Grouping elements

It is often convenient to group objects that have features in common. Shops provide a good example of this. In a department store, the goods are grouped so that you know where to buy them. You go to the clothing section for a new pair of jeans, to the jewellery section for a new watch and to the food section for a packet of potato chips. Scientists also organise objects into groups. Biologists organise living things into groups. Animals with backbones are divided into mammals, birds, reptiles, amphibians and fish. Geologists organise rocks into groups. The elements that make up all substances can also be organised into groups.

Metals and non-metals

Scientists have divided the elements into two main groups: the **metals** and the **non-metals**.

**Metals**

The metals have several features in common:

- They are solid at room temperature, except for mercury, which is a liquid.
- They can be polished to produce a high shine or lustre.
- They are good conductors of electricity and heat.
- They can all be beaten or bent into a variety of shapes. We say they are malleable.
- They can be made into a wire. We say they are ductile.
- They usually melt at high temperatures. Mercury, which melts at \(-40^\circ\text{C}\), is one exception.

**Non-metals**

Only twenty-two of the elements are non-metals. At room temperature, eleven of them are gases, ten are solid and one is liquid. The solid non-metals have most of the following features in common:

- They cannot be polished to give a shine like metals; they are usually dull or glassy.
- They are **brittle**, which means they shatter when they are hit.
- They cannot be bent into shape.
- They are usually poor conductors of electricity and heat.
- They usually melt at low temperatures.
- Many of the non-metals are gases at room temperature.

**Metalloids**

Some of the elements in the non-metal group look like metals. One example is silicon. While it can be polished like a metal, silicon is a poor conductor of heat and electricity and cannot be bent or made into wire. Those elements that have features of both metals and non-metals are called **metalloids**. There are eight metalloids altogether: boron, silicon, arsenic, germanium, antimony, polonium, astatine and tellurium.

Metalloids are important materials often used in electronic components of computer circuits.
REMEMBER
1 Recall four features that metals have in common.
2 Recall four features that non-metals have in common.
3 Define the term ‘metalloid’. List some examples.
4 Recall which metal is liquid at room temperature.
5 Define the term ‘metallic lustre’.

THINK
6 While all metals have similar characteristics, there are also differences between them. List three ways in which metals can differ from each other.
7 Silicon is used in the ‘chips’ of computer circuits, but it is never used in the connecting wires of electric circuits. Deduce why not.

DISCUSSION
1 Which of the six elements have a shiny surface when polished?
2 Which of the six elements do not have a shiny surface when polished?
3 Which of the six elements can be bent?
4 Which of the six elements cannot be bent?
5 Which of the six elements allow electricity to pass through?
6 Which of the six elements do not conduct electricity?
7 Attempt to divide the elements into two groups on the basis of your observations. Suggest names for these two groups.
8 Which of the six elements tested does not seem to fit into either of these two groups?

Characteristics of some elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Shiny or dull?</th>
<th>Does it bend?</th>
<th>Does it conduct electricity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur</td>
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<tr>
<td>Zinc</td>
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<td></td>
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<td>Tin</td>
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<td>Carbon</td>
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<td>Silicon</td>
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<td></td>
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<tr>
<td>Copper</td>
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</tbody>
</table>

IMAGINE
8 Imagine that you are a scientist who has discovered what appears to be a new element. It is golden in colour and very shiny. Propose experiments to test if it is a metal or non-metal. What results would you expect to get if it is a metal?

INVESTIGATE
9 Polonium is a metal discovered by Marie Curie. She also discovered another metal. Find out its name and the important role it played in medicine.

work sheets
11.1 The periodic table: atomic structure
11.2 Metals and non-metals