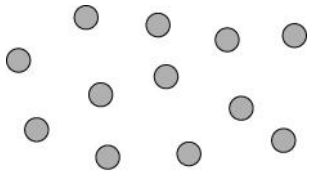
Atoms, molecules, elements and compounds

All substances are made up of tiny particles called **atoms**. Substances can be made of single atoms but they can also be made of atoms **bonded** together in small groups, called **molecules**. Substances can also be made of many trillions of atoms all bonded together.

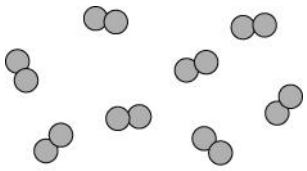


atoms of an element

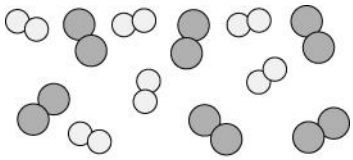
Natural materials can be **pure** (containing one substance) or **mixtures** (containing two or more substances which are not joined together). A **mixture** is formed if elements are mixed without joining.

Elements are simple substances made up of only one kind of atom.

There are about 90 different types of atom found on Earth. Therefore there are about 90 different elements.

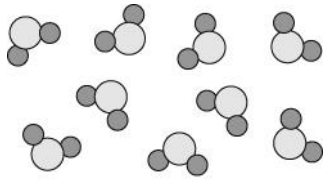


molecules of an element



molecules of a mixture of elements

Most substances are **compounds,** which contain more than one kind of atom (more than one element) bonded (joined) together.



molecules of a compound

The Earth's elements

The **periodic table** lists all 118 known elements.

Element are described by **symbols** of one or two letters.

The first letter is always a capital letter and the second is always lower case.

The same symbols are used in all countries.

e.g. Oxygen = O

Magnesium = Mg

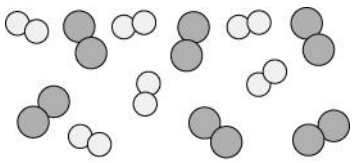
Iron = Fe

Silicon = Si

Although there are only about 90 natural elements, there are millions of compounds.

We obtain all the elements and compounds we need for living from the Earth's **atmosphere** and **crust**.

Our **resources** are limited and some may run out in the near future. We need to take care of our resources, **recycle** more and make less waste.



molecules of a mixture of elements

Metals and non-metals

Elements can be classified as **metals** or **non-metals**, depending on their properties.

The common properties of **metals** are:

- high melting point solids,
- strong and **flexible**,
- shiny (when polished),
- good **conductors** of heat,
- good conductors of electricity.

e.g. copper, iron, aluminium, zinc, and tin.

Note: mercury is the only liquid metal.

The common properties of **non-metals** are:

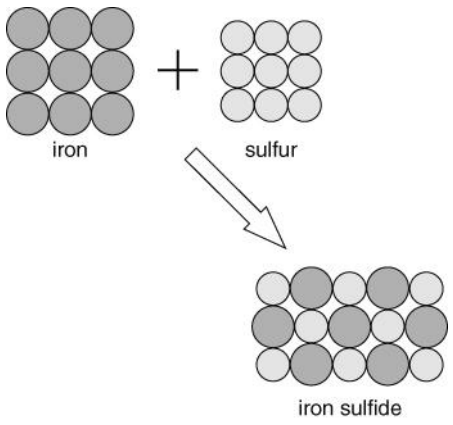
- low melting point (gases, liquids and solids),
- **brittle** (when solid),
- not shiny,
- poor conductors of heat,
- poor conductors of electricity.

e.g. sulfur, oxygen, nitrogen, carbon and iodine.

The **uses** of an element depend on its **properties**. For example, copper and aluminium are used for electrical cables as they are strong, flexible and conduct electricity very well.

Making compounds

Compounds are formed when elements are mixed and react so that the atoms join together.



Naming compounds

If there is a metal in the compound, the name of the metal goes first.

If the compound contains only two elements then one of the element's name has its ending changed to 'ide'.

e.g. zinc + oxygen = zinc oxide

iron + bromine = iron bromide

If a compound contains two elements plus oxygen, then the name ending of one of the elements is changed to 'ate'.

e.g. sodium + carbon + oxygen = sodium carbonate

Chemical reactions

Chemical reactions always form one or more new substances.

Many chemical reactions occur in everyday life, for example, burning, cooking, rusting, digesting food.

Typical signs of chemical reaction include:

- a colour change,
- a gas being given off,
- a solid forming in a liquid,
- an energy change.

How chemical reactions start

Some reactions start just by mixing the right substances together.	e.g. acid and alkalis
Heat is often needed to start a reaction, but once started many reactions give out heat.	e.g. burning natural gas
Others need a continuous supply of energy to keep them going.	e.g. breaking down metal ores

Modelling chemical reactions using word equations

reactants → products

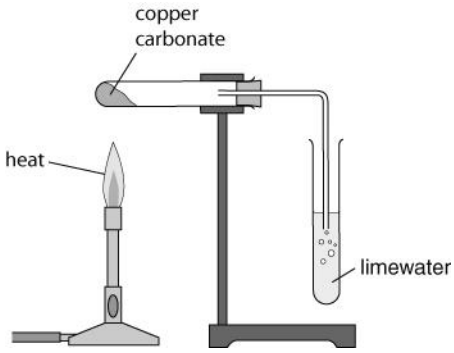
e.g. zinc + chlorine → zinc chloride

tin carbonate → tin oxide + carbon dioxide

Thermal decomposition reactions involve breaking down a single compound using heat.

Heating copper carbonate produces copper oxide and carbon dioxide.

Thermal decomposition reactions are used in industry to extract metals.



Sorting and presenting data

The way data is sorted and presented depends on the type of variable and what you want to show.

Tables – show values and order.

Bar charts – compare differences between qualitative/discrete variables.

Line graphs – shows trends between variables.

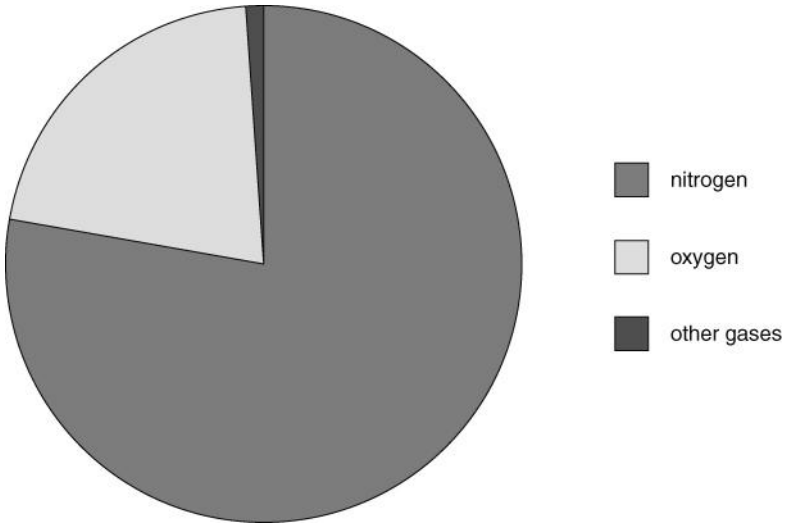
Scatter graphs – look for relationships between quantitative variables.

Pie charts – shows proportions of a total.

Note: Qualitative data = words. Quantitative data = numbers.

Discrete data = only certain number values.

Gases in air	%
nitrogen	78
oxygen	21
other gases	1



Pie chart of gases in air