

# Minerals, elements and the Earth's crust

## Introduction

Minerals are substances formed naturally in the Earth. They have a definite chemical composition and structure. There are over 3000 minerals known. Some are rare and precious such as gold and diamond, while others are more ordinary, such as quartz. Do you know of any more examples of minerals from the Earth?

Like all substances, minerals are composed of **elements**.

There are only about a hundred elements, and they are the basic building blocks of everything around us. They can be found either in their pure form or chemically combined with other elements to make **compounds**. A compound is two or more elements chemically joined together.

## What you will need

- A copy of the Periodic Table.

## The activity

### Elements in the Earth's crust

Almost 99% of the minerals making up the Earth's crust are made up of just eight elements. Most of these elements are found combined with other elements as compounds. Minerals are elements or compounds that occur naturally in the Earth's crust. Rocks are mixtures formed of minerals. Just as elements are the building blocks of minerals, so minerals form the building blocks of rocks. Table 1 gives some information about the most common elements in the Earth's crust in order of abundance.

Element name	Symbol	Percentage by weight of the Earth's crust
Oxygen	O	47
Silicon	Si	28
Aluminium	Al	8
Iron	Fe	5
Calcium	Ca	3.5
Sodium	Na	3
Potassium	K	2.5
Magnesium	Mg	2
All other elements		1

**Table 1 The elements in the Earth's crust**

The 'other' elements include copper, uranium, gold and silver. Although they are comparatively rare, these are very important to mankind.

- Q 1. Table 1 shows the relative amounts of the elements making up the Earth's crust. Draw a bar chart to show this information.
- Q 2. Which is the commonest element in the Earth's crust?

- Q 3. Which is the rarest single element in the Earth's crust of those named in Table 1?
- Q 4. The most common elements in the Earth's crust are rarely found on their own. They are usually found combined. Suggest why this is.
- Q 5. What do we call two or more elements chemically combined together?
- Q 6. Suggest which element in Table 1 might be the most expensive. Give a reason why you cannot be certain about your prediction.

### Mineral names and chemical composition

Table 2 gives the names of some minerals and their chemical formulae. The chemical formula of a mineral tells us what elements it contains and in what proportions.

Mineral name	Chemical formula	How many atoms of each element are present in the formula	Useful element	Uses of this element
Galena	PbS	Lead x 1 Sulfur x1	Lead	
Pyrite	FeS <sub>2</sub>	Iron x 1 Sulfur x 2	Sulfur (pyrite is not used as an ore of iron)	
Chalcopyrite	CuFeS <sub>2</sub>			
Chalcocite	Cu <sub>2</sub> S			
Bauxite	Al <sub>2</sub> O <sub>3</sub>			
Magnetite	Fe <sub>3</sub> O <sub>4</sub>			
Haematite	Fe <sub>2</sub> O <sub>3</sub>			
Rutile	TiO <sub>2</sub>			

**Table 2 Mineral names and chemical composition**

- Q 7. The mineral galena contains the elements lead and sulfur combined in a 1:1 ratio. Half the atoms in the mineral are lead. Pyrite has iron and sulfur combined in a 1:2 ratio; only one third of the atoms are iron.

Fill in the columns headed 'How many atoms of each element are present in the formula' and 'Useful element' in Table 2 (above). Use your Periodic Table to help you.

- Q 8. Which of the minerals chalcopyrite and chalcocite contains the highest proportion of copper atoms? (Hint. Add up the number of different atoms in each mineral and work out how many of them are copper atoms).
- Q 9. Suggest which copper mineral would be most profitable to mine for copper? Give a reason why you cannot be certain about your prediction.
- Q 10. Use your research skills to find out about the uses of the elements in the 'Useful element' column of Table 2 and put them in the 'Uses' column of this table.
- Q 11. For each of the 'useful elements' in Table 2, find out:
- their properties
  - their appearance
  - their date of discovery
  - how they got their names
  - the place of each one in the Periodic Table.