Rice is the staple diet of the people of Kerala. What is pictured above is a common sight in the courtyards of farmers in the harvesting season. Why is the paddy winnowed after the reaped stalk bundles are threshed? When the bundles are threshed there will be plenty of chaff mixed with paddy. What happens when it is winnowed? Why?

When paddy is de-husked what we get is rice mixed with bran. How are these separated?

Many of the substances which we use in our daily life are found in the form of mixtures.

What are the characteristic features of mixtures? Let us conduct an experiment to find out.

Take a teaspoon each of iron powder and sulphur powder in a china dish. Mix them thoroughly. Look at the mixture through a lens. Can you see the black grains of iron and the yellow powder of sulphur?

Some of the properties of iron and sulphur are given in the table below (table 2.1)

<table>
<thead>
<tr>
<th></th>
<th>Iron</th>
<th>Sulphur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>More</td>
<td>Less</td>
</tr>
<tr>
<td>Magnetism</td>
<td>Magnetic</td>
<td>Non-magnetic</td>
</tr>
<tr>
<td>In water</td>
<td>Insoluble</td>
<td>Insoluble</td>
</tr>
</tbody>
</table>

Table 2.1

What might be the most practical method of separating this mixture?

Find out on the basis of the properties of the components.
Can you suggest other methods?

If the proportion of iron powder and sulphur powder in the mixture is changed, can the same methods be used to separate the components? Why is this possible?

Now, with the help of the teacher, conduct the following experiments also, and record the observations.

★ Take a small portion of the iron and sulphur mixture in a test tube and add dilute hydrochloric acid (HCl). Which is the gas produced? What do you see at the bottom of the test tube? Which component has reacted with the acid? Write down the equation.

★ Take another portion of this mixture in a test tube and add a little carbon disulphide. Shake the test tube gently. What do you observe? Explain.

On the basis of the above experimental observations discuss the following.

★ What is the minimum number of substances necessary to form a mixture?

★ What is the required proportionate quantity of each substance?

★ Is there any change in the chemical/physical properties of the substances when they are mixed?

★ Is the formation of a mixture a chemical change or a physical change?

Note down the conclusions in the science diary.

Aren’t the components of the mixture used in the above experiment solids?

Saline water is a mixture formed from a solid and a liquid. Can mixtures be formed from substances in any physical state? Find more examples and add to the table.

<table>
<thead>
<tr>
<th>Type of mixture</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid and solid</td>
<td>Soil, ......, ......</td>
</tr>
<tr>
<td>Solid and liquid</td>
<td>Saline water, ..........</td>
</tr>
<tr>
<td>Liquid and liquid</td>
<td>......, ......, ......</td>
</tr>
<tr>
<td>Gas and gas</td>
<td>......, ......, ......</td>
</tr>
</tbody>
</table>

Table 2.2

Many mixtures like these are handled by us in our everyday life. On many occasions we have to separate their components.

Consider some examples.

• Removing the sediment from tea.
• Removing stones and paddy from rice.

Fig. 2.1

List more instances after discussion. Tabulate the method of separation in each instance and also the property on the basis of which the separation is effected (table 2.3). Enter in the science diary.
Now it is clear that mixtures are separated into components based on the properties of those components. Let us familiarise ourselves with some other methods used to separate mixtures.

### How to separate clear water from muddy water

- **Is it possible to filter clear water from muddy water by using the same type of strainer used for filtering tea?**
- **If a filter paper is used instead of the strainer?**

<table>
<thead>
<tr>
<th>Instance</th>
<th>Method</th>
<th>Property basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea</td>
<td>Filtration</td>
<td>Difference in the size of the particles</td>
</tr>
<tr>
<td>Stones and paddy in rice</td>
<td>Picking up by hand</td>
<td>Colour, size</td>
</tr>
<tr>
<td>Saline water</td>
<td>Vaporisation</td>
<td>Tendency to evaporate</td>
</tr>
<tr>
<td>Muddy water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron + sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar + sand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.3

Arrange the equipment as shown in the illustration, and try to separate by filtration clear water from water in which soil is mixed and water in which chalk powder is mixed.

- **Why was it possible to separate the water using filter paper?**
- **Why does one component remain in the filter paper after filtration?**

Think in terms of particle size. Write down your conclusion in the science diary.

- **Can this method be adopted to separate water and salt from saline water? Explain your answer.**

### Separation of components of saline water

How can the salt and water in saline water be separated?

You know that common salt is obtained by the vaporisation of sea water using solar heat.

- **What happens to the water when saline water is heated?**
- **Why is the salt left behind? Is there any method for collecting the evaporated water?**
See the illustration showing the equipment for separating such mixtures (fig 2.3)

![Diagram of equipment for separating mixtures](image)

**Separation of a mixture of completely miscible liquids**

Acetone and water are two liquids that mix with each other, in all proportions. The boiling point of water is 100°C and that of acetone is 56°C. Let us see a method of separating the components of this mixture based on the large difference in their boiling points. See fig 2.4. Have you noticed the thermometer fitted on the top of the flask? When the mixture is heated which component boils and evaporates first? Why? How can this substance be recovered from the vapour? Discuss and note down the conclusions in the science diary.

The mixture (saline water) is boiled in a round bottomed flask

★ Which component evaporates, salt or water?

When the vapour passes through the condenser, it condenses and flows into the collecting flask as a liquid.

★ What is the substance that remains in the round bottomed flask?

This process is known as distillation.

Ordinary drinking water contains many salts dissolved in it. These salts are removed by distillation in order to produce distilled water used for injecting medicines and in storage batteries.

This process is used in separating mixtures where one component is volatile and the other is not. Find out other examples.
Ethanol and methanol are two completely miscible liquids with only a small difference in their boiling points. The equipment shown in fig. 2.5 is used to separate this mixture. They can also be separated on the basis of the increasing order of their boiling points. This method is called fractional distillation.

Crude oil is a mixture of liquid hydrocarbons which have only small difference in their boiling points. The components of this mixture such as petrol, diesel, kerosene etc. are separated by the above mentioned method of fractional distillation.

How to separate the different components of air?

Ammonia is an important raw material in the manufacture of chemical fertilizers. Ammonia is manufactured by combining nitrogen and hydrogen. Nitrogen is obtained by separating it from air.

Some details about the components of air are given in table 2.4.

<table>
<thead>
<tr>
<th></th>
<th>Oxygen</th>
<th>Argon</th>
<th>Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling point</td>
<td>-183°C</td>
<td>-186°C</td>
<td>-196°C</td>
</tr>
<tr>
<td>Quantity (%)</td>
<td>20.9</td>
<td>0.9</td>
<td>78.1</td>
</tr>
</tbody>
</table>

Table 2.4

★ What is the physical state of oxygen at -182°C?
★ And at -184°C?
★ Which component has the highest boiling point?
Can the components of black ink be separated?

The ink we use is a dye which dissolves in water.

Carry out the following experiment.
Take some black ink in a china dish and heat it. (It is enough to keep the dish on hot sand bath.) Can you see the vapours? Once the evaporation stops, remove the dish from the heat source.

Which could be the substance that has evaporated?
Is there anything left behind in the dish?
Is ink a single substance? Or is it a mixture? What is your conclusion?
In black ink is there just one colour or is it a combination of many colours?

Take a filter paper strip 1 inch wide and 6 inches long. Put one drop of black ink (from a sketch pen or a fountain pen) at about 1 inch from one
end of the filter paper. Allow it to dry for one minute. Take water in a jar. Immerse the filter paper (as shown in the figure) into the water in the jar so that the ink spot is just above the water level (fig 2.7).

Observe carefully as the water rises up through the filter paper. Write down your observations in the science diary.

Fig. 2.7

★ Do different colours appear in the filter paper?
★ What could be the reason for the colours rising through the paper?

### Adsorption

Some substances like cotton, sponge etc. absorb liquids into them. But some other substances hold particles of certain other substances on their surface alone. This phenomenon is called adsorption. In this way, the carbon particles in gas masks remove poisonous gases from the air and the charcoal in water filters removes coloured and foul smelling substances from water. So also, dust particles stick to walls because of adsorption. The rate at which adsorption occurs on a substance depends on the nature of the substance. During adsorption of mixtures some of the components are adsorbed to a greater extent whereas some other components are not adsorbed to that extent.

The dyes present in ink are usually a mixture of two or more coloured substances. The water rises through the filter paper by capillary action. The weakly adsorbed component rises faster through the paper. Those which are strongly adsorbed rise slowly. In this way the colours are separated. As this method was first used for separating coloured substances it was termed chromatography. Chromatography is the process used for separation of solutes soluble in the same solvent. See the uses of this process.

- separation of components from dyes
- separation and identification of chemicals mixed in blood

Look at a situation in every day life where separation of mixtures happens.

### Butter from curd

You would have seen curd being churned to obtain butter. During churning, particles of butter are separated. Being less dense, these particles float on top of the curd.

An instrument called centrifuge (fig 2.8-a) is used to separate components from a mixture using the difference in densities of the components.

Examine some situations where this process is used.
Can the constituent elements of a compound be separated?

As already understood, formation of mixtures is a physical change. But the formation of compounds is a chemical change. Compounds are formed by chemical combination of elements in fixed proportions. Therefore, the elements in a compound can be separated only by suitable chemical processes.

See the compounds and their formulae given below.

Mercuric oxide - HgO
Calcium oxide - CaO

Both are metal oxides.

If HgO is heated it decomposes into Hg and O₂. But if CaO is heated the elements do not separate.

In order to separate the elements in compounds different methods suited to the nature of the compounds are adopted.

You can familiarise yourselves with these methods when you study more of chemical processes in higher classes.