutes)

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<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils identify three facts they have discovered about an element of their choice.</td>
<td>Pupils discuss their responses to the questions in Activity E2a.</td>
<td>Pupils present their PowerPoint summaries from Activity E2b.</td>
<td>Pupils play a domino game to reinforce element names and symbols.</td>
<td>Pupils write in what sorts of ways are the metals and non-metals the same and different.</td>
</tr>
</tbody>
</table>

### Learning outcomes

**Most pupils will ...**

- know that every element has a symbol and that each symbol begins with a capital letter
- know that all the elements appear in the Periodic Table and that they are arranged so that metals are on the left and non-metals on the right
- understand that there are about 100 elements
- know the names and symbols of ten elements
- use the Periodic Table to decide if an element is a metal or a non-metal.

**Some pupils, making less progress will ...**

- know that every element has a symbol
- know that all elements appear in the Periodic Table
- know that there are about 100 elements
- know the names of five elements and their symbols.

**Some pupils, making more progress will ...**

- also appreciate how some elements’ symbols were decided on
- also know that the Periodic Table is arranged in groups (vertical columns) and periods (horizontal rows)
- also know that new elements are still being discovered
- know the names and symbols of 15 elements
- also appreciate that elements in the same group have similar properties.

### Key words

symbol, Periodic Table, periods, groups, metals, non-metals

### Out-of-lesson learning

Homework E2
Textbook E2 end-of-spread questions
Pupils can research other contributors besides Mendeleev to the structure of grouping for elements.

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**Lesson planning guide**

**How elements differ**

### Learning objectives
1. The properties of metals and non-metals, their appearance and state at room temperature.
2. Many metals are elements.

### Scientific enquiry
1. Use a database to learn about elements and their properties. (Framework YTO Sc1 8d)
2. Use the Periodic Table and other secondary sources. (Framework YTO Sc1 8c)
3. Draw conclusions from data and describe how conclusions are consistent with the data obtained. (Framework YTO Sc1 8f)

### Learning outcomes
- Be able to describe the physical properties of a metal.
- Be able to use boiling point and melting point temperatures to classify any given element as a metal or non-metal. (Sc1)
- Use a database to learn about elements and compare with other elements.

### Suggested alternative starter activities (5–10 minutes)
- Recap last lesson
  - Quick quiz about the names and symbols of key elements.
- Sharing learning objectives
  - In groups, pupils match a range of temperatures to varying contexts.
- Brainstorming
  - Pupils look at elements in the air and elements in the Earth’s crust.
- Capture interest
  - Elements in the human body.

### Learning objectives (see above)
- Metalic and non-metallic elements
  - Pupils use a database to answer questions about elements.
- Physical properties of elements
  - Pupils use a database to find out the physical properties of one element and compare with other elements.

### Approx. timing
- 20 min
- 20 min
- 20 min

### Target group
- ✔️
- ✔
- ✔
- ✔

### Suggested alternative main activities
- **Textbook E3**
  - Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.
- **Activity E3a**
  - Metallic and non-metallic elements
    - Pupils use a database to answer questions about elements.
- **Activity E3b**
  - Physical properties of elements
    - Pupils use a database to find out the physical properties of one element and compare with other elements.

### Approx. timing
- 20 min
- 20 min

### Target group
- ✔️
- ✔
- ✔

### Suggested alternative plenary activities (5–10 minutes)
- **Review learning**
  - Each pupil is given a sticker or badge with a metal/non-metal. They are asked to find two others to group with and say why they have grouped together.
- **Sharing responses**
  - Pupils share how they worked out the equations in Activity E3a.
- **Group feedback**
  - Pupils present a Power Point® summary of a specific element from Activity E3b. The information can be merged to produce summary notes for the class.
- **Word game**
  - Pupils play happy families.
- **Looking ahead**
  - Pupils are presented with data for carbon (without naming it) and are asked to decide if it is a metal or non-metal. Pupils identify conflicting evidence.

### Learning outcomes

**Most pupils will …**
- Know that metals are shiny and conduct heat and electricity.
- Use the Periodic Table to decide if a metal is an element and explain why some metals are elements and others are not.
- Know that the elements iron, nickel and cobalt are magnetic.
- Use charts to see if a metal is a solid, liquid or gas at room temperature.
- Know that most non-metal elements do not conduct electricity or heat energy, nor look shiny.
- Know that some non-metal elements are solids, some liquids and many gases at room temperature.

**Some pupils, making less progress will …**
- Know that metals are shiny and conduct heat and electricity.
- Use the Periodic Table to decide if a metal is an element.
- Know that a few elements, including iron, are magnetic.
- Know that almost all metals are solid at room temperature.
- Know that many non-metal elements are gasses and some are solids.

**Some pupils, making more progress will …**
- Also use secondary sources to make judgements about which metal would be best used for a specific purpose.
- Also use charts to see if a metal is a solid, liquid or gas at various temperatures.
- Also realise that the properties of non-metal elements are much more varied than the properties of metal elements.
- Also know the uses of a few non-metal elements.

### Key words
- Melting point, boiling point, properties, magnetic, red only: chemical properties, physical properties, physical changes, chemical changes

### Out-of-lesson learning
- **Homework E3**
  - Textbook E3 end-of-spread questions
  - Pupils can research the development of filament lamps for gas lamps and then electric lamps leading to tungsten – use of argon for inert atmosphere.
Lesson planning guide

E4 Getting it right - Think about classifying

Learning objectives
i. Learn about classifying elements according to their properties.
ii. Recognise that the properties of some elements do not fit the general patterns of metal and non-metal. (red only)

The structure of this lesson is based around the CASE approach. The starter activities give concrete preparation. The main activities move away from the concrete towards a challenging situation, where pupils need to think. The extended plenary gives pupils time to discuss what they have learnt, to negotiate a method to commit to paper and express their ideas verbally to the rest of the class.

Scientific enquiry
iii. Realise that no classification system is perfect.

Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Bridging to the unit</th>
<th>Setting the context</th>
<th>Concrete preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who am I? Pupils identify the element being described.</td>
<td>Pupils brainstorm a range of physical properties and rank them in terms of their usefulness in deciding whether an element is a metal or not.</td>
<td>Pupils work in pairs to match the uses of elements to their properties.</td>
</tr>
</tbody>
</table>

Main activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objective see above</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook E4</td>
<td>i, ii and iii</td>
<td>Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.</td>
<td>30 min</td>
<td>R, G, S, K, E</td>
</tr>
</tbody>
</table>

Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Group feedback</th>
<th>Bridging to other topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils share their answers to the questions in the pupil book.</td>
<td>The class discusses and recaps the ways in which we group living things. Pupils identify that these different ways arise because of different purposes/needs.</td>
</tr>
</tbody>
</table>

Learning outcomes

Most pupils will ...

- relate the properties of elements to their classification as 'metal' or 'non-metal'
- realise that a few elements do not fit neatly into either category.

Some pupils, making less progress will ...

- group elements in different ways, one of which is 'metals' and 'non-metals'.

Some pupils, making more progress will ...

- also identify elements whose properties do not fit the general pattern of metals and non-metals
- name carbon as an element with some of the properties associated with metals.

Key words

- none

Out-of-lesson learning

- Textbook E4 end-of-spread questions
- Pupils can research the different types of periodic table

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E5

Reacting elements

Learning objectives
i. New materials are formed when atoms of elements join to form compounds
ii. Every compound has a formula.
iii. Using word equations to represent reactions.
iv. Use patterns in reactions to predict how other similar elements will react.

Scientific enquiry
v. Hazard recognition and risk analysis.
vi. Predict how elements will react together. (Framework YTO Sc1 1b)
vii. Draw conclusions from data and describe how conclusions are consistent with the evidence obtained, using scientific knowledge and understanding. (Framework YTO Sc1 8f)

Learning objectives
i. New materials are formed when atoms of elements join to form compounds
ii. Every compound has a formula.
iii. Using word equations to represent reactions.
iv. Use patterns in reactions to predict how other similar elements will react.

Scientific enquiry
v. Hazard recognition and risk analysis.
vi. Predict how elements will react together. (Framework YTO Sc1 1b)
vii. Draw conclusions from data and describe how conclusions are consistent with the evidence obtained, using scientific knowledge and understanding. (Framework YTO Sc1 8f)

Learning outcomes
Most pupils will ...
• explain that compounds are made when atoms of different elements join together
• write word equations for reactions in which the reactants and products have been identified
• distinguish between symbols for elements and formulae for compounds.

Some pupils, making less progress will ...
• use a word equation to identify the reactants and products of a reaction.

Some pupils, making more progress will ...
• also write word equations for reactions in which the products have to be deduced
• begin to represent compounds by formula.

Key words
compound, formula, MgO

Out-of-lesson learning
Homework E5
Textbook E5 end-of-spread questions
Pupils can explore the links of carbon monoxide with everyday contexts, e.g. sensors for monitoring gas central heating, affect on living things of carbon monoxide.
Pupils can be given exercises which help enforce the difference between symbols and formulae.

Homework E5

Textbook E5 end-of-spread questions
Pupils can explore the links of carbon monoxide with everyday contexts, e.g. sensors for monitoring gas central heating, affect on living things of carbon monoxide.
Pupils can be given exercises which help enforce the difference between symbols and formulae.

Most pupils will ...
• explain that compounds are made when atoms of different elements join together
• write word equations for reactions in which the reactants and products have been identified
• distinguish between symbols for elements and formulae for compounds.

Some pupils, making less progress will ...
• use a word equation to identify the reactants and products of a reaction.

Some pupils, making more progress will ...
• also write word equations for reactions in which the products have to be deduced
• begin to represent compounds by formula.

Key words
compound, formula, MgO

Out-of-lesson learning
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Textbook E5 end-of-spread questions
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This worksheet may have been altered from the original on the CD-ROM.
Copy the unit map and use these words to help you complete it. You may add words of your own too.

alchemist  atom  boiling point  compound  electrical conductivity  fixed ratio R  gas  group  liquid  material  melting point  Mendeleev R  metals  mixture  molecule  particle  pattern  period  periodic table  physical properties  pure substance  solid  symbol  thermal conductivity  word equations
Starters

It's elementary

Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Introduce the unit</th>
<th>Share learning objectives</th>
<th>Word game</th>
<th>Capture interest (1)</th>
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</table>

Introduce the unit

- **Either** draw the outline of the unit map on the board then ask pupils to give you words to add, saying where to add them. Suggest some words yourself when necessary to keep pupils on the right track.
- **Or** give out the unit map and ask pupils to work in groups deciding how to add the listed words to the diagram. Then go through it on the board as each group gives suggestions.

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about the variety and types of materials that exist. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Word game

- Pupils work in pairs to discuss the recipes provided on the Pupil sheet and answer the questions they are given.
- **Questions:**
  - What evidence do you have or know that suggests this recipe will or will not work?
  - Which of these words/phrases would you use to describe the material produced by your recipe: a mixture, something that is pure, a metal?

Capture interest (1)

- Use the image on the CD-ROM or a photograph of an alchemist to discuss with the pupils how modern day chemistry has developed from dubious beginnings dominated by trying to find the elixir of life and the recipe for gold.
- Ask pupils the following questions:
  - How does their way of working compare with modern day approaches (look at the tools and equipment in the painting)?
  - What techniques/processes do you think they used to try and change materials into pure gold?
  - Do you think alchemists still exist?
  - Were any alchemists female (females very important in Chinese alchemy)?
  - How was alchemists’ work viewed – with awe? with fear? with curiosity?

Capture interest (2)

- In this demonstration you are showing the pupils that the discovery of electricity gave chemists another procedure they could use to decide if a substance was indeed a single substance or not.
It's elementary

Word game

Concrete
Cement
Sand
Stone
Mix 1 part cement with 3 parts sand and 6 parts stone, add water, lay evenly and leave to set overnight.

Iron
Haematite
Coke
Limestone
Add a mixture of haematite, coke and limestone to a blast furnace.
Heat vigorously.
Collect and cool the molten iron.

Ice cream
550 cm³ single cream
sweet ginger
3 egg yolks
4 level tablespoons of sugar
Take the cream and bring to the boil, remove from the heat and add diced ginger.
Cover and leave for two hours.
Sieve the mixture.
Next beat the egg yolks and sugar.
Reheat the cream, add the egg mixture when boiling.
Continue to heat the mixture gently over a water bath for approximately 10 mins. until it thickens.
Place mixture in a cold container and transfer to the freezer. Stir from time to time.

Gold
10 oz of elixir
9lbs of mercury
Take 240 chu (10oz) of elixir, add to it 100 catties (lbs) of mercury.
Heat and it will turn into gold. If it does not, reseal the constituents and heat for as long as before.
Ko Hung (3rd century AD)

Nitrogen gas
Air
Cool the air until it liquefies (−200°C).
Then carefully reheat and collect the gas produced at −196°C.
It's elementary

Capture interest (2)

Teacher and Technician sheet

Equipment

- Hofmann voltameter containing distilled water which has been acidified with a drop of concentrated sulphuric acid
- 6-V dc power supply
- splints
- matches
- eye protection
- cobalt chloride paper
- anhydrous copper sulphate
- pipette

This demonstration is to show pupils that the discovery of electricity gave chemists another procedure they could use to decide if a substance was indeed a single substance or not.

- Top up the contents of the voltameter with distilled water in front of the class. You can then use this water to test with the cobalt chloride paper and/or the anhydrous copper sulphate to show the presence of water (remember the tests only confirm the presence of water and don’t indicate purity).
- Collect and test each of the gas samples collected in the two arms and confirm the presence of hydrogen and oxygen.
- Ask pupils to observe closely and:
  - Identify evidence to suggest water is made of more than one thing.
  - Suggest a recipe for water including details for the ratio/amounts of starting materials required.
  - Sketch graphs to show evolution of hydrogen and oxygen over time (use mini-whiteboards if available).
  - Use the graphs to illustrate fixed amount of oxygen and hydrogen present in any given volume of water. Amount of hydrogen produced is twice that of oxygen.
  - Suggest other techniques scientists could use to find out what is in a given material.
Recap last lesson

- Pupils use mini-whiteboards to quickly say whether each of the following statements describes an element, a material, an atom, a mixture or a pure substance.

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about elements. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Pupils discuss the statements on the Pupil sheet and decide if they are true or not. They must be prepared to justify their choice.

Capture interest (1)

- Show pupils video clips illustrating a range of properties of elements. Catalyst Interactive Presentations 2

Capture interest (2)

- Pupils discuss or are shown old fashioned names for elements, eg oxygen, sulphur and alchemy symbols.

Statements
everyday word we use to describe what things are composed or made of
contains one type of substance only
contains two or more substances jumbled up together
describes any substance which only contains identical atoms
simplest particle of matter which can exist on its own

Answers
ture: 1, 3, 4, and 7
false: 2, 5, and 6

Questions
What is the link between some metal elements and the planets?
What is the link between these metals and the days of the week?
Why is it that the most common metal elements have symbols that do not relate to the names we use for them?

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This worksheet may have been altered from the original on the CD-ROM.
The elements

Problem solving

Look at the statements below, then mark the boxes T (true) or F (false).

1. Elements can vary in colour and appearance.  
2. Steel is an element because it contains carbon and iron.  
3. Elements contain only identical atoms.  
4. The atoms in an element can join together in patterns.  
5. Only metals count as elements.  
6. Elements can be split up into other substances by using electricity.  
7. An element is a material.
## The elements

### Capture interest (2)

<table>
<thead>
<tr>
<th>Metal</th>
<th>Symbol</th>
<th>Planet</th>
<th>Day of week</th>
<th>Dalton's symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>☞</td>
<td>Sun</td>
<td>Sunday</td>
<td>☞</td>
</tr>
<tr>
<td>Silver</td>
<td>☼</td>
<td>Moon</td>
<td>Monday</td>
<td>☼</td>
</tr>
<tr>
<td>Iron</td>
<td>☤</td>
<td>Mars</td>
<td>Tuesday (Saxon, Tiw = Mars; French, mardi)</td>
<td>☤</td>
</tr>
<tr>
<td>Mercury (quicksilver)</td>
<td>☠</td>
<td>Mercury</td>
<td>Wednesday (Saxon, Woden = Mercury; French, mercredi)</td>
<td>☠</td>
</tr>
<tr>
<td>Tin</td>
<td>☣</td>
<td>Jupiter</td>
<td>Thursday (Saxon, Thor = Jupiter; French, jeudi)</td>
<td>☣</td>
</tr>
<tr>
<td>Copper</td>
<td>☠</td>
<td>Venus</td>
<td>Friday (Saxon, Friff = Venus; French, vendredi)</td>
<td>☠</td>
</tr>
<tr>
<td>Lead</td>
<td>☔</td>
<td>Saturn</td>
<td>Saturday</td>
<td>☔</td>
</tr>
</tbody>
</table>

Can you match these old names with their more common names today?

- dephlogisticated air
- sulphur
- brimstone
- oxygen
- inflammable air
- chlorine
- azote
- hydrogen
- dephlogisticated marine acid
- nitrogen
Recap last lesson
- Pupils use mini-whiteboards to answer the following questions quickly:
  - Which elements have the symbols O, H, P, S, Na?
  - What symbol is used to represent iodine, gold, potassium, aluminium, helium?
  - Name three elements whose symbol includes the letter C?
  - What if you discovered a new element tomorrow, what symbol would you give it and why?

Share learning objectives
- Ask pupils to write a list of FAQs they would put on a website telling people about the physical properties of metals. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving
- In groups pupils are asked to match a range of temperatures to the scenarios presented.
- Ask pupils: ‘What do you notice about the temperature of the Earth’s core and the melting point of diamonds?’

Brainstorming
- Pupils study data about the composition of the Earth’s crust and its atmosphere and discuss:
  - Which elements are the most abundant?
  - Why is so little carbon present in the Earth’s crust?
  - Where is the oxygen located in the Earth’s crust?
  - Describe one thing that has surprised you about this information.

Capture interest
- Provide pupils with the recipe on the Pupil sheet and see if they can suggest what it makes.
How elements differ

Problem solving

Draw a line to link each statement with an appropriate temperature value.

- temperature of human body: 23°C
- boiling point of water: −18°C
- melting point of ice: 4000°C
- temperature of Earth’s core: 0°C
- room temperature in summer: −215°C
- lowest temperature recorded on earth (Vostok Antarctica 1997): 4000°C
- typical temperature in your freezer at home: 100°C
- melting point of a diamond: −91°C
- surface temperature of the planet Pluto: 39.7°C
E3 How elements differ

Brainstorming

Elements present in the Earth's crust

- Oxygen 50%
- Silicon 26%
- Aluminium 8%
- Magnesium 2%
- Potassium 2%
- Sodium 3%
- Calcium 4%
- Iron 5%

Elements present in the air

- Nitrogen 78.10%
- Oxygen 21.00%
- Argon 0.90%
- Carbon dioxide 0.03%
How elements differ

Capture interest

What could we possibly produce from this selection of ingredients?

1.5 kg nitrogen
9 kg carbon
1 kg calcium
75 g of sodium
175 g of potassium
32 kg of oxygen
5 kg of hydrogen
25 g of magnesium
75 g of chlorine
125 g sulphur
500 g of phosphorus
7 g of iron
a dash of iodine, fluorine and silicon
Getting it right - Think about

**Suggested alternative starter activities (5-10 minutes)**

<table>
<thead>
<tr>
<th>Bridging to the unit</th>
<th>Setting the context</th>
<th>Concrete preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who am I? Pupils identify the element being described.</td>
<td>Pupils brainstorm a range of physical properties and rank them in terms of their usefulness in deciding whether an element is a metal or not.</td>
<td>Pupils work in pairs to match uses of elements to their properties.</td>
</tr>
</tbody>
</table>

**Bridging to the unit**
- A pupil assumes the identity of an element. They state one piece of information at a time.
- Other pupils can risk identifying the mystery element using their whiteboards.
- As soon as one or a number of pupils has correctly identified the element another pupil takes over.
- See how many elements the class can identify in five minutes. Pupils tally points.
- It might be useful to have a selection of pre-prepared element cards with information listed for pupils to choose at random. The pupil chooses which information to release each time.

**Setting the context**
- Explain that we have been classifying elements as metallic or non-metallic elements based on the physical properties of each element.
- Brainstorm the range of physical properties and summarise.

**Concrete preparation**
- Pupils work in pairs and complete the cards.
- Each pair now compares their choices with another pair and ranks the properties from ‘must have’ to count as a metallic element, to ‘non essential’.

**Mark scheme**
- 7 points awarded for correct identification based on 1 piece of information
- 5 points if it takes 2 pieces of information
- 3 points if it takes 3 pieces of information
- 1 point if it takes 4 pieces of information
Concrete preparation

Most metallic elements are shiny for example ____________ but
__________ is not.
I think this property is useful because

Most metallic elements are solid for example ____________ but
__________ is not.
I think this property is useful because

Some metallic elements are magnetic for example ____________ but
__________ is not.
I think this property is useful because

Some metallic elements are sonorous (they make a ringing noise when you
strike them) for example ____________ but ____________ is not.
I think this property is useful because

Metallic elements conduct electricity for example ____________.
But ____________ also conducts electricity.
I think this property is useful because

Another property of metallic elements is
__________
I think this property is useful because
Suggested alternative starter activities (3-10 minutes)

<table>
<thead>
<tr>
<th>Recap last lesson</th>
<th>Share learning objectives</th>
<th>Problem solving</th>
<th>Capture interest (1)</th>
<th>Capture interest (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>True/false statements to review previous learning.</td>
<td>• Be able to identify the characteristics of chemical change.</td>
<td>Pupils identify elements, compounds and mixtures from a selection given.</td>
<td>Demonstration of potassium/magnesium/iron wool burning in oxygen and test pH of product.</td>
<td>Show video clips of different elements reacting together.</td>
</tr>
<tr>
<td></td>
<td>• Be able to use word equations to represent a chemical reaction.</td>
<td></td>
<td>Demonstration of phosphorus/sulphur/carbon burning in air; test pH of product and discuss.</td>
<td>Catalyst Interactive Presentations 2</td>
</tr>
</tbody>
</table>

Recap last lesson

• Pupils decide which of the statements on the pupil sheet are true or false. They can respond by using red or green cards (red = false, green = true). They must be prepared to justify their response with evidence from previous lessons.

Share learning objectives

• Ask pupils to write a list of FAQs they would put on a website telling people about chemical change. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

• Pupils classify substances, from statements about them, as elements, compounds and mixtures.

• For each substance described, each pupil draws a sketch of how they visualise the atoms are organised and how this supports the substance being classified as a compound, element or mixture; this can be done quickly using mini whiteboards.

• Pupils are expected to say why they have made their choices. Any differences in representations can be discussed and challenged.

Capture interest (1)

• Carry out the demonstrations on the teacher and technician sheet and use the following questions to revise the characteristics of chemical reactions, patterns in reactivity of oxygen with elements and introduce the pH properties of metal or non-metal oxides:
  - What evidence do you have to state if these are chemical reactions?
  - Can you see a pattern in the pH values obtained?
  - Is there a golden rule we can tell others about predicting the pH of a given oxide?
  - How could we test our rule?

• Pupils write a word equation for one of these reactions.

Capture interest (2)

• Pupils view the reactions between elements on the CD-ROM and discuss the following:
  - What clues are there to tell us these are examples of chemical reactions?
  - Produce a word equation for one of the reactions.
  - What do you think would happen if we reacted sodium with iodine?
Recap last lesson

Read these sentences and decide which are true (T) or false (F). Write T or F in the box.

1. Any compound is made from at least two different types of atoms combined together in a fixed ratio.

2. Compounds and mixtures can contain the same atoms.

3. A word equation says which substances react (combine) together and what is produced in a chemical reaction.

4. Metallic elements are better thermal conductors than non-metal elements.

5. Water (H₂O) is a two element mixture.

6. Only elements have special boiling points and melting points.

7. All metal elements are solids at room temperature.
Problem solving

Decide for each of the statements below whether it is describing a compound, an element or a mixture. Write the correct word in the space.

1. Stainless steel contains mainly carbon with some nickel and chromium added. ________________
2. Carbon dioxide contains carbon and oxygen atoms in a ratio of 1 part carbon to 2 parts oxygen. ________________
3. Nitrogen gas contains nitrogen atoms which combine together in pairs. ________________
4. Argon gas contains argon atoms which remain single. ________________
5. Bronze contains a mix of tin and copper atoms – it is an alloy. ________________
6. Water contains hydrogen and oxygen atoms in a ratio of 2 parts hydrogen to 1 part oxygen. ________________
7. Copper contains copper atoms which are packed very closely together and make a regular pattern. ________________
8. For each of the seven statements above, draw how you would expect to see the atoms arranged if you could actually see them close up. Think about whether the atoms would be joined together in some way.
Reacting elements

Capture interest (1)

Teacher and technician sheet

Equipment

- safety screen and access to a fume cupboard
- eye protection for teacher and class
- deflagrating spoons to hold the samples of elements
- bunsen burner
- forceps
- distilled water in water bottle
- blue glass
- litmus paper and universal indicator paper

Samples of the following elements

- potassium (small sample 0.5cm cube stored under oil until required)
- white phosphorus (small pellet 0.5cm cube stored completely under water until required)
- sulphur (small pellet)
- magnesium (2cm strip of ribbon which has been cleaned of oxide build up)
- iron (in the form of iron wool)
- carbon

Safety notes

- If you have not previously attempted these demonstrations you must take advice and practice them beforehand with an experienced colleague.
- Hazard signs will be needed for Corrosive, Irritant, Toxic, Flammable etc with the information sheet. Make sure you carry out the demonstrations in a well ventilated room.
- The potassium and phosphorus must be handled with forceps (have a separate pair for each element).
- Remove excess oil from the potassium by dabbing it gently onto DRY filter paper to absorb the oil before transferring to the deflagrating spoon (but don’t dither).
- All present should wear eye protection. Magnesium burns with a very bright flame and must not be looked at directly. Pupils should be warned to look away when the magnesium burns or view burning magnesium through blue glass.
- Carry out the reactions of phosphorus and sulphur in a fume cupboard.

Note: White phosphorus ignites spontaneously when the water evaporates so it should be transferred to the gas jar immediately. If ignition is not immediate touch with the hot end of a glass rod.
- When preparing the sample of white phosphorus have 0.2M copper sulphate solution available to help detect and so aid removal of any particles on the skin if an accident occurs.

Running the activity

1. Take each element in turn and place in a deflagrating spoon then hold over a Bunsen flame and heat until the element begins to burn or is glowing red-hot.
2. Transfer quickly to the gas jar.
3. After the reaction has finished lift the lid up a little and squirt some distilled water over the deflagrating spoon and into the jar.
4. Remove the spoon and place a lid over the gas jar and shake.
5. Add pH paper or universal indicator.
6. Note colour and identify pH (it might be useful to place a sheet of white paper or a white tile under the base of the gas jar to help identify the colour change).

Expected outcomes

Potassium, magnesium and iron will give alkali values for pH. Sulphur, carbon and phosphorus will give acidic values for pH.
Running the activity

Provide multiple sets of the pupil materials for pupils themselves to handle and observe. Wait until the pupils have had a chance to suggest some ways to classify their examples first before you demonstrate any materials which are deemed unsuitable for pupils to handle. Summarise any observations made about these materials by the pupils.

Some pupils may benefit from using a hand lens when making their own observations. When pupils suggest their own examples to add to the groupings, list all the elements mentioned separately so that you can then identify these as such.

Weaker pupils may find it useful to use cards with the names of the materials provided to help them group and re-group the materials based on their ideas for sorting. Having large circles available to use for Venn diagrams may also help. Bear in mind that the way in which you present the sample may influence the pupils' thinking, eg using copper wire as the sample as opposed to strips of copper sheet may lead pupils to classify copper as a fibre.

Core: Instructions are given for the activity. Pupils decide on their own ways of sorting and recording their groupings.

Help: Structured questions lead to forms of grouping.

Expected outcomes

Pupils group materials in a variety of ways and can share their reasoning.

Pitfalls

Weaker pupils will need support and prompts to use their observations to group the materials. Large samples may be needed for pupils who are partially sighted.

Safety notes

Some of the materials, eg chlorine, bromine and mercury, are corrosive or poisonous and these must not be handled by pupils and should be handled by you only. All materials should carry the appropriate hazard warnings.

Answers

Core:
1. Possible groupings include: metals/non-metals, ceramics, fibres, rocks, solids, liquids and gases, mixtures, elements, living/non-living.
2. and 3. Answers will vary.

Help: examples:
1. solids: eg iron, silver, mercury, copper, aluminium, steel.
2. liquids: eg mercury, water, olive oil, sea water, honey.
3. mixtures: eg bromine, chlorine, nitrogen, air, oxygen, helium.
4. materials from living things: eg cake, honey, cotton, olive oil, soap, wool, sugar, bone, hair.
5. and 6. Answers will vary.
Grouping materials

Equipment

For each group:

- access to samples of the following labelled materials: brick, honey, rust, wax, aluminium, silver, clay, limestone, wood, soap, glass, olive oil, water, table salt, iron, steel, wool (as fibres), sugar, bone, hair, paper, plaster of Paris, plastic, sand, copper, granite, cotton, sponge, sea-water.

The sample size needs to be large enough to allow pupils to make decisions such as, is it a mixture? Is it a liquid? Clear film canisters or sealed plastic petri dishes would be ideal containers.

- hand lens
- samples of the following gases contained in clear sealed plastic bags: oxygen, nitrogen, helium, air (some forms of packing material use air bags)
- mercury in a clear sealed container teacher only
- chlorine and bromine in sealed gas jars teacher only

For your information

Running the activity

Provide multiple sets of the pupil materials for pupils themselves to handle and observe. Wait until the pupils have had a chance to suggest some ways to classify their examples first before you demonstrate any materials which are deemed unsuitable for pupils to handle. Summarise any observations made about these materials by the pupils.

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Help: Structured questions lead to forms of grouping.

Expected outcomes

Pupils group materials in a variety of ways and can share their reasoning.

Pitfalls

Weaker pupils will need support and prompts to use their observations to group the materials. Large samples may be needed for pupils who are partially sighted.

Safety notes

Some of the materials, eg chlorine, bromine and mercury, are corrosive or poisonous and these must not be handled by pupils and should be handled by you only. Keep the container of mercury in a containment tray in case of spillage. All materials should carry the appropriate hazard warnings.

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This worksheet may have been altered from the original on the CD-ROM.
In this activity you will study a collection of materials and suggest ways in which to group the collection of materials. Some of the materials are poisonous or corrosive so these will be demonstrated by your teacher. Make sure you understand the hazard warning provided with any of the samples and check with your teacher if you are unsure.

Obtaining and presenting the results

1. Look carefully at your material samples. Use your observations and knowledge to suggest ways of sorting and grouping the samples.
2. Record the different ways you can group your samples and remember to list which materials belong to the groups you have chosen.
   - How many different ways can you group the materials in the collection?
   - List five other materials not present in this sample.
   - Where would you place these five materials?
   - Which materials would you describe as consisting of a single substance, ie as ‘pure’.

2. Use your observations and knowledge to suggest ways of sorting and grouping the samples.
3. Record each way you group your samples and remember to list which materials belong to the groups you have chosen.

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This worksheet may have been altered from the original on the CD-ROM.
Which are the elements?

Running the activity

The activity can be organised as a circus with groups of pupils moving from one model to another. This is easier to organise than passing models from one group to another.

Pupils look at a variety of atomic models – each model should be labelled with a letter A, B, etc. – and pick out those that contain only one type of atom, i.e. are elements. Later the pupils can be supplied with the colour code for the different elements in the models, so that they can decide which elements are in each.

Suggestions for elements and compounds include: hydrogen H₂, water H₂O, carbon dioxide CO₂, ethane C₂H₆, diamond, graphite, sodium chloride NaCl, sulphur S₈, phosphorus P₄, chlorine Cl₂.

It does not matter which model system is used for this activity.

Answers

Core:
1. Answers will depend on the models supplied.
2. Models allow us to visualise atoms, which are too small to see.
Which are elements?

You are going to pick out the elements from atomic models of different substances.

Considering the evidence

The balls in each model represent atoms. Atoms of the same element are the same colour.

1. Look at each model in turn. If the atoms in the model are the same colour, you have an element.
2. Write down the letters of the models that are elements.
   1. Your teacher will tell you the colours for different elements. Look at the models again. Which elements are in each model?
   2. Describe how atomic models can be useful.
What's in a name?

Running the activity

In this activity the pupils use a range of secondary resources to investigate the history behind some of the names and symbols used for the elements in the periodic table. The information collected is to be summarised using PowerPoint which can be shown in the plenary. The information could then be shared with other teaching groups.

These are some elements which would be productive to investigate: bromine, chlorine, krypton, xenon, lead, phosphorus, selenium, helium, neon, oxygen, mercury, sulphur, silver, gold, hydrogen.

Other relevant material

The following websites provide information about elements:

- WebElements
- The Royal Society of Chemistry
- Chemsoc

For your information

- Oxygen – Greek oxygenes meaning acid forming
- Silicon – from Latin silicis meaning flint
- Mercury – symbol Hg from Latin hydrargyrum meaning liquid silver
- Sulphur – Sanskrit sulvere and in Latin, sulphurium
- Silver – symbol Ag from Latin argentum, silver
- Helium – Greek helios, the sun
- Carbon – symbol Latin carbo, charcoal
- Krypton – Greek kryptos, hidden
- Gold – symbol Au from Latin aurium, gold
- Neon – Greek neos, new one
- Potassium – symbol K from Latin kalium, first extracted from potash
- Xenon – Greek xenos means stranger
- Iron – symbol Fe from Latin ferrum, iron
- Lead – symbol Pb from Latin plumbum for lead
- Hydrogen – Greek hydro meaning water maker
- Iodine – Greek iodes means purple/violet
- Tungsten – symbol W from German wolfram: wolf = wolf and rahm = dirt
- Phosphorus – Greek phosphoros means bringer of light
- Bromine – Greek bromos means stench!
- Chlorine – Greek chloros means pale green
What's in a name?

In this activity you are going to use secondary resources to carry out some research to find out about why elements have been given the name they have.

**Equipment**

- access to ICT
- useful websites:
  - WebElements
  - The Royal Society of Chemistry
  - Chemsoc

Choose one of these elements to investigate: bromine, chlorine, krypton, xenon, lead, phosphorus, selenium, helium, neon, oxygen, mercury, sulphur, silver, gold, hydrogen.

**Collecting evidence**

1. Research the resources available to find out some history behind the name of your element. Things to find out:
   - Is your element named after a person or place? If so, why?
   - Is the word used for the name or symbol of your element from another language? Some names of the elements come from Greek, Latin or Arabic words.
   - What is the meaning of the word used for the name or symbol of your element?
   - How does the meaning of the word suit your element?

2. Summarise your information using PowerPoint to share with the rest of the class.
E3a Metallic and non-metallic elements

Other relevant material
The database for this activity is on the CD-ROM that accompanies this pack.

Most CD-ROM encyclopedias have an interactive periodic table. However, the majority are far too complicated for Year 8 pupils. One of the best is in the Eyewitness Encyclopedia of Science 2.0 (Dorling Kindersley), but this still includes complicated terms.

Running the activity
The database is meant for pupils at all stages in KS3. It contains information not needed at this stage, nor for this activity. The teacher may wish to 'hide' the columns Appearance, Position in periodic table and Density to make what appears on the screen less intimidating.

Expected outcomes
Pupils learn about the properties of metals non-metals. They realise that metallic and non-metallic elements vary in their properties. Pupils gain experience of handling large amounts of information using a database.

Pitfalls
Pupils will need clear guidance on how to use filters or sorts on the database.

Answers
Metals:
1. 53
2. tungsten
3. silver
4. zirconium
5. yttrium
6. caesium
7. 21
Non-metals:
8. 21
9. 9
(a) 1 (b) 11
11. 11
(b) nitrogen (fertilisers, proteins)
(c) chlorine, arsenic

<table>
<thead>
<tr>
<th>Type</th>
<th>Purpose</th>
<th>Differentiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>Pupils use a database to handle a large amount of information and establish that there are a large number of elements and that information is known about each of them.</td>
<td>Core</td>
</tr>
</tbody>
</table>
In this activity you will use a database to answer questions about elements.

### Metals

1. How many records in the database are about metals? (Select the metals using a filter.)
2. Which is the metal with the highest melting point? (Sort the metals according to melting point in descending order.)
3. Which metal is the best conductor of heat energy? (Sort the metals according to How well does it conduct heat energy? in descending order.)
4. Which metal is used to line the reactors in nuclear power plants? (Find ‘reactor’ in the Uses column.)
5. Which metal has the symbol Y? (Find ‘Y’ in the Symbol column. Click on Find in the Symbol column. Click on Find entire cells only.)
6. Which metal melts at 29ºC? (Find ‘29’ in the Melting point column.)
7. How many of the metals are good conductors of electricity? (Select the metals with a rating of 10 using a filter. Make sure you are searching through all records of metals.)

### Non-metals

8. How many records in the database are about non-metals? (Select the non-metals using a filter.)
9. How many of the non-metals are solids? (Select out the solids. This is done using the Appearance at room temperature column as follows:
   - Look under the filter at the top of the column. Select custom.
   - Type *solid* into the box to the right of equals. Click on OK. This will select any entry which ends in the word ‘solid’.)
10. How many of the non-metals are (a) liquids? (b) gases? (Re-select all the non-metals. Select out the liquids and gases in the same way as you selected out the solids in question (2).) (Another way of selecting all the gases would be to pick out all the non-metals with a boiling point less than 25ºC [room temperature]. See question (4).)
11. How many non-metals have a boiling point less than 0°C?
(Make sure you have all the non-metals selected:
- Look under the filter at the top of the column. Select custom.
- Look at the first box. It probably says ‘equals’. Look in the drop down menu for this box. Select ‘is less than’.
- Go to the next box [to the right]. Type in 0 [zero]. Click on OK.)

12. Which non-metal is used to make explosives? Give two other uses of this non-metal element. (Use the Find function to answer these questions. Make sure you have all non-metals selected at the beginning.)

13. Name one non-metallic element which is a poison. (Use the filter on Appearance at room temperature to make your selection for non-metals. Use the filter on the Uses column, select custom, equals and “poison”.)
Physical properties of elements

The database for this activity is on the CD-ROM that accompanies this pack. The following websites provide information about elements:

- WebElements
- The Royal Society of Chemistry
- Chemsoc
- E3b Resource

Running the activity

Pupils collect data regarding the following physical properties for a given element: appearance (including if it is a solid, liquid or gas at room temperature), electrical conductivity, melting point, boiling point and if it is classed as a metal or non-metal. These five properties are then transferred onto the faces of a cube. On the sixth face use the symbol for the element to help reinforcement of symbols.

To help weaker pupils and/or EAL pupils, have an exemplar cube to show them. Agreeing a colour code for each of the properties will help them track the properties being discussed too.

Core: Instructions are given for the data search. Pupils draw up their own recording grid to collate the physical properties, and questions prompt them to draw conclusions. A template is provided for pupils to construct their own cube.

Extension: Pupils can extend their data search to produce additional information cubes about elements of their choice, alternatively they can use their extended data search to produce a newspaper article announcing the discovery and usefulness of their chosen element.

Pupils could search the Internet for additional information regarding their chosen element to either: (a) Produce additional information cubes for the same elements, or (b) Write a newspaper report to announce the discovery and usefulness of a given element.

Pitfalls

Pupils will need clear guidance on how to interrogate the internet references and how to use filters or sorts on the database.

Answers

1. Various, eg all the gases are also non-metals, all the gases have low boiling points and melting points.
2. Various, eg all shiny, usually solid, usually high boiling points and melting points.
3. Metal elements.
4. Similar order.
5. solid
In this activity you will find out five facts about an element that are physical properties and transfer these onto a cube. You will then compare the properties of your element with the properties of other elements.

**Equipment**
- Resource sheet net for cube
- Database

**Obtaining evidence and presenting the results**

1. Make a table with these headings.

<table>
<thead>
<tr>
<th>Name of element</th>
<th>Symbol</th>
<th>Melting point</th>
<th>Boiling point</th>
<th>Metal or non-metal</th>
<th>Electrical conductor</th>
<th>Appearance</th>
</tr>
</thead>
</table>

2. Choose one of the elements in the database and fill in the properties in the appropriate column of the table.

3. Next place the symbol for your element on one face of the cube and then one physical property about your element on each of the remaining five faces of your cube. It might be useful to colour code each property.

4. Use your cube to compare the properties of your element with that of other elements.

5. Use the database to answer the following questions:
   1. Collect all the gas elements together and look at their other physical properties. What patterns can you find?
   2. Collect all the metal elements together and look at their other physical properties. What patterns can you find?
   3. Arrange the elements in order of their melting point data. What type of elements have high melting points?
   4. Can you predict what will happen to the order if you use the boiling point data? Try it.
   5. What state (solid, liquid or gas) are the elements with the highest boiling points?

6. Produce a further fact cube for your element. Here are some suggestions:
   - Can you give a use for your element?
   - What is the chemical symbol for your element?
   - Where might you come across this element in everyday life?
   - Who discovered your element?
   - When was your element discovered?
   - Whereabouts in the world would you find large amounts of your element?
Physical properties of elements
Making copper sulphide

Running the activity

A well-ventilated room is required for this experiment. Sets of one sealed jar of sulphur, one sealed jar of copper turnings and one sealed jar of copper sulphide should be placed about the room for pupil groups to look at when they want to observe differences in the reactants and products. Each group of pupils heats the copper/sulphur until it starts and then stops glowing. They must plug the test tube with mineral wool to absorb any toxic fumes. They then place the test tube on the heatproof mat to cool. Once cool, they try to tap the copper sulphide out of the test tube. If this fails, they should take the test tube to the teacher, who will break the test tube and pick out the copper sulphide.

Other relevant material

Skill sheet 15: Word equations

Expected outcomes

The mixture in the test tube will start to glow, indicating that a chemical reaction is happening. The glow will stop when the reaction is complete.

Pitfalls

The mixture of copper and sulphur must be carefully prepared. Only a small amount of the mixture should be placed in each combustion tube.

The copper sulphide often becomes stuck in the bottom of the test tube. The teacher should ensure that the test tube is wrapped in newspaper before breaking it using a mallet.

Safety notes

The room must be well ventilated for the copper and sulphur reaction. Pupils should wear eye protection, both for observing the demonstration and for carrying out the experiment. Copper compounds are harmful. The test tubes become extremely hot. They should be left for 10 minutes to cool. If necessary, the teacher should remove the copper sulphide from the test tube by breaking the test tube. This creates a hazard and the broken glass should be disposed of carefully.

Answers

1. Yellow powder.
2. Shiny orangey red pieces.
3. black
5. Not shiny or no orangey red turnings.
6. The yellow and red colours darken and disappear, pupils may also see a red glow.
7. Pupils link the black product to evidence of some change.
8. Pupils will be limited to describing the physical changes in appearance and colour.

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Making copper sulphide

Equipment needed

For the class:
- 4 samples of powdered sulphur in sealed, transparent jars
- 4 samples of copper turnings in sealed, transparent jars
- 4 samples of purchased copper sulphide in sealed, transparent jars

For the teacher:
- wooden mallet
- newspaper
- forceps

For each group:
- disposable test tube (a combustion tube) containing 0.5 cm³ of the copper/sulphur mixture
- test tube holder
- Bunsen burner
- heatproof mat
- mineral wool

Tips

Make up a mixture of copper turnings and powdered sulphur in the ratio of 2g iron copper turnings to 1g powdered sulphur. Make sure the mixture is well mixed, because the copper turnings will settle to the bottom of the bottle. Place 0.5 cm³ of the mixture in each test tube before the lesson.

For your information

Running the activity

A well-ventilated room is required for this experiment. Sets of one sealed jar of sulphur, one sealed jar copper turnings, one sealed jar copper sulphide should be placed about the room for student groups to share. Each group of pupils heats the copper/sulphur until it starts and then stops glowing. They must plug the test tube with mineral wool to absorb any toxic fumes. They then place the test tube on the heatproof mat to cool. Once cool, they try to tap the copper sulphide out of the test tube. If this fails, they should take the test tube to the teacher, who will break the test tube and pick out the copper sulphide.

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Skill sheet 15: Word equations

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Safety notes

The room must be well ventilated for the copper and sulphur reaction. Pupils should wear eye protection, both for observing the demonstration and for carrying out the experiment. Copper compounds are harmful. The test tubes become extremely hot. They should be left for 10 minutes to cool. If necessary, the teacher should remove the copper sulphide from the test tube by breaking the test tube. This creates a hazard and the broken glass should be disposed of carefully.
Making copper sulphide

You are going to make copper sulphide from copper and sulphur.

You can write a word equation to show the chemical reaction:

\[
\text{copper + sulphur} \rightarrow \text{copper sulphide}
\]

Equipment
- test tube containing copper and sulphur
- mineral wool plug
- test tube holder
- Bunsen burner
- heatproof mat

Obtaining evidence (1)

1. Heat the copper and sulphur as shown in the illustration. Remember to place a plug of mineral wool at the top of the test tube. Point the open mouth of the tube away from yourself and other pupils. Make sure you hold the bottom of the test tube in the hottest part of the Bunsen flame.
2. Heat for about 2 minutes or until you see the tube start to glow. Remove from the flame.
3. Place the test tube on the heatproof mat. Do not touch it for 10 minutes.
4. While your copper sulphide is cooling, look at the copper, the sulphur and the copper sulphide.

Considering the evidence (1)

1. What does the sulphur look like?
2. What does the copper look like?
3. What does the copper sulphide look like?
4. Write down one way in which the copper sulphide is different from sulphur.
5. Write down one way in which the copper sulphide is different from copper.
6. What did you see when the chemical reaction was happening?

Obtaining evidence (2)

5. After 10 minutes, try to remove the copper sulphide from the test tube. Turn the test tube upside down and tap it gently against the heatproof mat.

Considering the evidence (2)

7. Is a new substance made?
8. Are the properties of the new substance the same as or different from the copper and sulphur? Describe them.
Recording reactions

Running the activity

Core: This concentrates on oxides, with chlorides and sulphides briefly mentioned.

Help: Pupils only complete word equations rather than writing them from scratch. It also concentrates on oxides, with chlorides and sulphides only briefly mentioned.

Extension: This is more demanding with more reading required. It also introduces iodides, fluorides and nitrides but only as examples following the same patterns as oxides, chlorides and sulphides.

Answers

Core:
1. calcium + oxygen → calcium oxide
2. carbon + oxygen → carbon dioxide
3. carbon + oxygen → carbon monoxide
4. hydrogen + oxygen → water
5. sodium + chlorine → sodium chloride
6. calcium + chlorine → calcium chloride
7. potassium + sulphur → potassium sulphide

Extension:
8. sulphur + oxygen → sulphur dioxide
9. hydrogen + oxygen → water
10. strontium + oxygen → strontium oxide
11. magnesium + bromine → magnesium bromide
12. calcium + fluorine → calcium fluoride
13. sodium + iodine → sodium iodide
14. magnesium + nitrogen → magnesium nitride

Help:
1. calcium oxide
2. water
3. carbon dioxide
4. carbon monoxide
5. calcium chloride
6. potassium sulphide
In this activity you are going to use word equations to show chemical reactions.

**Oxides**
When a metal reacts with oxygen it makes an **oxide**. Most oxides have simple names, like magnesium oxide and copper oxide.

Non-metals also react with oxygen to make oxides. ‘Hydrogen oxide’ has a special name. ‘Hydrogen oxide’ is **water**.

Carbon forms two oxides when it burns. This means we need two different names. When carbon is burned with a lot of oxygen it makes **carbon dioxide**. When carbon burns and there is a lack of oxygen, it makes **carbon monoxide**.

1. Use Skill sheet 15: Word equations and the information above to write word equations for the following reactions:
   - 1. calcium and oxygen
   - 2. carbon and oxygen when there is a lot of oxygen
   - 3. carbon and oxygen when there is a limited amount of oxygen
   - 4. hydrogen and oxygen.

**Reactions of metals with other non-metals**
Metals also react with non-metals other than oxygen. For example:

- metals react with chlorine to make **chlorides**
- metals react with sulphur to make **sulphides**.

2. Write word equations for the following reactions:
   - 5. sodium and chlorine
   - 6. calcium and chlorine
   - 7. potassium and sulphur.

**Extension**

3. Write word equations to represent:
   - 8. the formation of sulphur dioxide
   - 9. hydrogen reacting with oxygen
   - 10. strontium reacting with oxygen.

**Reactions with other non-metallic elements**
Metallic elements react with other non-metallic elements. For example:

- bromine makes **bromides**
- fluorine makes **fluorides**
- iodine makes **iodides**
- nitrogen makes **nitrides**.

4. Write word equations for the following reactions:
   - 11. magnesium and bromine
   - 12. calcium and fluorine
   - 13. sodium and iodine
   - 14. magnesium and nitrogen.
Recording reactions

In this activity you are going to use word equations to show chemical reactions.

Oxides

When a metal reacts with oxygen it makes an oxide. Most oxides have simple names, like magnesium oxide and copper oxide.

1. Complete this word equation. It shows the reaction between calcium and oxygen.
   calcium + oxygen → _______________________________________________
   Non-metals also react with oxygen to make oxides. ‘Hydrogen oxide’ has a special name. ‘Hydrogen oxide’ is water.

2. Complete this word equation. It shows the reaction between hydrogen and oxygen.
   hydrogen + oxygen → _______________________________________________
   Carbon forms two oxides when it burns. This means we need two different names. When carbon is burned with a lot of oxygen it makes carbon dioxide. When carbon burns and there is a lack of oxygen, it makes carbon monoxide.

3. Complete this word equation. It shows the reaction of carbon and oxygen when there is lots of oxygen.
   carbon + oxygen → _______________________________________________

4. Complete this word equation. It shows the reaction of carbon and oxygen when there is a lack of oxygen.
   carbon + oxygen → _______________________________________________

Reactions of metals with other non-metals

Metals also react with other non-metals. For example, metals react with chlorine to make chlorides.

5. Complete the word equation. It shows the reaction between calcium and chlorine.
   calcium + chlorine → _______________________________________________
   Metals also react with sulphur to make sulphides.

6. Complete the word equation. It shows the reaction between potassium and sulphur.
   potassium + sulphur → _____________________________________________
It's elementary

Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils define what the terms material, element, pure substance and mixture mean to them.</td>
<td>In pairs pupils share responses to questions from Activity E1a.</td>
<td>In groups pupils feedback to the class their results from Activity E1a.</td>
<td>Pupils play odd man out.</td>
<td>Pupils brainstorm: what information about these special materials called elements do you think we should collect?</td>
</tr>
</tbody>
</table>

Review learning
- Pupils work in pairs to write a definition in their own words of these words: material, pure substance, mixture, element.
- Take feedback from pairs and summarise on the board.
- Identify the importance of using scientific vocabulary to avoid confusion when using the term ‘pure’ in science as opposed to everyday usage.
- Challenge: Ask pupils to suggest why yoghurt is not classed as a pure material in science.

Sharing responses
- In pairs pupils compare their ideas for classifying the sample materials. A summary list is made.
- Pupils identify examples of materials which appear in at least two different sorting groups and compare the criteria used to group these in each case.
- Pupils identify the elements found in the sample provided and in their additional suggestions.

Group feedback
- In groups pupils feedback to the class their results from Activity E1a.
- Pupils decide which materials they would describe as ‘pure’.

Word game
- Pupils identify the ‘odd man out’ in each list opposite and justify their answer.

Looking ahead
- Explain that in order to be classed as an element you need to possess unique properties, i.e. have characteristics that are not matched by any other material.
- Summarise pupils’ ideas and if possible identify suggestions linked to physical properties and also, suggestions linked to the atoms/particles present.

Questions
- What information about these special materials called elements should we collect?
- What features/characteristics/properties might help an element stand out?

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The elements

Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
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<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils identify three facts they have discovered about an element of their choice.</td>
<td>Pupils discuss their responses to the questions in Activity E2a.</td>
<td>Pupils present their PowerPoint summaries from Activity E2b.</td>
<td>Pupils play a domino game to reinforce element names and symbols.</td>
<td>Pupils write about the sorts of ways that metals and non-metals are the same and different.</td>
</tr>
</tbody>
</table>

Review learning

- Each pupil recalls three facts about one element and shares them with a partner. Two pairs then share.
- The four pupils then take turns asking each of the other three to recall one of the three facts about their element.
- Ask if any pupil can recall all 12 facts?
- Pupils could challenge other classmates by saying “my element ....(pupil shares the three facts).... who am I?”

Sharing responses

- In pairs pupils discuss their responses to the questions in Activity E2a.

Group feedback

- Pupils present their PowerPoint summaries from Activity E2b.
- Ask pupils which element they would nominate as the greatest element?

Word game

- Pupils play dominoes using the dominoes from the Pupil sheets.
- Two players draw five cards each. The rest are left in a pile face downwards. The top card is turned over and placed on the desk to start the game. Player one matches one of their cards to either end of the starting domino. Then player two takes their go. If either player cannot go then they must take an additional card from the pile. The game is over when one player has got rid of all their cards.

Looking ahead

- Pupils write four short paragraphs on elements on the basis of the information they have researched to date:
  - So far I think metal elements and non-metal elements both...
  - So far I think only metal elements...
  - So far I think only non-metal elements...
  - I think physical properties describe...
- These suggestions can then be referred back to in Lesson E4.

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The elements

Word game

calcium | potassium | copper | lead | magnesium

Pb | Cu | Ca | Ag | O

oxygen | sodium | aluminium | tin | chlorine

Na | Al | Sn | Ca | Zn

zinc | copper | magnesium | calcium

lead | aluminium | calcium | Al | Mg

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**The elements (continued)**

**Word game**

- nitrogen
- uranium
- sulphur
- iron
- platinum
- iodine
- phosphorus
- gold
- helium
- mercury
- carbon
- hydrogen
- iodine
- iron
- uranium
- sulphur
- platinum
- hydrogen
- sulphur
- iodine
- iron
- uranium
- sulphur
How elements differ

Suggested alternative plenary activities (5–10 minutes)

**Review learning**
- Pupils are given a label with an element on it (could just use the symbol to make it more challenging).
- Each pupil then finds two other pupils to link up with and has to explain why they have grouped together.

**Sharing responses**
- Individual pupils or pairs are asked to talk through how they worked out a given answer to one of the questions set in Activity E3a. How did they use the database, what did they find easy, what did they find difficult.

**Group feedback**
- In pairs pupils agree key features of elements they want to summarise. Each pair then produces a summary for the class. Each pair chooses their own format (this could be extended to form a homework).

**Word game**
- Pupils play Happy Families in groups of three.
- For full instructions, see Pupil sheets.

**Looking ahead**
- Pupils work in pairs. Read out each of the statements opposite in turn. After each statement ask individual pairs:
  - am I a metal element or non-metal element?
  - why do you think that?
  - finally when you have read all the statements, ask the pairs to make a choice and talk through the thinking they did to arrive at their decision. Ask them what other information they would like to have.

Examples

Na, K, Li (all belong to same group); Cu, C, Cl (all share letter C); Cu, Mg, Zn (all metals); O₂, N₂, Cl₂ (all gases); Ni, Co, Fe (all magnetic)

Statements

I exist as a solid; I am sometimes used in jewellery; I am not magnetic; I am black in appearance; I can be very soft; I conduct electricity

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How elements differ

Word game

Some Non-metals
硫 (S) — matches
氧 (O) — combustion
磷 (P) — matches
氧 (O) — nitrogen
䍈 (NP) — phosphorus
氧 (O) — oxygen
硫 (S) — sulphur
氧 (O) — sulphur

Group II Elements
镁 (Mg) — flash bulbs
钙 (Ca) — concrete
钡 (Ba) — spark plugs
锶 (Sr) — fireworks

E3 How elements differ (continued)

Word game

Group I Elements
- Li: lithium
- Na: sodium
- K: potassium

Group VII Elements
- F: fluorine
- Cl: chlorine
- Br: bromine
- I: iodine

Applications:
- Lithium: in batteries
- Sodium: in photoelectric cells
- Potassium: in Fertiliser
- Chlorine: in water purification
- Bromine: in photographic film
- Iodine: in disinfectant
- Fluorine: in toothpaste additives
disinfectant

Sheet 2 of 4

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Word game

<table>
<thead>
<tr>
<th>Group IV Elements</th>
<th>Ancient Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td>carbon</td>
<td>copper</td>
</tr>
<tr>
<td>Si</td>
<td>silicone</td>
</tr>
<tr>
<td>Pb</td>
<td>lead</td>
</tr>
<tr>
<td>Sn</td>
<td>tin</td>
</tr>
<tr>
<td>C</td>
<td>carbon</td>
</tr>
<tr>
<td>Pb</td>
<td>lead</td>
</tr>
<tr>
<td>Sn</td>
<td>tin</td>
</tr>
</tbody>
</table>

Elements and their uses:
- **Cu**: Copper - Pipe, wire, cable, car batteries
- **Ag**: Silver - Jewellery, mirrors
- **Au**: Gold - Microchips, coins, thermometers, car batteries, soup, tomatos
- **Hg**: Mercury - Cans, microchips, coincs, thermometers, mirrors

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Instructions for playing Happy Families

The game can be played by 2 or 4 players.

- Shuffle the cards.
- Deal out all the cards face down.
- Players look at their hands and decide which cards they need to complete each family.
- The player to the left of the dealer begins. They ask any player for a card (naming which member of the family they require – they must already hold at least one card in that family).
- If the player asked has the card, it must be handed over and the asker continues by asking the same or another player for another card.
- If the asked player does not have the wanted card they say ‘sorry no’ and the turn passes to them.
- Completed families are placed face down in front of the owner.
- When all the families are complete the player with the most families is the winner.
E4  Getting it right - Think about

**Suggested alternative plenary activities (5–10 minutes)**

<table>
<thead>
<tr>
<th>Group feedback</th>
<th>Bridging to other topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils share their answers to the questions in the pupil book.</td>
<td>The class discusses and recalls the ways in which we group living things. Pupils identify that these different ways arise because of different purposes/needs.</td>
</tr>
</tbody>
</table>

**Group feedback**

- Pupils share their answers to the questions in the pupil book and decide whose approach, Lillian’s, Joe’s, Yasmin’s (or Tony’s red book), will work best in classifying elements into metals or non-metals.

- If pupils carried out the ‘Looking Ahead’ plenary from lesson E2 they can review how their ideas have changed, stayed the same, changed a little.

**Bridging to other topics**

- The class discusses the ways in which we group living things. Pupils can be asked to consider these questions:
  - What criteria do we use to group living things?
  - How many different ways can we classify living things?
  - Do we need more than one way? Why?
  - Where else do we use classifying to help us?
  (Possible responses are rocks, solubility, fuels.)
E5  Reacting elements

Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils use a flicker book to mix and match elements into compounds.</td>
<td>Pupils share responses to Activity E5a reacting copper and sulphur.</td>
<td>Groups describe their way of teaching another pupil/group of pupils how to write word equations.</td>
<td>Pupils play bingo.</td>
<td>Pupils revise and consolidate knowledge from the unit.</td>
</tr>
</tbody>
</table>

Review learning
- Pupils use the mix and match booklet to see how many different compounds they can come up with in three minutes. (N.B. Symbols/formulae have been included to support later work but, when combined, will not always produce balanced formulae.)

Share responses
- What evidence do you have to suggest you have carried out a chemical reaction in Activity E5a?
- Can you suggest what might happen if sulphur reacts with magnesium?
- What do you notice about the name of your product and these names: iron sulphide, zinc sulphide. What name comes first, what name comes second? Which type of name always seems to change?
- Can you suggest a general rule or pattern for deciding how to name a product between a metal and a non-metal?

Group feedback
- Pupils work in pairs to suggest how they would help another pupil or group of pupils to start writing word equations.
- Are there any words or phrases they need to know?
- What should they do first? Second?
- Are there any do’s and don’ts?
- Outcomes could be summarised on a large wall display as a genuine prompt for the class and others. It could be put on PowerPoint and used when the class moves onto unit 8F.

Word game
- Pupils select nine words from the list to write into their bingo grid.
- Read out definitions from the teacher sheet in any order. Pupils match these to their chosen words. The game is over when a pupil can strike out a line.
- The ‘winning’ pupil has to recall the definitions of the words as they read each one in the winning line to the class.

Looking back
- Pupils revise and consolidate knowledge from the unit. They can use the Unit map, Pupil checklist, or the Test yourself questions.
Reacting elements

Review learning

- Copper (Cu)
- Carbonate (CO₃)
- Iron (Fe)
- Oxide (O)
- Magnesium (Mg)
- Sulphate (SO₄)
- Hydrogen (H)
- Nitrate (NO₃)
- Zinc (Zn)
- Bromide (Br)
- Potassium (K)
- Sulphide (S)
- Calcium (Ca)
- Fluoride (F)
- Lithium (Li)
- Chloride (Cl)
Reacting elements

Word game

Bingo!

Choose nine words from the list below and write them in the empty grid.

- material
- atom
- metal
- compound
- element
- iron
- air
- pH
- physical property
- nitrogen
- melting point
- water

Cross out each word when you hear the teacher read out its definition.

Shout BINGO! when you have crossed out a line of three words on the card.

The line can be across, down or diagonal.

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Reacting elements

Word game

Teacher sheet

Read out the definitions below in any order.

1. Everyday word we use to describe what things are composed or made of. [material]
2. Describes any substance which only contains identical atoms. [element]
3. Appearance, electrical conductivity, thermal conductivity, solid, liquid or gas are all examples of what kind of properties? [physical property]
4. Smallest particle of matter that can exist on its own. [atom]
5. This element combines with oxygen to produce an oxide commonly known as rust. [iron]
6. A gaseous element used in making fertilisers. [nitrogen]
7. Is a mixture of several gases jumbled up together. [air]
8. This name can be used to classify elements that are good electrical conductors. [metal]
9. The temperature at which a substance changes from solid to liquid. [melting point]
10. Made when elements react together. [compound]
11. Measures the acidity of a substance. [pH]
12. The more common name for hydrogen oxide. [water]
1. Draw lines to match the words to their descriptions.

- **mixture**
  - A word that can be used to mean an atom or a molecule.

- **element**
  - A group of atoms joined together.

- **atom**
  - The simplest type of particle.

- **molecule**
  - This is made up of two or more substances.

- **pure substance**
  - This is made up of one kind of substance.

- **particle**
  - This contains only one type of atom.

2. Look carefully at these diagrams. The diagrams show four different pure substances.

![Diagrams A, B, C, D]

Which of the pure substances are elements? Colour the elements in red.
3 Look at this list of materials. Use some of the materials to answer the questions.

- sea water
- gold
- air
- water
- sulphur
- tea
- mercury
- oxygen
- silver
- helium
- cola
- hydrogen

a Find the elements. Colour them in blue.

b What is the name of the element that is found near volcanoes? ..............................................

c What is the name of the element that is a yellow metal? .........................................................

d Which element is a liquid metal used in thermometers? .........................................................
1 Use some of these words to fill in the gaps.

a The ______________________________ is a list of all the elements.

b The columns in the Periodic Table are called ____________________.

c The rows in the Periodic Table are called ____________________.

d There are ____________________ than 100 elements in the Periodic Table.

e The ____________________ are found on the left of the Periodic Table.

    The ____________________ are found on the right of the Periodic Table.

f There are ____________________ metals than non-metals.

2 Write true or false for each sentence. You will need to use a copy of the Periodic Table to help you.

a Some elements have the same symbol. ______________

b All symbols start with a capital letter. ______________

c He is the symbol for hydrogen. ______________

d Cu is the symbol for copper. ______________

e Ne is the symbol for neon. ______________

f Ne is the symbol for nitrogen. ______________

g Gold is a non-metal. ______________

h Carbon is a metal. ______________
3 Draw lines to match the symbols to the elements.

- H: aluminium
- He: carbon
- C: chlorine
- N: copper (its Latin name is cuprum)
- O: helium
- Mg: hydrogen
- Al: iron (its Latin name is ferrum)
- P: magnesium
- S: nitrogen
- Cl: oxygen
- Fe: phosphorus
- Cu: sulphur
How elements differ

1. Write true or false for each sentence.
   a. All metals are shiny when polished. .................
   b. All non-metals are shiny. .................
   c. Most metals are liquids. .................
   d. Most non-metals are solids or gases. .................
   e. Only three metals are magnetic. .................

2. Look at this list of elements

a. Which elements are solids? Colour them blue.
   b. Which elements are liquids? Colour them green.
   c. Which elements are gases? Colour them yellow.
   d. Which element is a green gas? .................
   e. Which element is a yellow solid? .................
   f. Which elements are magnetic?
      ....................................................................

© Harcourt Education Ltd 2004 Catalyst 2
This worksheet may have been altered from the original on the CD-ROM.
### Getting it right

1. You need the fact files on page 53 in the *Catalyst* textbook. Use the information from the fact files to fill in this table. Use ticks (✓) and crosses (✗) and write in the correct answer – solid, liquid or gas – in that column.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphur</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromine</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Lillian says all metals are solids.
   - **a** Are all metals solids? Yes / No
   - **b** Is Lillian right? Yes / No
   - **c** If your answer to part **a** is ‘No’, which metal is not a solid? …………………

3. Joe says metals stick to magnets.
   - **a** Do all metals stick to magnets? Yes / No
   - **b** Is Joe right? Yes / No

4. Yasmin says all the elements that conduct electricity are metals.
   - **a** Do all the metals conduct electricity? Yes / No
   - **b** Do any non-metals conduct electricity? Yes / No
   - **c** Is Yasmin right? Yes / No
   - **d** If your answer to part **b** is ‘Yes’, which non-metal conducts electricity? …………………
E5 Reacting elements

1 Use these words to fill in the gaps.

- **a** A substance made up of only one type of atom is called an ____________.
- **b** A substance made up of more than one type of atom joined together is called a ________________.
- **c** To make a ________________ you need to ________________ the atoms of different ________________ together.

2 Look at these particle diagrams.

- **a** Find the diagrams which show elements. Colour them blue.
- **b** Find the diagrams which show compounds. Colour them red.
Magnesium and oxygen are elements. These pictures show what happens when magnesium is burned in oxygen.

a Which element is a silvery metal? Magnesium / Oxygen

b Which element is a clear, colourless gas? Magnesium / Oxygen

c Tick the correct answers.

i The substance made is …
   ..like magnesium  □
   ..like oxygen  □
   ..not like magnesium or oxygen; it is something new.  □

ii The substance made is called …
   ..magnesium oxygen  □
   ..magnesium oxide  □
   ..oxygen magneside.  □

iii The substance made is a …
   ..mixture  □
   ..compound  □
   ..element.  □

d Complete this word equation.
   magnesium + ........................................... → ........................................... oxide
E1 It’s elementary
1 mixture – This is made up of two or more substances.
element – This contains only one type of atom.
atom – The simplest type of particle.
molecule – A group of atoms joined together.
pure substance – This is made up of one kind of substance.
particle – A word that can be used to mean an atom or a molecule.
2 Coloured red – B and C
   a Coloured blue – gold, sulphur, mercury, oxygen, silver, helium, hydrogen
   b sulphur
   c gold
   d mercury

E2 The elements
1 a Periodic Table.
b groups
c periods
d more
 e metals, non-metals
 f more
2 a false
   b true
   c false
   d true
   e true
   f false
   g false
   h false
3 H – hydrogen
   He – helium
   C – carbon
   N – nitrogen
   O – oxygen
   Mg – magnesium
   Al – aluminium
   P – phosphorus
   S – sulphur
   Cl – chlorine
   Fe – iron
   Cu – copper

E3 How elements differ
1 a true
   b false
   c false
   d true
   e true
2 a Coloured blue – sulphur, iron, nickel, copper, cobalt, magnesium
   b Coloured green – mercury, bromine
   c Coloured yellow – chlorine, oxygen, helium
   d chlorine
   e sulphur
   f iron, nickel, cobalt

E4 Getting it right
1 Element | Metal | Non-metal | Shiny? | Solid, liquid or gas? | Magnetic? | Conducts electricity?
---------|-------|-----------|--------|----------------------|----------|----------------------
Copper   | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Aluminium| ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Iron     | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Nickel   | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Bromine  | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Hydrogen | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Carbon   | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Sulphur  | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
Chlorine | ✓     | ✓         | ✓      | ✓                   | ✓        | ✓                    
2 a no
   b no
   c mercury
3 a no
   b no
4 a yes
   b yes
   c no
   d carbon

E5 Reacting elements
1 a element
   b compound
   c compound, join, elements
2 a Coloured blue – A, B, C, E
   b Coloured red – D, F
3 a magnesium
   b oxygen
   c i Not like magnesium or oxygen; it is something new.
   ii Magnesium oxide.
   iii compound
   d magnesium + oxygen → magnesium oxide
HELP

1. Look at the three diagrams.

A  

B  

C  

a i. Which substance is a mixture?
   ii. Explain why it is a mixture.

b i. One diagram represents solid iron. Which one?
   ii. Explain why you chose your answer.
   iii. Why is this substance an element?

2. Copy the table and write the substances into the correct column.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Element</th>
<th>Molecule</th>
<th>Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>copper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gold</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carbon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>helium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>air</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carbon dioxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bread</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**E1 It's elementary (continued)**

**CORE 3**

**A**

- Which substance is a mixture of molecules?
- Which pure substance contains molecules?
- Which substance might be helium?
- i  Which substance might be mercury?
  ii  Explain your choice.

**4** Kevin found a piece of rock. He melted it and passed electricity through it. A gas was given off and a shiny silver solid appeared as well. Kevin could not break down the gas into a simpler substance. He found that the silver solid would burn very well. It made a brilliant flame and became a powdery white solid containing black flakes.

- The substances could be an element, a mixture or a molecule. Explain which description best fits each underlined substance by copying and completing the table.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Element, mixture or compound</th>
<th>Evidence for choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piece of rock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver solid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdery white solid with black flakes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Describe two important features of the atoms in the shiny silver solid.
In the Middle Ages, alchemists tried to make gold. Often, kings and princes employed them. They were trying to find out how to create wealth. One idea they had was that gold could be made from yellow substances.

One recipe suggested that boiling cow’s urine might make gold. It did not! But another material called phosphorus was obtained from urine.

In the recipe, a vat of urine was boiled until it had reduced to one quarter of its original volume. The liquid was cloudy so it was filtered to remove the undissolved solids and boiled again, leaving a solid in the bottom. They could not break down this solid into anything simpler. When dry, some bits of the solid would burn with a blue flame. During burning, the bits of phosphorus reacted with oxygen.

Oxygen has particles made from two oxygen atoms joined together.

In China, a group called the Taoists tried to develop an immortality pill to help them live forever. They refined cinnabar, a mineral containing mercury sulphide. Unfortunately, mercury is very toxic and their immortality pills killed many people, including several Chinese emperors!

**a** Why might the alchemists have thought that gold could be made from yellow substances?

**b** What is the evidence that phosphorus is an element?

**c** What is the evidence that oxygen is an element?

**d** Explain how the paragraph above shows that cinnabar is not a pure substance.

**e** Which two elements are found in the pure substance obtained from cinnabar?

**f** Explain how the information above shows that urine is a mixture.

---

When mercury sulphide is heated in air it becomes mercury oxide. A gas called sulphur dioxide is given off. The mercury oxide then goes on to break down into mercury metal and oxygen gas.

**a** This information contains the names of three elements. What are they?

**b** One of the elements is also a molecule. Which one?

**c** Three pure substances, that are not elements, are also named. Write them down.

**d** Where did the sulphur that was in the sulphur dioxide, come from?

**e** Where did the oxygen, that reacted with the sulphur, come from?
E2  The elements

HELP

1

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Li</td>
</tr>
<tr>
<td>3</td>
<td>Mg</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

a  Write down the symbol of an element in Group II.

b  Write down the symbol of the element in the same Group as Ar.

c  Write down the symbol of the element in the same Period as Mg.

d  i  In which group is element ‘a’?
    ii Explain how you know that the letter ‘a’ is not the symbol for this element.

e  How many of the elements shown are non-metals?

f  Write down the symbol of an element in the same Group as element ‘c’.

g  Which element, shown by a letter that is not its symbol, is in the same Group as N?

h  Which element is probably argon?

2  Copy and complete the sentence below:

Mendeleev is an important scientist because

CORE

3  Copy the outline of the Periodic Table, shown in question 1, but do not put in the symbols.

a  Shade in the elements that are non-metals.

b  Write the symbols for the following elements in their correct positions:
    i  Sodium, symbol Na, in Group I and Period 3.
    ii Chlorine, symbol Cl, in Group VII and Period 3.
    iii Xenon, symbol Xe, in Group O and Period 5.

c  How many of the elements in Group II are metals?

d  The symbol for lead is Pb. It was used by the Romans to line water tanks and plumbing generally. Suggest why its symbol is Pb rather than Le.
Look at the following information about some elements.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Reason for symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>Cuprum is Latin for copper</td>
</tr>
<tr>
<td>Tungsten</td>
<td>W</td>
<td>Wolfram means tungsten, in German</td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td>Plumbum is Latin for lead</td>
</tr>
<tr>
<td>Sodium</td>
<td>Na</td>
<td>Natrium is Latin for salt</td>
</tr>
<tr>
<td>Silver</td>
<td>Ag</td>
<td>In Latin, silver is argentium</td>
</tr>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>Ferrum is Latin for iron. Also, haem, as in haemoglobin, means 'containing iron'</td>
</tr>
</tbody>
</table>

a Which elements are likely to be found in each of the following minerals:
   i ferrite?
   ii wolframite?
   iii haematite?
   iv cuprite?

b In Africa, there is a lake called Lake Natron. What does it probably contain in the water?

c Why are people who mend pipes and sinks called plumbers?

d You may need a copy of the Periodic Table to work these out.
   i How many Groups contain only metals?
   ii How many Groups contain only non-metals?
   iii How many Groups contain both metals and non-metals?
How elements differ

1. Some of the statements below are true and some are false. For each statement say whether it is true or false.
   a. There are about one hundred metals in the Periodic Table.
   b. Iron is a magnetic element.
   c. When aluminium reacts with iodine it forms aluminium oxide.
   d. Most metals are electrical insulators.
   e. Some non-metal elements are gases.

2. Brass is a mixture of copper and zinc. It conducts both heat and electricity. It is a shiny gold colour when it has been polished.

   Copy and complete the following sentences:
   a. Brass is not in the Periodic Table because ..........................................
   b. Copper is a metal because .............................................................

3. Here is a list of elements.

   Copy the table below and write the elements into the correct columns.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Non-metal</th>
</tr>
</thead>
<tbody>
<tr>
<td>sodium</td>
<td>sulphur</td>
</tr>
<tr>
<td>carbon</td>
<td>gold</td>
</tr>
<tr>
<td>tin</td>
<td>nitrogen</td>
</tr>
<tr>
<td>chlorine</td>
<td></td>
</tr>
</tbody>
</table>
Here is some information about some elements.

<table>
<thead>
<tr>
<th>Element</th>
<th>Melting point (°C)</th>
<th>Boiling point (°C)</th>
<th>Electrical conduction</th>
<th>Cost per 100g (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>1083</td>
<td>2582</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Tungsten</td>
<td>3377</td>
<td>5527</td>
<td>10</td>
<td>268</td>
</tr>
<tr>
<td>Potassium</td>
<td>63</td>
<td>766</td>
<td>10</td>
<td>114</td>
</tr>
<tr>
<td>Oxygen</td>
<td>−219</td>
<td>−183</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Krypton</td>
<td>−157</td>
<td>−153</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>1455</td>
<td>2837</td>
<td>10</td>
<td>47</td>
</tr>
<tr>
<td>Iodine</td>
<td>114</td>
<td>185</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>1903</td>
<td>2642</td>
<td>9</td>
<td>260</td>
</tr>
<tr>
<td>Fluorine</td>
<td>−220</td>
<td>−188</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Rhodium</td>
<td>2020</td>
<td>3727</td>
<td>10</td>
<td>2040</td>
</tr>
</tbody>
</table>

a Which elements are gases at room temperature?

b Which elements are metals?

c Which elements will be liquids at −156°C?

d Which elements will condense when cooled from 2700°C to 2000°C?

e Which elements will stay solid at the temperature at which nickel melts?

f If all the elements were heated up, starting from −250°C, which one would:
   i melt first?
   ii boil first?
How elements differ (continued)

5  a Which element is best for the filaments in filament lamps, which get extremely hot?
   b Which gas is in Group VII of the Periodic Table? (You will need a copy of the Periodic Table.)
   c Suggest why potassium is not used to make electrical wires but copper is.
   d Suggest a reason why copper is used in house wiring circuits, rather than tungsten.
   e Explain why iodine can be kept in an open beaker, at 20 °C, but fluorine cannot.

EXTENSION

6  Use the information below to answer the questions.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Symbol</th>
<th>Electrical conduction</th>
<th>Other information or uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>C</td>
<td>7</td>
<td>Electrical conductors in electric motors</td>
</tr>
<tr>
<td>Silicon</td>
<td>Si</td>
<td>5</td>
<td>In the electrical circuits of computers, as silicon chips</td>
</tr>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>10</td>
<td>Nails, building girders, ships</td>
</tr>
<tr>
<td>Brass</td>
<td></td>
<td>10</td>
<td>Ornaments</td>
</tr>
<tr>
<td>Gold</td>
<td>Au</td>
<td>10</td>
<td>Jewellery</td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td>9</td>
<td>To make plumber’s solder</td>
</tr>
<tr>
<td>Selenium</td>
<td>Se</td>
<td>1</td>
<td>In light sensors</td>
</tr>
</tbody>
</table>

a  i Carbon and silicon are non-metals. Which property of both elements is unexpected?
   ii Why is it unexpected?

b  Explain why brass has not been given a symbol.

c  Which property of gold makes it very good for jewellery?

d  Plumber’s solder can be melted, using a blow-torch, to run into and seal the joints between pipes. Which property of lead makes it good for this purpose?

e  i Suggest whether selenium is a metal or a non-metal.
   ii Explain your decision.
When copper is heated in oxygen it forms a black solid called copper oxide.

a) Write down the name of the element that the copper reacted with.

b) Copy and complete this word equation:
   \[ \text{Copper} + \text{[Blank]} \rightarrow \text{[Blank]} + \text{[Blank]} \]

c) Copy the table below and write the names of the substances in your word equation into the table.

<table>
<thead>
<tr>
<th>Element</th>
<th>Compound</th>
</tr>
</thead>
</table>

Kerry is burning some elements in oxygen. She needs to take some safety precautions.

a) Why does she need to take safety precautions?

b) Describe two safety precautions she should take.

c) Kerry burns carbon in oxygen. It makes carbon dioxide. Some of these are reactants. Some are products.

Copy and complete the sentences:
   i) Carbon is [Blank].
   ii) Oxygen is [Blank].
   iii) Carbon dioxide is [Blank].
   iv) Write the word equation for this reaction.

The diagrams below show the particles in some substances.

a) Which substances are compounds?

b) Which substances are elements?

c) Explain how you could tell the difference.
4 Look at this list of formulae. Some represent elements and some represent
compounds.

\[
\text{CuO} \quad \text{Mg} \quad \text{SO}_2 \quad \text{FeS} \quad \text{Al}_2\text{O}_3 \quad \text{Xe} \quad \text{Pb}
\]

a Make a two-column table. Head the first column ‘Element’ and the second column
‘Compound’. Write each of the formulae into the table, in the correct column.

b Which of them are oxides?

c How many sulphides are there?

d How many do not contain a metal element?

EXTENSION

5 Make a copy of this table
but alter it to match the name
with the correct formula.

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium oxide</td>
<td>MgS</td>
</tr>
<tr>
<td>Magnesium sulphide</td>
<td>CaO</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>NiS</td>
</tr>
<tr>
<td>Nickel sulphide</td>
<td>Na$_2$O</td>
</tr>
</tbody>
</table>

6 Complete the following word equations.

a Calcium + chlorine → .........................................................

b Nickel + sulphur → ...............................................................

c ........................................ + oxygen → strontium oxide

d ........................................ .................................. → potassium fluoride

e ........................................ .................................. → carbon monoxide

7 Read the following extract about barium.

Barium ignites very easily and burns with a brilliant lime green flame. Pieces
of burning barium may fall off the burning solid, which reaches extremely
high temperatures. The solid product is very strongly corrosive when damp.

a Describe how you would show someone how barium burns.

b Describe what safety precautions you would take and why they would be needed.
### HELP

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ai</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ii</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>It contains more than one type of particle/atom.</td>
<td></td>
</tr>
<tr>
<td>b i</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ii</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Atoms/particles all touching; and in regular pattern.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>All the atoms/particles are the same.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Elements: Copper, Gold, Carbon, Helium.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Award 1 mark for each correctly placed substance.</td>
<td></td>
</tr>
</tbody>
</table>

### CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 a</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>d i</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>All the same atoms; close together; not in a regular arrangement.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Accept equivalent answers.</td>
<td></td>
</tr>
<tr>
<td>4 a</td>
<td>Shaded area is copied. The rest shows the pupil's answers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Substance</strong></td>
<td><strong>Element, mixture or compound</strong></td>
</tr>
<tr>
<td></td>
<td>Piece of rock</td>
<td>Compound</td>
</tr>
<tr>
<td></td>
<td>Gas</td>
<td>Element</td>
</tr>
<tr>
<td></td>
<td>Silver solid</td>
<td>Element</td>
</tr>
<tr>
<td></td>
<td>Powdery white solid with black flakes</td>
<td>Mixture</td>
</tr>
<tr>
<td>b</td>
<td>Two from: All the same; close together; all touching; regular pattern.</td>
<td>2</td>
</tr>
</tbody>
</table>

### EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 a</td>
<td>Same colour/gold is yellow(ish).</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>Could not break it down further.</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Has two oxygen atoms joined together/both atoms in it are the same.</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>It contains two different substances.</td>
<td>1</td>
</tr>
<tr>
<td>e</td>
<td>Mercury and sulphur.</td>
<td>2</td>
</tr>
<tr>
<td>f</td>
<td>Had to be filtered/contained several substances.</td>
<td>1</td>
</tr>
<tr>
<td>6 a</td>
<td>Mercury Sulphur Oxygen</td>
<td>One mark for each correct answer.</td>
</tr>
<tr>
<td>b</td>
<td>Oxygen</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Mercury sulphide; mercury oxide; sulphur dioxide. One mark for each correct answer.</td>
<td>3</td>
</tr>
<tr>
<td>d</td>
<td>From the mercury sulphide.</td>
<td>1</td>
</tr>
<tr>
<td>e</td>
<td>From the air.</td>
<td>1</td>
</tr>
</tbody>
</table>

Total for Help 14

Total for Core 13

Total for Extension 16

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### HELP

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Mg</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>Kr</td>
<td>1</td>
</tr>
<tr>
<td>1 c</td>
<td>Ar</td>
<td>1</td>
</tr>
<tr>
<td>1 d i</td>
<td>Group IV. Do not accept Group 4</td>
<td>1</td>
</tr>
<tr>
<td>1 d ii</td>
<td>It does not start with a capital letter</td>
<td>1</td>
</tr>
<tr>
<td>1 e</td>
<td>S</td>
<td>1</td>
</tr>
<tr>
<td>1 f</td>
<td>Li</td>
<td>1</td>
</tr>
<tr>
<td>1 g</td>
<td>B</td>
<td>1</td>
</tr>
</tbody>
</table>

Mendeleev is an important scientist because he worked out how the elements should be arranged in the Periodic Table. Accept equivalent answers. Underlined text shows pupil’s answer. 1

| Total for Help | 9 |

### CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 a</td>
<td>Outline table correct. Non-metals correctly shaded in.</td>
<td>1</td>
</tr>
<tr>
<td>3 b i-iii</td>
<td>Na, Cl and Xe in the correct position.</td>
<td>1</td>
</tr>
<tr>
<td>3 c</td>
<td>6/all of them</td>
<td>3</td>
</tr>
<tr>
<td>3 d</td>
<td>Comes from the Latin for lead/comes from plumbum in Latin</td>
<td>1</td>
</tr>
</tbody>
</table>

| Total for Core | 7 |

### EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 a i</td>
<td>Iron</td>
<td>1</td>
</tr>
<tr>
<td>4 a ii</td>
<td>Tungsten</td>
<td>1</td>
</tr>
<tr>
<td>4 a iii</td>
<td>Iron</td>
<td>1</td>
</tr>
<tr>
<td>4 a iv</td>
<td>Copper</td>
<td>1</td>
</tr>
<tr>
<td>4 b</td>
<td>Salt/sodium chloride/sodium</td>
<td>1</td>
</tr>
<tr>
<td>4 c</td>
<td>Latin for lead is plumbum. Plumbers use solder containing lead.</td>
<td>1</td>
</tr>
<tr>
<td>4 d i</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4 d ii</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4 d iii</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

| Total for Extension | 10 |
**HELP**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>False</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>True</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>False</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>False</td>
<td>1</td>
</tr>
<tr>
<td>e</td>
<td>True</td>
<td>1</td>
</tr>
</tbody>
</table>

2a Brass is not in the Periodic Table because it is not an element/it contains more than one substance/it is a mixture of copper and zinc.  

b Copper is a metal because it conducts heat and/or electricity/is shiny. Underlined text shows the pupil’s answer.

3 Metal: Sodium, Gold, Tin. Non-metal: Sulphur, Carbon, Nitrogen, Chlorine  
Award 1 mark for each correctly placed element.

**CORE**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a</td>
<td>Oxygen Krypton Fluorine One mark for each correct answer.</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>Copper Tungsten Nickel Chromium Rhodium One mark for each correct answer.</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Krypton</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>Copper Chromium One mark for each correct answer.</td>
<td>2</td>
</tr>
<tr>
<td>e</td>
<td>Tungsten Rhodium Chromium One mark for each correct answer.</td>
<td>3</td>
</tr>
<tr>
<td>f i</td>
<td>Fluorine</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>Fluorine</td>
<td>1</td>
</tr>
</tbody>
</table>

5a Tungsten  
b Fluorine  
c Melting point too low.  
d Copper is much cheaper.  
e Fluorine is a gas but iodine is a solid at this temperature.

**EXTENSION**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>6a i</td>
<td>They conduct electricity.</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>Non-metals are usually insulators.</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>It is not an element.</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Shiny yellow/does not tarnish/react.</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>Low melting point.</td>
<td>1</td>
</tr>
<tr>
<td>e i</td>
<td>Non-metal</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>Does not conduct electricity.</td>
<td>1</td>
</tr>
</tbody>
</table>

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Reacting elements

HELP

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Oxygen</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>copper + oxygen → copper oxide</td>
<td>2</td>
</tr>
<tr>
<td>c</td>
<td>Underlined text is pupil answer. Award 1 mark for the reactant and 1 mark for the product.</td>
<td>3</td>
</tr>
<tr>
<td>2 a</td>
<td>Because the reaction gets very hot/there might be a large flame/bits of burning metal might fly off, etc.</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>Any two from: Wear eye protection. Use a bench mat. Hold the metal in tongs.</td>
<td>2</td>
</tr>
<tr>
<td>c i</td>
<td>Carbon is a reactant.</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>Oxygen is a reactant.</td>
<td>1</td>
</tr>
<tr>
<td>iii</td>
<td>Carbon dioxide is a product.</td>
<td>1</td>
</tr>
<tr>
<td>iv</td>
<td>carbon + oxygen → carbon dioxide</td>
<td>1</td>
</tr>
</tbody>
</table>

Total for Help 13

CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 a</td>
<td>B and C.</td>
<td>2</td>
</tr>
<tr>
<td>b</td>
<td>A, D and E.</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>Elements only have one sort of atom/the compounds have more than one sort of atom joined together.</td>
<td>1</td>
</tr>
<tr>
<td>4 a</td>
<td>Element: Mg, Xe, Pb, He. Compound: CuO, SO₂, Fe₅, Al₂O₃, AgCl, CH₄</td>
<td>5</td>
</tr>
<tr>
<td>b</td>
<td>CuO, SO₂ and Al₂O₃</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Total for Core 16

EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Name (Formula): Sodium oxide (Na₂O), Magnesium sulphide (MgS), Calcium oxide (CaO), Nickel sulphide (NiS).</td>
<td>4</td>
</tr>
<tr>
<td>6 a</td>
<td>Calcium + chlorine → calcium chloride</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>Nickel + sulphur → nickel sulphide</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Strontium + oxygen → strontium oxide</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>Potassium + fluorne → potassium fluoride</td>
<td>2</td>
</tr>
<tr>
<td>e</td>
<td>Carbon + oxygen → carbon monoxide</td>
<td>2</td>
</tr>
<tr>
<td>7 a</td>
<td>Hold a piece of the metal in a flame; and take it out of the flame when it starts to burn. Accept alternative practical suggestions.</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>Hold the barium in tongs. In a Bunsen flame. On a bench mat. Not looking directly at the burning barium. Wear eye protection. Hold at arm's length. Do not touch the solid product. Any five from the suggestions above, or other appropriate alternative.</td>
<td>5</td>
</tr>
</tbody>
</table>

Total for Extension 18

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E Atoms and elements

1. Rearrange the letters to make the name we give to the ‘basic bits’ that all materials are made from.
LEN MEETS ...........................................

2. Write true or false for each statement.
   a. An element contains different types of atom. ............................
   b. A compound contains atoms of different elements combined together. ............................
   c. An oxide is formed when a metal is burned in oxygen. ............................
   d. Gases are at the far left-hand side of the periodic table. ............................
   e. There are about 100 different elements. ............................
   f. More of the elements are non-metals than are metals. ............................
   g. The name of the chart in which all elements and symbols are shown is the periodic table. ............................

3. Rearrange these letters to give the name of the element whose symbol is shown.
   Fe NIOR .............................................
   Ca CLAMIUC .............................................
   Au LOGD .............................................
   Zn IZCN .............................................
   C ARCNOB .............................................
   Mg MGEUNSMIA .............................................

4. Complete the following sentences about metals and non-metals.
   a. The ways an element looks and reacts are called its .
   b. Most metals are solid, shiny and conduct .
   c. Non-metals are mostly solids or .
   d. is a liquid metal.
5 Choose from this list of substances to answer the questions.

- calcium
- copper oxide
- magnesium
- nitrogen
- iron
- oxygen
- sodium chloride

a Which are elements?

b Which are compounds?

c Which are non-metallic elements?

d Which are elements made of molecules with two atoms?

e Which substance has the formula CuO?

6 Complete the table.

<table>
<thead>
<tr>
<th>Name of compound</th>
<th>Elements present</th>
</tr>
</thead>
<tbody>
<tr>
<td>magnesium oxide</td>
<td>magnesium and oxygen</td>
</tr>
<tr>
<td>copper oxide</td>
<td></td>
</tr>
<tr>
<td>carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>potassium oxide</td>
<td></td>
</tr>
<tr>
<td>magnesium sulphide</td>
<td></td>
</tr>
<tr>
<td>potassium chloride</td>
<td></td>
</tr>
</tbody>
</table>

7 Copper sulphide is formed when copper and sulphur react. The diagram shows the reaction. Write labels to show what each part represents.

[Diagram of reaction]
E  Atoms and elements

1. Rearrange the letters to make the name we give to the ‘basic bits’ that all materials are made from.
LEN MEETS ELEMENTS

2. Write true or false for each statement.
   a. An element contains different types of atom. ...false
   b. A compound contains atoms of different elements combined together. ...true
   c. An oxide is formed when a metal is burned in oxygen. ...true
   d. Gases are at the far left-hand side of the periodic table. ...false
   e. There are about 100 different elements. ...true
   f. More of the elements are non-metals than are metals. ...false
   g. The name of the chart in which all elements and symbols are shown is the periodic table. ...true

3. Rearrange these letters to give the name of the element whose symbol is shown.
   Fe NIOR ...IRON
   Ca CLAMIUC ...CALCIUM
   Au LOGD ...GOLD
   Zn IZCN ...ZINC
   C ARCNOB ...CARBON
   Mg MGEUNSMIA ...MAGNESIUM

4. Complete the following sentences about metals and non-metals.
   a. The ways an element looks and reacts are called its ...properties ...
   b. Most metals are solid, shiny and conduct ...heat/electricity ...
   c. Non-metals are mostly solids or ...liquids ...
   d. ...Mercury ...is a liquid metal.
5 Choose from this list of substances to answer the questions.

- **calcium**
- **copper oxide**
- **magnesium**
- **nitrogen**
- **iron**
- **oxygen**
- **sodium chloride**

**a** Which are elements?

- calcium, magnesium, nitrogen, iron and oxygen

**b** Which are compounds?

- copper oxide and sodium chloride

**c** Which are non-metallic elements?

- oxygen and nitrogen

**d** Which are elements made of molecules with two atoms?

- oxygen and nitrogen

**e** Which substance has the formula CuO?

- copper oxide

6 Complete the table.

<table>
<thead>
<tr>
<th>Name of compound</th>
<th>Elements present</th>
</tr>
</thead>
<tbody>
<tr>
<td>magnesium oxide</td>
<td>magnesium and oxygen</td>
</tr>
<tr>
<td>copper oxide</td>
<td>copper and oxygen</td>
</tr>
<tr>
<td>carbon dioxide</td>
<td>carbon and oxygen</td>
</tr>
<tr>
<td>potassium oxide</td>
<td>potassium and oxygen</td>
</tr>
<tr>
<td>magnesium sulphide</td>
<td>magnesium and sulphur</td>
</tr>
<tr>
<td>potassium chloride</td>
<td>potassium and chlorine</td>
</tr>
</tbody>
</table>

7 Copper sulphide is formed when copper and sulphur react. The diagram shows the reaction. Write labels to show what each part represents.

- copper/sulphur atoms
- sulphur/copper atoms
- copper sulphide molecules
Atoms and elements

1. Three useful materials are:
   - aluminium
   - concrete
   - glass

   a. Which material conducts electricity? 1 mark
   b. Which material can you see through? 1 mark
   c. Which material is an element? 1 mark

2. Here is a list of substances:
   - carbon
   - chlorine
   - copper
   - copper oxide
   - nitrogen
   - sulphur

   a. Which substance has the symbol Cu? 1 mark
   b. Which substance is a compound? 1 mark

3. Look at the diagram of an outline Periodic Table with only five symbols shown.

   a. Write down the symbols of two metals. 2 marks
   b. Write down the symbols of three non-metals. 2 marks
   c. Write down the symbols of two gases at room temperature. 2 marks
   d. The two elements on the left have similar properties.
      Give one property that they both share. 1 mark

4. Copper oxide is formed when copper and oxygen react together.
The diagram summarises the reaction.
Atoms and elements (continued)

a What name is given to a substance made up of molecules containing atoms of different elements combined together? 1 mark

b How many atoms are there in:
   i a molecule of oxygen 1 mark
   ii a molecule of copper 1 mark
   iii a molecule of copper oxide? 1 mark

c Write a word equation for this reaction. 1 mark

5 Sam heats a sample of magnesium in a crucible until the magnesium burns. A white powder is left behind after the reaction.

a What is the name of the white powder? 1 mark

b What has the magnesium joined with to make the white powder? 1 mark

c Write a word equation for the reaction. 1 mark

6 Andrew and Rebecca are investigating elements.

a Rebecca heats some magnesium in a crucible. She knows that the metal burns very brightly. What should she do to burn the magnesium safely? 1 mark

b Why should she be careful not to touch the crucible after the experiment? 1 mark

Rebecca drew the table below ready to compare different elements.

|---------|----------------|--------|--------|-----------|----------------------|

She had a bulb, a battery and some wires. How could she test to see if the element conducted electricity? 1 mark

How could she test to see if the element was magnetic? 1 mark

Why did she want to know the state of each element at 25 °C and not other temperatures? 1 mark
1 Look at the diagram of an outline Periodic Table with only five symbols shown.

a Write down the symbols of two metals. 2 marks

b Write down the symbols of three non-metals. 2 marks

c Write down the symbols of two gases at room temperature. 2 marks

d The two elements on the left have similar properties. Give one property that they both share. 1 mark

2 Copper oxide is formed when copper and oxygen react together. The diagram summarises the reaction.

a What name is given to a substance made up of molecules containing atoms of different elements combined together? 1 mark

b How many atoms are there in:

i a molecule of oxygen 3 marks

ii a molecule of copper

iii a molecule of copper oxide?

c Write a word equation for this reaction. 1 mark

3 Sam heats a sample of magnesium in a crucible until the magnesium burns. A white powder is left behind after the reaction.

a What is the name of the white powder? 1 mark

b What has the magnesium joined with to make the white powder? 1 mark

c Write a word equation for the reaction. 1 mark

4 Chlorine reacts with a large number of elements. A mixture of hydrogen and chlorine explodes to form hydrogen chloride.

A hydrogen chloride molecule contains one hydrogen atom joined with one chlorine atom.

Hydrogen and chlorine gases are made up of molecules.

Molecules of hydrogen have two atoms of hydrogen joined together.

Molecules of chlorine have two atoms of chlorine joined together.
Atoms and elements

a) Copy and complete the diagram. 3 marks

\[ \text{hydrogen gas} + \text{chlorine gas} \rightarrow \text{compound of hydrogen and chlorine} \]

b) Write a word equation for the reaction. 1 mark

c) The symbol for hydrogen is H. The symbol for chlorine is Cl. Represent hydrogen chloride using these symbols. 1 mark

5. Andrew and Rebecca are investigating elements.

Rebecca drew the table below ready to compare different elements.

|---------|----------------|--------|--------|----------|----------------------|

a) She had a bulb, a battery and some wires. How could she test to see if the element conducted electricity? 1 mark

b) How could she test to see if the element was magnetic? 1 mark

c) Why did she want to know the state of each element at 25 °C and not other temperatures? 1 mark

In 1860 scientists started putting elements in order.

d) What did the scientists look for to help them? 1 mark

e) Mendeleev used the mass of the atoms of each element and put the elements into groups, to create the Periodic Table. What did he base his conclusions on? 1 mark
# Atoms and elements

## Question Answer Mark Level

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Aluminium</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>Glass</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>Aluminium</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2 a</td>
<td>Copper</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>Copper oxide</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3 a</td>
<td>Na</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>C, Cl and He (three correct: two correct: one mark)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Cl</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>He</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>d</td>
<td>Both are solids or metals.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4 a</td>
<td>Compound</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b i</td>
<td></td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>ii</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>iii</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Copper + oxygen → copper oxide</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>5 a</td>
<td>Magnesium oxide</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>b</td>
<td>Oxygen</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Magnesium + oxygen → magnesium oxide</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>6 a</td>
<td>Put the lid on.</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>It will be very hot.</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>c</td>
<td>See if the bulb lit up when the circuit was completed.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>d</td>
<td>Should attract or repel a magnet.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>e</td>
<td>Make the comparison fair.</td>
<td>1</td>
<td>5</td>
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Scores in the range of:  

<table>
<thead>
<tr>
<th>NC Level</th>
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<tbody>
<tr>
<td>4-7</td>
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<tr>
<td>8-13</td>
</tr>
<tr>
<td>14-17</td>
</tr>
<tr>
<td>18-25</td>
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</table>
### Atoms and elements

**Red (NC Tier 4-7)**

<table>
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<tr>
<th>Question</th>
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<td>4</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>1</td>
<td>4</td>
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<td>b</td>
<td>C, Cl and He (three correct: two marks, two correct: one mark)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Cl</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>He</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>d</td>
<td>Both are solids or metals</td>
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<td>5</td>
</tr>
<tr>
<td>2 a</td>
<td>Compound</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b i</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Copper + oxygen → copper oxide</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>3 a</td>
<td>Magnesium oxide</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>b</td>
<td>Oxygen</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Magnesium + oxygen → magnesium oxide</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>4 a</td>
<td>Hydrogen gas showing molecules with pairs of hydrogen atoms joined.</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Chlorine gas showing molecules with pairs of chlorine atoms joined.</td>
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<td>6</td>
</tr>
<tr>
<td></td>
<td>Compound with hydrogen chloride molecules made up of one hydrogen and one chlorine atom joined.</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>b</td>
<td>Hydrogen + chlorine → hydrogen chloride</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>c</td>
<td>HCl</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>5 a</td>
<td>See if the bulb lit up when the circuit was completed.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>b</td>
<td>Should attract or repel a magnet.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>Make the comparison fair.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>d</td>
<td>Patterns</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>e</td>
<td>Evidence from the mass of the atoms.</td>
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<td>6</td>
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**Scores in the range of:**

<table>
<thead>
<tr>
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<th>11-16</th>
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<tr>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Learning outcomes</td>
<td>I can do this very well</td>
<td>I can do this quite well</td>
<td>I need to do more work on this</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>--------------------------</td>
<td>-------------------------------</td>
<td></td>
</tr>
<tr>
<td>I can explain to someone else what makes an element an element using my ideas about atoms.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe to someone else the difference between a compound and a mixture using my ideas about atoms.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can explain to someone the difference between atoms and molecules.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can recall the name and chemical symbol for at least 10 elements.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe where metals and non-metals are in the periodic table.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can name at least 1 element that is a solid or a liquid or a gas at room temperature.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can identify the reactants and products in a word equation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can write word equations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can interpret 2D drawings to identify simple examples of elements and compounds.</td>
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<td></td>
<td></td>
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<tr>
<td>I can represent the atoms in elements and compounds using 2D drawings.</td>
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<tr>
<td>I can describe a procedure for making fair comparisons of thermal conductivity between elements and other materials.</td>
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<tr>
<td>I can give reasons why classifying is very important in science.</td>
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## Glossary: Atoms and elements

<table>
<thead>
<tr>
<th>Word</th>
<th>Definition</th>
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<tbody>
<tr>
<td>alchemists</td>
<td>Early scientists who tried to turn substances into gold. <strong>R</strong></td>
</tr>
<tr>
<td>atom</td>
<td>A material that contains only one substance.</td>
</tr>
<tr>
<td>boiling point</td>
<td></td>
</tr>
<tr>
<td>chemical changes</td>
<td></td>
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<tr>
<td>chemical properties</td>
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<tr>
<td>element</td>
<td></td>
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<tr>
<td>formula</td>
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<tr>
<td>groups</td>
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<td>magnetic</td>
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<td>melting point</td>
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<tr>
<td>metals</td>
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<tr>
<td>MgO</td>
<td></td>
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<tr>
<td>mixture</td>
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<tr>
<td>molecule</td>
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<td>non-metals</td>
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<tr>
<td>particle</td>
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<tr>
<td>periodic table</td>
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<td>physical properties</td>
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<tr>
<td>properties</td>
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<tr>
<td>pure</td>
<td></td>
</tr>
<tr>
<td>symbol</td>
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</tr>
</tbody>
</table>

- **A material that contains more than one substance.**
- **A material that contains only one substance.**
- **Early scientists who tried to turn substances into gold.** **R**
- **Made from only one type of atom.**
- **The simplest type of particle.**
- **A group of atoms joined together.**
- **An atom or a molecule.**
- **Sign representing an element, e.g. Fe is the symbol for iron.**
- **A table containing all 113 elements, arranged by their properties into groups (columns) and periods (rows).**
- **The eight vertical columns in the periodic table.**
- **The seven horizontal rows in the periodic table.**
- **Materials that are usually solid and shiny when polished. A few are magnetic.**
- **Materials that are usually solids or gases. They have many different appearances.**
- **The appearance of a material and the way it reacts.**
- **The appearance of a material – solid, liquid or gas.** **R**
- **The temperature at which a solid becomes a liquid.**
- **The temperature at which a liquid becomes a gas.**
- **Reversible changes in which no new substances are made.** **R**
- **Attracted to a magnet.**
- **The way a material changes during chemical reactions.** **R**
- **Changes in which new substances are formed.** **R**
- **Made from more than one type of atom joined together.**
- **The formula representing magnesium oxide.**
- **Symbols used to represent atoms in a compound.**
E  Atoms and elements

alchemists R  groups  particle
atom  magnetic  periodic table
boiling point  melting point  periods
chemical changes R  metals  physical changes R
chemical properties R  MgO  physical properties R
compound  mixture  properties
element  molecule  pure
formula  non-metals  symbol

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This worksheet may have been altered from the original on the CD-ROM.
**E1 It's elementary**

**Green**

- a Any four from: washing powder, washing up liquid, Coke, cooking oil, biscuits, knife, Marmite, etc.
- b To be rich and to own something beautiful.
- c Gold is an element. It cannot be made from other elements.
- d A and C.

1. Some substances cannot be broken down using chemical reactions. These are called **elements**. They contain only one type of **atom**.
2. A, B and D.
4. The air.

**Red**

- a A and C.
- b air
- c Any pair of: sodium (or potassium) and water, or: sodium (or potassium, calcium, magnesium, iron, zinc) and an acid

2. a i A, B and C. 
   ii D and possibly F. 
   iii E and possibly F. 
- b no 
- c C, E and F. 
- d A, B and D. They contain only one kind of atom.
3. Gold is an element. No element can be broken down into anything simpler.

**E2 The elements**

**Green**

- a Fe 
- b Cu – copper, Ca – calcium, Co – cobalt
- c To the left. 
- d metals 
- e five 
- 1 a An element. 
   b Its symbol. 
- 2 a 26 
   b 26 
   c 113 
   d no 
- 3 a Mg 
   b Ni 
   c Zn 
   d Al 
- 4 a F 
   b N 
   c S 
   d Ne 

**Red**

- c To the left.

1. Sarah. It is to the far right in the table.
2. No. There aren’t enough letters in the alphabet to match all 113 elements. The names of many elements start with the same letter, so there would be confusion.
3. a No elements have yet been discovered with the characteristics required to meet the group and mass for 113 and 115.
   b ununpent 
   c Individual answers.

**E3 How elements differ**

**Green**

- a Oxygen is a colourless gas, chlorine is a pale green gas, bromine is a pale orange/brown liquid, sulphur is a bright yellow solid.
- b i no 
   ii 12 
- c i ii Any one from: boron, carbon, silicon, phosphorus, sulphur, arsenic, selenium, tellurium, iodine, astatine
   iii Any one from: hydrogen, nitrogen, oxygen, fluorine, chlorine, helium, neon, argon, krypton, xenon, radon
- d Any metal, excluding: iron, nickel, cobalt

1. a False. Only iron, nickel and cobalt are magnetic.
   b True. They allow electricity to flow through them.
   c False. Some metals look dull and some get rusty.
   d False. Mercury is a liquid at room temperature.
2. a bromine 
   b chlorine 
   c sulphur 
   d oxygen
3. Most non-metals are gases, have pale or no colour and do not conduct electricity. Most metals are solids, are silvery-coloured and conduct electricity.

**Red**

- a Oxygen is a colourless gas, chlorine is a pale green gas, bromine is a pale orange/brown liquid, sulphur is a bright yellow solid.
- b i no 
   ii 12
Atoms and elements (continued)

**E4 Getting it right**

**Green**

- **a**
  - i. Aluminium, iron, copper, nickel and sulphur.
  - ii. Mercury, hydrogen, bromine and chlorine.
  - iii. No. Lillian's metals group misses out mercury and incorrectly includes sulphur.
- **b**
  - i. Iron and nickel.
  - ii. Aluminium, copper, mercury, hydrogen, sulphur, bromine and chlorine.
  - iii. No. Joe's metals group will miss out the metals aluminium, copper and mercury. His non-metals group will incorrectly include aluminium, copper and mercury.
- **c**
  - i. Aluminium, iron, copper, nickel and mercury.
  - ii. Hydrogen, sulphur, bromine and chlorine.
  - iii. Yes. Of the elements given, only metals conduct electricity.
- **d**
  - Joe
  - e. Any correct idea, such as elements which are shiny and conduct electricity are metals, the rest are non-metals.
  - i. It is shiny.
  - ii. Not magnetic and does not conduct electricity.

- **Red**
  - b. Copper, mercury, carbon, sulphur, selenium, bromine and chlorine.
  - d. Sulphur, selenium, bromine and chlorine.

**E5 Reacting elements**

- **Green**
  - a. Yes. A new substance was formed.
  - b. Magnesium and oxygen.
  - c. Magnesium oxide.
  - d. Copper and oxygen.
  - e. Magnesium + sulphur → magnesium sulphide
- **Red**
  - a. Yes. A new substance was formed.
  - b. Calcium oxide.
  - c. Calcium oxide.
E  Atoms and elements (continued)

1a  i  Copper and oxygen.
    ii  Calcium and chlorine.
    iii  Iron and bromine.

b  copper + oxygen → copper oxide
   calcium + chlorine → calcium chloride
   iron + bromine → iron bromide

2a  zinc + oxygen → zinc oxide
    b  potassium + chlorine → potassium chloride
    c  iron + fluorine → iron fluoride
    d  sodium + sulphur → sodium sulphide

3a  i  Iron oxide.
    b  Copper fluoride.
    c  Silver sulphide.
    d  Magnesium chloride.
    e  Aluminium bromide.

4a  a  SO₃
    b  Sulphur trioxide. Because there is so much oxygen.