11 Air and Water

Before We Start, Let's Check

What you already know

What do we need for the following activities? Tick (✓) the correct option for each.

flying kites

air ☐
water ☐

washing clothes

air ☐
water ☐

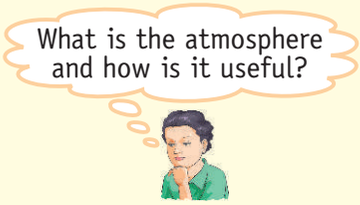
burning

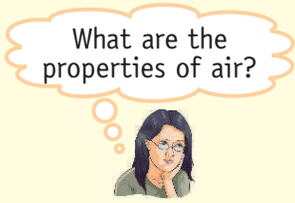
air ☐
water ☐

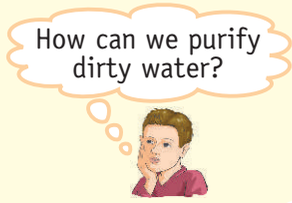
putting out fire

air ☐
water ☐

What you will know







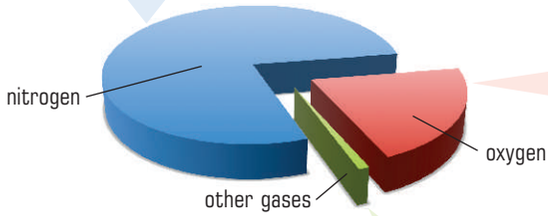
AIR

There is air all around us. We cannot see it but we can feel it when it moves.

Composition of air

Air is a mixture of many gases.

Nitrogen: It is the most abundant gas and makes up more than three-fourths (78%) of the air. We breathe in nitrogen, but we don't use it as it cannot be absorbed. It is important for the growth of plants. But plants do not take nitrogen from the air directly. Some bacteria living in the soil convert nitrogen in a usable form. From the soil, it is then taken up by plants.



composition of air

Oxygen: About one-fifth (21%) of the air is oxygen. It is needed by all the living beings to survive. Oxygen is produced by plants. When we breathe in, our lungs take oxygen from the air. Oxygen is also needed for burning.

Other gases: The remaining 1% of the air contains other gases like **carbon dioxide**, helium, argon, neon and hydrogen. Carbon dioxide is used by plants to make food by the process of photosynthesis.

Besides these gases, air also contains water vapour, dust, smoke and microbes, but their amount varies from place to place and time to time.

THE ATMOSPHERE

Our earth is surrounded by a thick envelope of air, called the atmosphere. It extends from the surface of the earth to about 10,000 km above it.

The atmosphere is present on the earth because of the earth's gravitational pull or gravity. All the gases and particles present in the air are held around the earth due to gravity. In the absence of gravity, air would have escaped into space.

Layers of the atmosphere

As we go high up above the earth, the amount of air reduces. On the basis of the density of air, temperature, etc., the atmosphere is divided into five layers. Starting from below, these layers are: the troposphere, the stratosphere, the mesosphere, the ionosphere and the exosphere.

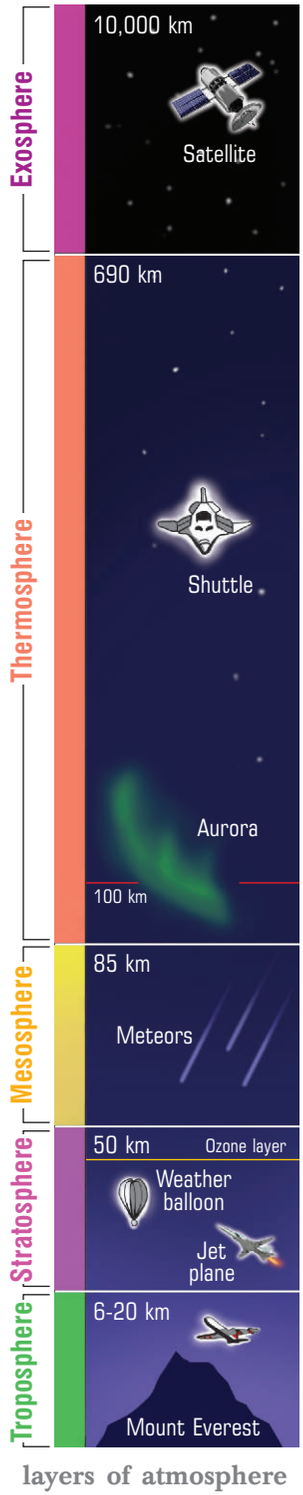
1. Troposphere: It is the lowest and most important layer of the atmosphere. The air is densest here. All weather changes take place here. Here, water evaporates from land to become rain or snow. Even in the troposphere, air gets very thin higher up and breathing is difficult. Most aeroplanes fly in this layer.

2. Stratosphere: It lies above the troposphere. Most fighter jet planes fly in this layer as it is quite stable. It contains the ozone layer. The ozone layer acts as a shield against harmful ultraviolet radiation from the sun.

3. Mesosphere: It is the coldest part of the atmosphere. Many meteors, rock pieces from outer space that fall through the earth's atmosphere, burn up in this layer.

4. Thermosphere: Air is very thin here. The temperature in this region can reach up to 1,500°C. The space shuttles orbit in this layer.

5. Exosphere: It is the outermost layer of the atmosphere. Satellites orbit the earth in the exosphere. The atmosphere here is extremely thin.



layers of atmosphere

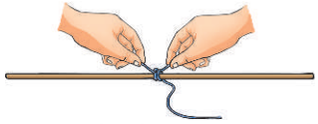
Importance of the atmosphere

- The atmosphere contains oxygen essential to sustain life on the earth.
- During the daytime, it blocks some sunrays and prevents the earth from getting too hot.
- At night, it does not let the heat escape completely and thus prevents the earth from getting too cold.
- The ozone layer protects us from the harmful ultraviolet rays of the sun.
- We are able to talk because of the atmosphere since without air, sound waves would not have any medium to travel.

PROPERTIES OF AIR

Fun and Learn

1. Take a stick.

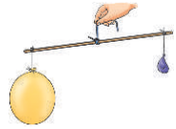


2. Tie a thick string in the middle of the stick.

3. Take a deflated balloon and tie it to one end of the stick.

4. Take another similar balloon and inflate it.

5. Tie the inflated balloon to the other end of the stick.



6. Hold the stick with the string.

The side with the inflated balloon goes down. It means it is heavier because of the weight of the air.

Property 1: Air has weight

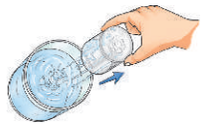
Fun and Learn

1. Take an empty glass tumbler.

2. Stick a cotton ball to the inside of its bottom.

3. Now, take a jar and fill it with water.

4. Hold the tumbler upside down and push it straight in the water.



5. Carefully take out the tumbler straight up.

6. Take out the cotton from the glass. It is dry. Why?

Water could not enter the tumbler as it was filled with air.

Property 2: Air occupies space

Fun and Learn

1. Take some water and boil it.

2. Take an empty plastic bottle and fill it with the hot water.

3. Leave the bottle for a minute. Then screw its cap tightly.

4. Lay the bottle in a jar as shown.

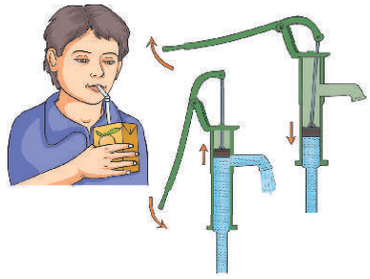
5. Fill the jar with ice-cold water.

6. Make the bottle stand upright. It collapses from all sides. Why?

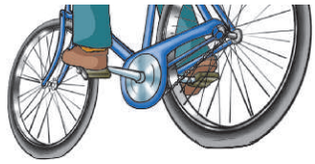
In the ice-cold water, the water vapour inside the bottle condenses. So there is very little air in the bottle. The pressure inside the bottle is low. The pressure of the air outside is high and it crushes the bottle.

Property 3: Air exerts pressure

Uses of air pressure



- Air pressure helps us to drink a cold drink, juice, etc using a straw. While using straw, we first suck out the air in it. When there is no air left in the straw, the liquid rises up in the straw and comes into our mouths.
- A hand pump works using air pressure. When the handle is pushed, the air pressure inside the pump is reduced. Water moves up to fill this space.



- When one pumps air into a bicycle tyre, it exerts pressure inside the tyre. The tyre gets hard which helps us to ride the bicycle smoothly.
- A doctor's syringe also works on the principle of air pressure. When the plunger of the syringe is pushed in, there is no air in the syringe. As the plunger is pulled, the medicine from the bottle rises up due to air pressure and fills the syringe.

- As an aeroplane moves, it pushes air away from its front side. It creates a low pressure area around it. It helps the aeroplane to move forward with ease.

WATER

Water is another essential need of all living beings. No living being can survive without water. Besides drinking, water has many other uses like bathing, washing, cooking, putting out fires, generating electricity, etc.

Nearly 70% of the earth's surface is covered with water. But most of it cannot be used by us. The water in the seas and oceans is salty. And most of the fresh water is in the form of icecaps and icebergs.

Properties of water

- Water is a colourless, tasteless and odourless liquid.
- Water is found in nature in three forms: solid as ice, liquid as water and gas as water vapour.
- Water is a universal solvent since it dissolves many substances.

Take a glass of water.

Add a spoonful of sugar in it.

Stir it for some time.

The sugar will disappear.

Where does the sugar go? It dissolves in water.

Here, water is the **solvent** and sugar is the **solute**. Together they form a **solution**.

Substances that do not dissolve in solvents are called **insoluble** substances.

IMPURITIES IN WATER

Rain is the purest form of water. But when it falls on the earth, it gets mixed with many impurities. Similarly, as water flows in rivers, streams, etc., many impurities mix with it.

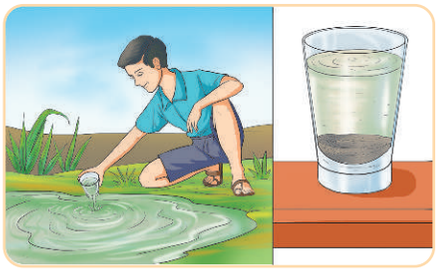
These impurities are of two kinds: insoluble impurities and soluble impurities.

Removal of insoluble impurities

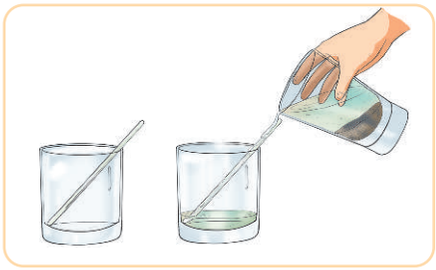
Mud, sand, chalk, pieces of stones, etc. are insoluble impurities. As they do not dissolve in water, they can be seen floating on water. These impurities can be removed by two methods.

1. Sedimentation and decantation

Fun and Learn



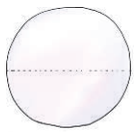
Go to a pond or a ditch where water is stagnant. Take some muddy water from there in a glass tumbler.
Leave the tumbler standing still for some time.
You will notice that some pieces of soil, etc. settle at the bottom. The water above is clear. The settled impurities are called sediments.
This process is known as **sedimentation**.



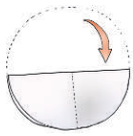
Now take an empty jar and a thin glass rod.
Place the rod in the jar as shown.
Pick up the water-filled tumbler carefully.
Tilt the tumbler and pour the clear water into the jar as shown.
Make sure that no sediment flows into the jar.
This process is called **decantation**.

2. Filtration

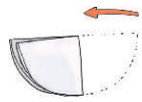
Fun and Learn



1. Take a circular piece of filter paper.

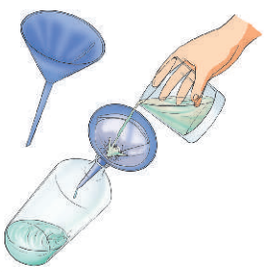


2. Fold it from the middle.



3. Again fold it from the middle as shown.

4. Open it out to form a cone.



5. Take a glass funnel. Put the paper cone in the funnel in such a way that three of its layers remain on one side and one layer on the other side.
6. Take an empty bottle and put the funnel into its mouth. Pour the muddy water into the cone carefully.

   Impurities are left on the filter paper and clear water goes into the bottle.

This process is called **filtration**.

Removal of soluble impurities

Soluble impurities are more difficult to remove from water than insoluble impurities. There are two common methods of removing them.

1. Evaporation

Fun and Learn

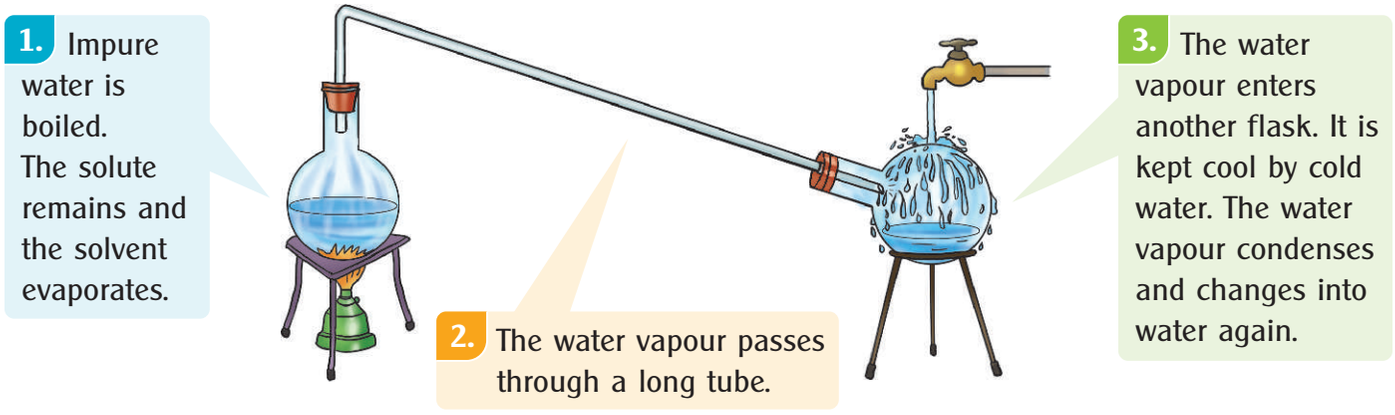
- Take a glass of water.
- Add a spoonful of salt and a spoonful of sugar in it.
- Stir it until both of them dissolve in the water.
- Pour the solution into a dish.
- Heat the solution and let it boil as long as there is water.

You will see that after sometime, all the water has turned into steam and escaped into the air.
The solid substance, solute, is left behind.

This process of separating impurities from water is called **evaporation**. But in this process, water is lost in the form of water vapour.

2. Distillation

Distillation is an extension of evaporation. In this process, water is first converted into water vapour. Then that water vapour is condensed and converted into water again.



The water collected in this way is called distilled water. It is the purest form of water. We use it in car batteries, medicines and in science labs.

POTABLE WATER

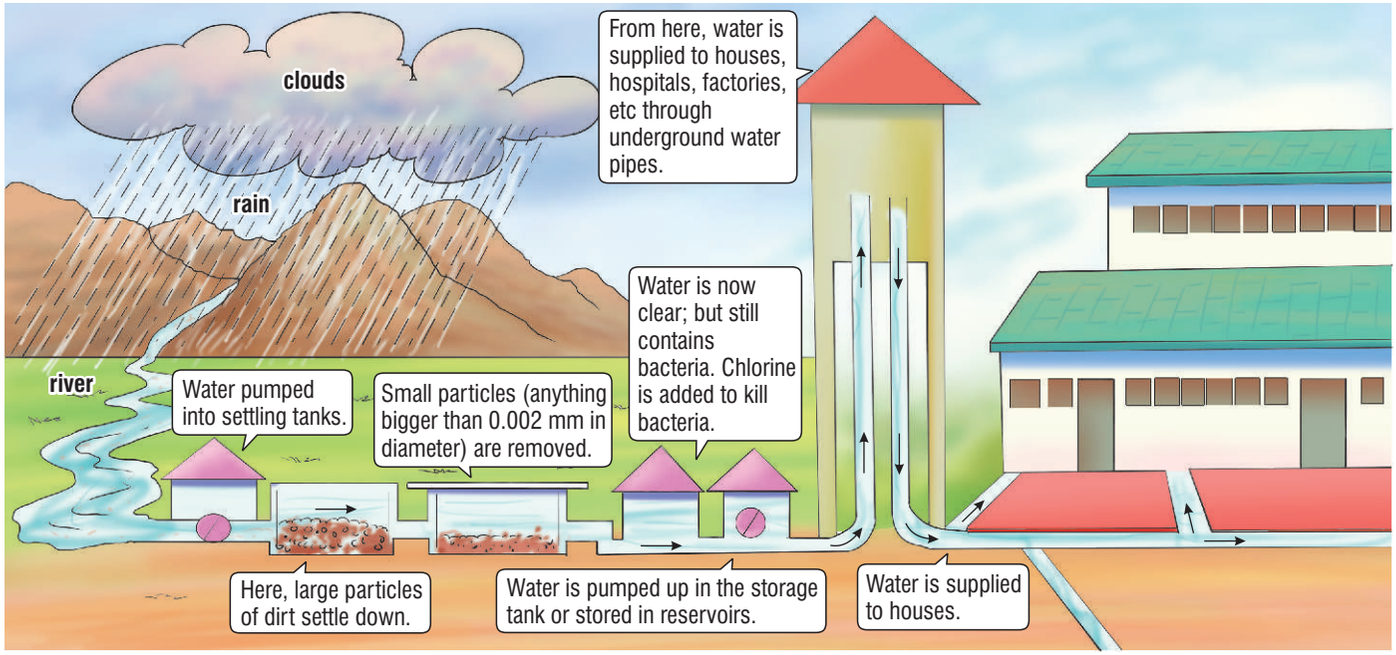
Water which is clean, pure and fit for drinking is called potable water.

We have read about many soluble and insoluble impurities. Some water also contains germs. If we drink such contaminated water, we may fall ill. Therefore, water needs to be purified to make it safe for drinking.

Town water supply

The water that we get in our taps is supplied by civic authorities. They get the water cleaned in water treatment plants before supplying it to our homes.

Water is cleaned in these plants in the following steps.



the process of water supply to cities

Cleaning water at home

Sometimes, due to a leak in water pipes, tap water may also contain germs. So we should clean tap water before consuming it. Here are two ways of cleaning water at home.

1. Boiling and filtering: Boiling is the oldest, safest and most effective way of purifying water. Boiling water for about 10 minutes kills the germs in it. After boiling, water should be filtered with the help of a clean cloth. Then it should be stored in clean and covered containers.

boiling

filtering

2. Water purifiers: Some households use water purifiers to clean drinking water. Some water purifiers use ultraviolet rays to kill germs. Some others have **reverse osmosis** (RO) process, which cleans water completely.

water purifiers

Words to Remember

atmosphere	–	the thick envelope of air surrounding the earth
gravity	–	the force that pulls a body towards the centre of the earth
ozone	–	a form of oxygen that is found in the stratosphere layer of the atmosphere
ultraviolet rays	–	invisible solar radiation that can burn the skin and cause skin cancer
solvent	–	a liquid that dissolves a substance
solute	–	the substance dissolved in a solvent

solution	–	the mixture of the solute and the solvent
insoluble	–	a substance that does not dissolve in a liquid
sedimentation	–	the process of the settling of heavy insoluble matter at the bottom of a solution
decantation	–	the process of pouring a solution from a container gently without disturbing the sediments
filtration	–	the process of passing a liquid through a filter in order to remove solid particles
evaporation	–	the process of the change of a liquid into a gas due to an increase in temperature
distillation	–	the process of purifying a liquid by a process of heating and cooling
potable water	–	water that is safe enough to be consumed by humans

Points to Recall

- Air is a mixture of many gases like nitrogen, oxygen, carbon dioxide, etc.
- Nitrogen is the most abundant gas.
- The earth is covered by a thick envelope of air called the atmosphere.
- The atmosphere is divided into five layers: the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere.
- The atmosphere is very necessary for life on earth.
- Air has weight, it occupies space and exerts pressure.
- Air pressure has many uses in our daily lives.
- There is a lot of water on the earth but a very little part of it is usable.
- Impure water has two kinds of impurities: insoluble and soluble.
- Insoluble impurities can be removed through sedimentation, decantation and filtration.
- Soluble impurities can be removed through evaporation and distillation.
- Civic authorities employ various techniques to supply drinkable water to the houses in a city.
- Boiling, filtering and using water purifiers are the ways through which we can make water clean in our homes.

Exercises

A. Tick (✓) the correct option.

1. Which of the following gases is/are a part of air?
   (a) argon ☐ (b) helium ☐ (c) neon ☐ (d) all of these ☐
2. Which is the coldest layer of atmosphere?
   (a) troposphere ☐ (b) mesosphere ☐ (c) stratosphere ☐ (d) thermosphere ☐
3. Which of the following work on the principle of air pressure?
   (a) tyres ☐ (b) syringes ☐ (c) hand pumps ☐ (d) all of these ☐
4. Which of the following is soluble in water?
   (a) chalk ☐ (b) sand ☐ (c) salt ☐ (d) none of these ☐
5. We get the purest form of water through
   (a) sedimentation ☐ (b) distillation ☐ (c) decantation ☐ (d) evaporation ☐

B. Correct the following sentences by changing one word in each. Cross (✗) the wrong word and write the right one.

1. Hydrogen is the most abundant gas in the atmosphere. _____

2. Satellites orbit the earth in the troposphere. _____
3. Water is a universal solute. _____
4. Insoluble impurities are harder to remove from water than soluble impurities. _____
5. In distillation, water is lost in the form of water vapour. _____

C. Match the following.

1. troposphere	(a) burning of meteors	1.	
2. stratosphere	(b) space shuttles	2.	
3. mesosphere	(c) changes in weather	3.	
4. thermosphere	(d) artificial satellites	4.	
5. exosphere	(e) ozone layer	5.	

D. Answer in one or two words only.

1. What gas is used by plants to make food? _____
2. What percentage of the earth's surface is covered with water? _____
3. What do we call the impurities settled at the bottom of still water? _____
4. What is the oldest and most effective way of purifying water? _____
5. Name the rays used by some purifiers to kill germs. _____

E. Answer in one sentence only.

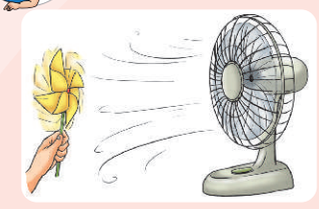
1. Why does air not escape into the space?
2. How does the atmosphere help us to talk?
3. Why is there a scarcity of usable water on the earth?
4. How does rainwater become impure?
5. Which is the best way of removing impurities from water, and why?

F. Answer in a few sentences.

1. How does the atmosphere help in maintaining the right amount of heat on the earth?
2. How can we prove that air has weight?
3. How does a syringe work on the principle of air pressure?
4. Explain in brief the sedimentation process of removing impurities from water.
5. Why is it good to purify water that we get from taps?

Creative Skills

BRAINSTORM



1. If we put a pinwheel in front of a running table fan, it starts rotating. Why?
2. Can we talk on the moon? If not, why?
3. Name the process that your mother uses for removing tea leaves from tea.

Tell Your Teacher

Read the following activities and tell your teacher what right or wrong each child does.

- Rajat goes to his school on his school bus. Yesterday, while coming back from school, he observed that his bus was emitting a lot of smoke. This morning, he went to the principal and informed him about it.
- Jyoti lives in a village. There is a stream flowing by her house. Every day, Jyoti throws all the household waste in the stream.
- Mohit's house has a modern bathroom with a shower in it. But Mohit always prefers to take a bucket bath and uses the shower very rarely.
- After drinking water from the disposable water bottles, Suhasini never forgets to crush them before throwing them away in a dustbin.

FIND OUT

Why do some balloons rise up in the air? Which gas is used in it?

_____

_____

What is a syphon pump? On what principle does it work?

_____

_____

Project

Go on a class trip to a nearby slum area.

Observe the supply and availability of potable water there. Discuss the importance of clean drinking water with the people living there. Write your observations in the form of a report and show it to your teacher.

Experiments

Some amazing tricks

A.

1. Take a plastic bottle with a cap and make small hole near its bottom.

2. Cover the hole with a sticky tape and fill the bottle with water.

3. Screw the cap and remove the tape carefully. **The water will not flow out through the hole.**

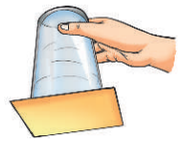
4. Now remove the cap. The water will start flowing out through the hole.

B.

1. Take a glass and fill it with water up to the rim.

2. Now place a piece of glazed paper on the glass so that it sticks to the wet rim of the glass.

3. Now, place one hand over the paper and turn the glass upside down carefully.



4. Remove your hand. **The water will not fall.**

Can you tell how both these amazing tricks are possible?