# 14. Elements, Compounds and Mixtures

**Let's recall.**

1. How many different states of matter are there? Name them.
2. What brings about a change of state of matter?
3. What are the properties of matter?
4. Do all substances have the same properties?

**Classify the following substances according to their properties.**

Water, thermocol, soil, iron, coal, paper, rubber, copper, coir, plastic.

**Can you tell ?**

1. What are objects made of ?
2. What are these articles of everyday use made of – electric wire, kitchen utensils, nails, tables and chairs, window panes, soil, salt, sugar ?

## Matter

We say that an object is made of a certain substance. The term matter is also used as a synonym of substance. In scientific language, however, a single term is used for a single concept, and that which an object is made of is called **matter.**

## The particulate nature of matter and properties of matter

**Try this.**

1. Take a piece of chalk and keep on dividing it into smaller pieces. What will happen?
2. Wipe a drop of ink with a handkerchief. What effect does it have on the cloth of the handkerchief ?
3. What happens when the lid of a bottle of perfume is opened?

It is the matter present in various things in solid, liquid or gaseous states that is responsible for their properties. Even though they are divided into small particles their properties due to the matter present in them, remain the same. The properties such as the white colour of a chalk, the blue colour of ink, the fragrance of a perfume are the properties of the matter of which each of them is made.

**Use your brain power!**

1. In day-to-day life, we come across many things in our surroundings. We touch them, we study their properties. Are all these things made from only one kind of matter or from more than one kind of matter?
2. Classify the following according to the nature of matter in them – whether it is made from one kind of matter or from more than one kind of matter; and whether it is in solid, liquid or gaseous state : an engraved idol, gold, milk, water, a plank, concrete, salt, soil, coal, smoke, sherbet, cooked *khichadi*, steam.

**Try this.**

1. Fill a glass of water upto the brim. Drop a small stone in it. What happens ?
2. Take a balance. Place a small stone in one pan and a big stone in the other. Which pan goes down? Why?

Which properties of matter can you tell from the above activities?

Objects have mass and mass can be measured with the help of devices like the common balance. Also, they occupy space. They acquire both these properties from the matter that they are made of. In other words, mass and volume are two important properties of matter.

Many kinds of matter found in nature are in pure form, that is, they contain only one constituent. In scientific language, matter made of only one constituent is called '**substance**', for example, gold, diamond, water, chalk. Other kinds of matter are made of two or more substances. They are called '**mixtures**'.

**Use your brain power!**

Which of the following are mixtures – water, sherbet, iron, steel, coal, air, salt, copper, brass, soil.

## Elements

**Try this.**

1. Take water in a teapot and cover it. Heat the water to a boil. What do you see on the inside of the lid?
2. Fill water in a spray pump, spray the water and observe the spray.

**14.1 Spray-pump**

The water droplets collected on the inside of the lid of the teapot are formed by condensation of the vapour from the boiling water. Water in the form of vapour is composed of extremely tiny particles and, therefore, we cannot even see them. You will see that the spray is also composed of small particles of water. Similarly, all substances are made of extremely tiny particles. The smallest particles of substances are molecules. A substance whose molecules are made of one or more atoms which are exactly alike, is called an **element**.

We do not get different substances by the decomposition of an element. The smallest particles of elements are made of only one type of atoms. We cannot see atoms with the naked eye, but when crores of atoms come together, their total volume is large enough to be visible to our eyes. The mass and volume of atoms of different elements are different.

**Do you know?**

To date, scientists have discovered 118 elements. Of these, 92 elements occur in nature, while the remaining are man-made. Hydrogen, oxygen, nitrogen, carbon, iron, mercury, copper are a few of the important natural elements. More new elements are being discovered through research work.

## Great Scientists

Democritus named the small particles of elements 'atom' because in the Greek language *atomos* means indivisible.

In 1803, John Dalton proposed his theory stating that atoms cannot be created or divided into smaller particles or destroyed.

He used certain symbols to represent elements.

For example : © Copper, ⊕ Sulphur, ⊙ Hydrogen.

Oxygen occurs in nature in the gaseous state. Two atoms of oxygen are joined to form a molecule of oxygen, which has an independent existence. Oxygen in air is always in molecular state. Just like atoms, molecules also cannot be seen with naked eyes.

### Use your brain power !

1. Which elements are present in air ?
2. Is carbon dioxide an element ?
3. Are the atoms of different elements similar or dissimilar ?

### Can you tell ?

What do the short forms Dr, H.M., AC, Adv., C.M., DC stand for ?

In day-to-day life, we use short forms in many places. A similar method is used to indicate elements.

The scientist, Berzelius, was the first to use the present method of using symbols for elements. The symbol of an element is written in the English script and is the short form of its name.

Some elements and their symbols are listed in the table alongside. When the initial letter in the names of two or more elements is the same, a pair of letters is used to write the symbol. For example, we write C for carbon and Cl for chlorine.

| Element | Symbol | Element | Symbol |
|---|---|---|---|
| Hydrogen | H | Sodium | Na |
| Helium | He | Magnesium | Mg |
| Lithium | Li | Aluminium | Al |
| Beryllium | Be | Silicon | Si |
| Boron | B | Phosphorus | P |
| Carbon | C | Sulphur | S |
| Nitrogen | N | Chlorine | Cl |
| Oxygen | O | Argon | Ar |
| Fluorine | F | Potassium | K |
| Neon | Ne | Calcium | Ca |

**From the Internet or reference books, obtain information about elements and prepare a table according to the format given below.**

| Name of the element | Symbol | Discovery of the element | State | Information and uses |
|---|---|---|---|---|
| | | | | |

**Can you tell ?**

1. Which metals do we use in day-to-day life ?

2. Are metals elements ?

Elements are generally classified into two groups: metals and non-metals. We have studied the properties of metals such as malleability, ductility, conductivity of heat and electricity, density, lustre and sonority. The elements that do not show these properties are called non-metals, for example, phosphorus, sulphur, chlorine. The elements that show some properties of metals and some properties of non-metals are called metalloids. This is the third group of elements. Arsenic, silicon, selenium are examples of metalloids.

**Do you know ?**

The wire that we see in the electric bulb in our house is made of the element tungsten. Its symbol 'W' is derived from its German name 'Wolfram'. Similarly the symbols of silver (Ag) and gold (Au) are derived from their Latin names Argentum and Aurum respectively. Elements occur in solid, liquid or gaseous state.

Some metals are difficult to use in pure form. For example, pure iron rusts in air, pure gold is very soft and bends easily. The properties of the original metal can be modified by mixing one or more elements in it. Such a mixture of metals is called an alloy. Brass, steel, twenty-two carat gold are a few examples of alloys.

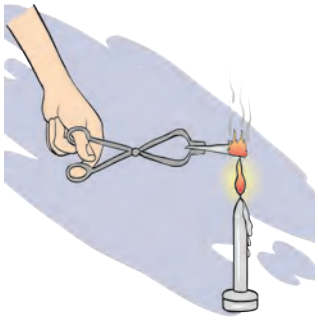
**Find out.**

Which of the elements are metals, which are non-metals and which are metalloids ?

## Compounds

**Try this.**

1. Take sugar in a test tube and heat the test tube. Observe what happens. What remains behind ?
2. Using tongs, hold a magnesium ribbon in a flame and observe. What changes took place in the above two experiments ?



**14.2 Burning of magnesium**

In the first case, the sugar melts and then it loses water leaving behind a black substance. This black substance is carbon. What does this imply ? How many elements is sugar made of ?

What does the name carbon dioxide imply – how many and which elements is this substance made of ?

**The substance formed by a chemical combination of two or more elements is a compound.**

1. Which of these are compounds, which are elements – water, oxygen, carbon dioxide ?

2. What is the smallest particle of a compound called ?

**Always remember –**

A substance is a compound only if its molecules are made up of atoms of different types. Water is a compound. One molecule of water is made of two atoms of hydrogen and one atom of oxygen.

**Can you tell ?**

1. Which element helps combustion ?
2. Does water help combustion ?

Hydrogen is a combustible substance, that is, it burns. Oxygen helps combustion. But water, which is formed by a combination of hydrogen and oxygen is used to extinguish a fire. In other words, the properties of a compound are different from those of the constituent elements.

Like an element, a compound is also written in an abridged form. A molecule of a compound is formed by a chemical combination of atoms of two or more elements. Therefore, a molecular formula is used to represent a compound. A **molecular formula** of a compound is a short form of its name written with the help of the symbols of the constituent elements and the number of their respective atoms.

**Collect information and prepare a table.**

Constituent elements and molecular formulae of various compounds such as salt, alum, blue vitriol, ammonium chloride, baking soda, chalk, washing soda.

| Compound | Constituent elements | Symbol and number of atoms | Molecular formula | Characteristics |
|---|---|---|---|---|
| Water | | | $H_2O$ | |

## Mixtures

**Try this.**

1. Prepare a sherbet.
2. Prepare a *bhel*.

Did the taste of the original ingredients change due to the above processes ?

A mixture is formed by mixing different elements or compounds. The proportion of various components in a mixture is not fixed. No chemical change takes place during the formation of mixtures and no new substance is formed.

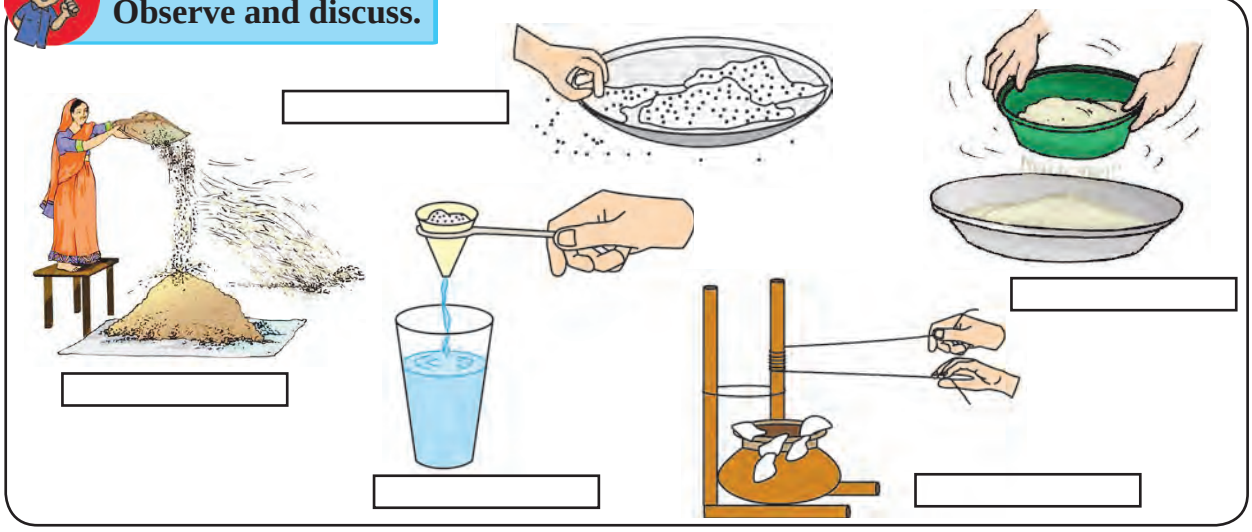
**Can you tell ?**

1. What are the mixtures used in everyday life ?
2. Are all mixtures useful to us ?
3. How will you separate each component from a mixture of semolina, salt and iron filings ?

You might remember that mixing unwanted substances in any foodstuff is called adulteration. In other words, an adulterated foodstuff is also a kind of mixture.

When an unwanted and harmful substance is mixed with another substance the resulting mixture no longer remains useful. In such cases, we separate the unwanted ingredients from the mixture. For this purpose, simple and easy methods such as straining (filtering), sifting, picking, sorting, winnowing, combing with a magnet and sublimation are used. Which ingredients, from which mixtures could be separated by using these methods ? We have learnt about the properties of matter and the effects of heat. These properties are also used for separating the components of a mixture.

## Observe and discuss.

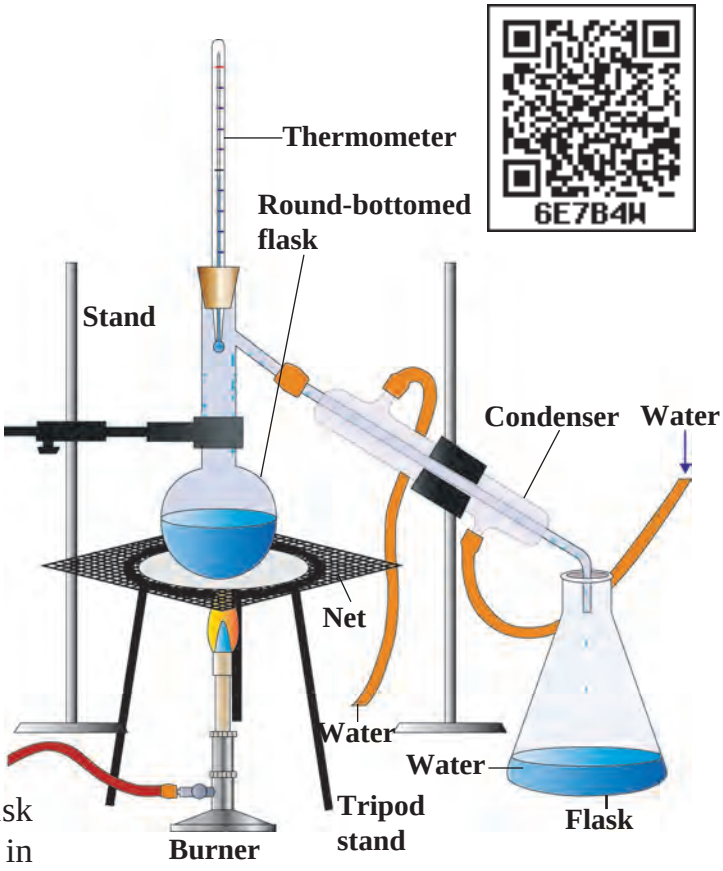


14.3 Some methods of separating the components of a mixture.

### Method of distillation

Take some salt water in a round-bottom flask. Arrange the apparatus as shown in the figure. Start heating the liquid in the flask placed on the wire gauze. Observe the conical flask. Slowly droplets of water start falling into it. Where did these drops come from?

The salt water in the round-bottom flask boils on heating. The water in it vapourizes. When the vapour passes through the inclined tube, it gets cooled due to the surrounding cold water and condenses to form water. Thus, the drops falling into the conical flask are of the water from the salt solution in the round-bottom flask. Salt remains behind at the bottom of the round-bottom flask when all the water has collected in the conical flask. This method is called distillation. Distillation is also used for purification of impure liquids.




14.4 Distillation method

## Use your brain power!

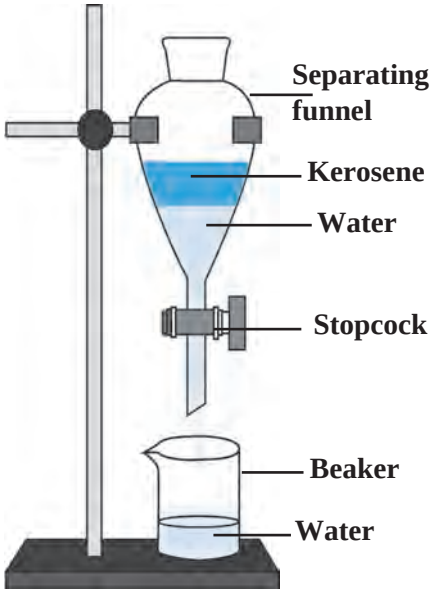
1. Is the water that falls from clouds naturally pure?
2. Which properties of a liquid are seen in the distillation method?
3. For what purposes is distilled water used?

## Method of separation using separating funnel

When a mixture of two immiscible liquids is left undisturbed two layers are clearly seen to have formed. The heavier of the liquids remains below and the lighter liquid floats on it. Two liquids in a mixture can be separated by making use of this property.

**Procedure :** Pour a mixture of kerosene and water into a separating funnel with its stopcock closed. Close the stopper. Fix the separating funnel firmly on a stand. Leave the mixture in the funnel undisturbed for a while. Water will remain below and kerosene will float on it.

Now, without shaking the funnel remove the stopper. Open the stopcock to collect the water at the bottom of the funnel, in a beaker. Close the stopcock when all the water is collected in the beaker. Now, kerosene and water are separated.



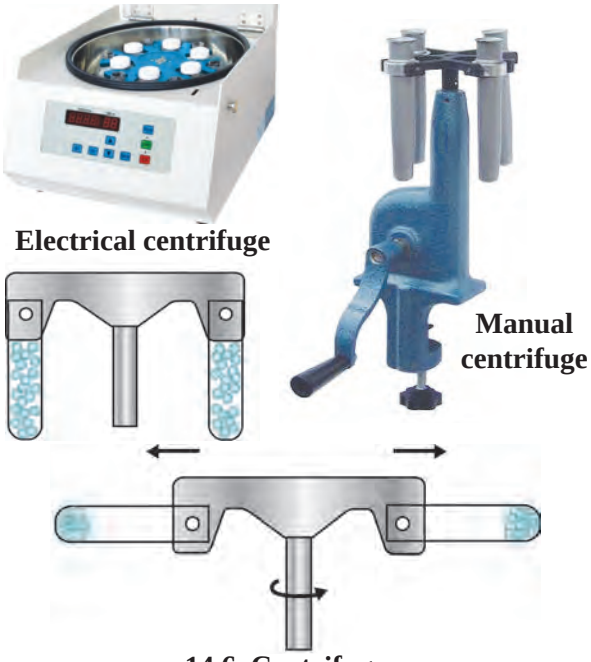

**14.5 Separation method**

## Method of centrifugation

Turbid water, ink, milk, buttermilk, blood are mixtures of liquids and insoluble solids. When turbid water is kept undisturbed for a while, the soil particles in it slowly settle to the bottom. The particles of milk or ink, however, do not settle even on being left undisturbed. This is because the particles of the solids in such mixtures, being very tiny and light, remain evenly distributed in the liquid. These particles cannot be separated from the liquid even by methods like filtration or settling.

How will you separate such solid particles from the liquid ? In the laboratory, a centrifuge machine is used to separate solids from a mixture of a liquid and solid. In consists of a disc, which rotates like a fan at great speed. There is a provision to attach test tubes at the rim of this disc.

When the tubes attached to the disc rotate at high speed, a force is generated which pushes the particles away from the centre. As a result, the solid particles in the mixture in the test tubes collect at the bottom of the tubes and are thereby separated from the liquid.



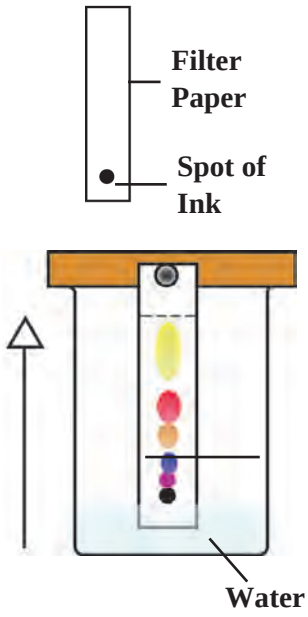

**14.6 Centrifuge**

## Method of chromatography

If two or more substances are dissolved in small proportions in the same solution, these substances are separated from each other by means of chromatography. This method is used in pharmaceutical science, factories and scientific laboratories for detecting new ingredients and for identifying and separating components of a mixture.

**Procedure :** Take some water in a beaker. Take a rectangular piece of a filter paper. Put one spot of blue ink on it about 2 cm away from one edge. Keep this paper upright in the water in the beaker. Place a lid on the beaker. After some time, the spot of the ink is seen to have risen and collected at a particular height on the filter paper. If there are two or more constituents of different colours in the ink, they will be seen to have risen to different heights due to their different colours and thus appear distinct from each other. This experiment can be done using a chalkstick instead of the filter paper.

In this method of separation called chromatography, two properties of substances are used. These are the solubility of the substance in the solvent that moves up and the ability of the substance to stick to the stationary filter paper. These properties are mutually opposite and are different for different substances. As a result, all the components of the mixture do not rise all the way to the upper end of the filter paper, but remain behind at different heights.




**14.7 Chromatography**

## Exercise

**1. Who are my companions?**

| Group 'A' | Group 'B' |
|---|---|
| 1. Stainless steel | (a) Non-metal |
| 2. Silver | (b) Compound |
| 3. *Bhajani* mixture for milling | (c) Mixture |
| 4. Salt | (d) Element |
| 5. Coal | (e) Alloy |
| 6. Hydrogen | (f) Metal |

**2. Write the names of elements from the following symbols : Zn, Cd, Xe, Br, Ti, Cu, Fe, Si, Ir, Pt.**

**3. What are the molecular formulae of the following compounds?**

Hydrochloric acid, sulphuric acid, sodium chloride, glucose, methane.

**4. Give scientific reasons.**

(a) Buttermilk is churned to get butter.

(b) In chromatography, the ingredients of a mixture rise up to a limited height when water rises up to the upper end of the paper.

(c) A wet cloth is wrapped around a water storage container in summer.

**5. Explain the difference.**

(a) Metals and non-metals

(b) Mixtures and compounds

(c) Atoms and molecules

(d) Separation by distillation and by separating funnel

**6. Write answers to the following questions in your own words.**

(a) How are the components of mixtures separated by simple methods?

(b) Which elements (metals and non-metals), compounds and mixtures do we use in our day-to-day life?

(c) In everyday life, where and for what purpose do we use centrifugation?

(d) Where are the methods of separation by distillation and by separating funnel used? Why?

(e) Which precaution will you take while using the methods of distillation and separation by separating funnel?

**Project :** Visit a jaggery or a sugar factory. Obtain information about the methods that are used to separate the components of the mixture while making jaggery or sugar. Present it in the class.

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