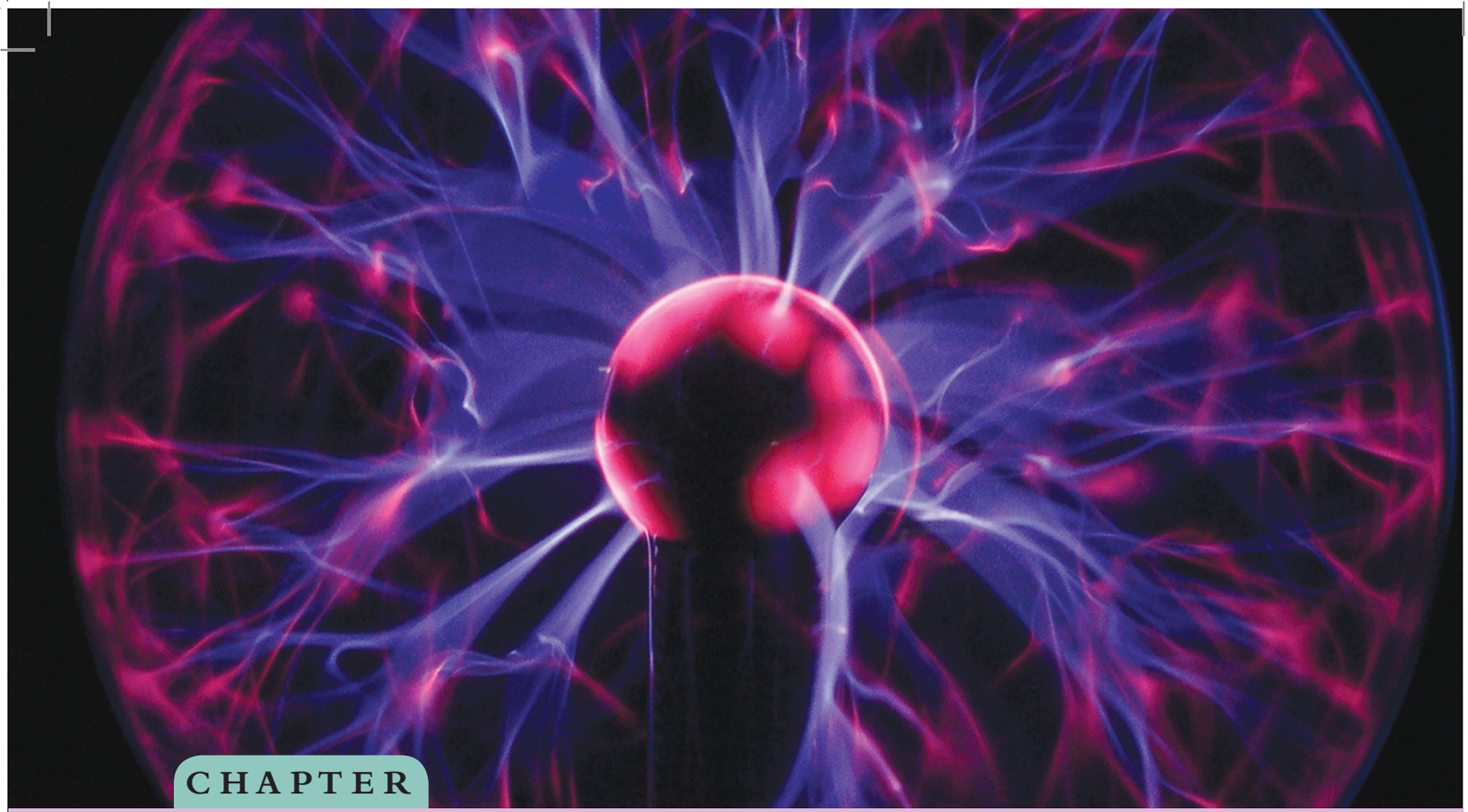
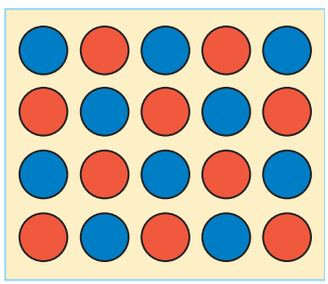


CHAPTER

3 Nature of Matter

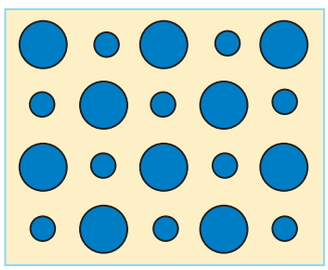
We see a variety of materials around us. They have different shapes, sizes, colours and other properties. It is difficult to study each and every property of every material separately. To make the study of materials, and their properties, easier, we classify them into groups and then study the general properties of each group.

1. Look at the marbles in the given box.



They have the same size and shape. But, they differ in their colour. We can put them into two groups on the basis of their colour: 10 **red** marbles and 10 **blue** marbles.

2. Now, look at the marbles in the box here.



They have the same colour and shape but they differ in their sizes. We observe that some of them are smaller than the others. We can now put them into two groups on the basis of their size: 10 **small** marbles and 10 **large** marbles.

3. **Now, consider the following set of materials.**

wood, water, air, glass tumbler, steel plate, milk, plastic bucket, kerosene.

They have different properties. But, some of them are naturally occurring while others are man-made. The materials, which occur naturally, are called **natural materials**. The materials, which are prepared by man, are called **man-made** or **synthetic materials**. We can, therefore, place these materials in two groups on the basis of their occurrence.

Activity 1

Write the names of the materials, you just read in Point 3 above, in the suitable column. Try adding some more names in each column.

Natural materials	Man-made materials

In all the above cases, various things, having similar properties, have been grouped together. Such a grouping of materials, having similar properties, is known as **classification**.

Matter

All the things that we see around us are made up of **matter**. Matter is something which has mass and which occupies space.

All matter can be broadly classified into three groups on the basis of its physical state, namely, **solid**, **liquid** or **gaseous** state.

Write five examples each of solids, liquids and gases.

Solids	Liquids	Gases

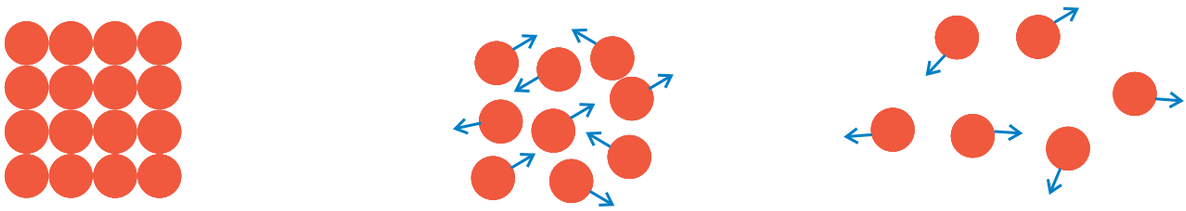
Constitution of Matter

All matter is made up of very small particles. Different states of matter have different arrangement of these particles.

In solids, the particles are very tightly packed with each other and cannot move. Hence, solids have a fixed shape and a definite volume.

In liquids, the particles are less tightly packed and can move a little. Liquids have a definite volume but do not have a fixed shape.

In gases, the particles have very little hold on each other. They can, therefore, move far apart from each other. Hence, gases have neither a fixed shape nor a definite volume.



Solid Liquid Gas

Arrangement of particles in three states of matter

Properties of Matter

Let us now study some common properties of matter.

Appearance and Feel

Materials are known to differ from one another in terms of their 'appearance' (lustrous/dull) and their 'feel' (smooth/rough). For example, metals generally have a lustrous 'appearance' and a polished piece of marble has a smooth 'feel'.

Activity 2

Add more names (to the two given here), of a few things, which differ on the basis of their appearance and feel.

S.No.	Things	Smooth/Rough	Lustrous/Dull
1.	Polished marble	Smooth	
2.	Sand paper	Rough	
3.			
4.			

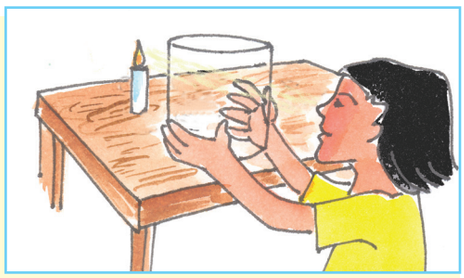
- ### Transparency

The property of a material to allow light to pass through it is called **transparency**. One can see through a transparent material.

Activity 3

Take an empty glass tumbler. Hold it against light and look through it.

Can you see the light on the other side of the tumbler?



Glass is a transparent material

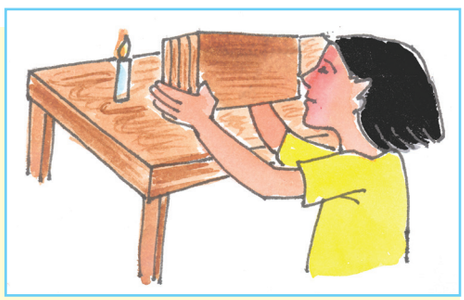
Glass is a transparent material as the light can pass through it. Pure water, air and a thin sheet of polythene are some other examples of transparent materials.

Some materials do not allow light to pass through them. Such materials are called **opaque** materials. Thick plastic sheet, blackboard and wall are some examples of opaque materials.

Activity 4

Take a piece of wood. Hold it against light and look through it.

Can you see the light on the other side of the wood piece?



Wood is an opaque material

Wood is an opaque material because light cannot pass through it.

Floating/Sinking

Materials which are lighter than water, generally, float over it.

Activity 5

Take some water in a mug. Drop some pieces of ice in the water. What do you observe?

The ice pieces float on water because they are lighter than water.

Ice pieces float on water

Materials, which are heavier than water, generally, sink in it.

Activity 6

Take some water in a mug. Drop some pebbles in it. What do you observe?

The pebbles sink because they are heavier than water.

Pebbles sink in water

Diffusion

The property of mixing of particles, of two materials, on their own, is called **diffusion**. This happens due to the free movement of the particles of such materials.

Gases diffuse very quickly into each other because their particles are in constant motion.

Activity 7

Place a lighted *agarbatti* in one corner of a large room. Very soon the fragrance of *agarbatti* will spread in the whole room. This happens because fumes of *agarbatti* diffuse into the air present in the room.

Fumes of *agarbatti* diffuse with air

Liquids diffuse into each other quite slowly. This is because particles in a liquid are not so free to move as they are in gases.

Activity 8

Take some clean water in a beaker. Put a few drops of blue ink in the water.

You will see that the blue ink spreads slowly in the water. This shows how one liquid diffuses into another liquid.

Ink gets diffused in water

Solids do not diffuse with each other because their particles are held tightly and cannot move freely. For example, sand and stones do not diffuse into each other. Solids can, however, diffuse slowly into liquids. This is because particles of liquid are able to move.

Activity 9

Take some clean water in a gas jar and place it on a table. Drop a few crystals of potassium permanganate in water. Observe the water.

You will see that pink colour spread slowly in water. This shows diffusion of a solid in a liquid.

Potassium permanganate crystals get diffused in water

Dissolution

When one substance mixes completely with another substance, to give a clear solution, we say it has **dissolved**. The property, by which a substance dissolves in another substance, is called **dissolution**.

Water can dissolve a large number of substances in it. Let us learn about the dissolution of solids, liquids and gases in water.

Dissolution of Solids in Water

Some solids dissolve in water and some do not dissolve. Let us perform an activity to understand this.

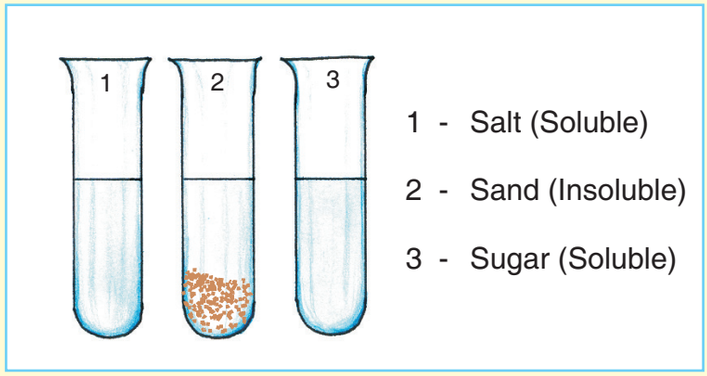
Activity 10

Take three test tubes and fill them half with water. Mark the test tubes as 1, 2 and 3.

Add half teaspoon of : salt in test tube 1, sand in test tube 2 and sugar in test tube 3.

Shake the test tubes well.

You will see that salt and sugar dissolve in water. They are said to be **soluble substances**. Sand does not dissolve in water. Hence, it is an **insoluble substance**.



Solubility and Saturated Solution

The maximum amount of a substance, that can be dissolved in a given volume of water, is called the **solubility** of that substance in water.

Let us perform the following activity to understand the meaning of saturated solution.

Activity 11

Take a glass tumbler half filled water. Add half teaspoon of sugar in it and stir well. The sugar dissolves. Now, add another half teaspoon of sugar and stir. This will also dissolve.

Keep on adding sugar in half teaspoon amounts and stir well after every addition.

After adding a particular amount of sugar, you will observe that sugar is no more dissolving in the given volume

Particular amount of sugar dissolves in given volume of water.

of water. This means maximum amount of sugar has been dissolved in a given volume of water.

Count the number of half teaspoons of sugar that you have added. This is a measure of the solubility of sugar in the given volume of water.

The above activity can also be performed by adding common salt in water instead of sugar.

The solution obtained in the above activity cannot dissolve more sugar. Such a solution which cannot dissolve more amount of a given substance at a given temperature is called a **saturated solution**.

- ## Effect of Temperature on Solubility

On increasing the temperature, that is, on heating a solution, the solubility of a substance, generally, increases. This means, in a given volume of water, a larger amount of a substance can be dissolved if water is heated.

Let us perform the following activity to understand this.

Activity 12

Take equal volume of water in two separate glass tumblers. Heat the water in one of the tumblers. Now, add equal amounts of sugar in two tumblers and stir. The sugar dissolves. Keep on adding measured amounts of sugar in two tumblers till it stops dissolving.

Find out in which tumbler more amount of sugar has got dissolved.

You will find that the amount of sugar dissolved in hot water is more.

This shows that the amount of a substance, dissolving in water, generally, increases with an increase in temperature.

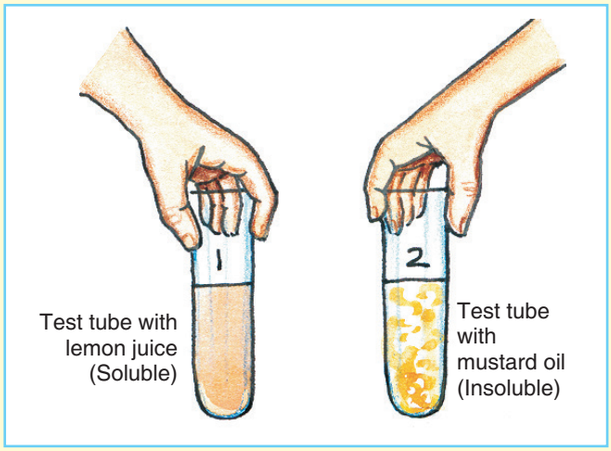
Dissolution of Liquids in Water

Some liquids are soluble in water, that is, they dissolve in water. Some other liquids are insoluble in water. Let us perform an activity to understand this.

Activity 13

Take two test tubes and mark them as 1 and 2. Fill half of each test tube with water. Mix half teaspoon of lemon juice in test tube 1 and half teaspoon of mustard oil in test tube 2. Shake both the test tubes and observe.

You will see that lemon juice is soluble in water, but mustard oil is insoluble in water.



Dissolution of Gases in Water

Some gases dissolve in water. For example, soda water is prepared by dissolving carbon dioxide gas in water. Let us perform the following activity to understand the solubility of gases in water.

Activity 14

Take a soda water bottle and open its lid.

What do you observe?

Bubbles of a gas are seen coming out of the bottle.

Keep the bottle open (without its lid) for sometime. You will notice that after sometime, bubbles will stop coming out of the bottle. It shows that all the gas, dissolved in that soft drink, has escaped from it.

Gas dissolved in Soda water bottle escapes after opening it

Oxygen gas also gets dissolved in water in small amounts. This oxygen is used by the aquatic animals to breathe. Gases like helium, ozone and hydrogen do not dissolve in water. This shows that some gases dissolve in water whereas some do not.

The solubility of a gas, in water, decreases with increase in its temperature.

Thus, we have learnt that all materials are made up of matter which exists in three forms, namely, solid, liquid and gas. Matter can be classified on the basis of properties, such as appearance and feel, transparency, diffusion, solubility, etc.

Keywords

diffusion	mixing of particles of two materials on their own.
dissolution	complete mixing of one substance with another substance.
man-made/synthetic materials	the materials, which are prepared by man.
matter	something which has mass and occupies space.
natural materials	materials which occur naturally.
opaque materials	materials which do not allow light to pass through them.
solubilility	maximum amount of a substance that can be dissolved in a given volume, of a given liquid (usually water).
saturated solution	solution, in which more of the given substance, cannot be dissolved at a given temperature.
transparency	property which allows light to pass through a material.

You Must Know

1. Grouping of materials, having similar properties, is known as classification.
2. Classification is done to make the study of materials and their properties easier.
3. Materials can be classified as naturally occuring and synthetic (man-made) materials.
4. All materials are made up of matter, that is, they have mass and occupy space.
5. Matter exists in three physical states, namely, solid, liquid and gas.
6. These states of matter differ from each other in properties due to differences in the nature of packing of particles in them.
7. Matter can be classified on the basis of different properties like appearance and feel, transparency, tendency to float or sink, diffusion, dissolution and so on.
8. Some materials allow light to pass through them, that is, they are transparent.
9. Some materials do not allow light to pass through them, that is, they are opaque.
10. Materials, which are lighter than water, generally, float over it; those, which are heavier than water, generally, sink in it.
11. Gases diffuse into each other quite readily; liquids diffuse much more slowly and solids generally do not diffuse into each other.
12. Some substances dissolve in water while some others do not dissolve in it.
13. The maximum amount of a substance, that can be dissolved in a given volume of water is called the solubility of that substance in water.
14. The solubility of a solid, in water, generally, increases on increasing the temperature.
15. Solubility of a gas, in water, decreases on increasing the temperature.
16. A solution which cannot dissolve more amount of a given substance at a given temperature is called a saturated solution.

Something To Know

A. Fill in the blanks.

1. The process of grouping objects with similar properties is called _____.
2. Anything that occupies _____ and has _____ is called matter.
3. In the _____ state of matter, the constituent particles have very little hold on one another.
4. Light does not pass through a blackboard as it is an _____ object.
5. Smell of a perfume reaches us by the process of _____.

B. Write True or False for the following statements.

1. Air is a man-made material. ☐
2. A thin polythene sheet is transparent. ☐
3. Pebbles float on water. ☐
4. Diffusion is the mixing of the particles of two materials, on their own. ☐
5. Oxygen gas is slightly soluble in water. ☐

C. Tick (✓) the correct option.

1. The state/states of matter, that have both a fixed shape and a definite volume, is/are—

   ☐ liquids and solids ☐ gas and liquids
   ☐ solids only ☐ liquids only

2. Your book is made up of matter, because it—

   ☐ has mass. ☐ occupies space.
   ☐ occupies space and has some mass. ☐ does not float on water.

3. Which of the following is an opaque material?

- ☐ a piece of wood
- ☐ a plane, thin sheet of glass
- ☐ pure air
- ☐ water in a clear glass container

4. In which of the following cases would diffusion be the fastest?

- ☐ gas in another gas.
- ☐ liquid in another liquid.
- ☐ a solid in a liquid.
- ☐ a gas in a liquid.

5. Which of the following is insoluble in water?

- ☐ mustard oil
- ☐ sugar
- ☐ carbon dioxide
- ☐ common salt

D. Answer the following questions in brief.

1. Define the following:

   (a) Natural materials

   (b) Transparent materials

2. Name any three materials that are (i) transparent (ii) opaque in nature.

3. Which state of matter (i) can (ii) cannot easily change its shape and volume? Why?

4. Why do materials diffuse into each other?

5. Define the term 'solubility'. How does it change on increasing the temperature of water?

6. Name three materials that are (i) soluble (ii) insoluble in water.

E. Answer the following questions.

1. Why do solids have a fixed shape and a definite volume?
2. Briefly describe an activity to show that pure water is a transparent liquid.
3. Describe an activity to show that a solid can diffuse slowly into a liquid.
4. What is a 'saturated solution'? How can one prepare a saturated solution of common salt in water?
5. Suggest one activity to show the effect of temperature on the solubility of a solid in water.

Value Based Question

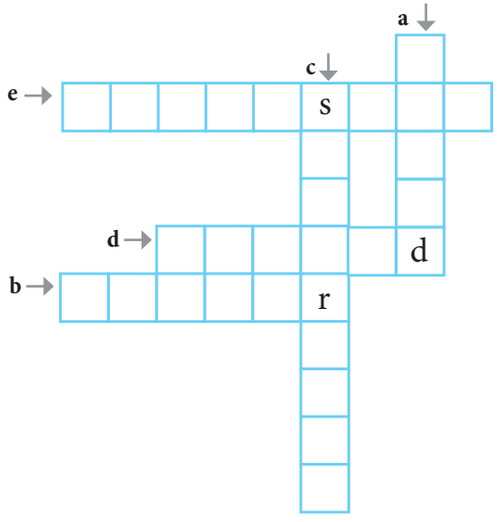
Neha went to a village to attend the marriage of her cousin. She was very much upset when she observed that there was no cleanliness in, and around, many houses. She used a gentle, polite and slow approach to make the villagers realise the importance, and necessity, of keeping their surroundings neat and clean. She was happy to find the village very much cleaner by the time she left. While leaving, she told her cousin that her success was similar to that of blue ink drops which slowly make the water in a bowl uniformly light blue when they are dropped in it.

1. State the values displayed by Neha.
2. Name the process through which blue ink drops make the water uniformly blue.
3. Let each student think of an incident, or a situation, in which the efforts of one person brought a useful, or desirable, change in that situation.

Something To Do

1. **Visit a nearby departmental store and observe how classification of the materials is useful. Try to find out the basis of classification of different materials. Write your observation in a tabular form.**
2. **Make a model to show the arrangements of particles in the three states of matter.**

3. Fill the boxes with suitable words on the basis of the clues given below.



Across →

b. It has mass and occupies space.

d. It has a definite volume but no fixed shape.

e. Particles of two materials mixing on their own.

Down ↓

a. It has a definite volume and a fixed shape.

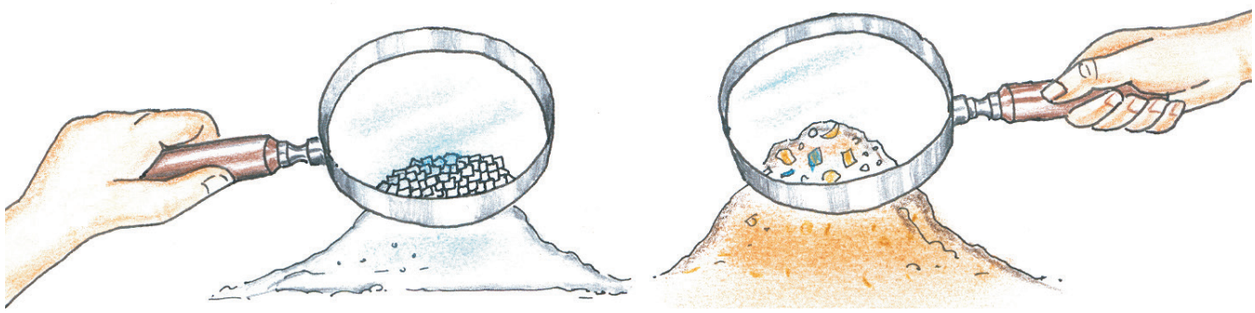
c. The solution that has the maximum amount of a substance, dissolved, in a given volume of it.

CHAPTER

4 Separation of Substances

In our day-to-day life, we come across a variety of materials like soil, air, oil, milk and so on. Most of these materials are **mixtures**, i.e. they are made up of two or more substances. For example, air is a mixture of very many gases, such as oxygen, nitrogen and carbon dioxide. Similarly, milk is a mixture of water, fat and other substances.

Let us closely observe the samples of some good quality sugar and soil with the help of a magnifying glass. We do so to observe whether these samples have only one type of substance or more.



Sugar Soil

We observe that in the sugar sample, each grain has nearly the same colour, size, and shape. However, the soil sample has particles of many different types, shapes and colours. These particles can be of sand, small stones, blades of grass, bits of paper, pebbles and so on.

We can, therefore, say that the sugar sample is a pure substance, i.e. it is made up of only one type of substance. The soil sample is a mixture as it contains more than one type of substances, present in it. Sugar, salt, oxygen, carbon dioxide, gold, pure water, copper are some examples of pure substances. All the different parts, or samples of these substances, have identical appearance and properties.

See the pictures given below and categorise them as 'pure substances' or 'mixtures'.


salt


sugar


milk


butter


jute rope


chocolate milk


vegetable curry


water from a pond

Pure substances	Mixtures

Let us now learn more about mixtures.

Mixtures

A **mixture** is formed when two or more substance are mixed together in any proportion. The components of a mixture are not combined chemically. Air, soft drinks, lemonade, sea water are some examples of mixtures.

The table, given below, indicates the components present in some of the common mixtures.

	Mixtures	Components
1.	Air	Gases like nitrogen, oxygen, carbon dioxide, argon, dust particles and water vapour
2.	Sea Water	Salts, water and sand particles
3.	Aerated drinks	Water, sugar and carbon dioxide
4.	Lemonade	Lemon juice, sugar and water
5.	Crude oil	Petrol, kerosene oil, diesel, etc.

A mixture can be in a solid, liquid or gaseous form. Some examples of mixtures of each of these forms are given in the following table:

Mixtures in different forms	Examples
Solid	Soil, alloys like brass, bronze, fuse wires
Liquid	Salt solution, aerated drinks, sea water
Gaseous	Air, CNG, PNG, LPG

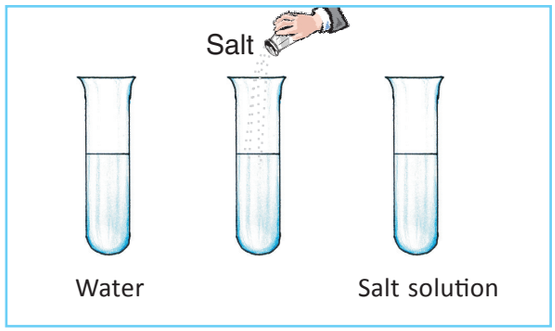
Types of Mixtures

Mixtures are of two types:

(a) Homogeneous mixtures

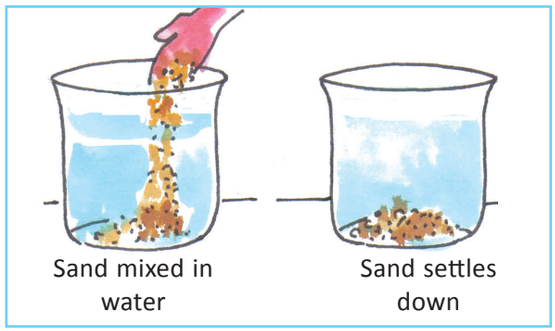
(b) Heterogeneous mixtures

A **homogeneous mixture** is that which has the same composition throughout, that is, its components are uniformly distributed. Hence, its different parts cannot be distinguished from each other. A solution of salt or sugar in water, soft drinks, alloys (brass, bronze, fuse wire) are some examples of homogenous mixtures.



Homogeneous mixture

A **heterogeneous mixture** is that which does not have the same composition throughout, that is, its components are not uniformly distributed. Hence, its different parts can be distinguished from each other. Mixtures of sand in water, iron nails in sulphur powder, pebbles in rice are some examples of heterogeneous mixtures.



Heterogeneous mixture

Do You Know ?

Some dishonest persons mix harmful and cheap components, with a pure substance, to earn more profits. For example, they mix white stones in rice, or dried papaya seeds in black pepper. This is called **adulteration** which is something that should not be done at all. It is always advisable to buy good quality food stuff from a reliable shop.

Separating the Components of Mixtures

The components of a mixture can be separated by simple physical methods. The methods, for separation of mixtures, are based on the difference in the properties of their components.

There are many different methods by which components of a mixture can be separated. For understanding them better, let us divide the mixtures into three categories:

(a) Mixtures of solids with solids.

(b) Mixtures of solids with liquids.

(c) Mixtures of liquids with liquids.

Let us now discuss them one by one in detail.

Mixtures of Solids with Solids

Hand Picking

The components, of a 'solid-solid mixture', can, sometimes, be separated by picking them with hands. This method is used when components of the mixture are of different colours, shapes or sizes and the quantity of the mixture is small.

Hand picking

Examples of separating the components of a mixture by hand picking are—separating pebbles from rice or *dal,* or separating grass from mint leaves.

Threshing

This method is generally used by farmers to separate the grains from the stalks after harvesting. The dried stalks are beaten, or threshed, to separate the grains. In large farms, threshing is done by using machines, called **threshers**.

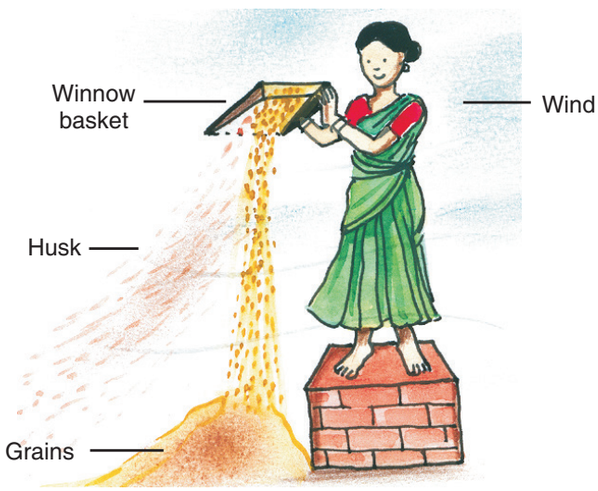
Wheat thresher

Do You Know ?

- The process, of cutting and gathering the ripened crop, is called **harvesting**.
- A farm machine, called **Combine**, is used for both harvesting and threshing.

Winnowing

This method is used to separate lighter husk from heavier grains like wheat. In this method, the mixture is allowed to fall from a height. The lighter components (the husk) get blown away to a distance while the heavier components, or the grains, fall down closer. The two parts, thus, get separated out into two separate heaps.



Winnowing

Sieving

This method is used to separate the components that are of different sizes. For sieving, a sieve is used. A 'sieve' is a wire mesh fixed tightly in a frame.

In this method, the mixture to be separated is put in a sieve. The particles, having a small size, pass through the holes of the sieve whereas the larger sized particles remain on the sieve. Sieves, with different sizes of holes, are used for different mixtures.

Sieving

At home, sieving of wheat flour may be done to separate finely ground flour particles from the coarse particles.

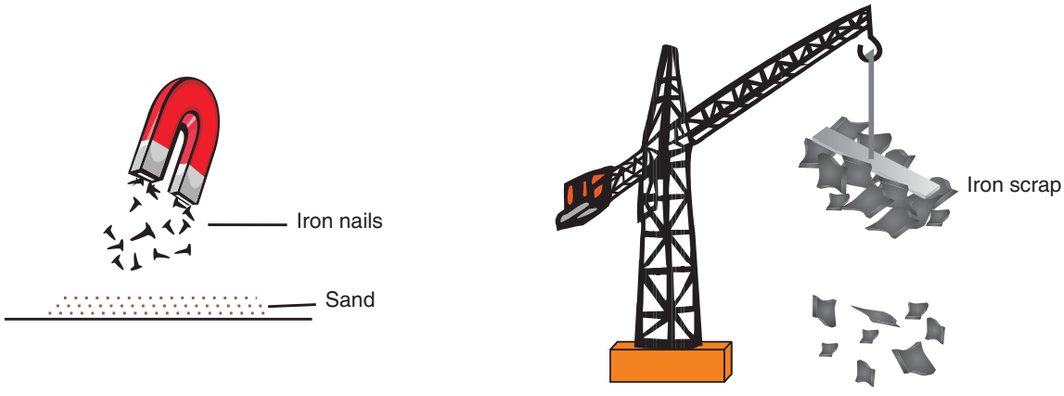
At construction sites, sieving of sand is done to separate fine sand from gravel and pebbles. The sieve, used there, is much bigger in size and the size of its holes is also big.

Do You Know ?

- In Kerala, cashewnuts of different sizes are separated by sieving.
- Jewellers use the process of sieving to separate pearls of different sizes.

Magnetic Separation

This method of separation is used when one of the components of a mixture is magnetic, that is, it gets attracted towards a magnet. For example, when a magnet is brought near iron pins, the pins tend to cling to it. The property, of attraction of magnetic substances (like iron), towards magnet, is used to separate out such substance present in a given mixture.



Magnetic separation

Scrap iron is removed from a heap of waste materials (garbage) by using strong magnets fitted to a crane. This iron can then be melted and reused.

Sublimation

Generally, solid substances, on heating, first change into their liquid form and, on further heating, change into their vapour form. However, some solids change directly into their gaseous form, when heated.

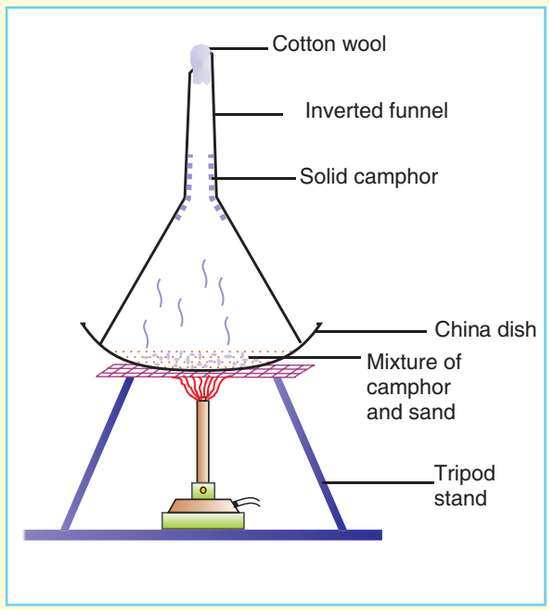
The process, in which a solid changes directly into its gaseous state, on heating, is called **sublimation**.

This can be understood better with the help of the following activity.

Activity 1

A mixture of sand and camphor can be separated by sublimation.

Take the mixture of sand and camphor in a china dish. Cover it with an inverted funnel whose narrow end has been closed with some cotton wool. Heat the china dish, on a wire gauge, as shown in the figure. On heating, camphor sublimes, and changes into its vapours, which rise up. On coming in contact with the walls of the funnel, vapours cool down and change back into solid state. It then sticks to the walls of the funnel. Sand gets left behind in the china dish. Thus, sand and camphor get separated from each other.



Sublimation

The method, of sublimation, is used to separate solids, which sublime easily, from substances which do not sublime. Substances, like naphthalene, camphor, iodine and ammonium chloride, sublime on heating. They can, therefore, be separated from substances, like sand, salt and sugar, by the process of sublimation.

Mixtures of Solids with Liquids

These can be of two types:

1. Solids which dissolve in liquids.
2. Solids which do not dissolve in liquids.

Separating solids that dissolve in liquids

Some solids dissolve completely in a liquid to form a clear solution. For example, salt or sugar dissolve completely in water. The components of such mixtures can be separated by the following methods:

Evaporation

This method is used to separate solid substances dissolved in a liquid. Let us understand this by performing the following activity.

Activity 2

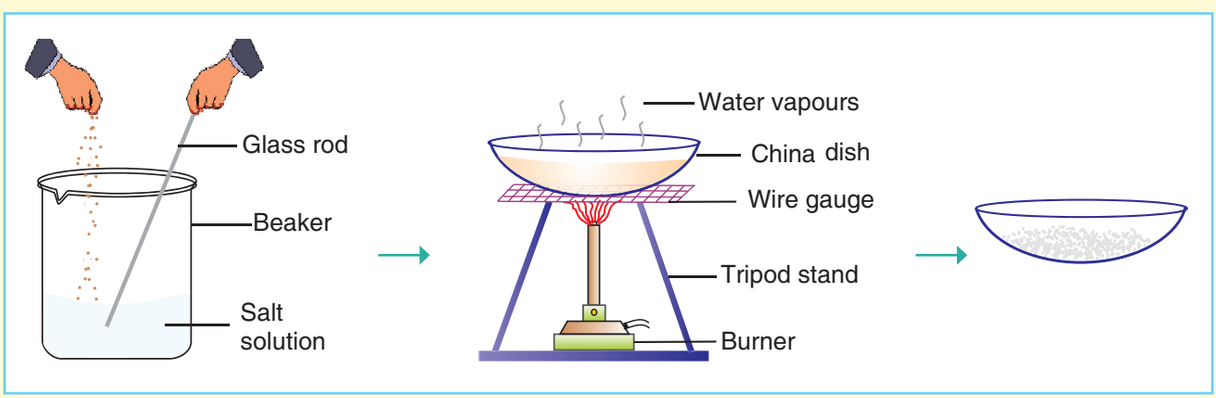
Take a glass beaker and fill it half with water. Add four teaspoons of salt to it. Stir it well till the salt dissolves in water.

Transfer this salt solution into a china dish. Heat it over a burner.

Water starts evaporating.

When almost all the water has evaporated, put off the burner and observe.

White particles of salt are left behind in the china dish.



Mixture of salt and water | Evaporation | China dish containing pure common salt

This method is commonly used to obtain common salt (that we use in our food) from sea water. Sea water is collected in shallow beds dug near the sea. The heat of the sun helps in evaporating water leaving behind the particles of salt.

Do You Know ?

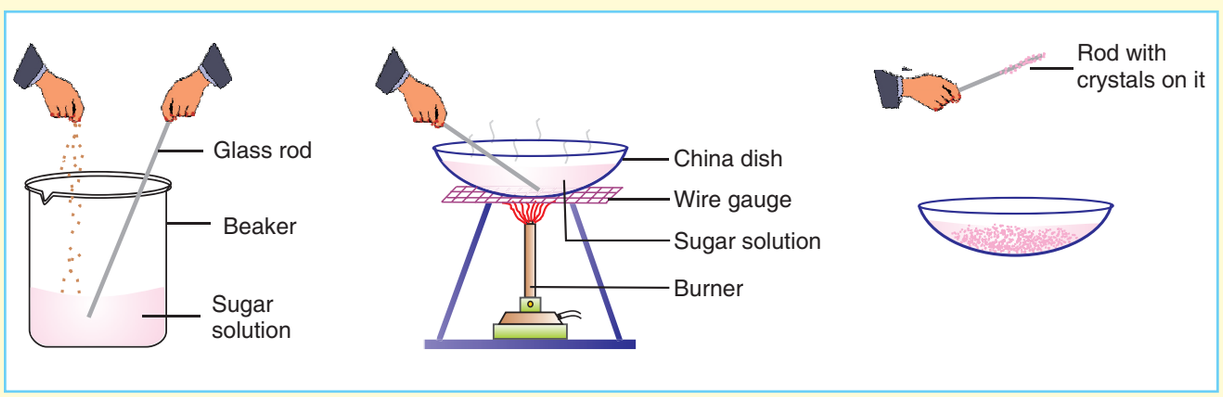
On an average, a litre of sea water has about 36 g of edible salt in it.

▸ Crystallisation

This method is used to obtain pure solids from a given solution. For example, the salt, we get from sea water, has many impurities in it. To remove these impurities, the process of crystallisation is used. **Crystallisation** is a process which separates a pure solid, in the form of its crystals, from a saturated solution. The following activity explains this process in detail.

Activity 3

Take 100 ml water in a beaker and prepare a saturated solution of sugar in it. For this, keep on mixing sugar in water until it can dissolve no more of sugar. Transfer this saturated solution into a china dish. Heat the china dish on a wire gauge. Stir the solution occasionally with a glass rod. When small crystals start appearing on the glass rod, stop heating the solution. Allow the solution to cool without disturbing it. Small crystals, of pure sugar, will appear in the china dish.



Preparation of saturated solution of sugar | Heating the sugar solution | Crystals of pure sugar

Crystallisation is often used for purification of salt we get from the sea. We can also use this process to separate out crystals of alum (*phitkari*) and blue vitriol (*neela thotha*) from their impure samples.

Separating solids that do not dissolve in liquids

Some solids do not dissolve in a liquid. For example, tea leaves, chalk powder, sawdust, pulses are all insoluble in water.

The components of such mixtures can be separated by the following methods.

Sedimentation and Decantation

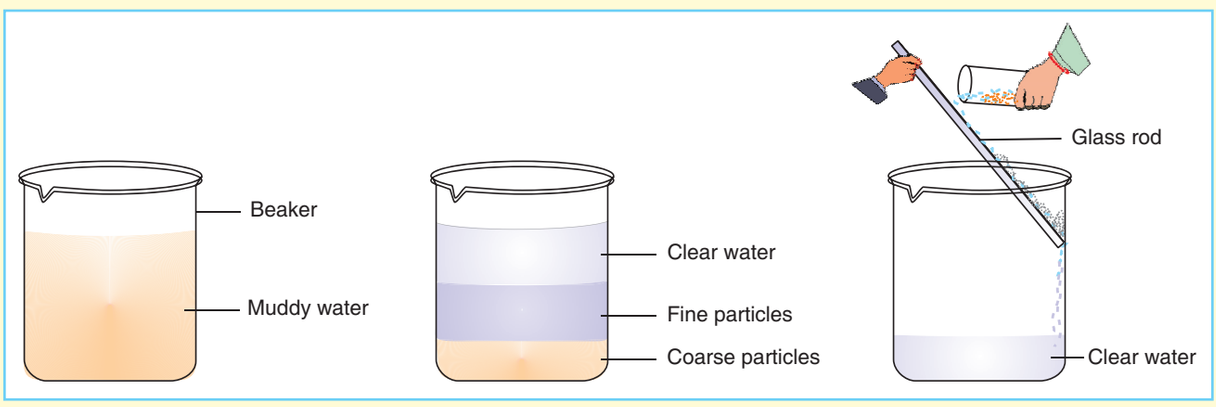
Sedimentation is a process by which insoluble, heavy solid particles in a mixture settle down on their own, when left undisturbed for some time. In order to separate out the two, the liquid has to be gently poured into another container without disturbing the settled down solid particles, or **sediments**. The process, of obtaining clear liquid, by pouring it into another container without disturbing the sediments, is called **decantation**.

Let us perform a simple activity to understand this process.

Activity 4

Take some water in a beaker. Add some sand into it and stir.

Let it stand undisturbed for sometime in a beaker. After a few minutes, the sand particles settle down. This is 'sedimentation'. Gently pour the clear water into another beaker without disturbing the layer of the sand particles. This is 'decantation'.



Mixture of sand and water | Sand settles down as a sediment | Decantation

Sedimentation

Sedimentation and decantation methods are used for removing insoluble impurities from river and canal water. They are used in water treatment plants that supply drinking water to our homes, schools and offices.

In homes, when pulses or rice, are washed before cooking, the water used for washing them, is separated by sedimentation and decantation methods.

▶ Loading

Sedimentation is a slow process. In this process, the finer particles can take a long time to settle down. In order to speed up this process, we often take the help of **loading**. Loading speeds up sedimentation by making light, suspended particles heavier by using suitable chemicals.

The activity given below will explain it further.

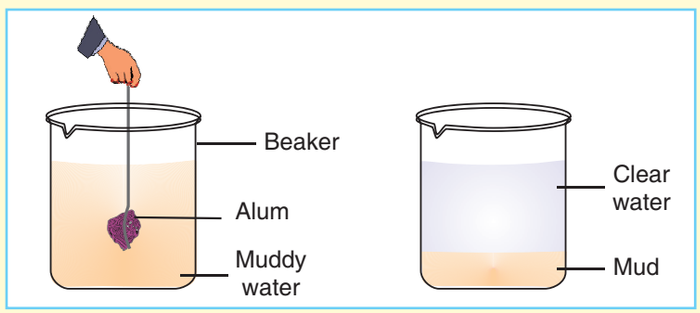
Activity 5

Take a piece of alum (*phitkari*). Tie it to a thread and dip it three or four times, in a beaker of muddy water.

Take it out and let the muddy water stand undisturbed for sometime.

Note the time taken by the mud particles to settle down. Compare it with the time taken by them during a direct sedimentation. You will find that 'loading' makes the process a lot faster.

In this particular case, the alum dissolves quickly, sticks to the fine mud particles and makes them heavier. The heavier mud particles settle down more easily and quickly.



Loading

It has been observed that it is sometimes difficult to breathe after a strong wind and storm. This is due to the presence of fine suspended dust particles in the air. However, a rainfall, after storm, removes these dust particles and the air becomes clear and fresh again. The dust particles, in the air, get loaded with water and settle down. Thus, loading helps in cleaning the air more quickly.

Do You Know ?

Shopkeepers often sprinkle water around their shops if the area is not cemented. Also, before sweeping a dusty room, water is sprinkled. In these situations, water is used to load the dust particles so that they do not float in the air.

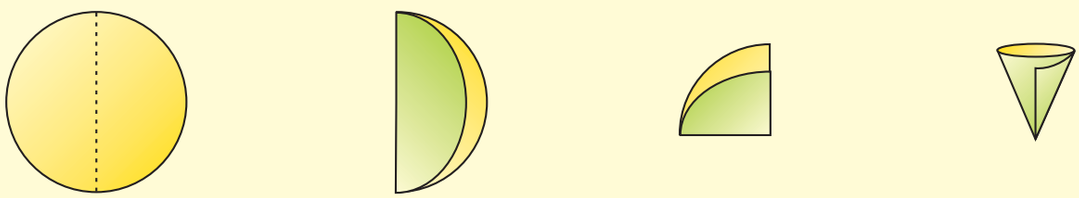
▶ Filtration

In order to make tap water fit for drinking, we often filter it. In this process, the insoluble solid impurities are separated from the water to make it fit for drinking. **Filtration** is, therefore, a process of separating insoluble solids (like mud, tea leaves, etc.) from a liquid using a fine porous material, called the **filter**. The activity given below will explain the process of filtration.

Activity 6

Take some muddy water in a beaker. Also take a piece of filter paper.

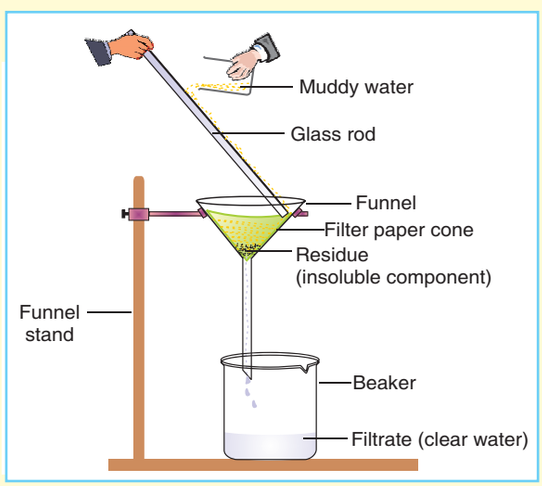
Cut the filter paper into a circular shape. Fold it and form a cone as shown below.



Folding of filter paper

Fit the cone into a funnel and hold it with your thumb. Moisten the cone with some water. The wet filter paper will now stick to the walls of the funnel. Place this funnel on the funnel stand. Place a clean beaker below the funnel. The tip of the funnel should be within the beaker and should be near its top.

Slowly pour the muddy water, along a glass rod, into the funnel. Clean water passes through the pores of the filter paper and gets collected in the beaker kept below the funnel.



Filtration

This clean water is called the **filtrate**.

The mud (solid impurities), that remains on the top of the filter paper, is called the **residue**.

Do You Know ?

Muslin cloth, filter paper, cotton wool, charcoal and even fine sand can all be used as filters. The choice of the filter depends upon the size of the particles to be removed.

The method of filtration is used to separate out tea leaves from tea. We use a sieve for it. Filtration is also used by the Water Works Department to purify water. They use layers of gravel and sand to filter very large quantities of water.

▶ Centrifugation

It is a method, used to separate the fine particles suspended in a liquid, by rotating the mixture at high speeds. Centrifugation is done with the help of a machine called the **centrifuge**. The heavier particles tend to settle down at the bottom of the container while the lighter ones stay at the top. Separating cream from milk, by churning it, is an example of centrifugation, often used in many households.

Centrifugation

Centrifugation is widely used in dairies, and at homes, to churn out butter from cream. Butter, being lighter, floats at the top.

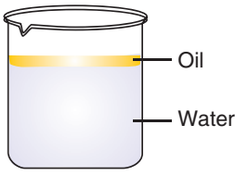
Do You Know ?

A traditional long-handed wooden churner is still in use to separate butter from cream.

Wooden churner

Mixtures of Liquids with Liquids

Separating immiscible liquids



We all know that when oil gets mixed with water, it stays as a separate layer on the top. The lower layer is of water.

Liquids which do not dissolve in each other are said to be immiscible. A mixture of two immiscible liquids gets separated into two separate layers. A separating funnel is then used to separate out the two immiscible liquids.

The activity given below explains the method of using a separating funnel to separate immiscible liquids.

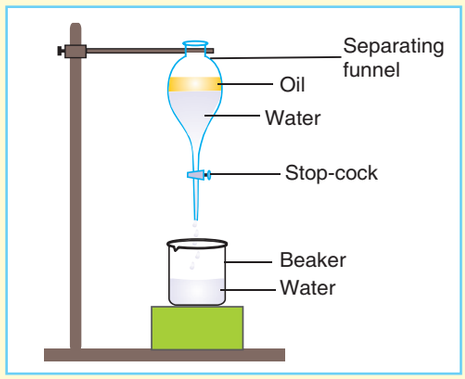
Activity 7

Mix some mustard oil in water, taken in a beaker. These two liquids form two separate layers.

Pour this mixture of mustard oil and water into a separating funnel.

Let it stand undisturbed for sometime so that the layers, of oil and water, get clearly separated out.

Rotate the stop-cock of the separating funnel at the bottom to let the lower layer, that is, water, move out of it into a beaker kept below it.



Separating oil and water

Slowly allow the water layer to move out of the separating funnel.

Stop the stop-cock as soon as the oil reaches the tip. Thus, oil is left behind in the separating funnel and water is collected in the beaker kept below.

Hence, water and oil get separated.

Do You Know ?

Separating two miscible liquids:

The method commonly used, for this purpose, is **distillation**. Here, the two liquids, present in a mixture have different boiling points. This method involves evaporation of a liquid followed by its condensation. The liquid having lower boiling point vaporises first and its vapours are condensed into liquid, which is, collected separately. The other liquid having higher boiling point is left behind.

Combining two or more methods of separation

Till now, we have discussed different methods of separation in isolation. In actual practice, if the mixture contains a number of substances, their separation involves a combination of two or more of these different methods. The selection of the methods depends upon the properties of different components present in it. Let us perform the following activities to understand this.

Activity 8

To separate sugar, sand and iron nails from a mixture.

Steps:

- **Magnetic Separation** — Iron nails are separated by using a magnet. Sand and sugar are left behind.
- **Filtration** — Put the mixture of sugar and sand in a beaker containing water. Stir till sugar gets dissolved. Filter the solution. Sand gets collected on filter paper. Sugar, dissolved in water, comes out in the filtrate.
- **Evaporation** — Heat the sugar solution till the water evoporates. Sugar crystals will be left behind.

Activity 9

To separate salt, ammonium chloride and sand.

Steps:

- **Sublimation** — Put the mixture in a china dish with an inverted funnel covering it. Heat the mixture on a wire gauge. Ammonium chloride sublimes and forms vapours which get condensed on the walls of the funnel. Thus, ammonium chloride is separated.
- **Filtration** — Dissolve the rest of the mixture, that is, sand and salt in water. Salt dissolves in water, while sand does not. Filter this mixture. Sand is left on the filter paper and the filtrate contains salt.
- **Evaporation** — Heat the filtrate in a china dish to evaporate water so that the salt is left behind.

Keywords

centrifugation	a method, used to separate fine particles, suspended in a liquid, by rotating the mixture at a high speed.
decantation	the process of pouring out clear liquid without disturbing the sediments.
evaporation	the process in which the liquid part of a mixture gets converted into its vapour form, leaving the solid part of the mixture behind.
filtration	a process of separating out insoluble solid substance from a liquid.
hand picking	separation of a mixture having solid particles of different shape, size, etc., by picking them with hands.
heterogeneous mixture	a mixture, having different compositions, over its different parts.
homogeneous mixture	a mixture, having the same composition, over all its parts.
loading	speeding up the rate of sedimentation, by making light, suspended particles heavier, using suitable chemicals.
magnetic separation	a method of separation used when one of the components of a mixture, is magnetic in nature.
mixture	it consists of two, or more, substances mixed together in any proportion.
pure substances	substances having only one kind of particles.
sedimentation	the process of settling down of heavy, insoluble solid particles mixed in a liquid.
sieving	a method, used to separate the different sized components of a mixture, by using an appropriate sieve.
sublimation	the process in which a solid changes directly into its gaseous state when heated.

threshing	separation of grains from harvested crop.
winnowing	the process of separation of lighter particles from heavier ones by wind.

You Must Know

1. Materials can be either pure substances, or a mixture of two or more substances.
2. A pure substance has only one kind of particles in it.
3. Mixtures consists of two, or more, substances.
4. Mixtures are classified as homogeneous and heterogeneous.
5. Mixtures can be divided into three categories—
   (i) solids with solids
   (ii) solids with liquids
   (iii) liquids with liquids
6. Methods of separating solid–solid mixtures are—
   - hand picking
   - threshing
   - winnowing
   - seiving
   - magnetic separation
   - sublimation
7. Solid-liquid mixtures are of two types—
   (i) solids that dissolve in liquids. Such mixtures can be separated using evaporation and crystallisation.
   (ii) solids that do not dissolve in liquids. Such mixtures can be separated out by the process of sedimentation and decantation, filtration or centrifugation.
8. A mixture, of two immiscible liquids, can be separated using a separating funnel.

Something To Know

A. Fill in the blanks.

1. Housewives sometimes use the method of _____ to remove unwanted substances from eatables like rice and pulses.
2. Common salt is prepared on a large scale through the process of _____.
3. Separation of tea leaves from tea is done by a process called _____.
4. The process of _____ can be used to increase the rate of sedimentation of the suspended particles in a solid-liquid mixture.
5. The method, used to separate the fine particles, suspended in a liquid, by rotating the mixture at high speed, is known as _____.

B. Match the following:

1.	Wind	(a)	hand picking
2.	Chalk powder and water	(b)	winnowing
3.	Oil and water	(c)	sedimentation
4.	Separating peas from cooked *pulao*	(d)	filteration
5.	Muslin cloth	(e)	separating funnel
6.	Camphor and salt	(f)	sublimation

C. Tick (✓) the correct option.

1. Which of the following is an example of a heterogeneous mixture?

☐ sugar in water ☐ pebbles in rice

☐ an aerated drink ☐ salt in water

2. Which one of the following is not an example of a pure substance?

- ☐ oxygen
- ☐ air
- ☐ copper
- ☐ carbon dioxide

3. The process of loading helps to—

- ☐ slow down the rate of sedimentation
- ☐ speed up the rate of sedimentation
- ☐ speed up the rate of decantation
- ☐ slow down the rate of decantation

4. Transferring the clear liquid, into another container, leaving behind the residue, is called—

- ☐ sedimentation
- ☐ decantation
- ☐ condensation
- ☐ crystallisation

5. A substance, that sublimes easily, is—

- ☐ naphthalene
- ☐ salt
- ☐ sugar
- ☐ chalk

D. Answer the following questions in brief.

1. Name any three methods used for separating a solid-solid mixture.

2. What is winnowing? Give an example of a mixture whose components can be separated by this method.

3. Some iron pins get scattered on the carpet when you are expecting guests. How can one collect all the pins in the shortest possible time?

4. Name any three substances which sublime on heating.

5. What is crystallisation? Name any three substances which can be purified using this technique.

E. Answer the following questions.

1. Differentiate between a pure substance and a mixture. Give two examples of each.
2. State the difference between heterogeneous and homogeneous mixtures. Give two examples of each type.
3. Can a mixture of iodine and camphor be separated by the sublimation method? Give reason for your answer.
4. Why does the size of naphthalene balls, put in open, keep on reducing with time?
5. After a dust storm, how does rain help in making air clear?
6. Sawdust, mixed in water, cannot be separated by the sedimentation method. Why?
7. The filtration method cannot be used to separate sugar and salt mixed in water. Why?
8. Describe the method of centrifugation using an appropriate example.

Value Based Question

The students, of Class-VI, participated actively in the '*Swachata Abhiyan*' for their school and its neighbourhood. They separated out the biodegradable and non-biodegradable wastes and put them in separate bins. Their science teacher appreciated their work. She compared their work with the methods of 'Sieving' and 'Winnowing' about which she had taught them last week.

1. State the values displayed by the students of Class-VI.
2. Give one example each of a situation in which 'sieving' and 'winnowing' can be used for bringing about the required separation.
3. Have a discussion in the class, in which each group of students gives one example of 'separation', that can be compared with 'some method of separation', studied by them.

Something To Do

1. **Draw a neat and well-labelled diagram of filtration method. Also name the different varieties of filters available.**

2. **Fill a glass with impure water. Using your knowledge of methods of separation, suggest a method to purify it. Justify your suggestions.**

3. **Suggest ways to separate the components of the following mixtures.**

   (a) Camphor, sand and salt.

   (b) Sawdust, common salt and iron nails.

   (c) Ammonium chloride, common salt and chalk powder.

4. **Visit the kitchen in your house and also your surroundings. Observe the different methods of separation that are being used by different people. Make a list of your observations and name the different methods used in different cases.**

CHAPTER

5 Changes Around Us

Everything in this world undergoes a change. We observe many changes around us at home, in school, in playground and at other places. The pictures, given below, show some of the changes that take place around us every day.

Melting of ice

Growing of plant

Evaporation of lake water

When we look at the changes shown above, we realise that every change has a cause. Ice melts due to the heat of the sun. Plants use the energy of sun to grow. Changes in weather occur due to the revolution of Earth around the Sun. Similarly, day and

night are caused due to the rotation of Earth. **Change**, therefore, is a phenomenon in which an object may become different in its shape, size, position and, at times, even in its composition. To understand the changes, that occur around us, we often classify them in the following categories:

1. Slow and Fast Changes
2. Reversible and Irreversible Changes
3. Physical and Chemical Changes

Now let us discuss them, one by one, in some detail.

Slow and Fast Changes

Activity 1

Add a small amount of curd into a bowl of lukewarm milk. The bacteria, that are already present in the curd, convert the whole milk into the curd. It takes a few hours to convert the milk into curd. It is, therefore, a slow change.

Curd added to milk

Formation of curd

Activity 2

Boil some milk and add a small amount of lemon juice to it. The milk will turn into a curdly substance, that is, cheese. The time required for this change is very small. In other words, the change of milk into cheese is a fast change.

Lemon juice added to milk

Formation of cheese

Let us compare these two types of changes.

Slow Change	Fast Change
1. The changes, that take place in a longer duration of time, are called **slow changes**. 2. Some examples of slow changes are: • change of seasons • growth of a plant • rusting of iron	1. The changes, that take place quickly, or in a shorter duration of time, are called **fast changes**. 2. Some examples of fast changes are: • burning of a paper • lighting of a bulb • cutting an apple

Do You Know ?

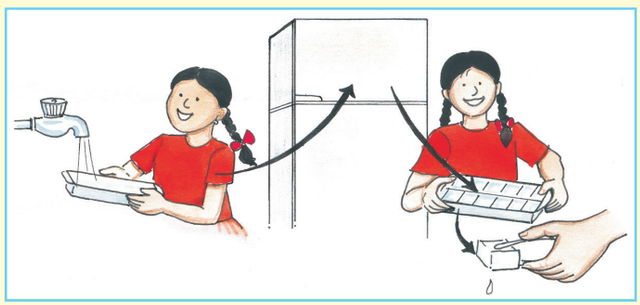
Rust is a reddish-brown substance which is formed due to corrosion of iron. Rust is formed when iron reacts with moisture and the oxygen present in air. We can prevent rusting by painting, greasing, or covering the iron objects with a layer of zinc metal.

Reversible and Irreversible Changes

Activity 3

Take out an ice tray from the freezer of a refrigerator and keep it outside at room temperature. You will observe that the ice will slowly melt and change into water. Now, put the tray back into the freezer and examine it after two hours. You will notice that the water again changes into ice. This shows that a change can be reversible, that is, it can occur in two opposite directions.

$$\text{ice} \underset{\text{freezes}}{\overset{\text{melts}}{\rightleftharpoons}} \text{water}$$

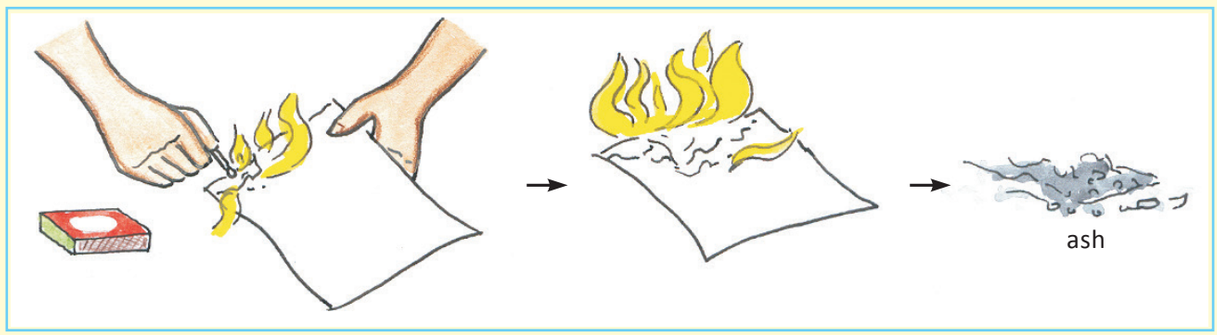


Reversible change: Conversion of water into ice and vice-versa.

Activity 4

Take a piece of paper and burn it. You will observe that the paper will change into ash. In this case, you cannot reverse the process and get back the paper. Hence, this is an irreversible change. Such a change can occur only in one direction.

paper $\xrightarrow{\text{burn}}$ ash



Irreversible change: Paper turns into ash on burning.

Let us compare these two types of changes.

Reversible Change	Irreversible Change
1. A change, in which the substance produced can get back to the original form, is called a **reversible change**.	1. A change, in which the substance produced cannot get back to the original form, is called an **irreversible change**.
2. These are temporary changes which can be reversed when the cause of the change is removed.	2. These are permanent changes which cannot be reversed even if the cause of the change is removed.
3. Some examples of reversible changes are: • freezing of water • evaporation • stretching of rubber string • switching 'on' or 'off' of a light bulb	3. Some examples of irreversible changes are: • changing of dough into *chappatis* • making a dress from a single piece of cloth • getting older • making curd from milk

Reversible change

Irreversible change

Physical and Chemical Changes

Activity 5

Switch on an electric bulb. It will start glowing. When we switch it off, it stops glowing. In this change, no new substance gets formed and we can get back the bulb to its original condition.

Activity 6

Take some sugar crystals. We know that sugar is white in colour, sweet in taste and has no odour. Now, grind the sugar in order to change it into powder form. We will observe that grinding changes it from crystal to powder form. It remains white in colour, sweet and odourless even in the powdered form. As such, no new substance has been formed.

Sugar crystals changed into powder form

A change, in which no new substance is formed, is known as a **physical change**.

A few more examples of physical change are:

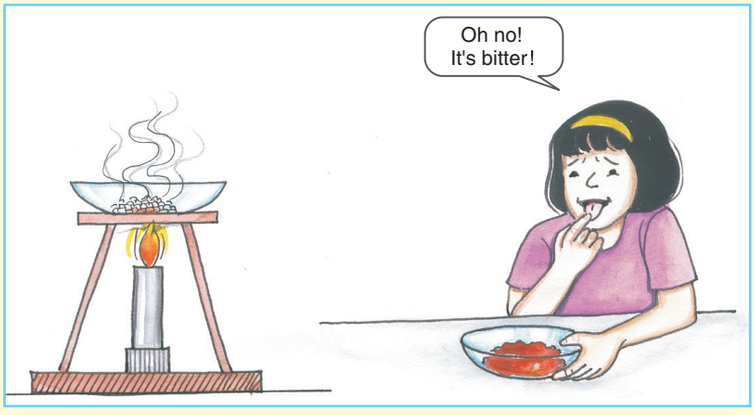
- Bending a copper wire into different shapes is a physical change. Here, copper does not change into another substance.

- Breaking of chalk is a physical change because by doing so no new substance is formed.
- Breaking of glass tumbler is a physical change. Here, when the glass breaks, its size, shape and ability to hold water are lost but no new substance gets formed.

Broken chalk pieces

Activity 7

Take some sugar in a china dish and heat it on a burner. You will observe that sugar becomes brownish-black and is now bitter in taste. It is a permanent and irreversible change in which a new substance has been formed.

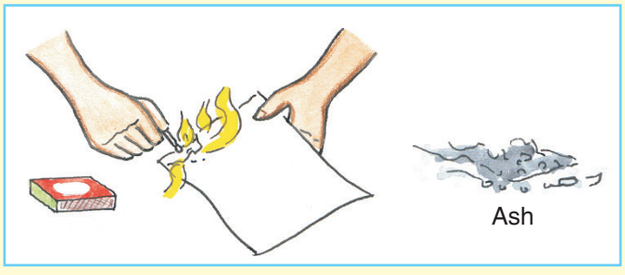


Chemical change

This type of change, in which a new substance, gets formed is called a **chemical change**.

Activity 8

Take a piece of paper and burn it with the help of matchstick. You will observe that the paper changes into ash. In this case, we do not get back the original substance. A new substance, that is, ash, is formed.



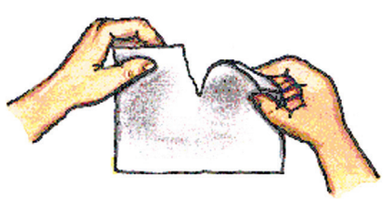
Burning of paper

A few more examples of chemical change are given below:

- Burning of wood is a chemical change. Before the wood is burnt, it is hard and brown in colour. After burning, it produces smoke and changes into wood charcoal and ash which are black and powdery.
- Change of milk into curd is a chemical change. Milk is a liquid. After curdling, it changes into a semi-solid material which has a different taste.
- Rusting of iron is a chemical change. Iron is a grey solid which gets attracted by a magnet. After rusting, the surface of iron gets covered with a brown solid which is not attracted by a magnet.

Now let us compare, a physical change with a chemical change.

Physical Change	Chemical Change
1. No new substance is formed. The substance may change its appearance or physical state.	1. New substance with different properties is formed.
2. Some examples of physical changes are: • tearing of paper • cutting a cauliflower • freezing of water • glowing of bulb • melting of ice	2. Some examples of chemical changes are: • respiration in living beings • cooking of food • burning of paper or fuels • growth of plants • fermentation of sugarcane juice



Physical Change

Chemical Change

In previous pages, we have classified changes into different categories. A given change, can however, be classified into more than one category. For example, curdling of milk is an irreversible change. At the same time, it is also a slow and permanent change. Since a new substance is formed, it is also a chemical change.

Classify the following changes into more than one category.

	Change	Slow/Fast, Reversible/Irreversible/ Physical/Chemical
1.	Burning of an incense-stick	
2.	Freezing of water	
3.	Formation of biogas from cowdung	
4.	Bursting of a balloon	
5.	Heating of sugar in a pan	
6.	Lighting of electric bulb	

Changes Involve Energy

We have seen that different types of changes take place around us. All these changes are accompanied by some change in energy also.

During some changes, energy is released. For example, burning of fuel produces heat energy. Similarly, in some changes, energy is absorbed. For example, when we tear the paper, the energy supplied gets absorbed for bringing about the observed change. A few more examples, given below, tell us about changes in which energy is (i) released (ii) absorbed.

Changes where energy is given out or released:

- burning of candle
- respiration
- burning of LPG

Burning candle

Changes where energy is absorbed:

- moving of cricket ball
- melting of ice
- boiling of water

Moving of cricket ball

There are many natural changes, such as change of weather, change of season, ripening of fruits and so on, that take place in the natural environment. All these natural changes are accompanied by some change in energy. We are not easily able to observe these energy changes. We will study more about energy changes, during various processes, in higher classes.

Keywords

chemical change	a change, in which a new substance, is formed.
fast change	a change, that takes place, in a shorter duration of time.
irreversible change	a change, in which substance produced, cannot be brought back into its original form.
physical change	a change, in which no new substance, is formed.
reversible change	a change, in which substance produced, can be brought back into its original form.
slow change	a change, that takes place, over a longer duration of time.

You Must Know

1. We observe many changes occuring in our surroundings.
2. These changes can be classified as—
   (i) slow or fast changes
   (ii) reversible or irreversible changes
   (iii) physical or chemical changes
3. Slow change is a change that takes place in a longer duration of time. A fast change takes place in a much shorter duration of time.
4. Changes, which can be reversed, to get back the original substance, are called reversible changes.
5. Changes, which cannot be reversed, to get back the original substance, are called irreversible changes.
6. In a chemical change, new substances, with different properties, are formed.
7. Physical changes are those in which no new substance is formed.
8. Some changes, like the burning of fuels, in our sorroundings, involve release of energy.
9. Some other changes, like melting of ice, involve absorbtion of energy.

Something To Know

A. Fill in the blanks.

1. All irreversible changes bring a _____ change in a substance.
2. A change, in which the substance produced can get back to the original form, is called a _____ change.
3. Bending of an iron rod is a _____ change.
4. Burning of fuel is a _____ chemical change, whereas rusting of iron is a _____ chemical change.
5. In chemical change, new substances with _____ properties are formed.

B. Write True or False for the following statements.

1. Glowing of an electric bulb is a fast change. ☐
2. Deforestation is a reversible change. ☐
3. Burning of paper is a temporary change. ☐
4. Cutting of an apple is a chemical change. ☐
5. Making of fruit salad is a chemical change. ☐
6. Changing milk into curd is a physical change. ☐

C. Tick (✓) the correct option.

1. Which of the following can be considered as a fast change?

   ☐ growth of a child

   ☐ germination of seeds

   ☐ bursting of a fire cracker

   ☐ cooking of food

2. Evaporation of water is a—

- ☐ physical change
- ☐ fast change
- ☐ irreversible change
- ☐ chemical change

3. Which one of these changes is a reversible change?

- ☐ burning of a candle
- ☐ inflating a balloon
- ☐ baking of *chappati*
- ☐ grinding of wheat grains into flour

4. Which one of these is an irreversible change?

- ☐ growth of a child
- ☐ stretching a rubber band
- ☐ evaporation of water
- ☐ formation of ice from water

5. A piece of paper undergoes a chemical change, when it is—

- ☐ cut
- ☐ folded
- ☐ reshaped into a paper toy
- ☐ burned

D. Answer the following questions in brief.

1. Define the following terms.

   (a) Reversible change

   (b) Chemical change

   (c) Physical change

2. Distinguish between fast and slow changes. Give two examples of each type.

3. Give two examples each of reversible and irreversible change.

4. State some of the irreversible biological changes that take place in nature.

5. Give one example of a physical change in which (i) energy is given out (ii) energy is absorbed.

E. Answer the following questions.

1. Give two differences between reversible and irreversible changes.

2. 'Formation of curd is an irreversible as well as a chemical change.' Justify this statement.

3. Water cycle is a natural change. Classify it as a (i) physical or chemical change (ii) a reversible or irreversible change. Also, justify your answer.

4. How can we say that burning of candle is a chemical change but the glowing of bulb is a physical change?

Value Based Question

Madam Emani, a very sincere and dedicated teacher, had a very honest, considerate and understanding approach towards the problems of her students. This helped her to make her students improve their performance and become better persons. Her school principal would often say, "The changes, brought about by Madam Emani, are quite similar to those that occur during a chemical change."

1. State the values that helped Madam Emani become a popular teacher.

2. State with reason, whether you agree or disagree with the principal's statement.

3. Have a 'group-discussion' in which one student suggests a possible 'change' (like a change of the section of the class) and the other students think of the likely effects of that change.

Something To Do

1. Solve the puzzle with the help of clues given below:

Across →

a. A change which cannot be reversed.

b. A metal which gets rusted.

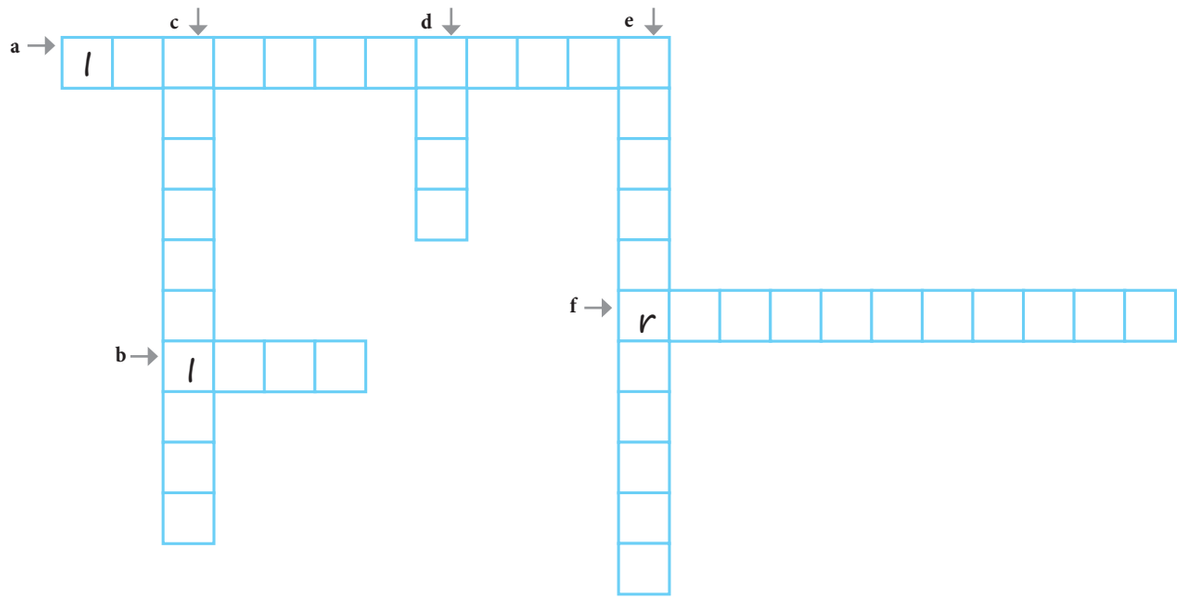
f. An example of a chemical change in which energy is released.

Down ↓

c. A change in which original condition can be re-attained.

d. The change which takes place in long duration of time.

e. A reversible change involving change of liquid into gas.



2. Go to your neighbourhood and make a list of all the changes you observe, such as setting of sun, burning of leaves, etc. Also, classify these as slow/fast; reversible/ irreversible and controllable/uncontrollable. Record your observations in a tabular form.

3. Take two test tubes, half filled with water. To the first test tube, add salt and to the second add quicklime. What do you observe? Is there a release of energy? Comment.