Air Around Us

Properties of Air

Have you seen kites flying in the sky? You may have also seen flags swirling in the sky? What makes these objects move?

They move because of the presence of air. The objects move along with the movement of air.

If air exists, then it should occupy space. Let us perform an activity to show that air occupies space.

Take a large, open bowl or a bucket and fill it with water. Now, invert an empty narrow bottle (may be a soft drink bottle) into the water. **Does water enter the narrow-mouthed bottle easily?**

Although the bottle looks empty, it is not actually so. Air occupies the space inside the bottle and therefore does not allow the water to enter it easily. Thus, all regions although may look empty, do contain some air. The layer of air that surrounds the Earth is called atmosphere.

Properties of oxygen

Combustion

When a burning matchstick is brought near kerosene gas stove (with its knob turned on), it will be observed that the gas coming out of the stove, i.e. LPG, starts burning instantly to produce heat and light. Hence, LPG is a fuel.

Similarly, there are fuels such as wood, coal, charcoal, petrol, diesel, etc. that are used for various purposes at home, in industry, and for running vehicles. These fuels burn to produce large amounts of heat. **Thus, burning or combustion is a chemical process in which substances react with oxygen to produce heat.**

Fuel + Oxygen (from air) → Carbon dioxide + Water vapour + Heat

Do you know that there are some substances which do not burn in air?

Glass, stone, and iron nail are examples of non-combustible substances. The substances which do not burn in air are called **non-combustible substances.**

On the other hand, the substances that undergo combustion are said to be **combustible substances** or **fuels**. Fuels may be solid, liquid, or gaseous. The light that is produced during their combustion may either be in the form of a flame or glow.

Now, we know that substances can be classified as combustible or non-combustible. **However, if a combustible substance is exposed to air, will it start burning on its own or does a fuel require special conditions for combustion to take place?**

In our houses, there are many substances that are made of wood. Even though they are exposed to air all the time, they do not burn on their own. However, when they are exposed to heat, a burning matchstick, or a candle, they start burning readily. This shows that some condition needs to be fulfilled before a substance starts burning.

Let us now discuss the essential requirements for combustion. For combustion to take place, essential conditions include the presence of a fuel, air, and heat.

Now, let us watch an animation before proceeding further.

Curiosity Corner

We have learnt that heat is one of the necessary requirements for combustion to take place. However, does a fuel start burning as soon as it is exposed to a source of heat?

Some minimum amount of heat is required for a substance to start burning. **The lowest temperature at which a substance burns is called its ignition temperature. Thus, a combustible substance cannot catch fire as long as its temperature is lower than its ignition temperature.** This can be demonstrated by performing a simple activity as shown in the following animation.

Phosphorous is a very reactive substance, having an ignition temperature of 35°C. Therefore, when it is exposed to air, it starts burning as its ignition temperature is easily attained at room temperature. Therefore, it is stored in water to cut off its contact with air.

Matchsticks contain a mixture of antimony trisulphide, potassium chloride, and red phosphorous. When a matchstick is struck against a rough surface, the red phosphorus gets converted into white phosphorus and gets ignited due to the heat produced because of friction.

Do you know that there are some substances which have very low ignition temperatures?

The substances which have very low melting points are called **inflammable substances**. These substances catch fire very easily. LPG, petrol, and alcohol are some examples of inflammable substances. Hence, one should be very careful when using these substances.

Rusting

You must have observed that when articles of iron are kept out in the open for some time, they get covered by a brownish substance. This brownish substance is called **rust**. Rust is the new substance obtained from the combination of iron and atmospheric oxygen. The characteristic properties of rust are different from that of iron as well as oxygen. Hence, rusting of iron is a chemical change, which affects articles of iron and slowly destroys them.

The two main factors that cause rusting are oxygen and water. As soon as the article comes in contact with air (oxygen) and moisture (water), it starts rusting. The chemical process that occurs during rusting can be represented as follows:

Iron (Fe) + Oxygen (O_2) + Water (H_2O) → Rust (Fe_2O_3)

Rusting becomes faster with an increase in the content of moisture in air. That is why water pipes made of iron tend to get rusted easily.

Curiosity Corner

Ships are made of iron and a part of them remain under water. Seawater contains many salts dissolved in it and salt water makes the process of rusting faster. Rusting is a complex process, involving many steps. The presence of salt speeds up the first step, which in turn speeds up the whole process. Therefore, ships suffer a lot of damage. As a result, a fraction of the ship's iron has to be replaced every year. Hence, a large amount of money is spent to replace the damaged iron and steel.

Every year, our world suffers huge monetary losses owing to the process of rusting, which causes harm to the articles made of iron. Therefore, attempts are being made to prevent rusting. Here are some ways that can prevent rusting.

1. Painting or coating iron articles with grease. This does not allow iron to come in contact with oxygen and water. Hence, it prevents rusting. In fact, paints and grease should be applied regularly to prevent rusting.

2. Rusting can also be prevented by depositing a layer of metal such as chromium or zinc on the surface of the iron article. **The process of depositing zinc on iron is called galvanisation.**

Alloying is another method used for the prevention of rusting. Stainless steel is an alloy. It is a homogeneous mixture of iron, carbon, chromium, nickel, and manganese. It does not rust.

Composition of Air

Air

The space around us is not empty, it is filled with air. Air is colourless and transparent. It forms a layer around the earth known as atmosphere.

Wind

Have you seen kites flying in the sky? You may have also seen flags swirling in the sky, what makes these objects move?

They move because of the presence of air. The objects move along with the movement of air. Moving air is called **wind**. The direction of moving wind can be observed using a wind vane.

Composition of Air

We know that air exists in all places and that it is a gas. However, what is it composed of?

Air is a mixture of many components. Let us list and understand the features of its various components.

Water Vapour

Water from the ponds, lakes, rivers, etc. evaporates into the atmosphere as water vapour and is known as humidity. This water vapour condenses to form clouds. When the water droplets become too heavy for the clouds to hold them, it falls to the earth as rain. Thus, water vapour plays an important role in the water cycle. The maximum amount of water vapour in the air will be 4-5%.The water vapour present in air depends upon the temperature and altitude of that place, therefore the amount of water vapour near sea and lakes is more than the water vapour present on land areas.

Oxygen

Let us perform a simple activity to prove that oxygen is present in the air. Place two burning candles in two different bowls containing some water. Invert two glasses of differing heights over the two burning candles. **Do the candles continue to burn? How long do they burn? Is there any change in the water levels inside the glasses?**

Oxygen is essential for burning. The candles continue to burn as the inverted glass contains oxygen. The candle that is covered by the longer glass burns longer than the candle covered with the shorter glass. This is because the longer glass contains more amount of air i.e., more amount of oxygen than the shorter glass. The water levels in the glasses increase with time. This is because the air present inside the glasses decrease as oxygen is being consumed by the burning candles. Water, therefore, moves in to fill these spaces.

Curiosity Corner

Deep sea divers carry oxygen cylinders. Humans cannot use dissolved oxygen unlike 

fish and other aquatic animals, which can use the oxygen that is dissolved in water.

Carbon dioxide

Lime water changes its colour to milky white in the presence of carbon dioxide. This property can be used to test the presence of carbon dioxide as shown in the given animation.

The process of burning any material produces carbon dioxide. The black-coloured smoke that is released during burning contains carbon dioxide. Since we breathe in oxygen, we tend to feel suffocated when we try to breathe in air that contains carbon dioxide.

Carbon dioxide is a very important component of air as plants utilise it to synthesise their food in the presence of sunlight by the process of photosynthesis. It is also used in fir extinguishers to control fire.

Dust Particles

On a sunny day, observe the beam of light entering the room carefully. You will observe numerous small particles floating in the air. These are dust particles.

The ceiling fans become dirty even when cleaned regularly because of the presence of dust. When furniture and other objects are not regularly cleaned, we can observe a layer of dust on them.

The amount of dust particles present in the air varies from time to time and also from place to place. Dry regions that have fewer plants tend to have more dust.

Curiosity Corner

The air that we breathe contains dust particles. Fine hair that is present in the nose filters this dust before the air reaches the lungs.

Smoke

Have you seen smoke coming out from long chimneys that extend from factories? Do you know why these chimneys extend so high up in the air?

Burning produces smoke. Smoke contains harmful materials such as carbon dioxide. It also contains other harmful gases. Therefore, these chimneys are present away from the people.

Automobiles produce smoke. Since policemen spend most of their time in traffic, we often observe them wearing protective masks.

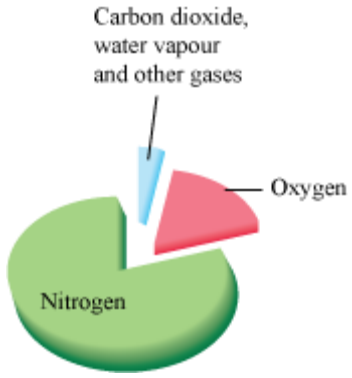
Argon

Argon is among the many unreactive gases present in the earth's atmosphere. It is present in very small amount in the atmosphere. It is used in industries for the manufacturing of high quality steels.

Nitrogen

Nitrogen is an important component of air. More than 78% of the air is composed of nitrogen. It is the largest constituent of air. It is used as fertilizer to increase the yield of crops. Also, in liquid form it is used as a coolent in industries.

Thus, it can be concluded that air is a mixture of many gases, water vapour, dust particles, and smoke. After nitrogen, oxygen is the most abundant gas constituting around 21% of the air. The rest 1% of the air contains carbon dioxide, argon, water vapour, and dust particles.



After studying all the above components of air, the question arises that whether air is a mixture or a compound?

Air is a mixture and not a compound which can be elucidated by the following reasons:

- It can be separated into its constituents, such as oxygen, nitrogen etc. by fractional distillation of liquid air, while the components of compounds cannot be separated.
- It shows the properties of all the gases present in it, whereas in compounds the individual properties of the components are not evident.
- It has variable composition as at different places, different amount of gases are present in it, whereas the composition of a compound is always fixed, irrespective of time and place.
- It cannot be represented by a formula because the proportion of the constituents present in it is not fixed, whereas the compounds have a definite formula.

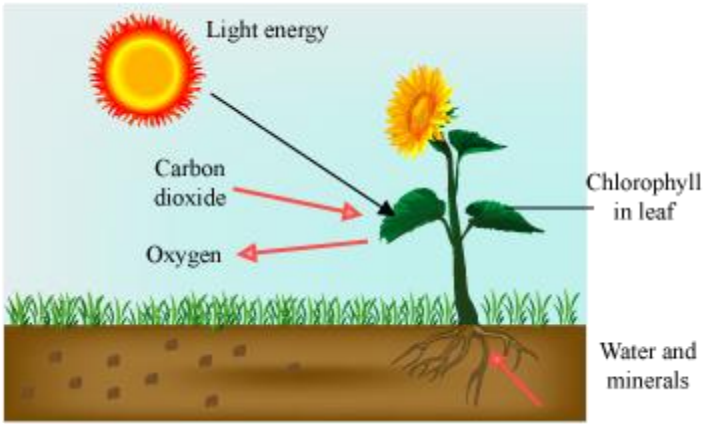
Do you know?

Matter can be changed from one state to the other by changing the temperature and pressure. Gases can also be changed into the liquid state by lowering the temperature and increasing the pressure of the gas. This process is known as "**liquefaction of gas**". Liquid gases like liquid oxygen and liquid hydrogen are used as a rocket fuel. LPG (**L**iquefied **P**etroleum **G**as) we use in our home is also a liquid gas which enables us to easy transportation and usage of it

Oxygen-Carbon Dioxide Cycle

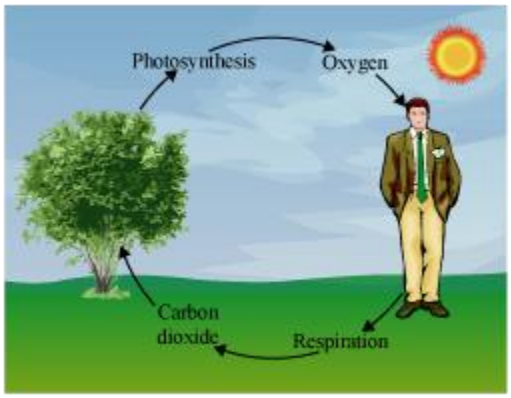
Oxygen is consumed during the process of respiration. If all the organisms consume oxygen, then the amount of oxygen in the atmosphere would continuously decrease. Over a period of time, there will be no oxygen left in the atmosphere. However, this does not occur.

Therefore, there must be some process that is constantly producing oxygen in the environment in order to maintain a balance.



The process illustrated in the figure is photosynthesis. Plants produce food by the process of photosynthesis. During photosynthesis, plants consume carbon dioxide and water to produce food and release oxygen into the environment.

$$6CO_2 + 12H_2O \xrightarrow[chlorophyll]{light} C_6H_{12}O_6 + 6H_2O + 6O_2$$



Animals and humans, on the other hand, breathe in oxygen and produce carbon dioxide that is released during the process of respiration. Thus, both plants and animals are important to maintain a balance of the respiratory gases in the environment.

Uses of Air

Air is present everywhere on Earth and occupies space. **Does this air also exist underwater? Is air present below the ground in the soil?**

Let us find out

Heat a container with water. You will observe small bubbles appear underwater on the inner surface of the container. These are air bubbles. The experiment can also be performed by placing a container with water under the Sun. After some time, you will see air bubbles appear on the inner surface of the container. This is because sunlight

heats up the water. The dissolved air tries to escape when heated. Thus, we know that air is present in water.

Dissolved oxygen that is present in water is utilized by fish and other aquatic animals. Humans cannot breathe dissolved oxygen and therefore deep sea divers carry oxygen cylinders.

Now, let us watch the following animation:

Plant roots absorb not only water, but also oxygen from the soil. Thus, soil contains air that is essential for the survival of earthworms and other small animals living underground. During the rains, we often see animals come out to the surface of the land. This is because the air spaces inside the soil get filled with water.

Thus, air is present in all regions and is essential for life. **What are the other roles that air plays in the environment?**

An important role of air is that it is used to produce energy. This is called wind energy. Windmills are used for producing electricity and for drawing out water from the wells. The long blades of a windmill rotate when the wind blows. This rotation in turn rotates an engine that produces energy.

Now, let us watch that how a windmill can be used to take water out of a tubewell.

Gliders, parachutes, airplanes, yachts, boats etc are all used by people as modes of transportation. These move because of the presence of wind.

Birds, insects, bats etc all fly with the help of air. Air also plays a major role in the distribution of the seeds and pollen from plants.

The circulation of water in the water cycle takes place in the atmosphere. Therefore, air is important for the water cycle.