Water is one of the most common compounds on Earth and its atmosphere. It covers more than 70% of the surface of the Earth. It exists in three physical states of matter, i.e. solid (ice), liquid (water), and gas (water vapours and steam).
Water freezes at 0°C and boils at 100°C. The temperature at which water converts into ice is called its freezing point (F.P.) and the temperature at which water starts boiling is called its boiling point (B.P.).

Water H_2O

We know that everything is made of atoms. Atoms join together to form molecules. A water molecule has three atoms: two hydrogen (H) atoms and one oxygen (O) atom. A single drop of water contains billions of water molecules.

5.1: Water for life

All living things need water to survive. Plants, fish, insects, birds and other animals all need water to grow. Green plants must have water to make food during photosynthesis. Some plants and animals live only in water. Aquatic animals use oxygen dissolved in water. Aquatic plants use carbon dioxide dissolved in water.
Our body also needs water. Water makes up about two-third of our body. Water helps us in several ways. Water helps to digest our food. It helps to remove waste products from our body. Water keeps our body cool in hot weather by sweating which is mainly water.

Tidbit
We might be able to live for a month without food, but we cannot survive without water for more than a week.

Extend Your Thinking
How does water help us to live?

Facts about Water

- Water makes up 95% of our blood, 75% of our brain, and 85% of our lungs. Overall, our bodies are 60–70% of water.
- A tomato is about 95% water. An apple is about 85% water.
- Pure water has no colour, no taste and no smell.

5.2: Sources of Water

Fig. 5.1: Our body needs. water to use in different processes.

Water is present not only on the surface of the Earth but also beneath its surface.

5.2.1: Surface Water

About 97% of Earth's surface water is found in the oceans. It is salt water. Only 3% of water is fresh water which is present on the surface of the Earth, in the air (water vapours) and under the ground.

Fig. 5.2: Why is the Earth also called the water planet?

Ocean Water

Ocean water is a mixture of dissolved gases and salts in pure water. The major dissolved gases in ocean water are nitrogen, oxygen and carbon dioxide. The major dissolved salts are sodium chloride (table salt), magnesium chloride, magnesium sulphate and calcium sulphate, etc. Sodium chloride is the most abundant salt in ocean water. Ocean water is unusable for drinking because of salts. Some countries like Saudi Arabia, Kuwait, etc. remove salts from the ocean water to make it drinkable.

Fresh Water

Most of the fresh water is frozen. The frozen water is found in mountains in the form of glaciers. Snow accumulates year after year to form ice sheets. These ice sheets are called glaciers. Fresh water is also found in streams, rivers, lakes and ponds. At some places where ground is low, the water stays for part of the year and makes the ground very wet. Such places are called wetlands. Pugri, Kur and Kharki are a few wetlands in Sind Province. The water in wetlands moves down into the soil and becomes groundwater.

5.2.2: Water Beneath the Surface of Earth

Recall what happens to rain when it falls! Rainwater can evaporate, run off the surface, or soak into the ground. The water that soaks into the ground is called groundwater. The top level of groundwater in an aquifer is the water table. The level of water table changes during the year. It rises when water is added by rain. It becomes lower when there is a drought. People dig wells to bring groundwater to the surface.

Fig. 5.3: Some people use hand pumps to bring groundwater to the surface.

Tidbit

At some places, the water table rises and reaches near the surface of the soil. This water may come out in the form of spring or geyser. Several natural springs are found in Nathia Gali (KP Pakistan).

5.3: Impurities of Water

We need clean drinking water. Our water resources are becoming unfit due to the presence of impurties in water. Water may have germs. It may also have salts, dirt or other chemicals in it. The addition of harmful substances into the water is called water pollution. Harmful and unwanted substances in water are called pollutants.

We can classify water pollutants into different groups.

1. Bacteria, virus and other microorganisms are disease causing pollutants.
2. Acids, salts, etc. are water soluble pollutants. These pollutants can increase the growth of algae in the water. The presence of algae can block the sunlight to reach other plants in the water. Plants cannot make their own food and die. As a result, fish and other aquatic animals also die.
3. Oil, plastic and pesticides are also harmful to all plants and animals in the water.

Extend Your Thinking

You are hiking and you are thirsty. Would you drink water from a stream? Why or why not?

Sources of Water Pollution

The three major sources of water pollution are human wastes, industrial wastes and chemical run off.

Human Wastes

People release sewage into drains which carry it to rivers. Sewage from houses contains fat, toilet wastes, food particles, detergents, harmful bacteria, etc. These human wastes not only cause diseases in human beings but also destroy aquatic life.

Industrial Wastes

Industries release a large number of toxic chemicals into rivers and canals (Fig.5.4). Smoke and toxic gases released from industries also cause the rain water to become acid rain. These chemicals can kill fish and other aquatic animals and plants.

Fig. 5.4: Industries add Chemicals to water resources

Fertilizers

Farmers use fertilizers and pesticides in their crops (Fig.5.5). The rainwater carries these chemicals to water resources and causes water pollution. This polluted water is not fit for aquatic plants and animals.

Fig. 5.5: Fertilizers can also cause water pollution.

Extend Your Thinking

Why do cities and towns purify water before it is supplied to homes?

Activity 5.1 Is polluted water drinkable? (Group Activity)

You will need

- four glasses
- canal water
- pond water
- tap water
- ink

Procedure:

1. Take four glasses. Add some canal water in glass No.1, some pond water in glass No.2 and some tap water in glasses No.3 and 4.
2. Add a few drops of ink in glass No.4.
3. Ask the participants what kind of water they would like to drink from these glasses.

- In the light of their answers, what did you conclude from this activity?

Activity 5.2 How Fertilizers Affect the Growth of Algae

You will need

- two glass bottles
- tap water
- pond water
- fertilizer

Procedure

1. Label the two glass bottles A and B.
2. Pour water to each bottle up to three-quarters full.
3. Add water from a pond to fill the remaining parts of the bottles.
4. Add a little amount of fertilizer to bottle A only.
5. Put the bottles in the sunlight.
6. Observe the bottles everyday for a week.

Things to think

- Why was there more algae in the bottle A?
- Can you explain the growth of algae in a pond or lake near fields?

Soft and Hard Water

The water which gives rich lather with soap is called soft water. The water we use in house is soft water. The water which does not give good lather with soap, but forms curds is called hard water. Sea water is hard water. Water becomes hard when chloride, sulphate or carbonate salts dissolve in it.

5.4: Cleaning of Water

Water may have germs, dirt, salt and other things dissolved in it. All of these things must be removed before drinking the water. The process of removing impurities from water is called purification of water. We can use following methods to purify water.

1. By Filtration

In laboratory, we can purify water by this method on small scale. Impure water is passed through a filter paper. Suspended particles and insoluble salts are left on the filter paper whereas clear water is obtained in the beaker. To remove dissolved substances present in the water, special membranes can be used. These membranes have microscopic pores to separate dissolved substances from the water.

2. By Boiling

Boiling is the safest way to purify water. In villages, people can easily use this method to purify their drinking water. Bacteria, germs and other microorganisms present in water are killed by boiling water for 15 to 30 minutes. The water is cooled before drinking.

3. By Chlorination

If boiling is not possible we can add liquid household bleach to the water. Bleach contains chlorine. For this purpose, place the water in a clean container. Add the amount of bleach or chlorine according to the table below:

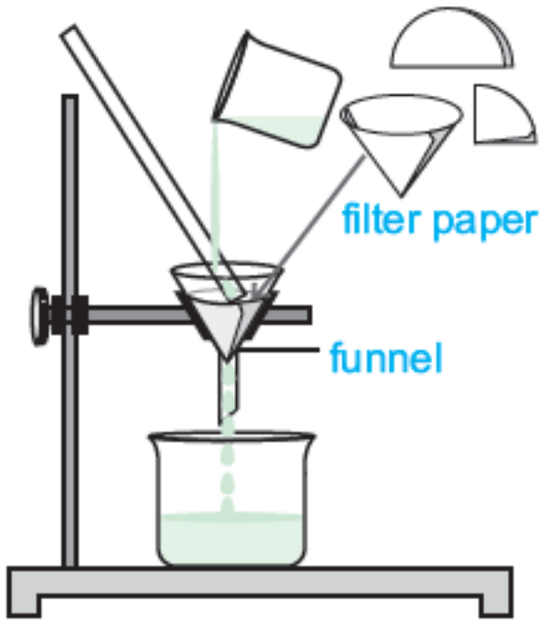


Fig: 5.6. In laboratory, a filter paper is used to purify water.

In Lahore city, District Government has installed Water Filtration Plants near tube-wells to provide citizens with pure clean water.

Volume of clear water	Amount of 5-6 percent liquid chlorine bleach
1 litre	3 drops
2 litre	5 drops
1 gallon	1/8 teaspoon

4. Use of Potash Alum

We can add potash alum to the water to purify it. Sand, clay and other suspended impurities of water will settle down. Water will be pure after decantation.

Do You Know?

- Water coming out of a natural spring may contain sulphur. Presence of sulphur makes this water germicidal. People use water of such spring to treat skin diseases.
- Every year, a large number of children die because of water-related diseases such as diarrhoea.

Distillation

We get clear tap water, but it is not pure. It may contain some salts and bacteria in it. We can use the process of distillation to separate impurities from water. In simple distillation , the water is heated to convert into steam. Then the steam is cooled down into distilled water (Fig.5.7). Impure water is boiled in a closed container (flask). Water vapour from the surface of boiling water pass through a pipe into a vessel called a condenser. The condenser is a tube surrounded by a large tube through which cold water is passed to cool the water vapours. As the water vapours pass through the condenser, they lose heat and become liquid water. This distilled water is collected in a separate container (beaker). Solid impurities remain at the bottom of the flask.

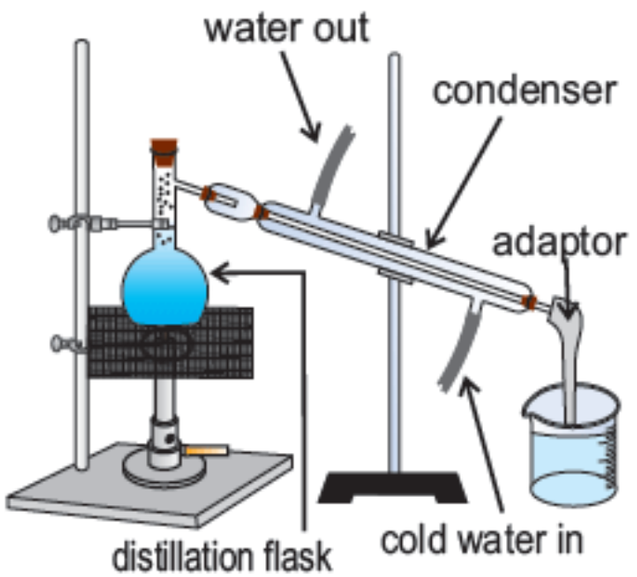
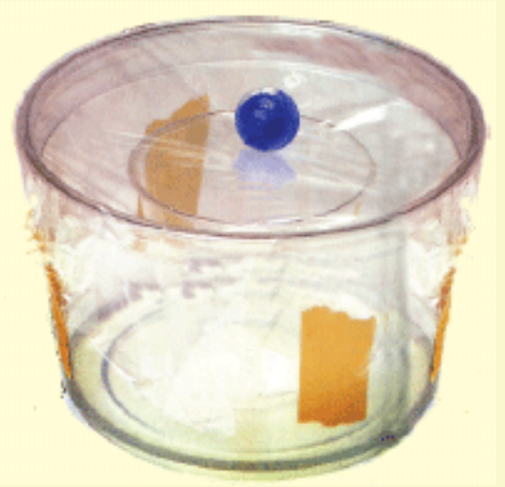


Fig. 5.7: We can obtain the purest form of water by the process of distillation.

Activity 5.3 **Distillation Process**

You will need:

- salt water
- spoon
- a small cup
- a glass bowl
- plastic sheet
- tape
- marble



Procedure

1. Take some amount of salt water in the glass bowl. Put a small cup in middle of the bowl.
2. Cover the bowl with plastic sheet. Use tape to hold the plastic sheet. Put a marble on the plastic sheet.
3. Place the apparatus in sunlight for several hours.
4. Remove the plastic sheet and cup from the bowl.

Let the water evaporate from the bowl.

Observe the bottom of the small cup and the bowl.

Questions

- What did you find in the bottom of the cup and the bowl?
- From where did the water come in the cup?

5.5: Uses of Water

People in Pakistan use water in homes, agriculture, as a source of energy (hydroelectricity) and in industries.

In Homes

A large quantity of water is used in our homes. We use water in washing, cleaning, brushing the teeth, flushing the toilet, cooking and drinking. People use most of the water in their kitchens and bathrooms.

In Agriculture

Plants need water to grow. Our farmers use 88% of our fresh water in fields to grow crops and vegetables.

As a Source of Energy— Hydroelectricity

The potential energy of water is used to move propellers of turbines. Turbines in turn run generators that produce electricity which is called hydroelectricity. There are five major and several small hydroelectric projects in Pakistan.

In Industries

Industries use water in a number of ways. Beverage and food industries use water as a raw material. Factories use water to clean and wash metal surfaces. Heavy mechanical complexes, oil refineries and nuclear reactors use water for cooling purposes.

Tidbit

People also use water for water sports such as swimming, fishing, sailing, etc. We can enjoy water sports in water parks.

How to conserve water?

There is only a limited amount of fresh water that we can use. We can save water by acting upon following tips:

Turn off the tap when you brush your teeth or take water in a tumbler.

Wash fruits and vegetables in a bowl.

Don't wash dishes under running water.

Only use washing machine with a full load.

If you have a lawn, water it early in the morning or late in the afternoon so the Sun would not evaporate the water.

Check regularly the leaks in water pipes and get them repaired immediately.

Science, Technology and Society

Paper mills, oil refineries, chemical industries, heavy mechanical complexes and nuclear power plants should conserve water by:

- reducing water use.
- recycling of water.
- reusing water.