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கிண்வனையில் குழு வேலை இருந்து
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மூந்தியும் மையத்தின் துளண்டிய பண்பாடு

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பொருத்து குறுக்கு பொழுது புதுப்பிக்கு - அடு
மையத்தின் துளண்டிய பண்பாடு

-மாணவரால் பாட்டுரை
Chandra, while preparing for a competition, came across the above Bharathiar’s poetry. She was astonished and admired that how Bharathiar loved animals and presented their characters in sweet and short evergreen lines. She ran to her mother to show the poem.

Amazed by her daughter’s interest, Chandra’s mother told her that since time immemorial man coexisted with birds and animals. Everyday from dawn to dusk man’s life is influenced by animals. He woke up listening to the call of birds. He had to depend on animals for food, clothing, transport, fuel etc. The buzzing of bees was his first music and the dance of the peacock was his first entertainment. Dogs and cats were his first playmates.

The life on this planet Earth is sustained by plants and animals. With the development of knowledge and technology, man’s dependance on animals for economic purpose increased. The balance in nature will be upset if the relationship between human and animals deteriorates.
ACTIVITY - 1.2

Children, shall we fill in the blank spaces?

<table>
<thead>
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<th>Name of the Animal</th>
<th>Why do we keep them?</th>
</tr>
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<tr>
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<td></td>
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<td>2. ..................</td>
<td>gives milk</td>
</tr>
<tr>
<td>3. ..................</td>
<td>pulls cart</td>
</tr>
<tr>
<td>4. Ox</td>
<td></td>
</tr>
<tr>
<td>5. Hen</td>
<td></td>
</tr>
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<td>6. Fish</td>
<td></td>
</tr>
<tr>
<td>7. ..................</td>
<td>we love it</td>
</tr>
<tr>
<td>8. Honey bee</td>
<td></td>
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1.1. USES OF ANIMALS

Animals and their products are of great use to man. Based on the utility of animals, they are classified into three groups

1. Food yielding animals
   Animals are reared for milk, eggs and meat. Breeds of cows are mainly raised for milk eg. Jersey. Certain breeds of goat are reared for milk and meat. Honey bees give us honey. Fishes are a good source of protein.

2. Fibre yielding animals
   Animals such as sheep, Llama and goat provide us fur. The fur is processed into wool. Silk moth gives us silk fibre.

3. Draught animals
   Animals which are used for ploughing and transporting are called draught animals. Bullock (kangeyam), Ox, horse, elephant, donkey, etc are employed in farm activities and transport.

MORE TO KNOW
Some cows produce around 16 litres of milk a day or 6000 litres a year.
1.2. ANIMAL PRODUCTS

Animals provide us a variety of products like wool, silk, milk, honey, meat, leather, pearl, egg, lac and so on. Let us learn about some.

1. **Wool**: Wool is obtained from hairs on the bodies of animals such as sheep, llama and goat. It is used to make sweaters, shawls, blankets, socks, hand gloves etc.

2. **Meat**: Animals such as goat, sheep, pig, poultry birds, prawn, crab etc. yield flesh as food.

3. **Silk**: Silk is obtained from silkworm and it is used for making silk clothes.

4. **Leather**: The skin of animals such as goat, sheep, and cattle is used for manufacturing leather goods( bags, shoes, purses, suitcases, belts).

5. **Pearl**: Pearl is a valuable gem obtained from pearl oysters and is used in making ornaments.

6. **Lac**: Some insects secrete a resin like substance called lac. It is used for making paints, varnish, printing inks and cosmetics.

7. **Milk**: Animals like cows, buffaloes and goats give milk as food.

8. **Honey**: Honey is obtained from honey bees. It is consumed along with food and used in the preparation of certain medicines.

9. **Egg**: Poultry birds such as hen, duck, goose and turkey give us eggs as food.

MORE TO KNOW

In 2004 December 26th, some tribes that live in the forests of Andaman islands noticed the animals behaving in a different manner. They guessed some danger. So they moved to a safer part of the island. Soon after their move the islands were hit by Tsunami, but the people were saved.
1.3. ANIMAL FIBRES

One day Selvan saw his grandmother wearing a shawl and his mother asked him why they should wear these clothes? His mother said that woollen clothes trap air and act as a bad conductor of heat or cold. Hence they keep us warm during winter.

Wool

Wool is a thick coat of hairy fibres (fleece) obtained from sheep, goat, yak and other animals. It is composed of a protein called keratin. Several breeds of sheep are reared in our country that yield different kinds of wool. The skin of sheep has two types of hair.

a) Coarse beard hair and b) Fine soft under hair.

Normally fine hairs provide the fibres for making wool. **Yak wool** is common in Tibet and Ladakh. **Angora wool** is obtained from Angora goats which are found in Jammu and Kashmir. The wool from Angora goat is called as “Mohair”. The underhair of Kashmiri goat (Pashmina) is woven into fine shawl. It is very soft and expensive.

**Processing of wool**

There are many steps involved in processing the fur into wool. The process of cutting off the woollen fleece of sheep with a thin layer of skin is called shearing.

The wool is used to manufacture sweaters, shawls, blankets, hand gloves etc.

**Silk**

Silk is also a natural animal fibre. Silk worm secretes the silk fibre. The best known type of silk is obtained from the cocoon of larvae of mulberry silkworm. Silk fabric was first developed in ancient China.

**Uses of Silk**

Silk is used for making silk clothes, parachutes, insulation coils for telephone and wireless receivers.

**MORE TO KNOW**

Australian scientists have invented a way of removing wool from Sheep without shearing. The new wool harvest technology is called Bioclip.

**ACTIVITY - 1.4**

Let us collect pictures of animals that produce wool and paste them in the scrapbook.
1.4. SERICULTURE

Selvan and Valli attended a marriage function. They noticed that some of the women were wearing colourful sarees. Selvan asked his mother, why those sarees are shining?. His mother told him that those sarees are made of silk.

The rearing of silk worms for obtaining silk is called **Sericulture**. It is a very old occupation in India. The silk fibre is obtained from the cocoon of the silk moth. There are varieties of silk moths and the silk they yield is different in texture.

**The types of silk are**

1. Mulberry silk
2. Tassar silk
3. Eri silk
4. Muga silk

The most common silk is mulberry silk. Mulberry silk is superior in quality because it is soft, lustrous and creamy white in colour. It is secreted by the silk producing glands of silkworm.

**Steps of preparing silk fibre.**

1. A female silk moth lays hundreds of eggs at a time.
2. The eggs are kept under hygienic conditions and under suitable temperature.
3. When the eggs hatch into larvae, they are fed on mulberry leaves.
4. After 25 to 30 days of feeding, they spin a protective case around them called cocoons.
5. The cocoons are dipped in hot water and the silk fibres are separated.
6. The process of taking out threads from the cocoon is called **Reeling**.
7. The thread is woven into silk cloth.

**MORE TO KNOW**

It is believed that silk was first discovered in China by the Empress Si Ling Chi. India is the world’s second largest producer of Silk.

Kancheepuram, Siruvanthadu, Thirubhuvanam and Arani are famous for silk in Tamil Nadu.

**ACTIVITY - 1.5**

Let us mark the places in the map of Tamil Nadu where silk is produced and woven into fibres and clothes.
1.5. APICULTURE

I am used in cakes.
I am found in sweets.
I am used in medicines.
I am manufactured by bees.
Can you guess who am I?
Yes, I am HONEY.

Where do bees live?
Honey bees live in beehives. A beehive consists of numerous small compartments called honey combs. Bees live in colonies. There are three kinds of bees in a beehive. They are

1. The queen bee (fertile female bee).
2. The drones (fertile male bees)
3. The workers (sterile female bees).

There is only one queen bee in a beehive. The work of the queen bee is to lay eggs. There are a few hundreds of male bees which help in reproduction. The worker bees are thousands in number. They perform various functions.

Honey is used as food. It is used in the preparation of certain medicines in Siddha, Ayurveda and Unani. Bees also produce wax, which is used for making candles. Some Indian varieties of bees are

1. Rock bee (Apis dorsata)
2. Little bee (Apis florea) and
3. Indian bee (Apis indica)

MORE TO KNOW

Composition of Honey.
Sugar - 75%
Water - 17%
Minerals - 8%

Nowadays, bee-keeping is practised to produce more honey. The rearing of honey bees to produce honey in large scale is known as apiculture. A well known Italian breed called Apis mellifera is the best for bee-keeping because it has high honey collecting capacity and it does not sting much.

ACTIVITY - 1.6

Shall we check if the honey is pure or not?
1. Let us take a glass of water.
2. Add a drop of honey to it.
3. If the drop of honey reaches the bottom without dissolving, then the honey is pure.
4. If the drop of honey dissolves before reaching the bottom then the honey is impure.
Selvan and Valli eagerly wait for lunch everyday. They get an egg with their midday meal in school. Selvan wants to know from where they get huge amount of eggs. Valli said that they get the eggs from poultry.

The rearing of hens and other fowls to produce eggs and flesh is called Poultry farming. Several kinds of birds like hen, duck, turkey, goose etc. are reared for the production of eggs and flesh. The place where the fowls are reared is called Poultry farm.

Namakkal district in Tamil nadu is famous for poultry industry.

In our country, hen is the most favourite domestic bird. Poultry keeping has developed into a very big industry. Some varieties of hens are reared for the production of eggs only. Such hens are called layers. There are some varieties of hens grown for flesh. They are called broilers.

The poultry house should be well lighted and well ventilated. The common poultry feed is grains and lots of fresh water. Hens that hatch eggs are called Broody hens. They sit on eggs and keep them warm. This is known as incubation. The eggs hatch after 21 days.

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Expand TAPCO - Tamil Nadu Poultry Development Corporation.

Silver Revolution

The massive step taken in India to increase egg production by adopting enlightened practices of poultry is called Silver Revolution.

**ACTIVITY-1.7**

1. Take a broiler egg and a country egg. Differentiate these two eggs.
2. Try making penguins out of egg shells and eye drop filler caps.

**ACTIVITY-1.8**

We can distinguish a fresh egg from a rotten one by putting them in a bowl of water.

The fresh egg will sink. But the rotten one will float.
1.7. ANIMAL PROTECTION AND MAINTENANCE

Ever since human beings appeared on the earth, they have been living with animals. Plants and animals are dependent on each other. We have to protect them to maintain the balance in nature because our own survival depends on this.

**Domestic animals can be cared by**

1. Providing animals with good feed and clean drinking water to keep them fit and healthy.
2. Providing shelters that are clean, airy and well lighted.
3. Protecting them from diseases

**MORE TO KNOW**

Some of the famous wildlife sanctuaries in Tamil Nadu are Vedanthangal, Mudumalai, Mundanthurai, Kalakadu and Kodiakarai.

**Care of Wildlife**

As people use more and more land to cultivate crops, graze cattle, build houses and factories, animals and plants are being forced out of existence. Poaching, pollution and use of excess pesticides have killed so many plants and animals. Some have been completely wiped out from the earth. If an animal no longer exists, it is said to be extinct. If they are in danger of becoming extinct, they are said to be endangered. Wildlife protection and maintenance is called wildlife conservation.

Some of the conservation measures are:

1. setting up of National Parks and Wildlife Sanctuaries.
2. stringent action against poaching.
3. discouraging deforestation.

Wildlife and forest are the wealth and pride of a country. So it is our moral duty to protect the plants and animals. We can protect our animals by

1. Not harming any animal or plant.
2. Growing trees that provide home to birds and insects.
3. Not buying animal products that are banned. eg. Tusk

**MORE TO KNOW**

Blue Cross is a registered animal welfare society. It helps to find homes for uncared animals and promote animal protection.

**ACTIVITY-1.9**

Collect different types of animal eggs. Display in the classroom.

Hen, duck, lizard, crow, turkey.

Varaiadu - The state animal of Tamil Nadu
1. **PICK OUT THE CORRECT ANSWER :-**

1. Fibres obtained from an insect ________________
   (Wool / Silk)
2. ________________ is reared in a poultry farm.
   (Buffalo / Hen)
3. There is only one ________________ bee in a bee hive.
   (queen / drone)
4. After incubation, the hen’s egg hatch in ________________ days.
   (21 / 31)
5. A sheep has a coat of wool for ________________
   (man / itself)

2. The following jumbled words denote the stages in the life cycle of a silkworm. Could you write the correct sequence.
   THOM, GEKS, VARAL, APBU
   MOTH -> ___________ -> ___________ -> ___________

3. On the way home you notice a goat with a broken leg. You feel sad and want to help it. Write down the things you would do.
   a) ________________
   b) ________________
   c) ________________

4. Complete the chart given below by observing the following animals in your surrounding.
   crow, cow, lizard, donkey, goat, horse, housefly, ant, monkey, butterfly, mosquito, dog, cat.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Animal</th>
<th>Sound it makes</th>
<th>Food it eats</th>
<th>Where it lives</th>
<th>Relationship with man</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>dog</td>
<td>wow, wow</td>
<td>rice, meat</td>
<td>kennel</td>
<td>friend, guard</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>3</td>
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<td>5</td>
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</tr>
</tbody>
</table>
5. In the given map of Tamilnadu some famous wildlife sanctuaries are marked.

(a) Name the places.
(b) Find out the animals / birds which are found there.
(c) Mark your place of residence and find the name of the sanctuary near your home.

FURTHER REFERENCE

Books:


Biology Understanding Life (3rd edition) - Sandra Alters.

Jones and Barthlett Publishers, U.K.

Webliography:


Places of scientific importance for visit

Arignar Anna zoological Park, Vandalur, Chennai.
Food is a basic necessity for all living organisms to survive. It is because food provides energy to all living organisms to do their life activities. Food also helps them to grow and build their bodies. How do living organisms obtain their food? Green plants can make their own food by using sunlight, water and carbon dioxide. Animals cannot make their own food. They depend on plants directly or indirectly for their food. The mode of taking food by an organism and utilizing it by the body is called **nutrition**.

### 2.1. MODES OF NUTRITION IN PLANTS

There are two modes of nutrition in organisms. They are autotrophic and heterotrophic nutrition.
2.2. AUTOTROPHIC & HETERO TROPHIC NUTRITION

Green plants are the only organisms which can synthesize food for themselves and also provide food for other organisms including us. The mode of nutrition in which organisms make their own food is called **Autotrophic Nutrition** and such organisms are called **autotrophs**.

*eg. Green plants.*

Non-green plants and most animals (like us) take in readymade food from plants and other animals. The mode of nutrition in which organisms depend on others for their food is called **Heterotrophic Nutrition** and those organisms are called **heterotrophs**. *eg. All animals, including human beings.*

2.2.1. PHOTOSYNTHESIS

Dear children, we shall be surprised if we could peep inside a leaf and find that sunlight comes into a leaf through the leaf’s surface. Inside, the leaves also have a wonderful green substance called **chlorophyll**.

At the same time air comes into the leaf through tiny openings named **stomata** and water moves up from roots below.
Imagine what would happen if there is no sun? In the absence of the sun, there would be no photosynthesis. Hence, there would not be any food. In the absence of food, life would be impossible on earth.

Photosynthesis can be represented by the equation given below:

$$\text{Water} + \text{Carbon dioxide} \xrightarrow{\text{Sunlight}, \text{Chlorophyll}} \text{Starch} + \text{Oxygen}$$

So, the sun is the ultimate source of energy for all forms of life. Using sunlight for energy, the chlorophyll changes water and carbon dioxide into food for the plant.

The process of preparing food with the help of water, carbon dioxide, sunlight and chlorophyll in plants is called photosynthesis.

**ACTIVITY 2.1**

When the weather is sunny, let us put a steel bowl on a patch of grass. Leave the bowl for 5 days. No peeking! Lift the bowl and look at the grass. How is it different from the grass exposed to sunlight?

There are some leaves of plants which show different colours other than green. Can they do photosynthesis? Yes, they can. The huge amount of red, brown and other pigments eclipse the green colour.

Fig 2.3. Photosynthesis chart

Fig 2.4 Leaves of various colours
2.2.2. OTHER MODES OF NUTRITION IN PLANTS

There are some non-green plants which cannot prepare their own food. They take readymade food prepared by other plants. They follow heterotrophic nutrition. They may be saprophytes, parasites, insectivorous plants etc.

**ACTIVITY 2.2**

Let us take a piece of bread. Moisten it and leave it for a few days. We can see the cotton-like mass growing on it. What is it?

**Saprophytes**

Sometimes we see umbrella-like structures growing on decaying matter on the road side during the rainy season. What are they? How do they get their nutrients?

These organisms are called fungi. They grow on dead organic matter. They produce digestive enzymes on the dead matter and change it into simple nutrients. They absorb the nutrients in dissolved form (solution) and utilize it. Such a mode of nutrition is called saprotrophic nutrition and those plants are called saprotrophes.

eg: mushroom, bread mould.

**Parasites**

Shall we look at the picture 2.7 carefully. We can see yellow coloured tubular structures coiling around the stem of a tree. This is a plant called cuscuta. It cannot synthesize food. As it lacks chlorophyll, it depends on the tree on which it is climbing for food. The plant which provides food is called host and the plant which consumes it is called parasite.
Insectivorous Plants

We know that many insects eat plants, but we shall be surprised to know that some plants eat insects.

Let us observe the picture 2.8 of venus fly trap, pitcher plant. They need to eat insects because their soil does not have certain nutrients like nitrogen for them to grow.

Symbiotic Plants

There is yet another mode of nutrition in which two different types of organisms live together and mutually help each other for nutrition. Lichens are organisms that consist of a fungus and alga. The algae gives food to the fungus and the fungus absorbs water and minerals and gives to algae. Here, both the organisms help mutually. The phenomenon by which two different organisms live together for mutual help is called symbiosis. The organisms are called symbionts.
2.3. NUTRITION IN ANIMALS:

Let us observe machines like a car, bus or a train etc. How do they work? They get energy to do work from fuels. Our body is also a machine. We get energy from the food that we eat. Food contains not only energy but also the raw materials needed for body’s growth, maintenance and repair. Mostly animals take in solid food. This mode of nutrition is called **holozoic nutrition**.

![Fig 2.10 Ingestion](image)

**Nutrition includes five steps**

1. **Ingestion**
   The process of taking food into the body is called **ingestion**. The mode of intake of food differs in different organisms. eg: Butterflies and bees suck the nectar of the flowers. Snakes (Python) and frogs swallow their food. Aquatic animals (Blue Whale) filter feed.

2. **Digestion**
   The process of breaking down of complex food into simple food with the help of enzymes is called **digestion**.

3. **Absorption**
   The process by which the digested food passes into the villi of the wall of the intestine is called **absorption**.

4. **Assimilation**
   The ways in which the absorbed food is utilized in cells is called **assimilation**.

5. **Egestion**
   The removal of undigested food through anus is called **egestion**.
2.4. NUTRITION IN AMOEBA

Amoeba is a unicellular organism. It lives in the stagnant water bodies. It feeds on microscopic organisms. Though amoeba is a one-cell animal, it takes in solid food through its body surface. So the mode of nutrition is holozoic. Whenever the food touches the body surface of amoeba, it engulfs the food with the help of pseudopodia (false feet) and forms the food vacuole. The food is digested with the help of enzymes inside the food vacuole. The digested food reaches the entire cell by diffusion. Amoeba uses the food for getting energy, making proteins for growth, etc. The undigested food is thrown out of the body through its body surfaces.

2.5. HUMAN DIGESTIVE SYSTEM

Think of any food that you like, a sweet, a fruit etc. Let us find out what happens to it when eaten. It passes through the digestive system. This system is made up of mouth, oesophagus, stomach, small intestine, large intestine and anus.

Mouth

We ingest the food into mouth cavity through mouth. Mouth cavity contains teeth, tongue and salivary glands.

Teeth

Teeth help us to cut the food into small pieces, chew and grind it.

Salivary Glands

There are three pairs of salivary glands in our mouth. These glands secrete a watery fluid called saliva. It makes the food wet so that we can easily swallow it. It contains an enzyme called amylase which helps in the digestion of starch.

Tongue

The tongue is an organ of taste. It helps to mix the food with saliva and make it wet. It also helps in rolling and pushing the food while swallowing.
**Stomach**

Stomach is a bag-like structure where the food is further digested. The food is churned. Stomach secretes digestive juice called gastric juice which helps to digest food.

**Small Intestine**

It is a very long tube and is about 7 metre in length. Here the food is mixed with bile juice, pancreatic juice and intestinal juice. These juices help in completing the digestion.

At the end of digestion, carbohydrates are broken down into glucose and fructose, proteins into amino acids and fats into fatty acids and glycerol. This digested food is absorbed by the villi in the small intestine.

**Large Intestine**

It is about 1.5 metre in length and helps in absorbing water. It is the place for temporary storage of undigested food. Digestion does not take place here.

**Anus**

The undigested food (faecal matter) is eliminated through anus and the process is called egestion.

Let us find out how the food moves in our digestive system.

Food in the digestive system moves from the oesophagus to the anus by rhythmic contraction and expansion of the wall of the digestive system. This movement is called **peristalsis.**
2.5.1. TYPES OF TEETH

We all have two sets of teeth in our life time. The first set of teeth grows when a baby is about one year old. This set of teeth is called **milk teeth**. They are twenty in number. Milk teeth stay in a child up to the age of seven to eight years. When the milk teeth fall off, a new set of teeth grow. They are called **permanent teeth**. They are thirty-two in number. Of these, sixteen are in the upper jaw and sixteen are in the lower jaw. All the teeth in our mouth are not the same. There are four types of teeth. They are **incisors**, **canines**, **premolars** and **molars**.

---

**ACTIVITY 2.3**

To demonstrate peristalsis.

1. Take a rubber tube and wet it inside.
2. The tube represents the food pipe.
3. Put many marbles into the tube.
4. The marbles represent food.
5. Squeeze the rubber tube from the top with your hand in a forward direction.
6. You can observe a kind of wave-like motion in the rubber tube.
7. This movement represents peristalsis.
**Incisors:** These are chisel shaped teeth at the front of the mouth. They are eight in number. Four are present in each jaw. These are used for biting the food.

**Canines:** These are sharp and pointed teeth. They are four in number and two are present in each jaw. Canines are used for cutting and tearing of food.

**Premolars:** These are large teeth behind canines on each side. They have large surface. They are eight in number and four are present in each jaw. They help in chewing and grinding the food.

**Molars:** These are very large teeth present just behind the premolars. They have more surface area than premolars. They are used for chewing and grinding of food like premolars. They are twelve in number and six are present in each jaw.

**Tooth Care**

Permanent teeth serve for lifetime. They are not replaced like the milk teeth. Hence, great care should be taken for keeping the teeth clean.

The enamel in the teeth of children is much thinner than on the teeth of adults. So, teeth of children are more liable to decay than those of adults. Children should avoid very cold or very hot food. They should brush twice a day. Teeth should not be rubbed with hard things like brick powder.

---

**ACTIVITY 2.4**

Let us take any fruit. Enjoy eating it. Now find out.

<table>
<thead>
<tr>
<th>Function</th>
<th>Teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biting</td>
<td></td>
</tr>
<tr>
<td>Tearing and cutting</td>
<td></td>
</tr>
<tr>
<td>Chewing and grinding</td>
<td></td>
</tr>
</tbody>
</table>

---

“Valli... are there animals without teeth?”

“Yes Selva, Bluewhale, the largest mammal does not have teeth.”

---

**MORE TO KNOW**

Interesting facts about teeth in other animals.

1. Birds have no teeth.
2. Rats have continuously growing teeth.
3. The tusks of elephants are actually incisors that have become very long.
4. Very few adult humans have all the 32 teeth.
2.6. RUMINANTS

Shall we observe some grass eating animals such as goat, cow and buffalo. They keep on chewing even when they are not eating or at rest. They have an interesting digestive system. In fact they eat grass hurriedly and swallow quickly and store it in the first chamber of the stomach called rumen.

In the rumen, the grass is fermented with the help of certain bacteria and the partially digested grass is called cud. Later, the cud is brought back to the mouth in small quantities and the animal chews it. The process of chewing the cud is called rumination. Animals which chew the cud are called ruminants.

Grass is rich in cellulose which is a kind of carbohydrate. Herbivorous animals can digest it. The other animals and humans cannot digest cellulose. There is a sac-like structure called caecum between the small and large intestine in ruminants. This sac contains some bacteria which produce an enzyme called cellulase which digest the cellulose.

**ACTIVITY 2.5**

From the given list of animals, shall we find out the ruminants and the non-ruminants:

- Bison, deer, horse, camel, rabbit, and donkey.

**MORE TO KNOW**

A Cow makes 40,000 to 60,000 jaw movements per day while it keeps on chewing and rechewing.
1. From the given list of living things list out the autotrophs and heterotrophs.

grass, snake, neem tree, man, mushroom, amoeba, mango tree, cabbage, cow, sunflower.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>AUTOTROPHS</th>
<th>HETEROTROPHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Fill in the boxes with the given words to complete the equation for photosynthesis.

water, starch, oxygen, sunlight, carbon dioxide, chlorophyll.

3. Given below is a list of food items with their constituents. In the table given below write the names of the food that you took yesterday and tick the constituents in it.

<table>
<thead>
<tr>
<th>Food</th>
<th>Constituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idli</td>
<td>Carbohydrates, proteins</td>
</tr>
<tr>
<td>Dosai</td>
<td>Carbohydrates, proteins</td>
</tr>
<tr>
<td>Sambar</td>
<td>Protein, vitamin, minerals, fat</td>
</tr>
<tr>
<td>Rice</td>
<td>Carbohydrates</td>
</tr>
<tr>
<td>Egg</td>
<td>Protein, fat</td>
</tr>
<tr>
<td>Channa sundal</td>
<td>Protein</td>
</tr>
<tr>
<td>Vegetable poriyal</td>
<td>Vitamins, minerals</td>
</tr>
<tr>
<td>Vadai, milk</td>
<td>Fat, protein</td>
</tr>
<tr>
<td>Fish</td>
<td>Protein</td>
</tr>
<tr>
<td>Millet (Kambu/Cholam)</td>
<td>Carbohydrates</td>
</tr>
<tr>
<td>Greens</td>
<td>Vitamins, minerals</td>
</tr>
</tbody>
</table>

Could you find out the nutrient missing in your diet.
4. Observe the teeth of your family members. Count the teeth and record below.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Family member</th>
<th>Jaws</th>
<th>Incisors</th>
<th>Canines</th>
<th>Premolars</th>
<th>Molars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Father</td>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Mother</td>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Self</td>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Brother</td>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Sister</td>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>L</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Self</td>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>L</td>
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<td></td>
</tr>
</tbody>
</table>

Dental formula of human being = I $\frac{2}{2}$; C $\frac{1}{1}$; PM $\frac{2}{2}$; M $\frac{3}{3}$ x 2 = 32

5. Look at the diagram, find out the teeth and list its use in human being.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Picture of teeth</th>
<th>Name of the teeth</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><img src="image1.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td><img src="image2.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td><img src="image3.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td><img src="image4.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FURTHER REFERENCE**

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- How the body works - Steve Parker, DK Ltd, London.

**Webliography:**

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- [www.phschool.com/science/biology/photosynth/overview.htm](http://www.phschool.com/science/biology/photosynth/overview.htm)
Mani and Mythli are helping their mother in the kitchen.

**Mother** : Children, will you help me to make a fresh vegetable salad?

**Mani** : Sure Amma. We will be glad to help you.

**Mother** : Choose some vegetables that you want from the basket.

Mani and Mythli selected tomato, spinach, cabbage, groundnut, cucumber, green peas, carrot and beetroot.

Shall we classify them?

<table>
<thead>
<tr>
<th>Roots</th>
<th>Leaves</th>
<th>Fruits</th>
<th>Seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The Children made a tasty salad with the different parts of the plant.
3.1. CHARACTERISTICS OF LIVING THINGS

Things that have life are called living things.

eg. Plants and animals.

Things that do not have life are called non-living things.


Among living things, some are plants and some are animals. Now the question is, how do living things differ from non-living things?

Living things show the following characteristics, whereas non-living things do not.

All living things
- need food,
- respire to convert food into energy.
- grow at certain stages of life.
- respond to their surroundings.
- live for a definite span of time.
- reproduce their own kind.
- are made up of cells.

3.2 HABITAT - VARIOUS HABITATS OF PLANTS

Children, shall we go for a walk around our school and make a list of different plants and animals there. We see different varieties of plants around us. All plants are well adjusted to the place where they live. The living place of a plant provides food, shelter and suitable climate to survive and reproduce successfully. Such a place of living is called a habitat. Plants live in different habitats such as water, land, desert, hills and so on.

WARMING (1909) classified the plants into three types on the basis of their water requirement. They are

1. Hydrophytes
2. Mesophytes
3. Xerophytes

1. Hydrophytes

Hydrophytes means water plants (Hydro = Water, and Phytes = Plants).

These plants live in the water of ponds, lakes and rivers. Plants which live in water are called hydrophytes. They are divided into three types:

a) Free-floating hydrophytes

These plants float freely on the water surface.

eg. Water hyacinth (Agayathamarai)
b) Attached floating hydrophytes

These plants are fixed at the bottom of the pond and the leaves float on the surface of the water.

*eg. Water-lily (alli), Lotus.*

![Fig 3.3 Water-lily](image)


c) Submerged hydrophytes

These plants are rooted in the mud and remain under-water.

*eg. Vallisneria*

Adaptations of Hydrophytes

1. Root system is poorly developed. In some cases roots are even absent.
2. Stem is thick, short and spongy with air spaces to float in water.

![Fig 3.4 Vallisneria](image)

3. Leaves have a waxy-coat that prevents their decay in excess water.

2. Mesophytes

These plants grow in places with moderate water supply. They cannot grow in places with too much of water or too little water. Most of the crop plants are mesophytes.

*eg. Wheat, maize, sunflower, mango, neem.*

![Fig 3.5 Sunflower (Surya kanthi)](image)

Adaptations of mesophytes

1. They have well developed root system.
2. Leaves are usually large and broad.

3. Xerophytes

*Xerophytes means desert plants:*

(Xero = Desert and Phytes = Plants)
Flowering plants can be grouped based on their size of stem. They are herbs, shrubs and trees.

1. **Herbs**
   - Small plants with soft and green stems are called herbs.
   - They are non-woody plants and do not grow more than one metre in height.
   - eg. Radish, wheat, paddy, sunflower.

   **ADAPTATIONS OF XEROPHYTES:**
   1. They have long roots which go deep into the ground so as to absorb water.
   2. In Opuntia, the stem is thick, flat and green and does the function of photosynthesis.
   3. Leaves are reduced or modified into spines to prevent the loss of water from their surface.

   **3.3. Herbs, Shrubs and Trees**

   ![Opuntia (chappathikalli)](image)

   Fig 3.6. Opuntia (chappathikalli)

   “Valli... the walk around the campus was very interesting wasn’t it?”
   “Yes Selva, did you notice that all plants are not of the same size”.
   “You are correct valli”.

2. **Shrubs**
   - The medium sized plants with a thin but hard and woody stem are called shrubs.
   - They do not have a clear main stem.
   - They tend to branch and become bushy.
   - eg. Rose, jasmine, croton, Tulsi, lemon.

3. **Trees**
   - Tall and big plants with a distinct hard and woody stem are called trees.
The main stem is called trunk which gives out branches and leaves.

eg. Neem, mango, teak, coconut, banyan.

3.4. PARTS OF A PLANT

Shall we recollect the salad that Mani and Mythili made. It was made with different parts of the plant.

A typical flowering plant consists of two main systems, viz. Root System (underground part), and Shoot System (aerial part). The root System consists of main root and its lateral branches. The Shoot System has a stem, branches and leaves. The flowering plant produces flowers, fruits and seeds at maturity. Root, stem and leaves are called vegetative parts of a plant as they do not take part in reproduction. Flowers, fruits and seeds are reproductive parts of a plant as they take part in reproduction.

Root system

The part of the plant which grows under the soil is called Root System. It usually develops from the radicle of embryo. It is the descending part of the plant. It grows away from sunlight. It does not have chlorophyll. Nodes and Inter-nodes are absent. It does not bear leaves or buds. Root system is broadly classified in two types. They are

1. Tap root system
2. Adventitious root system

---

**ACTIVITY 3.1**

Let us take a jar and fill it with water. Place an onion in the neck of the jar and its base in the water. Observe the onion roots.
1. Tap Root System

The radicle of the embryo grows deep into the soil and becomes the primary root (tap root). This root gives rise to lateral roots such as secondary roots and tertiary roots. Generally dicot plants have tap root system.

**eg. Mango, neem, carrot, radish, etc.**

2. Adventitious Root System

Roots that grow from any part of the plant other than the radicle are called adventitious roots. These roots arise in cluster which are thin and uniform in size. As these roots arise in cluster, they are also called as fibrous roots. Most monocot plants show adventitious roots.

**eg. Rice, grass, maize, bamboo.**

Normal functions of roots

1. Roots absorb water and minerals from the soil and transport to the stem.
2. Roots fix the plant firmly to the soil.

Shoot system

The part of the plant which grows above the ground is called shoot system. It develops from the plumule of the embryo. Stem is the ascending part of the plant axis. It grows towards the sunlight. The shoot consists of main stem with branches, nodes, internodes, leaves, buds, flowers and fruits. Young stems are green and old stems are brown in colour. The place from where the leaf arises is known as node. The distance between the two successive nodes is called internode. It bears buds either in the axils of leaves or at the tip of the stem.
Normal functions of stem

1. **Support**: The stem holds the branches, leaves, flowers and fruits.

2. **Conduction**: The stem transports water and minerals from roots to the upper parts. It also transports the prepared food from leaves to other parts.

### ACTIVITY 3.2

Children, it is very interesting to help our mother in the kitchen, and next time when you clean greens (Keerai), try to observe the various parts of the plant.

**Leaf**

Leaf is a thin, broad, flat and green part of the plant. The leaf consists of three main parts. They are leaf blade (leaf lamina), leaf stalk (Petiole) and leaf base.

**Leaf blade (leaf lamina):**

It is the expanded part of the leaf which is green in colour. It has a midrib (a main vein) in the centre of the leaf blade. The midrib has branches on either side which are called veins.

**Petiole**

The stalk of the leaf is called petiole. It connects the lamina to the stem.

**Leaf base**

The basal part of the leaf with which it is attached to the stem is called leaf base. The leaf base may bear two small lateral leaf-like structures called stipules.

Normal functions of leaf

1. **Synthesis of Food**: Leaves produce food by photosynthesis.

![Leaf Diagram]

2. **Exchange of Gases**: Leaves exchange gases through stomata. Plants take in carbon dioxide and give out oxygen during photosynthesis. They take in oxygen and give out carbon dioxide during respiration. This is called exchange of gases in plants.

3. **Transpiration**: The loss of excess water from the leaf in the form of water vapour through stomata is called transpiration.

![Transpiration Diagram]
A flower has four parts, viz. Calyx, Corolla, Androecium and Gynoecium.

**Calyx:** The green, leaf like parts in the outermost circle of a flower are called sepals. They protect the flower when it is a bud.

**Corolla:** The brightly coloured parts of a flower are called Petals. They are the second part of the flower.

**Androecium:** The stamen is the third part of a flower. It is the male part of the flower. Each stamen consists of a stalk called filament and a bag like structure on the top of filament called anther. Anther forms pollen grains which are the male gametes.

**Gynoecium:** It is the inner most part of the flower. It is the female part of a flower. A carpel has three parts. The upper part of the carpel is the stigma. The middle part is called style. The lower swollen part is called ovary. Ovary contains ovule which has the egg (female gamete).

**Uses of a Flower**

Flowers are used to make perfumes, medicines and for ornamental purposes.

**ACTIVITY 3.3**

Let us cover a leaf of a potted plant with a transparent polythene bag. Observe it after few hours. We will find water droplets in the polythene bag. This proves transpiration in leaves.

Flower

Flower is called the reproductive part of a plant because it helps in sexual reproduction. The flower changes into fruit after pollination and fertilization. Like leaves, flowers also have stalk. The stalk of a flower is called pedicel. There are stalk less flowers also.

**eg. Banana.**

**Parts of a typical flower**

- **Petal**
- **Anther**
- **Carpel**
- **Sepal**

They can be of different colours, shapes and sizes.
3.5. Modifications of Root, Stem and Leaves

Root, stem and leaf have their normal functions as mentioned earlier. In addition to the normal functions, some of the roots, stems and leaves change their shape and structure to do extra functions.

Modifications of Tap Root:

1. Storage Roots:

   The tap root becomes thick and fleshy due to storage of food materials. Based on the shape of the root, they are

   a) Conical: The root is broad at the apex and gradually tapers towards the base like a cone.

   eg: Carrot

   b) Fusiform: When the root is swollen in the middle and tapers gradually towards both the ends like a spindle, it is called fusiform.

   eg: Radish.

   c) Napiform: When the root is swollen at the apex coming almost spherical and tapers suddenly towards the base give a top-like appearance, it is called napiform.

   eg: Turnip, beetroot.
2. Respiratory Roots

Plants which grow in saline swamps near the sea shore develop numerous upright aerial roots called respiratory roots. They help in breathing.

eg. Avicennia (vellai alayatri)

It is found at Pitchavaram in Tamilnadu.

2. Supporting Roots

a) Prop Roots: A number of roots are produced from aerial branches. These roots grow vertically downward and fix into the ground. These roots act as pillars and give additional support to the main plant. Such roots are called prop roots.

eg. Banyan.

b) Stilt Roots: Plants with delicate stems develop short and thick supporting roots from the basal part of the stem. They fix to the ground and give support. Such roots are called stilt root.

eg. Maize, sugarcane

Modifications of Adventitious Roots

1. Storage Roots

a) Tuberous Roots: Some of the adventitious roots store food and become swollen without any definite shape.

eg. Sweet Potato (chakravalli kizhangu).

b) Fasciculated Roots: The swollen tuberous roots occurring in clusters are called fasciculated roots.

eg. Dahlia.

The big banyan tree in the Indian Botanical Garden near Kolkata has produced over 900 such prop roots from its branches. Its age is more than 200 years and its diameter is well over 360 metre.
3. Parasitic Roots

Roots of parasitic plants penetrate into the host tissue to absorb nourishment. Such roots are called parasitic roots.

eg. *Cuscuta*

4. Epiphytic Roots

There are some plants which grow on the branches of other trees for only shelter and not for food. These plants grow some roots which hang freely in the air and velamen tissue in these roots absorb moisture. Such roots are called epiphytic roots.

eg. *Vanda* (orchid)

Modifications of stem

In addition to the normal functions of stem, the stem also performs certain special functions in some plants. In such cases, either the complete plant or a part of the stem is modified to do those special functions. Such stems are called modified stems.

1. Underground Stem Modifications

Stem of some plants remain underground and do the function of storage. They are of different types.

a) **Tuber**: It is modified underground stem which develops by swelling of tip of stem. It stores a large amount of food.

eg. *Potato*.

b) **Rhizome**: These are thickened stem that grow horizontally under the soil.

eg. *Ginger*.
2. Sub-Aerial Modifications of Stem

This modification is meant for vegetative propagation. In some plants, branches are weak and they lie horizontal on the ground or may become buried in top soil. Aerial branches and adventitious roots develop at nodes. These are called as Creepers.

The Creepers are of two types.
(a) Runners: eg. Grass, Pumpkin
(b) Stolons: eg. Strawberry.

3. Aerial Stem Modifications

Normally buds develop into branches or flowers. In some plants, the buds undergo modification for definite purpose. Some of the aerial stem modifications are:

a) Stem Tendril: In some plants, the axillary bud is modified into tendril, which helps the plant to coil around a support.

eg. Passion flower, snake gourd.

b) Thorn: In some plants, the axillary bud is modified into thorn for protection.

eg. Bougainvillea.

c) Phylloclade: In some xerophytes, the leaves are reduced to spines. The function of the leaves is taken over by the stem which is green and flat. Such a stem is called Phylloclade.

eg. Opuntia
PLANT MORPHOLOGY

MODIFICATIONS OF LEAF:

In some plants, the leaf is modified as under:

a) Leaf Tendril: In some plants, the leaf is modified into slender, wiry coiled structure, known as tendril. They help in climbing.

   eg. Pea

b) Leaf-Spine: In opuntia, the leaves are reduced to spines. They are protective in function and prevent transpiration.

   eg. Opuntia.

c) Pitcher: In some plants, the leaves are modified into pitcher to trap insects to fulfill their nitrogen deficiency.

   eg. Nepenthes.

d) Bladder: In some plants, the leaf is modified into a bladder, to trap insects.

   eg. Utricularia. (Bladder-wort)

3.6. KINDS OF STEM

Stems of flowering plants attain diverse forms in order to perform their various functions. Based on the texture, stems of plants are grouped under three broad categories.

1) Reduced Stems: In some plants, the stem is reduced to small disc. Nodes and inter-nodes are absent in the disc.

   eg. Radish, carrot, turnip, onion.

2) Erect Stems: Most of the flowering plants possess upright erect woody stems.

   eg. Bamboo, banyan, eucalyptus, coconut

MORE TO KNOW

The Amazon Water Lily bears leaves measuring upto 7 feet in diameter and flowers between 12 and 16 inches.
3) **Weak Stems**: There are thin, soft and delicate stems which cannot stand erect without support. They are two types.

1. **Upright Weak Stems**: They may be twiners or climbers
   a) **Twiners**: The stems are long, slender, flexible and very sensitive. They coil around an upright support without any special structure. 
   eg. bean.
   b) **Climbers**: They climb up the support with some clinging structures
   eg. Betelvine (vetrilai), pepper (Milagu).

2. **Prostrate Weak Stems**: These stems spread over the ground. They may be trailers or creepers.
   eg. Tridax (vettukaya poondu).

### 3.7. MOVEMENTS IN PLANTS

Plants generally do not move from place to place like animals. But the parts of the plant show growth movements in response to some stimuli like sunlight, water, soil, etc. Therefore, the tendency of the plant parts to grow towards or away from the direction of stimuli is called tropism.

#### MORE TO KNOW

J.C. Bose, an Indian Botanist invented Crescograph which showed that plants have feelings. He was awarded nobel prize for his invention.

#### 1. Tropism

There are three types of tropism.

a) **Phototropism**: The tendency of the plant parts to grow either towards or away from the direction of sunlight, is called phototropism.

Stem grows towards the sunlight. So, stem is positively phototropic. Root grows away from the sunlight. So, root is negatively phototropic.

b) **Geotropism**: Roots tend to grow towards the soil or gravity. This
is called geotropism. Root is positively geotropic and stem is negatively geotropic.

c) Hydrotropism: The roots tends to grow towards the direction of water, whereas stem does not. So, root is positively hydrotropic and stem is negatively hydrotropic.

2. Nastic movement

The plant Mimosa - Touch Me Not (Thotta surungi) is sensitive to touch. When the plant is touched, the leaves fold. The folding of leaves in Mimosa is not due to growth. It is an irregular movement and it is called nastic movement.

3.8. OBSERVATION OF PLANTS AND TREES

1. Recording data and drawings

Children, we are planning to go for a trekking during the holidays to the hills or the forest area which is nearer to our school. We shall observe the types of plants present over there. Collect different kinds of leaves, flowers, seeds, etc. We shall place the leaves and flowers that we have collected between the pages of our used old notebooks, after drying, paste them in a scrapbook.

2. Let us make

Children, let us make animals with leaves. Collect some leaves of peepul tree (Ficus tree). Tear along the midrib to make the body of a cat. Tear V shape for face. Join the face and body to make a cat.

Try to make elephant, deer, tortoise, peacock with different leaves.
EVALUATION

1. Pick out the correct answer:-
   a. Absorption of water is a function of ___________ system. (Shoot / root)
   b. Thulasi is an example of a ___________ (herb / shrub)
   c. The stalk of a leaf is called ___________ (stipule / petiole)
   d. ___________ protects the flower when it is a bud. (calyx / corolla)
   e. Movement of plant towards ___________ is called phototropism. (Water / light)

2. The diagram of a flower is given below. Label the following parts.
   a) sepal    b) petal    c) stamen    d) stigma

3. The jumbled words below are the various movements of a plant. Write the correct word.
   a. SICTAN = NASTIC
   b. PSIMORTOEG = ______________________
   c. PISOMTRORDHY = ______________________
   d. SIMPTROOOTH = ______________________

4. The answers to the following are found in the word grid below. Find the answers and fill in the blanks.
   a. I am a hydrophyte _________________
   b. I am a herb _________________
   c. I grow in desert _________________
   d. I am a tree _________________
e. I produce food in the plant ____________
f. I am a fusiform root ____________
g. I am a tuber ____________
h. I am a climber ____________
i. Touch-me not ____________
j. I am a flower endemic to Tamil Nadu ____________

5. Match the following.

1. Vallisneria - Sugarcane
2. Stomata - Opuntia
3. Stilt root - Pepper
4. Phylloclade - Submerged hydrophyte
5. Climber - Transpiration
CHAPTER 4

BASIS of classification
Inba and Valli are going to their uncle’s house in their village. Their uncle takes them around his farm. They see number of animals neatly kept in coops and paddocks. They asked their uncle how he had arranged them. Uncle replied that he classified them according to their kind, the food they eat etc. There are many varieties of living things in the world. Are they also arranged in a similar way?

Yes, we call the arrangement as classification.
There is great diversity among living organisms found on the planet earth. They differ in their size, shape, habitat, mode of nutrition and other ways of life. The biodiversity of the earth is enormous.

We call such a variety among living organisms as biodiversity. Even though there is such a variety and diversity among them, the living organisms show a lot of similarities and common features so that they can be arranged into many groups. In order to understand and study them systematically, these living organisms mainly the plants and animals are grouped under different categories.

The system of sorting living organisms into various groups based on similarities and dissimilarities is called classification.

4.1. NEED FOR CLASSIFICATION

It is not possible for anyone to study all the organisms. But if they are grouped in some convenient way, the study would become easier. Classification allows us to understand diversity better.

Necessity for classification

1. Classification helps us to identify the living organisms easily.
2. It helps us to learn about different kinds of plants and animals, their features, similarities and differences.
3. It enables us to understand how complex organisms evolve from simple ones.

### ACTIVITY 4.1

Shall we name some common vegetables and find out if they have any other name...

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Common name</th>
<th>Other name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Brinjal</td>
<td>Egg plant</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4.2. THE FIVE KINGDOM CLASSIFICATION

R.H. Whittaker (1920–1980) was an American plant ecologist. He was the first to propose the five kingdom classification of the world’s biota, based on their evolutionary relationships. In 1969 he classified the organisms into five kingdoms. This classification has been accepted by all scientists.

### MORE TO KNOW

About 9,000 species are identified under Kingdom Monera. The number of species in Kingdom Protista is about 59,950. The number of species under Fungi is about 100,000. The number of species identified under the Kingdom Plantae is about 289,640. The total number of species identified under Animalia is about 1,170,000.
The Five Kingdoms are Monera, Protista, Fungi, Plantae and Animalia.

This classification takes into account the following important criteria.

- **Complexity of Cell structure (prokaryote to Eukaryote)**
- **Body organization (unicellular or multi-cellular)**
- **Mode of nutrition (autotrophs and heterotrophs)**
- **Phylogenetic or evolutionary relationship**
4.2.1. KINGDOM OF MONERA

General features
- The kingdom Monera comprises all bacteria and the cyanobacteria.
- They are Primitive unicellular (single cell organisms).
- They do not have a true nucleus (prokaryotic).
- Their mode of nutrition is autotrophic or heterotrophic.
- They cause diseases like diphtheria, pneumonia, tuberculosis, leprosy etc.
- They are also used in manufacture of antibiotics to cure many diseases.

ACTIVITY 4.2
Children, shall we find out what converts milk into curd, ferments idli batter, causes disease like cholera, and produces medicines

Yes, the organism is bacteria.

Discovery of Bacteria
In 1675 Anton Von Leewvenhoek, a Dutch scientist, discovered bacteria. He called the bacteria as ‘animalcules’. Anton Von Leewenhoek is called as the father of bacteriology. Bacteria are considered as the first formed organisms in the world.

Shape of Bacteria
The shape of bacteria varies in different species. The important shapes are
(A) rod
(B) spherical
(C) comma
(D) spiral.

ACTIVITY 4.3
Children, shall we keep a drop of curd on clean glass slide and observe under microscope. We can see rod shaped Lactobacillus.

MORE TO KNOW
The average human gut contains about 1kg of bacteria. Their presence is essential for normal health.

Beneficial bacteria

Harmful Bacteria
Bacteria cause many diseases in plants and human beings.
There are two main groups of protista.
1. Plant-like protista which are photosynthetic are commonly called microalgae. They can be seen only under a microscope. They occur as single cells or filaments or colonies. e.g. Chlamydomonas, Volvox etc. Algae are autotrophs.
2. Animal-like protista are often called protozoans. Protozoans include Amoeba and Paramoecium like animals. The Paramoecium, which consists of cilia, belongs to class Ciliata. Amoeba which consists of pseudopodia belongs to class Sarcodina. All unicellular plants are collectively called phytoplanktons and unicellular animals as zooplanktons.

Euglena, a protozoan possesses chloroplast and make their own food by photosynthesis. It has two modes of nutrition. In the presence of sunlight it is autotrophic and in the absence of sunlight it is heterotrophic. This mode of nutrition is known as myxotrophic and hence they form a border line between plants and animals.

### Diseases in Plant
- Canker disease (Lemon)
- Ring rot disease (Potato)
- Fire blight disease (Apple)
- Wilt disease (Tomato)

### Diseases in Man
- Tuberculosis
- Cholera
- Leprosy
- Plague

### 4.2.2. Kingdom of Protista

**General features**

- The kingdom Protista includes unicellular eukaryotes.
- Animals and plants of Protista live in sea as well as in fresh water.
- Some are parasites. Though they are single celled they have the capacity of performing all the body activities.
- They have nucleus enclosed by a nuclear membrane (eukaryotic).
- Some of them possess chloroplast and make their own food by photosynthesis. e.g. Euglena

![Fig 4.3 Euglena](image)
4.2.3. KINGDOM OF FUNGI

General features

This kingdom Fungi includes Yeast, Moulds, Mushrooms (Kaalaan), Toadstools, Puffballs and Penicillium

- Fungi are eukaryotic and mostly multicellular. The body is made up of filamentous hyphae.
- Their mode of nutrition is heterotrophic (obtain their nutrients from other organisms) since they lack the green pigment chlorophyll.
- They have cell walls, made of a tough complex sugar called chitin.
- Fungi act either as decomposers (decay-causing organisms) or as parasites (live in other organisms) in nature.
- Mould fungi grows on stale bread, cheese, fruit or other food.

Penicillium is a fungus. It lacks chlorophyll. It lives as saprophyte. The body consists of filamentous structures. The antibiotic penicillin is extracted from it. The Penicillin is also known as “the queen of drugs”.

Yeast is an unicellular organism and oval in shape. It is a saprophytic fungus. It is useful for the preparation of alcohol by fermentation process. Conversion of sugar solution into alcohol with the release of carbon dioxide by yeast is called fermentation. It is also used in bakery.

ACTIVITY 4.4

Let us mix the yeast powder with the sugar solution. After a few days you can see the formation of whitish layer on the surface of the extract. When it is observed under the microscope, yeasts can be seen.

MORE TO KNOW

Children, some fungi are extremely poisonous. Never touch or eat wild fungi without the advice of elders.
4.2.4. KINGDOM OF PLANTAE

General features

Kingdom Plantae includes all multicellular plants of land and water.

1. Algae (Multicellular)
   eg. Laminaria, Spirogyra, Chara

2. Bryophytes
   eg. Riccia, Moss

3. Pteridophytes
   eg. Ferns

4. Gymnosperms
   eg. Cycas, Pinus

5. Angiosperms
   eg. Grass, Coconut, Mango, Neem (veppa maram)

- The plant cells have an outside cell wall that contain cellulose.
- They show various modes of nutrition. Most of them are autotrophs since they have chlorophyll.
- Some plants are heterotrophs. eg. Cuscuta is a parasite.
- Nepenthes and Drosera are insectivorous plants.

MORE TO KNOW

Kingdom Plantae includes

- Bryophyta - 24,000 species
- Pteridophyta - 10,000 species
- Gymnosperms - 640 species
- Angiosperms - 255,000 species
4.2.5 KINGDOM OF ANIMALIA

General features

- This kingdom includes all multicellular eukaryotic animals.
- All animals show heterotrophic mode of nutrition. They directly or indirectly depend on plants for their basic requirements particularly the food.
- They form the consumers of an ecosystem.
- The cells have plasma membrane.
- They have contractibility of the muscle cells.
- They have well developed, controlled and coordinated mechanisms.
- They can transmit impulses due to the presence of nerve cells.
- Some groups of animals are parasites e.g. tapeworms and roundworms.

Most members of the animal kingdom can move from place to place. However, some animals, such as adult sponges and corals are permanently attached to a surface.

 Kingdom Animalia includes the following phyla

<table>
<thead>
<tr>
<th>S.N</th>
<th>PHYLUM</th>
<th>CHARACTERS</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Porifera</td>
<td>Pore bearers</td>
<td>eg. Sponges</td>
</tr>
<tr>
<td>2.</td>
<td>Coelenterata</td>
<td>Common body cavity and digestive cavity</td>
<td>eg. Hydra, Jelly fish</td>
</tr>
<tr>
<td>3.</td>
<td>Platyhelminthes</td>
<td>Flatworms</td>
<td>eg. Tape worm (Taenia)</td>
</tr>
<tr>
<td>4.</td>
<td>Aschelminthes</td>
<td>Thread-like worms</td>
<td>eg. Round worm (Ascaris)</td>
</tr>
<tr>
<td>5.</td>
<td>Annelida</td>
<td>Body is segmented</td>
<td>eg. Nereis, Earthworm</td>
</tr>
<tr>
<td>6.</td>
<td>Arthropoda (insect group)</td>
<td>Have jointed legs</td>
<td>eg. Centipede, Cockroach, Scorpion</td>
</tr>
<tr>
<td>9.</td>
<td>Chordata</td>
<td>Have backbone</td>
<td>eg. Fish, Frog, Man.</td>
</tr>
</tbody>
</table>

MORE TO KNOW

Tamil Nadu ranks first among all states in the country to have endemic animals.
4.3. BINOMIAL NOMENCLATURE

History of classification

Aristotle categorized organisms into plants and animals.

- Hippocrates, the Father of Medicine, listed organisms with medicinal value.

- Aristotle and Theophrastus classified the plants and animals on the basis of their form and habitat.

- John Ray introduced the term species.

- Carolus Linnaeus organized a simple naming system for plants. So, he is known as Father of Taxonomy. He developed the Binomial System of nomenclature, which is the current scientific system of naming the species.

Necessity for Binomial Nomenclature

In the earlier period, organisms were referred by their common names. Since common names or vernacular names were in the local languages, they differed at different places resulting in total confusion. They were not universally applicable.

In order to avoid this confusion, a scientific system of naming organism which is universally followed was evolved. So Linnaeus devised a system of naming animals and plants with two names. This is called binomial nomenclature.

Basic Principles of Binomial Nomenclature

1. Scientific names must be either Latin or Latinized.

2. The name of the genus begins with a capital letter.

3. The name of the species begins with a small letter.

4. When printed, the scientific name is given in italics.

5. When written by hand, name should be underlined.

ACTIVITY 4.5

Shall we observe some plants and animals and find their binomials.

<table>
<thead>
<tr>
<th>ZOOLOGICAL NAME</th>
<th>BOTANICAL NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockroach</td>
<td>Hibiscus</td>
</tr>
<tr>
<td>(Karapan Poochi)</td>
<td>rosasinensis</td>
</tr>
<tr>
<td>Housefly</td>
<td>Musca domestica</td>
</tr>
<tr>
<td>(Ee)</td>
<td></td>
</tr>
<tr>
<td>Frog</td>
<td>Rana hexadactyla</td>
</tr>
<tr>
<td>(Thavalai)</td>
<td></td>
</tr>
<tr>
<td>Pigeon</td>
<td>Columba livia</td>
</tr>
<tr>
<td>(Pura)</td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>Homo sapiens</td>
</tr>
<tr>
<td>(Manithan)</td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td>Lycopersicon esculentum</td>
</tr>
<tr>
<td>(Thakkali)</td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>Solanum tuberosum</td>
</tr>
<tr>
<td>(Urulai)</td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td>Mangifera indica</td>
</tr>
<tr>
<td>(Maankai)</td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>Oryza sativa</td>
</tr>
<tr>
<td>(Nel)</td>
<td></td>
</tr>
</tbody>
</table>
EVALUATION

1. Pick out the correct answer:-
   
a) The five kingdom system of classification was proposed by ________
   (R.H.Whittaker / Carl Linnaeus)

b) Kingdom Monera includes ________ organisms.
   (multicellular / unicellular)

c) The queen of drugs is ________
   (yeast / penicillin)

d) Plant cells have it. Animal cells do not have it. What is it? ________
   (Nucleus / cell wall)

e) Oryza sativa is a binomial of ________
   (rice / wheat)

2. Place the following animals in their phylum.
   
tapeworm, sponges, hydra, ascaris, scorpion, human, snail, starfish, earthworm.
   
Tapeworm - Platyhelminthes

a) ________- ______________
   e) ________- ______________

b) ________- ______________
   f) ________- ______________

c) ________- ______________
   g) ________- ______________

d) ________- ______________
   h) ________- ______________

3. Some beneficial and harmful effects of bacteria are given below. Write (B) for BENEFICIAL and (H) for HARMFUL.

   a) Leprosy - Beneficial / Harmful
   b) Ring rot of potato - Beneficial / Harmful
   c) Recycling of waste - Beneficial / Harmful
   d) Tuberculosis in man - Beneficial / Harmful
   e) Tanning of leather - Beneficial / Harmful
   f) Wilt of tomato - Beneficial / Harmful
   g) Processing of tea - Beneficial / Harmful
4. Draw different shapes of bacteria.

5. Euglena possesses chloroplast. In the absence of sunlight it is heterotrophic. In which kingdom will you place it? Animal or plant?

6. Find out the names of the following in as many languages as you can with help of your teachers and parents.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>English Name</th>
<th>Tamil Name</th>
<th>Binomial Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Lion</td>
<td>Singam</td>
<td>Panthera leo</td>
</tr>
<tr>
<td>2.</td>
<td>Mango</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Dog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Potato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Hibiscus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Groundnut</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FURTHER REFERENCE**

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- Frame Work of Science - Paddy Gannon Oxford University Press, New Delhi

**Webliography:**

- [www.rhs.org.uk](http://www.rhs.org.uk)
- [www.mhhe.com](http://www.mhhe.com)
CHAPTER 5

MATTER IN OUR SURROUNDINGS
We are surrounded by a number of objects. eg: iron, wood, water, air etc. We do not see air but we feel its presence. All these things occupy space and have mass. In the **World of Science, matter is anything that has mass and occupies space.** There are different kinds of matter. Here, we learn about matter based on its physical properties.

### ACTIVITY 5.1

Look at your surroundings, observe and write the objects around you.

| In your house | 1. ..................................................  
| 2. ..................................................  
| 3. ..................................................  |
| In the playground | 1. ..................................................  
| 2. ..................................................  
| 3. ..................................................  |
| In your classroom | 1. ..................................................  
| 2. ..................................................  
| 3. ..................................................  |

### 5.1. PHYSICAL NATURE OF MATTER

Let us perform an activity to learn about the nature of matter.

### ACTIVITY 5.2

Let us take a small piece of chalk and powder it. We can see that the chalk powder consists of small particles. These particles are responsible for the formation of matter (chalk). **Matter is made up of tiny particles** known as atoms and molecules. Molecules are made up of atoms. Molecules and atoms are the building blocks of matter.

### MORE TO KNOW

The size of the atoms and molecules of matter is very small, almost beyond our imagination. It is measured in nanometres \((1\text{nm} = 10^{-9}\text{m})\).
5.2. CHARACTERISTICS OF PARTICLES OF MATTER

**ACTIVITY 5.3**

- Take some water in a beaker.
- Mark the level of water. Add some sugar to the water and stir well.
- Do you observe any change in the water level?
- What does the solution taste like?
- What happened to the sugar?
- How did it disappear?

From the above activity you can notice that there is no change in the water level but the taste is sweet. It indicates that the sugar is completely dissolved in water. When you dissolve sugar in water, the molecules of sugar occupy the space between molecules of water and get uniformly distributed in water. It is understood that there exists a space between the molecules in matter.

**ACTIVITY 5.4**

- Take some water in a beaker.
- Add a drop of blue ink slowly and carefully into the beaker.
- Leave it undisturbed in your classroom.
- Record your observation.

From the above activity you can understand that the molecules of matter continuously move and mix with each other.
**ACTIVITY 5.5**

- Open a water tap.
- Try to break the stream of water with your fingers.
- Are you able to break the stream of water?
- What could be the reason behind the stream of water remaining together?

The above activity shows that *molecules of matter have force of attraction between them*. This force binds the molecules together. Force of attraction between the molecules (Intermolecular forces) varies from one kind of matter to another. The structure and properties of matter – whether they are hard or soft, coloured or transparent, liquid or gas – depends on the way in which the atoms and molecules are arranged.

### 5.3. STATES OF MATTER

Matter can exist in three physical states, i.e., solid, liquid and gas.

![States of matter diagram with examples of objects in each state](image-url)
Solid

Solids are characterized by definite shape, size and volume. In solids, the molecules are very closely arranged because the force of attraction between the molecules is very strong. They are incompressible. The following figures 5.7(a & b) are a few examples to show that matter exists in the solid state. Fig (5.8) shows how molecules are closely arranged in solids.

Fig. 5.7- Examples of matter in solid state

Fig. 5.8 Close arrangement of molecules in solid

TO THINK...

Sponge is also a solid. Yet we are able to compress it. Why? Sponge has minute holes in which air is trapped. When we press it, the air is expelled and we are able to compress it. Solids may break under force. It is difficult to change their shape as they are highly incompressible.

Fig. 5.9. Sponge

MORE TO KNOW

Matter exists in two more states.

Fourth State of Matter - Plasma- super heated gaseous State.

**Liquid**

Liquids occupy definite volume but have no definite shape. It takes the shape of the container as shown in fig 5.11. Do you know why? The intermolecular force of attraction between the molecules in a liquid is less when compared to solids and these molecules are loosely packed. This allows the liquid to change its shape easily. They are negligibly compressible. A few examples for matter that exist in liquid state are water, oil, juice etc. From the fig 5.12 you can also see how the molecules are loosely arranged in liquids.

![Liquid](image)

**Gas**

The atoms or molecules of matter that always occupies the whole of the space in which they are contained is called a gas, as shown in Fig 5.13. It neither occupies a definite volume nor possesses a definite shape. The intermolecular force of attraction between the molecules of a gas is negligibly small, because the molecules are very loosely packed as in Fig 5.14. The molecules are distributed at random throughout the whole volume of the container. Gases are highly compressible when compared to solids and liquids. Gases will expand to fill the space of the container. The Liquefied Petroleum Gas (LPG) cylinder that we get in our home for cooking and the oxygen supplied to hospitals in cylinders are compressed gases. These days Compressed Natural Gas (CNG) too, is used as fuel in vehicles. In Delhi, CNG gas is used as a fuel in buses.

![Gas](image)
**ACTIVITY 5.6**

Take a cork ball and press it. Do you find any change in the size or shape. No, it cannot be compressed. You know well that solids are incompressible.

Let us compare the compressibility of liquids and gases using an activity.

Take two hypodermic syringes and label them 1 and 2.

1. Plaster the nozzle and seal it with a cork.
2. Remove the piston (Plunger) from the syringes.
3. Fill syringe-1 with water.
4. Do not add anything in syringe 2 (still it contains air).
5. Insert the piston back into the syringes. You may apply some Vaseline on the piston before inserting them into the syringes for smooth movement.

Now try to compress by pushing the piston in each syringe. In the case of water (liquid) in syringe 1 the piston moves just a little. But in the case of air in syringe 2, the piston can be pushed completely.

This shows liquids can be compressed slightly, while gases can be compressed easily.

![Fig. 5.15. Effect of pressure on liquid and air](image)

**MORE TO KNOW**

Why does the smell of hot cooked food spread out easily?

Here the particles of the aroma of food mix with the particles of air in the kitchen and spread out from the kitchen very easily. This is due to

(i) The free particles or molecules of gas in aroma and air.
(ii) The high speed of the gaseous particles or molecules.
(iii) The large space between them.

So gases diffuse much faster than solids and liquids.
Properties of Solid, Liquid and Gas:

Table 5.1

<table>
<thead>
<tr>
<th>S.No</th>
<th>SOLID</th>
<th>LIQUID</th>
<th>GAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Have definite shape and volume</td>
<td>Have definite volume but no definite shape</td>
<td>Have neither definite shape nor definite volume</td>
</tr>
<tr>
<td>2</td>
<td>Cannot flow</td>
<td>Can flow from higher level to lower level</td>
<td>Can flow very easily and quickly in all directions</td>
</tr>
<tr>
<td>3</td>
<td>Intermolecular space is minimum</td>
<td>Intermolecular space is moderate</td>
<td>Intermolecular space is maximum</td>
</tr>
<tr>
<td>4</td>
<td>Intermolecular forces are maximum</td>
<td>Intermolecular forces are less than solid</td>
<td>Intermolecular forces are negligible</td>
</tr>
<tr>
<td>5</td>
<td>They are incompressible</td>
<td>They are compressible to an extent</td>
<td>They are easily compressible</td>
</tr>
</tbody>
</table>

5.4 EFFECT OF TEMPERATURE ON SOLID, LIQUID AND GAS

Can you change the state of matter? i.e., from solid to liquid or from liquid to gas. Let us perform an activity to understand the effect of temperature on matter.

**ACTIVITY 5.7**

Take some ice cubes in a container, heat the container and observe the changes.

![Ice (Solid)](image1) ![Water (Liquid)](image2) ![Vapour (Gas)](image3)

Fig. 5.16. Effect of temperature on matter.
On varying the temperature, you can notice that matter will change from one state to another. For example, ice (solid) in the container, on heating, becomes water (liquid) and on further heating, it changes into water vapour (gas).

Water can exist as three states of matter.
- Solid, as ice.
- Liquid, as water
- Gas, as water vapour.

What happens to the particles of matter during the change of states? How does this change of state take place? Don’t we need answers to these questions?

On increasing the temperature of solids, the kinetic energy of the particles (molecules/atoms) increases. Due to the increase in kinetic energy, the particles start vibrating with greater speed. The energy supplied by heat overcomes the forces of attraction between the particles. The particles leave their fixed positions and start moving more freely. A stage is reached when the solid melts and is converted into a liquid. The temperature at which a solid melts to become a liquid is called its melting point. The melting point of ice is 0°C.

When we supply heat energy to water, the particles (molecules or atoms) start moving even faster. At a certain temperature, a point is reached when the particles have enough energy to break free from the forces of attraction between each other. At this temperature, the liquid starts changing into gas. The temperature at which a liquid starts boiling is known as its boiling point. The boiling point of water is 100°C.

Particles from the bulk of the liquid gain enough energy to change to the vapour state. So, we infer that one state of matter can be changed into another state by varying the temperature.

THINK AND ANSWER

Does coconut oil solidify during the winter season?
Magesh is interested in classifying the different states of matter shown in the box below. Shall we help Magesh to classify the objects below, depending on its state. Put the appropriate objects in the given table (Table 5.2).

Table 5.2

<table>
<thead>
<tr>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone</td>
<td>Smoke from incense sticks</td>
<td>Water</td>
</tr>
<tr>
<td>Iron Rod</td>
<td>Honey</td>
<td>Petrol</td>
</tr>
<tr>
<td></td>
<td>Ice Cubes</td>
<td>Oxygen inside the Cylinder</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACTIVITY 5.9

To check whether all solids change their state at the same temperature.

- Take ice, butter and wax.
- Put the ice into the pan. Heat it until the ice changes into water. Use the thermometer to measure the temperature at which it changes the state.
- Continue this process for butter and wax.
- Note down the temperature at which the solid state is converted into liquid state in the following table.

Table 5.3

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Solids</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ice</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Butter</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Wax</td>
<td></td>
</tr>
</tbody>
</table>
EVALUATION

1. Materials which are very familiar to Raveena are given below. Help her to classify them into solids, liquids and gas.
   bricks, kerosene, milk, coconut oil, air, book, table, oxygen, carbon dioxide

2. Give reason for the following observation.
   a) We can smell the jasmine flower while we are sitting several metres away.
   b) The level of water remains the same when a pinch of salt is dissolved in it.

3. Gas can be compressed into a smaller volume but a solid cannot be. Could you explain. Why?

4. Match the following:
   a) Liquid on heating - liquid
   b) Solid - easily compressible
   c) Atoms and molecules - becomes vapour
   d) Milk - cannot flow
   e) Gas - building blocks of matter

5. Choose the correct one from the answers given in bracket:
   a) The only substance which exists in all the three states of matter is __________ (water, stone, glass)
   b) The matter which has a negligible intermolecular space is __________ (solid, liquid, gas)
   c) 1 Nanometer is equal to __________
      (10^{-10}m, 10^{-9}m, 10^{-12}m)

6. Fill in the blanks:
   a) The force of attraction between the particles in gas is __________ (less / more) than that of a solid.
   b) __________ (Solid / Liquid) state has definite volume, but no definite shape.

7. Mohan went to a shop to buy milk. He took his bicycle to go to the shop. He saw that the air in the cycle tube was a very little. He took it to the cycle shop. The cycle mechanic used a compressor pump to inflate the cycle tube. Mohan had a doubt. “How does the compressor works?”. Help Mohan to find the answer.
8. On varying the temperature, you can notice the process that matter will change from one state to another. Name the process A, B, C and D.

![Diagram showing states of matter: Ice, Water, Water Vapour]

9. Solids are incompressible. Sponge is also a solid. We are able to compress it. Could you explain why?

**PROJECT**

Collect 5 or 6 different types of used 1 litre water bottles. Take a bucket of water. Fill the bottles with water fully. Based on your observation, answer the following questions.

a) Does the volume remain the same?

b) Does the shape of the liquid remain same?

![Images of 5 different water bottles]

1 Litre 1 Litre 1 Litre 1 Litre 1 Litre 1 Litre

**FURTHER REFERENCE**

**Books:**


2. Introductory Chemistry - M Katyal, Oxford University press, New Delhi

**Webliography:**

http://chemistry.about.com/od/everydaychemistry.in.everyday-life.htm

http://www.classzone.com/books/earth-science/terc/content/visualizations

http://chemistry.about.com/library/btacid.quiz.htm

Places of scientific importance for visit:

Birla Planetorium, Guindy, Chennai.
Arun and his father went to see a plot of land they wanted to buy. The owner of the land gave the size of the plot in square feet. Arun’s father asked the owner to give the size of the plot in square metre. Arun knew that length is measured in metre. He was confused with the terms square metre and square feet. Let us help him to understand.

The measure of a surface is known as area. **Area is the extent of plane surface occupied.** The area of the plot of land is derived by multiplying the length and breadth.

\[
\text{Area} = \text{length} \times \text{breadth}
\]

The unit of area will be metre \(\times\) metre = (metre) \(^2\) read as square metre and written as \(m^2\).

### 6.1. **DERIVED QUANTITIES**

You have already studied the fundamental quantities (length, mass and time) in the sixth standard. Quantities got by the multiplication or division of fundamental physical quantities are called **derived quantities**.

**Area** is a derived quantity as we obtain area from the fundamental physical quantity - length.

**Volume** and **density** are some other derived quantities.

One square metre is the area enclosed inside a square of side 1m.

**Other units of measurement**

![Diagram](1m_and_1m2.png)

The area of a surface is 10\(m^2\) means that it is equivalent to 10 squares each of side of 1m.

Breadth, height, depth, distance, thickness, radius, diameter are all different measures of length.
### Sl.No. Unit of length Unit of area
1. centimetre (cm) square centimetre (cm²)
2. millimetre (mm) square millimetre (mm²)
3. feet (ft) square feet (ft²)

Area of agricultural fields is measured in acre and hectare

1 Acre = 4047 m² = 100 cent
1 hectare = 2.47 acre

### Activity 6.1
Let us find the area of the given figure.

```
1m
1m
```

### Activity 6.2
Let us find the area of the given figure (coloured portion) in cm² and mm². The side of each small square is 1cm.

### Activity 6.3
Name the unit convenient to measure the area of these surfaces we see in everyday life [mm², cm², m², ft², acre].

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Surface</th>
<th>Unit of area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teacher’s table top</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Black board</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Science text book</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Measuring scale</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Eraser</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Class room</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Play ground</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Agricultural land</td>
<td></td>
</tr>
</tbody>
</table>

### More to Know
A metre is much longer than a foot. Do you know how many feet make a metre?

1 metre = 3.28 feet

So, 1 m² = 10.76 ft²

### Self Check

1 cm² = __________ mm²

1 m² = __________ cm²

### Remember

Even though the area is given in square metre, the surface need not be square in shape.
The surfaces need not be a rectangle or square always. We use the following formulae to calculate the area of some regular objects. (i.e.) objects which have definite geometric shape.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Shape</th>
<th>Figure</th>
<th>Area</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Square</td>
<td><img src="image" alt="Square" /></td>
<td>length x length</td>
<td>$l^2$</td>
</tr>
<tr>
<td>2.</td>
<td>Rectangle</td>
<td><img src="image" alt="Rectangle" /></td>
<td>length x breadth</td>
<td>$l \times b$</td>
</tr>
<tr>
<td>3.</td>
<td>Triangle</td>
<td><img src="image" alt="Triangle" /></td>
<td>$\frac{1}{2} \times$ base x height</td>
<td>$\frac{1}{2} \times b \times h$</td>
</tr>
<tr>
<td>4.</td>
<td>Circle</td>
<td><img src="image" alt="Circle" /></td>
<td>$\pi \times$ radius x radius</td>
<td>$\pi r^2$ or 3.14</td>
</tr>
</tbody>
</table>

Let us try the method of measuring the area of irregular objects (i.e) objects which do not have regular geometric shape.

We can use a graph sheet to measure their area.

**ACTIVITY 6.4**

- Take a graph sheet and draw a square of any size in it and find its area in square millimetre $(\text{mm}^2)$ and in square centimetre $(\text{cm}^2)$.
- Repeat the activity by drawing a rectangle.
- Verify your answer by using the formula.

![Fig. 6.2.](image)
ACTIVITY 6.5

Let us take an object having irregular shape like a broken glass or a broken tile and measure its area.

Follow the steps given below:

1) Place the object on a graph sheet and draw the outline (like shown in figure 6.2).

2) Count the number of small squares enclosed within the outline. If more than half a square is inside the boundary, count it as one otherwise neglect it.

3) Each small square of the graph sheet has a side of 1mm or area 1mm².

4) Area of the irregular object = Number of squares counted X 1 mm²

The area of the irregular object = _______mm².

= _______ cm².

EXPERIMENT

1) Repeat the procedure to find the area of a leaf.

2) Draw squares of the area of one square metre and one square foot. Compare the two areas.

TO THINK

How would you find the surface area of

(a) a banana and

(b) your palm?

Volume

Kumar’s family lives in a small house. They have no cupboard to keep their clothes. Kumar asked his father to buy a cupboard. His father refused to buy it as the cupboard would occupy much space in the house.

The space occupied by a body is called its volume.

ACTIVITY 6.6

Shall we observe the following figures of the objects and get an idea about their size and volume?
From your observation, name the objects in increasing order of size and answer the following questions.

1) Which object is the smallest and which is the biggest in size?
2) Which object occupies the minimum space and which the maximum space?
3) What do you infer from the above?

[ Objects of smaller size occupy less volume and objects of larger size occupy more volume ]

Shall we calculate the volume of regular objects?

Volume of some regular objects is obtained by multiplying the base area by their height.

**Volume = base area x height**

Can you tell the unit with which volume is measured?

It is, \( m^2 \times m = m^3 \) which is known as cubic metre.

The volume may also be expressed with different units depending upon the unit of measurement.
<table>
<thead>
<tr>
<th>Unit of length</th>
<th>Unit of volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>milli metre (mm)</td>
<td>cubic millimetre (mm³)</td>
</tr>
<tr>
<td>centimetre (cm)</td>
<td>cubic centimetre (cm³)</td>
</tr>
</tbody>
</table>

The volume of an object is 10 m³ means that it is equivalent to 10 cubes each of side 1 m.

**ACTIVITY 6.7**

Let us calculate the volume of the objects shown below:

The side of each small cube is 1 cm in length.

**ACTIVITY 6.8**

1. How many small cubes make the big cube shown in the picture?
2. If the side of each small cube is 1 cm in length, find the total volume of the big cube.

Using the concepts discussed so far, try to write the names of the given shapes and the formula for calculating their volume.
Measuring liquids

Your mother asks you to get milk from the milkman. When you buy milk from the milkman, he will give it to you in litres (i.e) volume of liquid is measured in litres.

What is the meaning of 1 litre?

1 litre = 1000 cm$^3$.

One cubic centimetre is otherwise known as 1 millilitre written as ml.

What are the different instruments used to measure the volume of liquids?

**Measuring cylinder**

Fig 6.3

Fig 6.4

**Pipette**

Used to measure and transfer a definite volume of liquid.

Fig 6.5

Used to measure the volume of liquid.
Burette

Used to make a small fixed volume of liquid to flow.

Measuring flask

Designed to hold a fixed volume.

ACTIVITY 6.9

Let us find the volume of a stone using a measuring cylinder.

Follow the steps given below.

1) Pour water in the measuring cylinder up to a certain level.
2) Note the initial level of water.
3) Tie the stone by means of a thread.
4) Lower the stone into the water so that it is completely immersed without touching the sides.
5) Note the final level of water.
6) The difference between the final and initial levels gives the volume of the stone.

MORE TO KNOW

How will you express volume of water stored in a dam or reservoir?

In thousand million cubic feet (tMc).
Have a look at the pictures. Who is happier? Radha or Seetha?

Definitely Seetha will not be happy as her load (iron ball) is heavier, while Radha will be happy as her load (sponge sheet) is lighter.

The lightness or heaviness of a body is due to density. If more mass is packed into the same volume, it has greater density. So, the iron ball will have more mass than the sponge of same size. Therefore iron has more density.

Density is the mass of unit volume of the substance.

\[
\text{Density} = \frac{\text{mass}}{\text{volume}}
\]

The SI unit of density is kg/m\(^3\).

**ACTIVITY 6.10**

Let us take three balls (spheres) of the same size but made of different materials like cork (cricket ball), iron (shot put) and rubber (bouncing ball) Hold them separately in your hand. Arrange them according to the descending order of their mass.

1.
2.
3.

We see that the iron ball has more mass when compared to cork and rubber. It shows that iron has greater density.
Why does this hot air balloon fly?

A balloon filled with air does not fly whereas a balloon filled with helium gas can fly. Why?

**Self Check**

1) Density of steel is 7800 kg/m³. Will it float or sink in mercury?

2) Give the mass of water contained in a tank of length 5m, breadth 3m and height 2m.

**To Think**

A balloon filled with air does not fly whereas a balloon filled with helium gas can fly. Why?

**Activity 6.11**

Let us identify the following:

(i) The liquid denser than water is _______

(ii) The liquid lighter than water is _______

If a substance is lighter than water, it will float; but if it is heavier than water, it will sink.

**More to Know**

The density of water is 1000 kg/m³. This means that water filled in a tank of length 1m, breadth 1m and height 1m, has a mass of 1000 kg.

If the same tank is filled with mercury it will have a mass of 13,600 kg. So mercury is 13.6 times denser than water.

**Why do we need to measure time?**

We need to measure time for many reasons— to know when to go to school, when to take food, when to watch TV and when to sleep. The earlier clocks like the sundial, water clock and hour glass were not very accurate. There was the need to have more accurate and precise instruments. The earliest pendulum clocks which had weights and a swinging pendulum satisfied this need.
A story is told of Galileo. He went to a church in Pisa (in Italy). He noticed that a lamp suspended from the roof by a long chain was swinging periodically. Using his pulse beats he found that the time of swing of the lamp remained constant even as the swinging decreased. His keen observation made him understand the importance of the constant time of the swing.

Before his death in 1642. He made plans for the construction of a pendulum clock; but the first successful pendulum clock was constructed by the Dutch scientist Christian Huygens only in 1657.
ACTIVITY 6.12

1. Set up a simple pendulum in your class room with a thread of length 60cm.
2. Set the bob into oscillations
3. Note the time taken for 20 oscillations in seconds, using a stop clock.
4. Time period = \[\text{Time for one oscillation} = \frac{\text{time taken for 20 oscillations}}{20}\]

EXPERIMENT

Repeat the above experiment using
(i) bobs of different sizes without changing length of the pendulum.
(ii) threads of length of 80 cm and 100cm.
(iii) various amplitudes.
Do you notice any change in the time period?
In the first and third cases you will find no change in the time period
But in the second case the time period increases with increase in length.
So we infer that time period of a simple pendulum depends on the length of the pendulum and is independent of mass of the bob and the amplitude.

6.3. ASTRONOMICAL DISTANCES

Meera and Sundar were very excited as their uncle had joined ISRO (Indian Space Research Organisation). They were eagerly anticipating a visit to his new work place to see rockets and satellites. Let us listen to a conversation between Meera, Sundar and their uncle.

Meera : Uncle, will you become an astronaut?
Uncle : No, Meera, I will be joining a team responsible for the launch of rockets.
Sundar : Rockets shoot up many thousands of kilometre in the sky, don’t they?
Uncle : Yes, indeed they do. These rockets send satellites into orbits and spacecraft on their journey into outer space. A spacecraft travels lakhs and lakhs of kilometres in space. Don’t you feel that to measure such long distances unique units of measurement are required?
Imagine this boy is travelling at the speed of light. He can travel around the world seven and a half times in one second. He would take eight minutes and twenty seconds to reach the earth from the sun. A racing car travelling at 1,000 kilometres per hour would take 17 years to complete the same journey.

Meera & Sundar: What are these units? Do tell us!

Uncle: Now you see, to measure very long distances like the distance of the sun, other stars and different planets from the earth we use convenient units like **astronomical unit** and **light year**.

**Astronomical Unit** is the average distance between the earth and the sun.

1 Astronomical Unit = 149.6 million kilometre (14.96 crore km).

\[1 \text{ AU} = 1.496 \times 10^{11} \text{ m}\]

**Light year** is the distance travelled by light in vacuum in one year.

1 Light year = 9.46 x 10^{12} km (9,46,000 crore kilometres). (or)

1 Light year = 9.46 x 10^{15} m

**MORE TO KNOW**

Light travels distance of 3 lakh km in one second.
1. Anand’s father had a rectangular plot of length 60 feet and breadth 40 feet. He built a house in the plot and in the remaining area he planted a garden as shown.

Can you help Anand to find out the area of his garden.

2. ‘Density is the lightness or heaviness of a substance.

Kamala wanted to know whether water or coconut oil had lesser density. Her sister Mala asked her to bring a cup of water and some coconut oil. How did Mala clear Kamala’s doubt?

3. Observe the given picture and note

(i) Mass of the liquid -------- gm
(ii) Volume of the liquid --------- cc
(iii) Density of the liquid -------- g/cc

4. Kandasamy, a farmer had a fenced square shaped field in which he allowed his cow to graze. He tied his cow to a stake at the centre of the plot by a rope of length 7 m.

Kandasamy’s son, Raju was amused to see that the cow grazed over a large circle of grass but left grass at the corners untouched. How could Raju find out the area of the land not grazed by the cow?
**PROJECTS**

1. Take a vessel with water and a 25ml graduated beaker. Distribute the water by giving 100ml, 125ml, 175 ml and 200 ml respectively to each of your four friends with the help of the beaker. How many times did you use the beaker for each friend?

2. Use a stop clock and determine how many times the following activities can be repeated in a span of one minute.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Activity</th>
<th>Number of repetitions in one minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Your friend inhales and exhales</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>The heart beat of your friend</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>blinking of eyes by your friend</td>
<td></td>
</tr>
</tbody>
</table>

3. Using an overflow jar and a measuring cylinder find the volume of different stones.

Record Your observations:

<table>
<thead>
<tr>
<th>Stone</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

**FURTHER REFERENCE**

**Book:**

1. Frame work of Science - Paddy Gannon, Oxford University Press, New Delhi

**Webliography:**

http://www.kidastronomy.com

http://www.bbc.co.uk/schools/ks3bitesize/phys/html
7.1. SPEED

Two of the most exciting events in any sports meet is the 100m dash and 4x100m relay. Though all athletes run the same distance, the athlete who runs the distance in the shortest time will be the winner. In other words, the athlete who has the highest speed or is the fastest will win.

The most obvious feature of an object in motion is speed. It is a measure of how fast or slow an object is moving.

MORE TO KNOW

Usain Bolt won the 100m in 9.63 seconds and 200 m in 19.23 seconds at the London Olympics in 2012. He also won the 4 x 100 m relay along with his team mates. His high speed made the media call him ‘Lightning Bolt’.

ACTIVITY 7.1

Let us observe a car, a cycle and a bullock-cart as they move on the road. Which of these takes the shortest time to cover a certain distance?

The car is the fastest as it takes least time. The bullock-cart is the slowest as it takes longest time. The cycle moves at a speed between that of the car and the bullock-cart.

A fast moving object has high speed and a slow moving object has slow speed.

Now, what about an aeroplane?
7.2. WHAT IS SPEED?

Speed of a body is the distance travelled by the body in one second.

\[
\text{SPEED} = \frac{\text{DISTANCE TRAVELLED}}{\text{TIME TAKEN}}
\]

Distance travelled is measured in metre and time in second.

Therefore, the unit of speed is metre / second [m / s].

It can also be expressed in kilometre / hour [km / h]

What do you mean by saying the speed of a car is 50 km/h?

It means that the car travels a distance of 50 km in one hour.

\[
\begin{align*}
1 \text{ km} &= 1000 \text{ m} \\
1 \text{ hour} &= 60 \times 60 \text{ s} = 3600 \text{ s}
\end{align*}
\]

So, \[1 \text{ km/h} = \frac{1000 \text{ m}}{3600 \text{ s}} = \frac{5}{18} \text{ m/s}\]

Example:

a) \[2 \text{ km/h} = 2 \times \frac{5}{18} \text{ m/s}\]

b) \[3 \text{ km/h} = 3 \times \frac{5}{18} \text{ m/s}\]

If you know the speed of an object, you can find out the distance covered by it in a given time. All you have to do is to multiply the speed and time.

Distance covered = Speed x Time

ACTIVITY 7.2

Let us give a cricket ball to a group of four friends and ask each of them to throw the cricket ball from a given point. Mark the point up to which each of them throws the ball. Measure the distance thrown and discuss the speed of the ball.

SELF CHECK

a) \[36 \text{ km/h} = \ldots \text{ m/s}\]  

b) \[72 \text{ km/h} = \ldots \text{ m/s}\]  

c) \[180 \text{ km/h} = \ldots \text{ m/s}\]  

d) \[15 \text{ m/s} = \ldots \text{ km/h}\]  

e) \[25 \text{ m/s} = \ldots \text{ km/h}\]  

f) \[35 \text{ m/s} = \ldots \text{ km/h}\]  

ACTIVITY 7.3
Let us organise a toy car race to understand the concept of speed. Divide the class into 5 groups. Draw a line at the starting point.

One from each group should roll the toy car along the ground. Another should note the time taken by the car from the instant the car crosses the line to the instant it stops. Measure the distance. Calculate the speed of each car and record it.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Group</th>
<th>Distance travelled by the car</th>
<th>Time taken</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>III</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>IV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Find

1) Which group is the fastest?
2) Which group is the slowest?

**Variable Speed**

The speed of a bus during a journey may vary. When the bus is nearing a bus stop, its speed decreases.

On the highways the bus travels with greater speed. But in a city or town it travels with less speed due to heavy traffic.

The bus has different speeds at different time intervals. So we say that it has **variable speed**.

For such bodies, we can calculate the average speed:

\[
\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}
\]
If a body moves with the same speed at all times we say that it has **uniform speed**.

![Graph 7.3: Uniform speed](image)

**Graphical representation**

Have you seen a graph shown on your television screen while watching a cricket match?

It gives you an idea of the runs scored and also compares the performances of two teams.

Why is graphical representation used?

When you are given a set of numbers which are relative to one another, it may not give you a clear idea of the relationship between them.

If the same numbers are represented on a graph, it gives a beautiful visual representation and a clearer idea of the relation.

Hence, change of distance with time may be represented by a distance - time graph.

**Science today**

Have you noticed a meter fitted in the front of a scooter or a motorcycle?

Such meters can be found on the dashboard of cars, buses etc. This meter has provision to measure both speed and distance. One of the meters has km/h written. This is a **speedometer**. It gives the speed of the vehicle every instant in km/h. There is another meter also which measures the total distance covered by the vehicle in metre. This is called an **Odometer**.
7.3. DISTANCE – TIME GRAPH

Rajesh was travelling with his father in their car from Erode to Coimbatore. He kept himself busy by noting the distance travelled by the car every 5 minutes.

This is what he noted in the first 30 minutes.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Time in minutes</th>
<th>Distance in km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

You can make a graphical representation of his observations:

Follow these simple steps.

**Taking axes and scale:**

Take a graph sheet and draw two lines perpendicular to each other.

Mark the horizontal line as OX (x-axis) and the vertical line as OY (y-axis).

Time is taken on the X-axis and distance on the Y-axis.

Choose scales to represent distance and time.

For example, the scales could be

X-axis : 1 cm = 5 minutes
Y-axis : 1 cm = 5 km

**Plotting the graph:**

Mark the values on the axes for time and distance according to the scales you have chosen.

According to the values noted, mark the points on the graph sheet. Join the points. You will get a straight line.

For uniform speed, the distance time graph is always a straight line.

For variable speed, it could be of any shape.

Fig 7.5. Distance Time Graph
Three cars, A, B and C travel from Madurai to Salem. The time taken and the distance covered are given in the table below.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Time taken in hours</th>
<th>Distance travelled in km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Car A</td>
<td>Car B</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>100</td>
</tr>
</tbody>
</table>

Plot the distance-time graph for the three cars in the same graph sheet.

a) What do you infer?
b) Which car had the maximum speed?
7.4. VELOCITY

Every day when you go to school from your house, you could take path 1 or path 2 or path 3. Do these paths have the same distance? No, the distance is not the same; it varies with the path taken.

Imagine that you travel from your house to school in a straight line.

This will be the shortest distance among them, called displacement. In the picture, it is represented by a dotted line.

Displacement is the shortest distance between two points in a particular direction.

MORE TO KNOW

Anemometer is a device used for measuring wind speed. It has aluminium cups which turn on a spindle. As the wind speed increases the cups rotate faster.
Velocity is the displacement of a body in one second.

\[ \text{Velocity} = \frac{\text{Displacement}}{\text{Time Taken}} \]

Its unit is m/s.

Velocity is nothing but speed in a definite direction.

### 7.5. ACCELERATION

Do you ride a bicycle to school? If you are late, what would you do?

Obviously, you would pedal faster to reach school on time. In other words, you would increase your velocity or accelerate.

So, acceleration is the measure of change in velocity.

**Acceleration is the change of velocity in one second.**

\[ \text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken}} \]

Its unit is m/s².

If a car has an acceleration of 5 m/s² every second its velocity increases by 5 m/s.

If the velocity of a moving body decreases, we say that it has negative acceleration or retardation or deceleration.

**Example** : A train slows down to stop at a station.

**Acceleration due to gravity**

Let us see what happens when a ball is thrown up vertically?

As the ball rises, its velocity gradually decreases till it becomes zero i.e., the body is decelerated. When the ball falls down its velocity gradually increases i.e., it is accelerated.

The deceleration or acceleration is due to the earth’s gravitational force. It is known as acceleration due to gravity. It has an average value of 9.8 m/s² on the surface of the earth and is represented as g.

\[ g = 9.8 \text{m/s}^2 \]

This means that the velocity of a body decreases by 9.8 m/s every second when it is thrown up and the velocity increases by 9.8 m/s every second when it falls down.

**To Think**

A marble and a big stone are dropped simultaneously from a particular height. Which will reach the ground first?
7.6. SCIENCE TODAY - ADVENTURE SPORTS

Have you ever dreamed of flying like a bird or gazed up at flying birds and longed to join them.

1. Hang gliding

Hang-gliding is a sport in which a pilot flies a light un-motorized aircraft called a hang glider launched by foot.

Most modern hang-gliders are made of aluminium alloy. The pilot is safe when fastened to a harness suspended from the frame of the glider.

2. Paragliding

Paragliding is the latest aero sport. A paraglider is a non-motorised, foot launched inflatable wing, easy to transport, launch and land. It is basically a parachute made of special nylon or polyester fabric. The pilot is clipped to a harness in a comfortable sitting position. A paraglider is much lighter than a hang glider and easier to operate.

Yelagiri in Vellore district of Tamil Nadu is a hill station with gentle slopes ideal for paragliding. Tamil Nadu Tourism holds a paragliding festival at Yelagiri in August-September every year.
1. Selvi goes for a morning walk in the park near her house. She starts from point ‘A’, walks a circular path of radius 7m and returns to the same point ‘A’.

(i) What is her displacement?
(ii) Find the distance she has walked.

2. Mani and Shankar walk from their home to the market in 20 minutes, Mani takes path 1 while Shankar takes path 2.

(i) What are their speed?
(ii) What is their velocity?
(iii) What do you infer?

3. Raju is travelling in a train moving at a speed of 72 km/h. In order to stop the train, the driver decreases the speed. The rate of decrease in speed of the moving body is known as deceleration or retardation.

If the deceleration of the train is 10m/s², how much time will it take to come to a stop?
4. The given graph depicts the motion of a bus. Interpret the motion the bus.

![Graph](image)

a) AB represents ________
b) BC represents ________
c) CD represents ________

**PROJECTS**

1. Take a graph sheet. Draw a distance – time graph with the data given below.

<table>
<thead>
<tr>
<th>Time (minute)</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (km)</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

2. Conduct a race and find who is the fastest among your friends. Make 4 friends run a distance of 50 m one by one and note the time taken by each. Complete the given table.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the friend</th>
<th>Time taken (second)</th>
<th>Speed (m/s)</th>
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<tbody>
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<td>4.</td>
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</tbody>
</table>

**FURTHER REFERENCE**

**Books:**

1. Physics for higher Tier - Stephen people, Oxford University Press, New Delhi.


**Webliography:**

http://www.scencemadeeasy.com
‘I can, I did’
Student's Activity Record

Subject:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Date</th>
<th>Lesson No.</th>
<th>Topic of the Lesson</th>
<th>Activities</th>
<th>Remarks</th>
</tr>
</thead>
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</table>
Ravi visited the site of their newly built house. He asked his father how a house is constructed. His father explained that a house is made of sand, bricks, stones and cement. Ravi wondered what his body is made of.

When we compare the structural organization of a human body with that of a building, we see that we can more or less match:

- a cell with a brick
- tissues with bricks, mortar and iron rods
- organs with the walls
- an organism with the house
Children, let us know....

One of the striking features of all living things is their excellent organization. The human body is composed of special structures with specific forms and functions. All these structures work in co-ordination with one another.
1.1. STRUCTURE AND FUNCTIONS OF THE HUMAN ORGAN SYSTEMS

We have already learnt that our body is made up of many organ systems. There are about ten organ systems in our body.

Let us study about human organ systems in brief.

1. The Integumentary System

The Integumentary System includes the skin, hair, nails, sweat glands and oil glands.

Functions:
1. It protects the inner parts of the body.
2. It works as an excretory organ by way of sweating.
3. It acts as a sense organ.
4. It helps to produce Vitamin D.

2. The Digestive System

The digestive system consists of mouth, food pipe, stomach, liver, intestines and the secretory glands.

Functions:
1. Ingests and digests different types of food.
2. The digested food molecules are absorbed and distributed through the bloodstream.
3. The undigested food is egested as waste.

3. The Respiratory System

Respiration is essential for the survival of living organisms. It is a process in which food is broken down

MORE TO KNOW
The skin is the heaviest organ of our body and it weighs about 7 kg.

Raju was playing in the garden. He was pricked by a thorn. He was curious to know how we feel pain.

The Skin is a sense organ. It helps us to feel the pain.
into simpler forms with the help of oxygen and enzymes.

**Functions:**

1. Lungs procure oxygen from the surrounding and conduct it to the tissues through the bloodstream. (Inspiration)

2. Oxygen is used to combust the food and the carbon dioxide produced in this process is released into the surrounding through lungs. (Expiration)

**5. The Muscular System**

The Muscular System is made up of three types of muscles. They are skeletal muscles (striated muscle), smooth muscles (non-striated muscle) and cardiac muscles. Skeletal muscles are attached to the bones. Smooth muscles are found in the walls of blood vessels and in the lining of hollow organs such as stomach, intestines etc. Cardiac muscle is exclusively found in the heart.

**Functions:**

1. Skeletal muscles give shape to the body and make the movements of our body possible.
2. These muscles generate the heat required for maintaining our body temperature.
3. Other muscles enable movements in the internal organs.
The Circulatory System transports substances from one part of the body to another. It is made up of the heart and the blood vessels. The heart is the pumping organ. It pumps the blood into the blood vessels, which carry the blood to all parts of the body and bring it back to the heart.

**Functions**

2. It regulates the water level and the body temperature.

**MORE TO KNOW**

Our facial expressions are formed by the action of about forty muscles.

**6. The Circulatory System**

RBC contain red pigments called haemoglobin, which gives red colour to the blood.

**ACTIVITY 1.1**

**Aim:** To measure the pulse rate, per minute.

**Method:**
1. I measure my pulse by placing the index finger and the middle finger over the underside of the opposite wrist, below the base of the thumb.
2. I count the beat for 30 seconds.
3. Then I double the result to get the number of beats per minute.

The normal pulse rate is 72 / minute.

From the pulse rate, I shall know how my heart functions.
7. The Nervous System

The Nervous System is composed of the brain, the spinal cord and the nerves. The nervous system is divided into two types. They are the Central Nervous System (CNS) and the Peripheral Nervous System (PNS). There are five sense organs, which help us to know the outside world. They are eyes, nose, ears, tongue and skin.

The CNS consists of the brain and the spinal cord. The PNS consists of the cranial nerves and the spinal nerves.

8. The Endocrine System

A group of ductless glands in our body form a system called the Endocrine System. These glands secrete certain chemicals called hormones. These hormones are transported to the target organs through blood and regulate various functions of the body.

9. The Excretory System

The Excretory System helps in the elimination of wastes from our body. It comprises a pair of kidneys, a pair of ureters, a urinary bladder and urethra. The blood is filtered and the waste is separated to form urine, which is expelled periodically.

10. The Reproductive System

The Reproductive System is mainly composed of testes in males and ovaries in females. The testes produce male gametes called sperms. The ovaries produce female gametes called eggs. This system helps in producing new individuals for the survival of human race.

1.2. THE BODY AND ITS HEALTH AS UNDERSTOOD IN THE INDIAN SYSTEM OF HEALTH CARE

Health Care is prevention of illness and treatment for illness. Most of the rural people rely on two types of medicines. They are the Siddha and the Ayurveda systems of medicine.
Siddha system of medicine
(Tamil maruthuvam)

Siddha vaidhya is an indigenous traditional system originated in Tamilnadu. It has references from age-old literature such as ‘Thirumandiram’, ‘Thirukkural’ and ‘Tholkappiam’. The Siddha is a traditional Tamil system of medicine which is also practised in the neighbouring states of Kerala, Karnataka and Andhra pradesh. The Siddha Medical System was founded by a group of 18 spiritual people called Siddhars. The word ‘Siddhar’ is derived from “Siddhi” which means “Eternal Bliss”. Agastiyar, being the first Siddhar, is called the Father of Siddha Medicine.

The concept of the Siddhars is “FOOD IS MEDICINE, MEDICINE IS FOOD”. Diet and lifestyle play major roles in maintenance of good health and in curing diseases. The medicines are prepared from plants (mooligai), metals and minerals (dhatu) and animal products (jeeva). Around 1,200 herbs are used in the preparation of Siddha medicine. The concept of treatment is to treat the sick with leaves, and subsequently with roots of the herbs. If the severity of illness is not reduced, then they go for powders (paspam).

Some of the medicines used in Siddha are Chooranam, Mathirai, Thailam, Legiyam, Rasayanam, Paspam, Chendooram and so on.

Ayurveda

Ayurveda is a ‘System of healing using natural means’ (herbs). It which originated in India. ‘Ayurveda’ means the Science of Life (Ayur = Life, Veda = Science).

The object of Ayurveda is to counteract the imbalance of Vaatham, Pitham and Kabam which originate from the body. This system of healing is believed to treat the ailments of body, mind and spirit. The most amazing part of Ayurveda is that it includes almost all methods of healing like Yoga, Meditation, Purification and so on. In this system, herbs, massages, diet and exercises are used individually and collectively to cure a number of ailments.

ACTIVITY 1.2

Given below are names of some medicinal plants. I shall find out their medicinal uses.

<table>
<thead>
<tr>
<th>Name</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pepper (Milagu)</td>
<td></td>
</tr>
<tr>
<td>Turmeric (Manjal)</td>
<td></td>
</tr>
<tr>
<td>Garlic (Poondhu)</td>
<td></td>
</tr>
<tr>
<td>Thulasi</td>
<td></td>
</tr>
<tr>
<td>Neem (Vembhu)</td>
<td></td>
</tr>
<tr>
<td>Aloe vera (Katrazhai)</td>
<td></td>
</tr>
<tr>
<td>Mint (Pudhina)</td>
<td></td>
</tr>
</tbody>
</table>
MORE TO KNOW

Homeopathy Medicine

Homeopathy is a form of alternative medicine, first proposed by the German Physician Samuel Hahnemann, in 1796.

Unani Medicine

Unani Medicine is a form of traditional medicine based on the teachings of the Greek physician Hippocrates and the Roman physician Galen, and is developed into an elaborate medical system by the Arab and the Persian physicians.

1.3. DISEASES, DISORDERS AND PREVENTION

Valli :- Can we prevent diabetes?

Inba:- Yes. Diabetes can be prevented by practising healthy food habits and regular physical activity.

Valli:- Inba, what are healthy food habits?

Inba:- Healthy food habits are:

1. eating right amount of food and right type of food at regular intervals.
2. drinking 3 to 5 litres of water per day.
3. increasing intake of fibre rich foods like greens, leafy vegetables, whole grains and seasonal fruits.

Diabetes mellitus

The food that we eat is broken down into glucose. Glucose is a source of energy needed for all living beings. Insulin is a hormone secreted by pancreas to control glucose level. When the glucose level in blood exceeds the normal limit (80-120mg/dl), the person is said to be affected by Diabetes.

Diabetes is not a disease but a disorder. It may lead to harmful conditions like obesity, hypertension, heart ailments, etc., It is caused due to lack of physical activity, unhealthy food habits and lack of insulin.
1.3.1 ADVANTAGES OF PHYSICAL ACTIVITY

One evening, Chandra and Amara went to a park with their grandfather. The children became tired after playing for sometime. But they found their grandfather still walking briskly. Chandra asked her grandfather, how he could be so active. Grandfather replied that he had neither been to a hospital nor had he taken any medicine in his life. He added that his daily exercises had helped him keep his body fit.

Shall we find out the importance of physical exercises?

Physical exercise is essential for all human beings. Aerobic exercises supply oxygen efficiently to the muscles, heart, lungs and the circulatory system. A good supply of oxygen to the body is a sign of good health.

Some examples of aerobic exercises are:
1. Jogging
2. Playing basketball
3. Playing football
4. Swimming
5. Cycling
6. Brisk walking for a long distance
7. Yoga and aerobic dancing

These exercises can be followed daily.

Advantages of physical exercise

1. Exercise makes the muscles of the heart, lungs and various parts of the body strong. Children must be physically active for at least 60 minutes everyday.
2. It burns unwanted calories, reduces weight and prevents obesity.
3. It helps in lowering the blood glucose level.
4. It helps in reducing blood cholesterol level.
5. It reduces hypertension and improves the quality of life.

Fig 1.10  Aerobic Exercises
1.4. PRESERVATION OF FOOD

When milk or meat is left uncovered on a table for a day, it gets spoiled. But when rice or sugar is stored at room temperature, they do not get spoiled. Why? There are certain food items which get spoiled soon at room temperature due to the excess of moisture content in them. Such food items are called **perishable food**. eg. fruits, vegetables, milk, meat etc.

There are certain food items which do not get spoiled at room temperature as they are dry in nature. Such food items are called **non-perishable food**. eg. rice.

In order to avoid wastage of food from spoilage, food items are processed and preserved in different ways. The milk we get in sachets is an example. There are several methods of preserving food. Some are age-old methods and others are the results of modern development in science.

What is preservation of food?

The process of keeping the food for a long time without spoilage is called preservation of food.

**The Purpose of Food Preservation**

1. To prevent food from spoilage.
2. To retain the colour, taste and nutritive value of the food.
3. To make food available throughout the year.
4. To add variety to our meal.

1.4.1. METHODS OF PRESERVATION

Preservation involves prevention of the growth of bacteria, fungi and other microorganisms in the food.

Even the action of the enzymes within the food should be prevented. Some common methods of preserving food are: drying, freezing, heating, addition of salt or sugar. Some modern methods like irradiation is also used to preserve food. Let us study some of the common methods of food preservation.

**Drying**

This method involves the removal of water content from the food by drying. The harvested cereal grains are properly dried in the sun to reduce the moisture in them. This prevents the food from the attack of insects, fungi and bacteria.

**Heating**

Heating is a method of food preservation. It kills the microorganisms and denatures the enzymes present in the food. Hence food is stored safely. eg. boiling of milk before it is stored or used. Whenever we think of heating, the word ‘pasteurized milk’ comes to our mind. The process of heating milk
at a temperature of $70^\circ\text{C}$ to $75^\circ\text{C}$ for some time and immediately cooling is called **pasteurization**. This method was discovered by Louis Pasteur.

**Freezing**

Frozen food like meat and fish at very low temperature prevents water activity in the food material. Thus the microbial growth and enzyme activity can be prevented.

**Addition of salt:** When salt is added to food, it removes the water from food by osmosis. When there is no moisture in the food, microorganism and enzymes cannot act on the food. Food like meat, fish, gooseberry, lemon, tamarind, raw mangoes etc. are preserved by salting.

**Addition of sugar:** When sugar is added to food, sugar dissolves in the water content of the food and does not allow the water to be available. So, in the absence of water, microbes do not grow. Hence the food is preserved. Preservation of food by adding sugar not only saves the food from spoilage, but also produces new food such as jam, jelly, murrabbas, squash etc.

1.4.2 **FAST FOOD AND ITS ILL EFFECTS**

Fast food is liked by almost everyone today for many reasons. Fast food is easy and convenient to be cooked within a short time. Its taste and flavour is also appreciated by everyone. Food, today is no more home cooked wholesome food but processed with multiple additives.

Fast food, if eaten in large quantities on a regular basis can cause many ailments like obesity, diabetes, high blood pressure etc..

Fast food covers a wide range of products, like processed food, pre-prepared food like burgers, fries, vadai, samosa, bajjis etc. These food items are unhealthy and do not contain the nutrients and vitamins of a wholesome home-cooked meal.

They are low on the nutritional elements and hardly provide any benefit to the body. Food like pastas, pizzas,
burgers, noodles, bajjis, samosas etc. are high on the taste quotient.

Fast food, if consumed on a regular basis over a period of time, can have devastating effects on the overall health of an individual. Most families have a number of earning individuals, which leave them with no time or energy to do conventional cooking using fresh food ingredients.

**Negative effects of fast food**

1. Fast food item have a very high energy density. Food item with a high energy density confuse the brain's control system.

2. Continuous intake of fast food leads to weight gain and obesity. This is because fast food interferes with the normal appetite control systems.

3. The human appetite was designed for low energy density food and not for high energy density food.

4. Fast food may speed up the risk of clogged arteries, which may lead to heart attacks.

Fast food meals are high in saturated fats, low quality carbohydrates and high salt content. Our body requires fibre and healthier saturated fats. Fast food represents a dietary pattern that is the opposite of what is recommended for a healthy body.

“Fast food can be delicious but it is a silent killer”.

1.5. **SCIENCETODAY-IRRADIATED FOOD PRESERVATION**

Heating, drying, pickling, cold storage are some traditional methods of preserving food. But, nowadays, food can be preserved by some modern methods like irradiation - a process by which food is exposed to X-rays, Gamma rays or Ultraviolet rays. These rays are powerful enough to kill the bacteria and the moulds.

Will irradiation destroy the taste and nutritional value of the food? No, Irradiation does not destroy the taste or nutritive value of foods. Onions, potatoes, sprouted grams etc. remain fresh, when exposed to radiation.

Some people are of the opinion that irradiation may lead to formation of toxic substances, but it is not so.
1. Pick out the correct answer:
   a) The skeletal system is made up ________ bones.
      i) 206
      ii) 306
      iii) 606
   b) The muscle found exclusively in the heart is ________
      i) skeletal muscle
      ii) cardiac muscle
      iii) smooth muscle
   c) The endocrine glands secrete chemicals called ________
      i) Enzymes
      ii) Vitamins
      iii) Hormones
   d) ________ is an ancient system of natural medical healing that originated in India.
      i) Siddha
      ii) Ayurveda
      iii) Unani
   e) Pasteurization method was discovered by ________.
      i) Hippocrates
      ii) Louis Pasteur
      iii) Agastiyar

2. The following words are the various levels of organization in living organisms. Arrange them in correct sequence:
   Atoms, Cells, Organs, Organelles, Tissues, Organism, Molecule, Organ system.

3. Observe the given table with a set of organs in column A. In each set, there is an odd organ. Pick the odd one out and write it in column B. In column C, write the system to which the remaining three belong.
S.No. | A                      | B          | C                  |
-------|------------------------|------------|--------------------|
1.     | saliva, bones, liver, pancreas | bones     | digestive system   |
2.     | skin, hair, nail, tooth   |            |                    |
3.     | arteries, veins, fingers, capillaries |      |                    |
4.     | brain, spinal cord, nerves, kidneys |      |                    |

4. Match the following:

a) Drying        | Jam
b) Boiling       | Fish
c) Addition of sugar | Silent killer
d) Freezing      | Dry cereals
e) Fast food    | Milk

5. Write any two functions of each of the following:

i) Kidney
(1)____________________________________
(2)____________________________________

ii) Bone
(1)____________________________________
(2)____________________________________

iii) Skin
(1)____________________________________
(2)____________________________________

iv) Blood
(1)____________________________________
(2)____________________________________

6. What happens when :-

i) You eat fast food.
__________________________________________________________

ii) Your blood glucose level exceeds 120mg/dl.
__________________________________________________________
7. Diet and lifestyle play a major role in preventing sickness and keeping us healthy. Write down any 3 things that you will do and any 3 you will not do to maintain good health.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>I will do</th>
<th>I will not do</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>exercise daily</td>
<td>eat fast food</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Ravi is obese and overweight. His glucose level is also high. His mother seeks the advice of a doctor. The doctor suggests a daily activity programme. What could be the suggested activities?

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

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Places of scientific importance for visit

GASS FOREST MUSEUM - Coimbatore.
Chandru, Murugan and their friends were playing football in the playground. After they finished playing, they felt tired and were breathing harder and faster. Let’s now know and understand how we breathe and why we breathe harder, after running or playing.
2.1. NEED FOR RESPIRATION

Living things need energy to do any kind of work. They stop doing work, when their energy levels drop. Our body needs energy to carry out all its activities. Even when we are idle, certain organs of our body, such as the heart, brain, kidneys and lungs keep working. Hence, our body needs energy all the 24 hours.

Where do we get energy from? We eat food. Food contains energy. The food is broken into simpler forms in the alimentary canal. They are then absorbed by the small intestine and carried by the blood to all parts of the body. The energy supply of food is of no use until it is released from the food.

Why do your parents insist that you should eat food regularly? We get energy from food. Energy is released from the food during respiration. So, respiration is a vital process in living organisms.

When we breathe, oxygen is transported to the lungs and gets mixed with blood. The oxygen-mixed blood flows to all parts of the body and finally to all the cells. When oxygen combines with the food in cells, oxidation (burning) of food takes place. During this process, energy is released along with water and carbon dioxide as waste. The process of oxidation of food to release energy along with water and carbon dioxide as wastes in living cells is called respiration or cellular respiration.

ACTIVITY 2.1  I DO
Let me now sit quietly and count how many times I breathe per minute. (The average breathing rate is 16 to 18 times per minute)

Types of respiration

Respiration is of two types: (a) Aerobic respiration and (b) Anaerobic respiration. Most of the living organisms use oxygen to break up the food in order to get energy. So, the respiration that requires usage of oxygen is called aerobic respiration. It is represented by the equation below:

\[
\text{Glucose} + \text{Oxygen} \rightarrow \text{Carbon dioxide} + \text{Water} + \text{Energy}
\]

Anaerobic respiration

Some microorganisms like yeast and bacteria obtain energy from food in the absence of oxygen. So, the respiration that takes place in the absence of free oxygen is called anaerobic respiration. Anaerobic respiration takes place in our skeletal muscles.

\[
\text{Glucose} \rightarrow \text{absence of Oxygen} \rightarrow \text{Ethyl alcohol} + \text{Carbon dioxide} + \text{Energy}.
\]

MORE TO KNOW

Bacteria and fungi can respire anaerobically, which is useful in converting sugar into alcohol. Alcohol, on one hand can be bad for the society. On the other hand, it can be used as a fuel. Yeast is a one-celled fungus and respires anaerobically to produce alcohol. Therefore, it is used in making wine and brewing beer.
**ACTIVITY 2.2**

We’ll find out how many times your friends breathe, per minute.

<table>
<thead>
<tr>
<th>Name of your friend</th>
<th>Normal</th>
<th>Brisk walk</th>
<th>Running</th>
<th>At rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Differences between breathing and respiration**

<table>
<thead>
<tr>
<th>Breathing</th>
<th>Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is a physical process because only the air moves from one place to another.</td>
<td>1. It is a chemical process because the food undergoes chemical changes.</td>
</tr>
<tr>
<td>2. Energy is not released.</td>
<td>2. Energy is released.</td>
</tr>
<tr>
<td>3. It takes place in breathing organs.</td>
<td>3. It takes place in living cells.</td>
</tr>
</tbody>
</table>

Respiration is the process of burning food with the help of oxygen to release energy. Then, what is the difference between the burning of food in cells and burning of wood?

<table>
<thead>
<tr>
<th>Respiration</th>
<th>Burning of wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It takes place in living cells.</td>
<td>1. It takes place outside.</td>
</tr>
<tr>
<td>2. Heat energy is liberated.</td>
<td>2. Heat and light energy are liberated.</td>
</tr>
<tr>
<td>3. Energy is released step by step in small quantities.</td>
<td>3. Energy is released all of a sudden in a large quantity.</td>
</tr>
</tbody>
</table>

You have learnt about photosynthesis. Can you distinguish respiration from photosynthesis?

<table>
<thead>
<tr>
<th>Respiration</th>
<th>Photosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It takes place during day and night.</td>
<td>1. It takes place only during day time.</td>
</tr>
<tr>
<td>2. All living organisms respire.</td>
<td>2. Only green plants prepare food through photosynthesis.</td>
</tr>
<tr>
<td>3. Food is consumed.</td>
<td>3. Food is synthesized.</td>
</tr>
<tr>
<td>4. During this process oxygen is taken in and carbon dioxide is given out.</td>
<td>4. During this process, carbon dioxide is taken in and oxygen is given out.</td>
</tr>
</tbody>
</table>

**2.2. RESPIRATION IN MAN:**

The human respiratory system consists of nose, nasal cavity, trachea, bronchi and lungs. The lungs are present in the chest cavity. We have muscles in our chest that help us breathe. Some are fixed to our ribs and make the ribcage move in and out. Below the lungs is a strong, flat sheet of muscle called the diaphragm.
Our nose has two openings called nostrils. Nostrils lead to nasal cavity which in turn leads to trachea (wind pipe). The trachea divides into two branches called bronchi. (singular – bronchus). Each bronchus enters the lungs and divides into small tubes called bronchioles. The bronchioles end up in air sacs called alveoli. (singular – alveolus).

The walls of alveoli are supplied with thin blood vessels called capillaries which carry blood in them. Oxygen from the lungs enters the blood and carbon dioxide from the blood reaches the lungs in the regions of alveoli.

How do we breathe?

Breathing involves both inhalation and exhalation. It is a continuous process which takes place all the time and throughout the lifespan of organisms. The number of times a man breathes in a minute is called the breathing rate.

As we breathe in, the diaphragm moves down and ribs move up and expands. This movement increases the space in our chest cavity.

Then the air, rich in oxygen rushes into our lungs from outside through the route given below:

Nose → Nasal Cavity → Trachea → Bronchi → Bronchiole → Alveoli
As we breathe out, the diaphragm moves up to its original position and the ribs move down. This reduces the size of the chest cavity and air is pushed out of the lungs through bronchi, trachea and nose.

**ACTIVITY 2.3**

- **Aim**: To verify that exhaled air contains more amount of carbon di oxide.
- **I Need**: Two transparent glasses with cover, one straw and limewater.
- **Method**: i) I fill both the glasses with limewater and cover them. I make a hole on the cover of one cup.

  ii) I insert the straw and blow some air into the first glass alone. Observe the changes.

  The limewater in the first glass turns more milky than that in the second glass.

  Carbon di oxide has the property of turning limewater, milky. So the limewater in the first glass turns milky. From this observation, I conclude that the exhaled air contains more amount of carbon di oxide.

**MORE TO KNOW**

Shall we find out why we sneeze?

We sneeze when foreign particles such as dust or pollen enter and irritate the nasal cavity. A sneeze expels unwanted and harmful particles from the nasal cavity.
Exchange of gases

When oxygen-rich air reaches the alveoli, oxygen is absorbed by the blood and it combines with the haemoglobin. It is then carried as oxyhaemoglobin to all cells of the body. In the cells, oxygen is used for oxidation of food to release energy along with water and carbon dioxide. This carbon dioxide is absorbed by the blood and is transported to the lungs, where it is exhaled.

![Fig 2.3 Structure of alveoli](image)

**ACTIVITY 2.4**

**WE OBSERVE**

Let us take a wide plastic bottle. Remove the bottom. Get a Y-shaped glass tube. Make a hole in the lid so that the tube may pass through it. To the forked end of the tube, fix deflated balloons. Introduce the tube into the bottle. To the open base of the bottle, tie a thin rubber or plastic sheet. When the plastic sheet is pulled, air from outside rushes into the balloon to inflate them. When the sheet is pushed to its original place, the volume inside the bell jar gets reduced and the air in the balloon is sent out. This shows the breathing mechanism.
MORE TO KNOW

- Air pollution causes many respiratory disorders.
- Smoking can cause lung cancer.
- Sound (voice from voice box) is the useful byproduct of the respiratory system.

2.3. RESPIRATION IN ANIMALS

Like human beings, animals and plants also breathe and respire. The basic process of respiration is the same in all organisms. Let us study the structures of some animals and how they enable them to respire.

(a) In unicellular and smaller multicellular animals, all the cells take in oxygen from the surrounding air or water and give out carbon dioxide by diffusion.

**eg. Amoeba, Paramecium**

(b) Creatures like the earthworm and the leech respire through their skin, which is moist and slimy.

(c) In insects, there are several small openings called spiracles on the lateral side of their bodies. These spiracles lead to air tubes called trachea. Exchange of gases takes place through spiracles into trachea.

(d) Fishes have special organs called gills, which are used to absorb oxygen dissolved in water.

(e) Animals like reptiles, birds and mammals have lungs for breathing.

(f) Animals such as frogs respire through their skin and lungs.
2.4. RESPIRATION IN PLANTS

Like other living organisms, plants also respire to get energy from food. Generally, plants do not have any special organ for breathing. They do not show breathing movements like that of animals.

Plants breathe through tiny pores in the leaves called stomata. Oxygen from the air diffuses into the leaves and carbon dioxide from the leaves diffuses out through stomata. Stems have minute openings on their surfaces. These openings help in the exchange of gases. Roots also respire independently. Roots draw in air from the air spaces present between the soil particles. Thus, all parts of the plant like the root, stem and leaf respire independently. Aquatic plants directly exchange gases with the water that surrounds their leaves, roots and stems.

The process of photosynthesis in plants takes place during the day. During this process, carbon-di-oxide is used and oxygen is released.

A part of the oxygen released during photosynthesis is used by the plants for respiration and the rest is sent out through the stomata. Carbon dioxide released during respiration is used up by the plant for photosynthesis. During the night, photosynthesis does not take place.

The carbon dioxide that is released as a result of respiration is sent out through the stomata into the atmosphere. The oxygen in the atmosphere is taken in and used for respiration.

**Types of Respiration**

Respiration is of two types depending upon the presence or absence of oxygen.

1) Anaerobic respiration and
2) Aerobic respiration.

In lower organisms like the yeast and the bacteria, anaerobic respiration takes place.

In higher organisms like plants, aerobic respiration takes place.

MORE TO KNOW

Plants take in $O_2$ and give out $CO_2$ during respiration. They take in $CO_2$ and give out $O_2$ during photosynthesis. They are two contrasting and yet complementary processes.
EVALUATION

1. Match the animals with their organs of respiration.

<table>
<thead>
<tr>
<th>ANIMALS</th>
<th>ORGANS OF RESPIRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Cockroach</td>
<td>Gills</td>
</tr>
<tr>
<td>b) Frog</td>
<td>Lungs</td>
</tr>
<tr>
<td>c) Fish</td>
<td>Lungs and skin</td>
</tr>
<tr>
<td>d) Earthworm</td>
<td>Spiracles</td>
</tr>
<tr>
<td>e) Dog</td>
<td>Skin</td>
</tr>
</tbody>
</table>

2. Arrange the following parts of the Respiratory System in order:
   trachea, nose, alveoli, bronchi, nasal cavity, bronchiole.

3. The diagram of the Respiratory System of man is given here.
   Label the following parts in it.
   nose, trachea, bronchi, lungs, bronchiole.

4. Pick out the correct answers:
   a) The clean air we breathe is rich in ___________. (oxygen / carbon dioxide)
   b) Respiration that takes place in the absence of oxygen is called ___________.
      (aerobic / anaerobic) respiration.
   c) Plants breathe through tiny pores in the leaves called ___________.
      (trachea / stomata)

5. Fill up the missing words in the equation given below.
   a) _________ + Oxygen → _________ + _________ + Energy
   b) Glucose → _________ + Carbon dioxide + _________

6. Name the organs of respiration in the:
   i) Amoeba _________ ii) Fish _________ iii) Frog _________

7. Photosynthesis takes place only during day time. Respiration takes place all the time.
   i) Write down the names of gases exchanged during these processes.
   ii) How does the exchange of gases take place in a leaf?

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Everyday we notice a variety of changes that takes place around us. These changes may involve one or more substances. For example, ice melts, water evaporates, sugar dissolves in water and milk turns into curd. A change occurs in all these instances. ‘A rubber band that is stretched’ also represents a change since the action causes the change. Changes in matter occur under certain conditions. In this chapter, we shall perform some activities and closely examine the nature of these changes. The changes that take place around us are of two types:

1. Physical changes
2. Chemical changes

### 3.1. PHYSICAL CHANGES

#### ACTIVITY 3.1

**I need:** A small stick.

Let me break the stick into two pieces and shall find out the change that happen. I break a stick into two pieces. I keep the pieces on a table in such a way that the pieces acquire the shape of the original stick. Obviously, I cannot join the broken pieces together to obtain the original stick. It is because the stick has undergone a change in the size (physical appearance), but no change has taken place in the chemical composition. Hence I conclude, it is just a physical change that has taken place.

![Fig. 3.1. Broken Stick](image)

#### ACTIVITY 3.2

**I need:** A sheet of paper, A pair of scissors.

Now, let me cut a paper into small pieces and see what change it undergoes.

I cut a sheet of paper into four square pieces.

Further, I cut each square piece into four square pieces.

Then I lay the pieces on a table in order to get the original shape back.

The original paper has undergone a change only in size (physical appearance), and not in chemical composition. It is only a physical change that has occurred.

Do you know that the melting of an ice stick is an example of physical change?

![Fig. 3.2. Melting of ice stick](image)
MATTER AND ITS NATURE

ACTIVITY 3.3

I DO

I need: Magnet, tray, sand, iron fillings.

Does sand react with iron fillings to form a new chemical substance? Let us find out what happens by doing an activity. I take some sand and iron fillings in a tray and mix them well. I notice that no new substance is formed. I move a magnet over the mixture. The fillings are easily attracted by the magnet, while the sand remains on the tray. Since, no new substance has been formed, it is a physical change that has taken place.

We found that no change had taken place in the chemical composition and no new product was formed. Only a physical change had taken place in all the cases. From this we understand that a physical change does not involve the formation of any new substance and it is readily reversible.

ACTIVITY 3.4

CRISTALLIZATION

AIM: To show that crystallization is a physical change.

We need: China dish, Funnel, Conical Flask, Tripod stand, Wire gauze, Burette stand, Funnel holder, Sulphuric acid, Copper sulphate, Filter paper and Bunsen burner.

Procedure:

➔ Take a little amount of water in a china dish.

➔ Add sufficient amount of copper sulphate crystals to get a saturated solution. Add a few drops of acid (Sulphuric acid- H₂SO₄) to this solution.

➔ Heat the solution till the crystals are completely dissolved. Allow the solution to cool and then filter it.

➔ Continue to cool the filtered solution for some more time, without disturbing it. After sometime, crystals are formed in the solution.
From this activity we observe that the copper sulphate crystals that we dissolved in water have turned into crystals again. Therefore, dissolution of copper sulphate is a physical change. We also observe that the newly formed crystals have definite geometrical shape and size. Thus crystals of pure substance can be obtained from their solution. This process of crystal formation is known as **crystallization**.

**ACTIVITY 3.5 WE OBSERVE**

**SUBLIMATION**

**Aim:** To show that sublimation is a physical change.

**We need:** Camphor, China dish, Funnel, Tripod stand, Wire guaze, Bunsen burner.

**Procedure:**

- Take a small amount of camphor in a china dish.
- Invert a funnel over the dish.
- Close the stem of the funnel with a cotton plug. On heating it gently, camphor is converted into vapour. The vapour of camphor gets condensed on the walls of the funnel.

From this activity, we observed that the camphor first got vapourised, but it was deposited back as camphor on the sides of the funnel. Also, the chemical composition of camphor had not changed and the reaction was reversible. Therefore, we understand that heating of camphor is a physical change.

The process of converting a solid directly into its gaseous state is known as **sublimation**.

**TO THINK...**

When electric current is passed through the filament of a bulb, the filament starts glowing and there is a change in the appearance of the filament. When the current is cut OFF, the bulb stops glowing and its original appearance is restored. Do you think the burning of electric bulb is a physical change?
**Aim:**

To show that the change of state is a physical change.

**We need**

Beaker, Ice cubes, Bunsen burner, Tripod stand, Plate.

**Procedure:**

- Take some ice cubes in a beaker and place it on a tripod stand and heat it with the help of a burner. What do you observe? Ice melts to form water.
- Can we change this water into ice again? **Suggest a method for it.**
- Take some water in a beaker and boil it. What do you observe?
- You can observe the water evaporating into water vapour.
- Cover the beaker with an inverted plate.
- Do you notice some water droplets condense on the inner surface of the plate and fall into the beaker?
- Can we change this water into ice again?
From this activity, we see that

- On heating, water changes from solid state (ice) into liquid state (water) and from liquid into gas (vapour) and then gas changes into a liquid. Water (liquid) can be changed into a solid (ice), again when it is frozen.
- In all these changing processes, the chemical composition of water does not alter. Therefore, this is a physical change. Solids change into liquids on heating. This process is called melting.

Liquids change to gas on heating. This process is called evaporation.

The vapour, when allowed to cool, condenses into its liquid state. This process is called condensation.

Water, when cooled to zero degrees, changes into ice. This process is called freezing.

In all the above activities, the changes take place only in the physical properties of a substance, such as shape, size, colour and temperature. A physical change occurs when the substance changes its physical state but does not change its chemical composition. A change in which a substance undergoes changes only in its physical properties is called a physical change. A physical change is generally reversible and no new substance is formed.

3.2. CHEMICAL CHANGES:

You are quite familiar with the rusting of iron. If you leave an iron object such as bolt or iron rod in the open air or in the rain, a reddish brown layer is deposited on its surface. The layer thus formed is called rust and the process is called rusting.

In the presence of moisture, iron reacts with oxygen present in air to form hydrated ‘iron oxide’ known as rust. Oxygen and water are two essential ingredients for the rusting of iron.
ACTIVITY 3.7

Aim: To show that both oxygen and water are essential for rusting.

We need: test tube, iron nail, oil, calcium chloride, cork

Procedure:

- Take three test tubes and label them 1, 2 & 3.
- Place a clean iron nail in each of them.
- In test tube-1, pour a small amount of tap water.
- In test tube-2, add boiled and distilled water and add some vegetable oil to keep off the air.
- In test tube-3, add a small amount of calcium chloride (a dehydrating agent).
- Keep them undisturbed for three to four days and observe the nails in each of the test tubes.

WE OBSERVE

We notice that the nails in test tube-2 and 3 have not rusted, while the nail in test tube-1 has rusted. From this activity, you can infer that both oxygen and water are essential for rusting.

Rust is a brittle substance that flakes off easily from the surface. Rust is different from the iron on which it gets deposited. It means a new substance has formed.

MORE TO KNOW

Burning of a candle is an example of a chemical change. Wax molecule is converted into carbon dioxide and water molecules.
ACTIVITY 3.8

Aim:
To show that the burning of magnesium ribbon is a chemical change.

We need:
Magnesium ribbon, bunsen burner, holder.

Procedure:
Take a fine strip of magnesium ribbon. Bring the tip of the strip near a candle flame. It burns with a brilliant white light and finally leaves behind a residue of powdered ash.

Does the ash look like the magnesium ribbon?
No, we cannot get it back. Can we get the magnesium ribbon back from the ash?
No, we cannot recover the magnesium ribbon from the ash.

In this experiment a new compound is formed whose chemical composition is different from that of magnesium. This is a chemical change.

MORE TO KNOW

Phenolic compounds are responsible for the bright colours, aroma and flavour of many fruits and vegetables. They reduce the risk of heart disease and certain types of cancer.

MORE TO KNOW

Vegetables and fruits turn brown on cutting. It is due to the reaction between the phenolic compound in fruits and the oxygen in air. Phenolic compound and oxygen react to form a brown pigment known as melanin.

TOTHINK...

During Diwali, we enjoy lighting firecrackers with our family members. The combination of colour and sound creates an exciting light show and we have a spectacular display. Do you ever think, what happens to the crackers after they are burnt completely? Similarly, burning of paper or wood produces heat and light and finally you get a small amount of ash, (i.e.) a new substance is formed. In all these cases, we cannot get back the original substances. Say what change has taken place here.
ACTIVITY 3.9

**Aim:** To show that the reaction of baking soda with lemon juice is a chemical change.

**We need:** lemon juice, baking soda, test tube, test tube holder.

**Procedure:**
Take a teaspoonful of lemon juice (citric acid) in a test tube. Add a pinch of baking soda to it.

We would hear a hissing sound and see gas bubbles coming out.

The gas that is formed is carbon dioxide.

Lemon juice (citric acid) + Baking soda → Carbon dioxide + Salt + Water

The sound produced is due to the evolution of gas (carbon dioxide) in this reaction. It is a chemical change.

ACTIVITY 3.10

**Curdling of Milk:**

**Aim:** To show that curdling is a chemical change.

**We need:** Milk, buttermilk (or) curd.

**Procedure:**
- Boil the milk and cool it to lukewarm temperature
- Add a teaspoon of buttermilk or curd starter into it. Keep it aside for a few hours.

Do you notice any change?

The milk has changed into curd. As both milk and curd have different properties, a chemical change has occurred.

Find out what happens if excess of buttermilk or curd starter is added?

What happens if buttermilk or curd starter is added to milk at a very high temperature?

Will the curd set faster when it is placed outside or inside the refrigerator?

When a large quantity of starter buttermilk / curd is used, What happens to the taste of the curd? Find out the reason for your answer.

In all the above activities, you can see that one or more new substances are formed. The properties of the new substances are not the same as that of the original ones. These processes are also irreversible. This type of change is called a chemical change. Any change that results in the formation of one or more new substances is called a chemical change. A complete and permanent change in the properties of the substance is produced in the process. A chemical change is also referred to as a chemical reaction.
Chemical changes are very important in our day-to-day life. A medicine is a product of chemical reaction. Useful materials like plastic, detergents, dyes and paints are also produced by chemical reactions.

In addition to the new products formed, the following may also accompany a chemical change.

- Heat or light may be given off or absorbed
- Sound may be produced
- Colour change may occur.
- A change in smell may take place.

**AMAZING FACT!**

**Iron Pillar**

In New Delhi, near Qutub Minar, stands an iron pillar which is more than 7 meters tall and weighs more than 6000 kg. It was built 1,600 years ago. Strangely, even after such a long period of time, it has not rusted. Scientists from all over the world have examined its quality of rust resistance. It shows the advancement India had made in metallurgy technology as far back as 1600 years ago.

If you have any object made of silver you know that the bright, shiny surface of silver gradually darkens and becomes dull. This discolouration is known as tarnishing. Look at the picture of two silver spoons ‘A’ and ‘B’. ‘A’ shines well but ‘B’ does not. What happens? Why does this discolouration occur? This happens because silver undergoes a reaction with sulphur contained in the air. You can use chemistry to reverse the tarnishing reaction, and make the silver shine again.

You know that ships are made of iron. A part of the ship always remains under water. Since seawater contains a great amount of salt, the ship suffers a lot of damage from rusting inspite of being painted. These rusted parts need to be replaced every now and then. Imagine the loss of money incurred this way!
### 3.2.1. DIFFERENCES BETWEEN PHYSICAL CHANGE AND CHEMICAL CHANGE

**Table 3.1**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Physical change</th>
<th>Chemical change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The physical changes are reversible.</td>
<td>The chemical changes are irreversible.</td>
</tr>
<tr>
<td>2</td>
<td>New substances are not formed.</td>
<td>New substances are formed.</td>
</tr>
<tr>
<td>3</td>
<td>The molecular composition of the substance remains the same.</td>
<td>The molecular composition of the substance changes.</td>
</tr>
<tr>
<td>4</td>
<td>No energy change is involved.</td>
<td>Energy change is involved.</td>
</tr>
<tr>
<td>5</td>
<td>Temporary change.</td>
<td>Permanent change.</td>
</tr>
</tbody>
</table>

#### MORE TO KNOW

Rusting of metals can be prevented by:

1. Applying oil, paint or grease.
2. Galvanisation (deposition of zinc over iron)
3. Chrome plating (deposition of chromium over iron)
4. Tinning (coating of tin over iron)

---

Fig. 3.18 - Painted Window
3.3. ACIDS, BASES AND SALTS

On Sunday, Keerthivasan’s mother boiled an egg for his lunch. Since it was very hot, she took a bottle of water from the fridge, poured some into a bowl and put the egg in it to cool. She went to the market and forgot all about the egg. When she came back and took the egg out of water, she was surprised to find that the hard shell of the egg had disappeared. She wondered what happened. She smelt the liquid and realized her mistake. She had poured vinegar into the bowl, instead of water. Can you say what would have happened? Perhaps you can do it at home with the help of your mother.

In our daily life, we use substances such as lemon, tamarind, tomato, common salt, sugar and vinegar. Do they all have the same taste? If you have not tasted any of these substances, taste it now and enter the result in table 3.2

<table>
<thead>
<tr>
<th>Substance</th>
<th>Taste (sweet/sour/bitter/saline/any other)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curd</td>
<td></td>
</tr>
<tr>
<td>Orange juice</td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td></td>
</tr>
<tr>
<td>Lemon Juice</td>
<td></td>
</tr>
<tr>
<td>Tamarind</td>
<td></td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
</tr>
<tr>
<td>Unripe Mango</td>
<td></td>
</tr>
<tr>
<td>Gooseberry (Nelli)</td>
<td></td>
</tr>
<tr>
<td>Baking soda</td>
<td></td>
</tr>
<tr>
<td>Vinegar</td>
<td></td>
</tr>
<tr>
<td>Common salt</td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td></td>
</tr>
</tbody>
</table>

CAUTION!

1. Do not taste anything, unless you are asked to.
2. Do not touch anything, unless you are asked to.
3.3.1 ACIDS, BASES AND SALTS USED IN OUR DAILY LIFE

During summer, when your grandmother prepares pickles (lime, mango, etc.), she adds vinegar to them. Did you ever ask her why she does that? If not, ask her now and find out the reason.

Curd, lemon juice, orange juice and vinegar taste sour. These substances taste sour because they contain acids. The chemical nature of such substances is acidic. The word ‘acid’ comes from the Latin word ‘acidus’ which means sour. We come across many acids in our daily life.

In general, acids are chemical substances which contain replaceable hydrogen atoms. Acids can be classified into two categories namely organic acids and mineral acids or inorganic acids.

**Organic acids**

Acids which are obtained from animal and plant materials are called organic acids. Many such acids are found in nature. Lemon and orange contain citric acid. Hence they are called citrus fruits. Milk that has turned to curd tastes sour. It contains an acid called Lactic acid. The acids found in food stuffs are weak. Soft drinks contain some carbonic acid which gives a tingling taste. Apple contains malic acid. Some common organic acids are shown in Fig.3.19.

![Fig. 3.19. Acids and their sources](image)
Mineral acids

Acids that are obtained from minerals are called mineral acids or inorganic acids. For example, Hydrochloric acid, Nitric acid, Sulphuric acid (Fig. 3.20) which are commonly available in the laboratory must be handled with a lot of care. They are corrosive. It means that they can eat away metal, skin and clothes. But they cannot corrode glass and ceramic. Hence they are stored in glass bottles.

An acid is a substance which contains replaceable hydrogen ions.

Find out...

Observe how copper and brass vessels are washed in your house. Why is tamarind used for washing them?

Bases and alkalies in our daily life

Substances such as baking soda does not taste sour. It is bitter in taste. It shows that it has no acid in it. If you rub its solution with your fingers, it is soapy. Substances like these which are bitter in taste and are soapy to touch are known as bases. The nature of such substances is said to be basic. Bases are oxides or hydroxides of metals. They are chemically opposite to acids. Some bases like caustic soda [Sodium hydroxide] and caustic potash [Potassium hydroxide] are very corrosive.

Bases give hydroxyl ions when treated with water. Bases which are soluble in water are called Alkalies. The hydroxides of Sodium and Potassium are examples of alkalies. They are water soluble bases. All alkalies are bases, but not all bases are alkalies. The word ‘alkali’ is derived from the Arabic word ‘alquili’ which means plant ashes. Ashes of plants are composed mainly of sodium and potassium carbonates.

Some common bases used in our daily life are given in Table 3.3.

CAUTION!

Never taste or touch any unknown chemical.
Table 3.3

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Other Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quicklime</td>
<td>Calcium oxide</td>
</tr>
<tr>
<td>2</td>
<td>Potassium hydroxide</td>
<td>Caustic potash</td>
</tr>
<tr>
<td>3</td>
<td>Calcium hydroxide</td>
<td>Slaked lime</td>
</tr>
<tr>
<td>4</td>
<td>Sodium hydroxide</td>
<td>Caustic soda</td>
</tr>
<tr>
<td>5</td>
<td>Magnesium hydroxide</td>
<td>Milk of magnesia</td>
</tr>
</tbody>
</table>

Table 3.4

<table>
<thead>
<tr>
<th>Name of Base</th>
<th>Found in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium hydroxide</td>
<td>Lime water</td>
</tr>
<tr>
<td>Ammonium hydroxide</td>
<td>Window cleaner</td>
</tr>
<tr>
<td>Sodium hydroxide/ Potassium hydroxide</td>
<td>Soap</td>
</tr>
<tr>
<td>Magnesium hydroxide</td>
<td>Antacid</td>
</tr>
</tbody>
</table>

Test for identifying acids and bases

We should never touch or taste a substance to find out whether it is an acid or base because, both acids and bases are harmful and will burn the skin. A safe way to find it out is to use an indicator. Indicators are a group of compounds that change colour, when added to solutions containing either acidic or basic substances. The common indicators used in the laboratory are litmus, methyl orange and phenolphthalein. Apart from these, there are some natural indicators like turmeric, red cabbage juice and beetroot juice.

Table 3.5

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Colour in Acid</th>
<th>Colour in base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litmus</td>
<td>Red</td>
<td>Blue</td>
</tr>
<tr>
<td>Phenolphthalein</td>
<td>Colourless</td>
<td>Pink</td>
</tr>
<tr>
<td>Turmeric powder</td>
<td>Yellow</td>
<td>Brick red</td>
</tr>
<tr>
<td>Beetroot juice</td>
<td>Pink</td>
<td>Pale yellow</td>
</tr>
<tr>
<td>Red cabbage juice</td>
<td>Pink/Red</td>
<td>Green</td>
</tr>
</tbody>
</table>
3.3.2. NATURAL INDICATORS

Litmus: A natural dye

The most commonly used natural indicator is litmus. It is extracted from lichens (Fig. 3.21) and it has a purple colour when put in distilled water. When added to an acidic solution, it turns red and when added to a basic solution, it turns blue. It is available in the form of solution or in the form of strips of paper known as litmus paper. Generally, it is available as red and blue litmus paper.

![Fig. 3.21. Lichens](image)

![Fig. 3.22. Red litmus paper dipped in Base solution changes to blue](image)

![Fig. 3.23. Blue litmus paper dipped in Acid solution changes to red](image)

**ACTIVITY 3.11**

**Aim:** To find out the nature of solution using litmus paper.

**We need:** Test solutions, Litmus paper, Test tube, Test tube stand.

**Procedure:** Add some water to orange juice in a test tube. Put a drop of the above solution on a strip of the red litmus paper with the help of a dropper. Is there any change in colour? Repeat the same exercise with the blue litmus paper.

Note down the change in colour. Perform the same activity with the following substances, and tabulate the results. If the solution does not change its colour to either red or blue on litmus paper, they are neutral solutions. These solutions are neither acidic nor basic. e.g. Distilled water.
Table 3.6

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Test solution</th>
<th>Effect on red litmus paper</th>
<th>Effect on blue litmus paper</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tap water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Detergent solution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Shampoo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Common salt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sugar solution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lime water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Washing soda solution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Vinegar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Milk of Magnesia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Aerated drink</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Turmeric as a natural indicator

**ACTIVITY 3.12**

**Making my own Greeting Card**

👩 I prepare my own greeting card using turmeric powder.
👩 I take a tablespoon full of turmeric powder.
👩 I add a little water and make a paste.
👩 I spread the turmeric paste on a plain paper and dry it.
👩 I draw designs on the turmeric paper using soap solution.
👩 My greeting card is ready to use.
👩 I cut the yellow turmeric paper into thin strips.
👩 I use it for testing the test solution in the following table.

![Fig. 3.25. Preparing Greeting Card](image)
Aim: To prepare our own indicator.

We need:
- Red cabbage
- Beetroot
- Some bright coloured flowers such as hibiscus

Procedure:
1. We take cabbage, beetroot, and some bright coloured flowers such as hibiscus.
2. We grind each one of the above items separately using a mortar.
3. We mix each one to a suitable solvent with the help of our teacher.
4. We filter and collect the filtrate in a separate bottle.
5. Our indicator is ready to use.

Table 3.7

<table>
<thead>
<tr>
<th>S.No</th>
<th>Test Solution</th>
<th>Effect on strips of turmeric paper</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lemon juice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Orange juice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Vinegar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Milk of Magnesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Baking soda solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Lime water solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sugar solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Common salt solution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Coffee is brown and bitter in taste. Is it an acid or a base?
Don’t guess the answer without doing a test.
Properties of Acids

1. They have a sour taste.
2. Strong acids are corrosive in nature.
3. Hydrogen is the common element present in all acids. However, all compounds containing hydrogen are not acids. For instance, ammonia, methane and glucose are not acids.
4. They react with metals and produce hydrogen.
   \[
   \text{Metal + Acid} \rightarrow \text{Salt + Hydrogen gas}
   \]
5. Acids turn blue litmus in to red.
6. The indicator phenolphthalein is colourless in acids.
7. The indicator methyl orange is red in acids.
8. They are good conductors of electricity.

MORE TO KNOW

Cells in the human body contain acids.
   DNA (deoxyribonucleic acid) in cells controls the physical features of our body such as appearance, colour and height.
   Proteins are bodybuilders and they contain amino acids.
   Fats contain fatty acids.

Pink or blue? Hydrangea macrophylla, an ornamental plant, can blossom in different colours depending upon the nature of the soil. In acidic soil, the colour of the flower is blue, in basic soil it is pink, and in neutral soil, it is white.
Uses of Acids

Inorganic acids are used in:

1. Chemical laboratories as reagents.
2. Industries for manufacturing dyes, drugs, paints, perfumes, fertilizers and explosives.
3. The extraction of glue from bones and metals from their ores.
4. Preparation of gases like Carbon dioxide, Hydrogen sulphide, Hydrogen, Sulphurdioxide etc.
5. Refining petroleum.

Organic Acids like carboxylic acids are used:

- as food preservatives.
- as a source of Vitamin C.
- for preparation of baking soda.
- to add flavour to foodstuffs and drinks.

Fig. 3.29. Uses of Acids
Properties of Bases

1. Bases are bitter in taste.
2. Strong bases are highly corrosive in nature.
3. Generally, they are good conductors of electricity.
4. Basic solutions are soapy to touch.
5. Bases turn red litmus paper into blue.
6. Bases are compounds that contain hydroxide ions.

Uses of Bases

1. in chemical laboratories, as a reagent
2. in industries, for manufacturing soap, textile, and plastic.
3. for the refining of petroleum.
4. for manufacturing paper, pulp and medicine.
5. to remove grease and stains from clothes.

**ACTIVITY 3.14**

**Debate on Acid Rain.**

- We divide ourselves into small groups.
- Each group discusses and debates about acid rain formation and its impact on the environment.
- We ask the group leaders to present the views of their groups.
- Our teacher concludes and summarizes it.
Neutralisation

You have learnt that acids turn blue litmus into red and bases turn red litmus into blue; hence they have different chemical properties. What do you think would happen when an acid is mixed with a base? Let us perform the following activity:

**ACTIVITY 3.15**

**Aim:** To show that acid is neutralised by base.

**We need:** Hydrochloric acid, sodium hydroxide, phenolphthalein, beaker, glass rod, test tube, test tube stand.

**Procedure:**
- Take a test tube and add 5 ml of (caustic soda) sodium hydroxide into it.
- Add 2-3 drops of phenolphthalein in it and you can see that the solution turns pink.
- Now add dilute hydrochloric acid slowly in drops and see what happens.
- The colour will disappear.
- This shows that the base is completely neutralised by the acid.

When an acidic solution is mixed with a basic solution, both solutions neutralise the effect of each other. When an acid solution and a base solution are mixed in suitable amounts, both the acidic nature of the acid and the basic nature of the base are destroyed. The resulting solution is neither acidic nor basic. Touch the test tube immediately after neutralisation. What do you observe? In the process of neutralisation, heat is always evolved or liberated. The evolved heat raises the temperature of the mixture.

In neutralisation reaction, a new substance is formed. It is known as salt. Salt may be acidic, basic or neutral in nature.

**Neutralisation** can be defined as a chemical reaction that takes place between an acid and a base. In this process, salt and water are produced with the evolution of heat.

\[
\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water} \quad \text{& heat is evolved.}
\]

**MORE TO KNOW**

Sulphuric acid \((\text{H}_2\text{SO}_4)\) is called the **king of chemicals**, because of its industrial importance. The amount of sulphuric acid that a country uses indicates the economy of country. Fluorosulphuric acid \((\text{HFSO}_3)\) is one of the strongest acids.

We know that even our stomach produces an acid. Once we start eating, acid is secreted in the stomach to start the digestion process. It is often not the food that we eat that causes acidity problems in the stomach, but an overproduction of this acid that is secreted does. In fact, some food can help to reduce the acidity in the stomach by neutralising (reducing) some of the acidity. Milk is one of the most beneficial food items that helps in reducing acidity in the stomach.
Salt

A salt is a substance formed by the neutralisation of an acid with a base.

\[
\text{Sodium hydroxide + Hydrochloric acid} \rightarrow \text{Sodium chloride + Water + Heat}
\]

(Base)                      (Acid)                     (Salt)

Table 3.8

<table>
<thead>
<tr>
<th>Name of acid</th>
<th>Salt formed</th>
<th>Names of salts</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl</td>
<td>Chloride</td>
<td>Sodium chloride, Copper chloride, Ferric chloride</td>
</tr>
<tr>
<td>HNO₃</td>
<td>Nitrate</td>
<td>Sodium nitrate, Copper nitrate, Ferric nitrate</td>
</tr>
</tbody>
</table>

Uses of Salt (Table 3.9)

<table>
<thead>
<tr>
<th>Name of Salt</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For the human body</strong></td>
<td>For the proper functioning of the human body.</td>
</tr>
<tr>
<td>Calcium phosphate, Calcium lactate, Ferrous sulphate, Sodium chloride etc.</td>
<td></td>
</tr>
<tr>
<td><strong>For domestic purposes</strong></td>
<td>Used as a preservative/ To add taste to our food</td>
</tr>
<tr>
<td>1. Sodium chloride</td>
<td>In baking/ in effervescent drinks.</td>
</tr>
<tr>
<td>2. Sodium bicarbonate</td>
<td>In purification of water.</td>
</tr>
<tr>
<td>3. Hydrated potassium, aluminium sulphate</td>
<td></td>
</tr>
<tr>
<td><strong>For Industrial Purposes</strong></td>
<td>In manufacture of washing powder.</td>
</tr>
<tr>
<td>1. Sodium carbonate</td>
<td>As an insecticide.</td>
</tr>
<tr>
<td>2. Copper sulphate</td>
<td>In manufacture of gunpowder.</td>
</tr>
<tr>
<td>3. Potassium nitrate</td>
<td></td>
</tr>
</tbody>
</table>
3.3.3. NEUTRALIZATION IN EVERYDAY LIFE

**Indigestion:**
Our stomach contains hydrochloric acid. It helps us digest the food we eat. Secretion of excess acid in the stomach will cause stomach upset or indigestion. Sometimes indigestion becomes painful. We take an antacid such as milk of magnesia to neutralise the excess acid.

**Ant bite:**
When an ant bites, it injects acidic liquid (Formic acid) into the skin. The effect of the acid can be neutralized by rubbing the bitten area with moist baking soda or calamine solution (Zinc Carbonate).

**Fill the table yourself:**

<table>
<thead>
<tr>
<th>Acids</th>
<th>Bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. They have sour taste.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>They turn red litmus to blue.</td>
</tr>
<tr>
<td>3. It contains hydrogen.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Generally good conductors of electricity.</td>
</tr>
</tbody>
</table>

**EVALUATION**

1. The physical change is generally reversible. The chemical change is irreversible. Classify the following changes as physical change or chemical change.
   a) Frying of egg  
   b) Burning of petrol  
   c) broken glass  
   d) formation of curd from milk  
   e) compression of spring  
   f) photosynthesis  
   g) digestion of food

2. Kumar had put some naphthalene balls in his wardrobe to keep the insects away. After a few days, he found that they had become very small. Give reason for the change. Name the phenomenon behind it.
3. Malarvizhi’s father bought an apple. He cut it into slices and gave them to her. The slices turned brown after some time. Seeing the brown colour, she asked her father how it happened. What could be her father’s explanation?

4. Sting operations!
Bee stings can be very painful. If a bee stings your friend, how would you help him?
   a) What substance will you apply on the bite area?
   b) What chemical does that substance contain?

5. Answer the following:
   a) Tablets for prescribed indigestion contain a base. Why?
   b) Explain why the rusting of iron objects is faster in coastal areas.

6. Anaerobic bacteria digest animal waste and produce biogas (change A). The biogas is then burnt as fuel (change B). The following statements pertain to these changes. Choose the correct one.
   i) ‘A’ is a chemical change.
   ii) ‘B’ is a chemical change.
   iii) Both ‘A’ and ‘B’ are chemical changes.

7. Burning of wood and cutting a log of wood into small pieces are two different types of changes. Give reason.

8. Match the following:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Vinegar</td>
<td>quick lime</td>
</tr>
<tr>
<td>b)</td>
<td>Milk</td>
<td>acetic acid</td>
</tr>
<tr>
<td>c)</td>
<td>Tamarind</td>
<td>milk of magnesia</td>
</tr>
<tr>
<td>d)</td>
<td>Calcium oxide</td>
<td>tartaric acid</td>
</tr>
<tr>
<td>e)</td>
<td>Magnesium Hydroxide</td>
<td>lactic acid</td>
</tr>
</tbody>
</table>

9. Fill in the blanks:
   a) Acids have ________ (bitter / sour) taste.
   b) Burning of a candle is an example of ________ (physical / chemical) change.
   c) Some commonly used natural indicators to identify acids and bases are ________ and ________.

10. Take a fresh iron nail and a rusted iron nail. Beat them up with a hammer and check for yourself which of the two is stronger? Why?
PROJECTS

1. Let us make a list of items that we use at home and classify them as acid, base or salt. You can organize your list under following heads:
   a) Accessories / toiletries (soaps, detergents, disinfectants, etc.)
   b) Cosmetics (lotions, shampoos, etc.)
   c) Food items (pickle, lemon, ajinomoto, soda water)
   d) Miscellaneous (car batteries, refrigerators, window cleaners, insect repellants, etc.)

2. Prepare a natural indicator. collect water samples (minimum 5 samples) from your area and test the samples using the indicator. Find out whether it is acidic, basic or neutral. Record your observations and tick (√) the appropriate column in the table below. Discuss the results.

<table>
<thead>
<tr>
<th>Water samples</th>
<th>Acid</th>
<th>Base</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample - 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample – 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample – 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample – 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample – 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After classifying various water samples, write down which of the samples you will use for the purpose of: (a) Drinking    (b) Washing    (c) Irrigation    (d) Bathing.

FURTHER REFERENCE

Books:
1) *Introductory Chemistry* - M Katyal, Oxford University Press, New Delhi
2) *Advanced Organic Chemistry* – Bahl and Arun Bahl Johnson

Webliography:
- [http://chemistry.about.com/library/btacid.quiz.htm](http://chemistry.about.com/library/btacid.quiz.htm)
Muthu’s father sprang a pleasant surprise on his children one morning.

**Father**: Hurry up, children! get ready. We are going to visit the Indira Gandhi Centre for Atomic Research at Kalpakkam.

**Muthu**: Don’t we have a nuclear reactor at Kalpakkam, Dad?

**Father**: Yes, there is a nuclear reactor at Kalpakkam, where electricity is generated. Do you remember, last year during the holidays, we went to Mettur Dam and saw how they generate electricity at the hydro-electric power station? The year before, we visited the Ennore thermal power plant, where coal is used. This year, we shall visit the kalpakkam plant, where nuclear energy is used for power generation.

**Malar**: That will be great, daddy. I really enjoyed visiting the power stations and see the way electricity is generated.

**Father**: You know how essential electricity is in our daily life. You will learn more interesting facts about electricity in your physics classes.

“Electricity plays an important role in our day to day activities. It is almost impossible to imagine life without electricity. Electricity has made our tasks easier and our lives more comfortable. Can you list the things you use which need electricity to work?”
Electricity lights up the bulbs for us to see even in the dark and heats up the oven to cook food.

Electricity helps to transmit our voices along wires instantaneously. Electric trains carry people from one place to another at a faster pace.

Even Computers, which have become an integral part of our lives, run on electricity.

**Where do we get this electricity from?**

The electricity we use at home and school comes from the substation in the neighbourhood which draws power from the larger power stations. These power stations get electricity from the electrical plants. From the power station, electricity flows through cables and wires to the step up transformers where the voltage is raised to facilitate long distance travel. The substation transformers receive the current, lower the voltage and send it to pole transformers. From these transformers, electricity is supplied to homes, schools and buildings, wherever required. Inside the power stations, there are huge rotating wheels called turbines.

Each turbine is made of curved blades arranged like the sails of a windmill. These turbines are made to rotate by flowing water or steam. They are attached to the coils of electric generators.

Generator

A simple generator consists of a coil of wire that rotates between the poles of a strong magnet. As the coil rotates, electric current is generated.

At Thermal power stations, steam is used to rotate the coil. Hot steam is allowed to fall on the blades of a turbine that spin and turn the shaft, which in turn makes the coil to rotate. Steam is made by heating water, burning fossil fuels like coal, oil or natural gas.

In Nuclear power stations, splitting of uranium atom produces energy to heat water and thereby produces steam, which in turn is used to rotate the turbines.

In Hydro-electric power stations, fast flowing water is used to rotate the turbines.
The first electric cell was developed by an Italian scientist Luigi Galvani and then improved by Alessandro Volta. It has been further developed into the modern day cell or torch battery. Now, we also have rechargeable alkali cells and solar cells. These solar cells convert light energy into electrical energy.
Let us observe the given pictures and group them as the appliances or devices that run on electric cells and those that do not:

- Refrigerator
- Television
- Cell phone
- Wall clock
- Microwave oven
- Electric train
- Calculator
- Wrist watch
- Computer
- Electric Toy

Fig 4.4
4.2. ELECTRIC CIRCUIT

An electric circuit is the continuous or unbroken closed path along which electric current flows from the positive terminal to the negative terminal of the battery.

A circuit generally has:

a) A source of electric current - a cell or battery.

b) Connecting wires - for carrying current.

c) A device that consumes the electricity - a bulb.

d) A key or a switch – This may be connected anywhere along the circuit to stop or allow the flow of current. When the current flows, the circuit is said to be closed. When the current does not flow, the circuit is said to be open.

Look at the following figures:

![Fig 4.5](image)

Does the bulb glow in any of these figures shown? Can you say why?

In figure (a), the source that produces electric current is missing.

In figure (b), there is no wire for the electric current to flow through.

In figure (c), the path is broken or incomplete.

So, the bulb does not glow in any of the figures shown above.

A circuit with a cell and a bulb is given here:

![Fig 4.6](image)

Galvanometer is an instrument used to detect the flow of current in electrical circuits. When current flows through the galvanometer, the needle gets deflected.
An electric lemon cell:

**We need**: a lemon, a 5 cm length of copper wire, two plastic coated wires, an iron nail and a galvanometer.

1. Press the lemon on the table to make it soft and juicy.
2. Twist one end of a plastic coated wire around the copper wire and push the copper wire into the lemon. Connect the other end of the wire to one terminal of the galvanometer.
3. Wind one end of the other wire around an iron nail and push the nail into the lemon at a distance of 3 cm from the copper wire. Connect the free end to the other terminal of the galvanometer.
4. You can observe the galvanometer showing the deflection. In the lemon cell, lemon juice acts as the electrolyte, whereas the copper wire and the iron nail work as the electrodes. Since a single lemon cell can produce only very little electric current, three or four such cells should be connected together to make an LED glow.

In the above activity, the copper wire acts as the positive terminal, the iron nail as the negative terminal and the lemon juice as the electrolyte.

Try the same activity, using a potato or a beetroot instead of a lemon. Do they produce electricity?
**Why symbols?**

If you were to describe an electric circuit to someone, it is likely that you would want to draw it. It takes time to draw a circuit, because people might draw batteries, bulbs, etc., in different ways. This could be very confusing. This can be overcome by using standard symbols to draw a circuit.

### 4.3. SYMBOLS OF ELECTRIC COMPONENTS

The given table shows the symbols of electric components commonly used in electric circuits.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the component</th>
<th>Picture</th>
<th>Symbol</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cell</td>
<td><img src="image" alt="Battery Symbol" /></td>
<td><img src="image" alt="Cell Symbol" /></td>
<td>The longer line denotes the positive terminal and the shorter line denotes the negative terminal.</td>
</tr>
<tr>
<td>2.</td>
<td>Battery</td>
<td><img src="image" alt="Battery Symbol" /></td>
<td><img src="image" alt="Battery Symbol" /></td>
<td>Two or more cells when joined together form a battery</td>
</tr>
<tr>
<td>3</td>
<td>Switch (Key)</td>
<td><img src="image" alt="Switch Symbol" /></td>
<td><img src="image" alt="Switch Symbol" /></td>
<td>Switch is OFF– circuit is OPEN</td>
</tr>
<tr>
<td></td>
<td></td>
<td><img src="image" alt="Switch Symbol" /></td>
<td><img src="image" alt="Switch Symbol" /></td>
<td>Switch is ON– circuit is CLOSED</td>
</tr>
<tr>
<td>4.</td>
<td>Bulb</td>
<td><img src="image" alt="Bulb Symbol" /></td>
<td><img src="image" alt="Bulb Symbol" /></td>
<td>Bulb does not glow</td>
</tr>
<tr>
<td>5.</td>
<td>Connecting Wire</td>
<td><img src="image" alt="Connecting Wire Symbol" /></td>
<td><img src="image" alt="Connecting Wire Symbol" /></td>
<td>used for connecting different components</td>
</tr>
</tbody>
</table>
4.4. ELECTRIC SWITCH

What is used to turn the light or fan ON and OFF?

The device used is called a switch or a key.

An electric switch is a device that opens or closes an electric circuit.

When the switch (key) K is closed, the circuit is complete; current flows through the circuit and the bulb glows.

A circuit with the switch in the ‘ON’ position

Fig 4.7

When the switch (key) K is open, the circuit is not complete; current does not flow through the circuit and the bulb does not glow.

A circuit with the switch in the ‘OFF’ position

Fig 4.8

To Think...

If the filament inside the bulb is broken, will the bulb glow? Why?
**ACTIVITY 4.2**

**I DO**

**I shall make a simple switch**

**I need**: a small block of softwood, a paper clip, two metal drawing (board) pins, 3 pieces of insulated wire, a small bulb with a holder and a battery.

1. I attach a piece of wire to each board pin. I push one pin into the flat side of the wood.

2. I push the second pin through the end loop of the paper clip and into the board. The drawing pins are about 1 cm apart.

3. To test the switch, I connect the free end of one of the wires to the positive terminal of the battery.

4. I use the free wire to connect the negative terminal of the battery to the bulb holder.

5. I connect the free wire on the switch to the free screw on the bulb holder.

6. When the paper clip is turned to touch both the board pins, the bulb glows.

*My switch is ready now.*

---

**MORE TO KNOW**

The Electric eel is an electric fish. It is capable of generating powerful electric shocks for hunting its prey and for self defence.

The electric eel lives in the fresh water of the Amazon and the Orinoco river basins in South America.
I need: a battery, a key, a small bulb, a plastic scale, a wooden scale, a copper wire, a metal key, a metal safety pin and a glass rod.

1. I connect the circuit as shown in the figure with the help of connecting wires.
2. I connect different materials between the points A and B, one by one.
3. I check if the bulb glows when key K is closed and I record the observation with a tick mark (√) in the appropriate box.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>OBJECT</th>
<th>BULB GLOWS</th>
<th>BULB DOES NOT GLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Metal key</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Wooden scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Plastic scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Metal safety pin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Copper wire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Glass rod</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. I see that the bulb glows when the copper wire, the metal safety pin and the metal key are connected. Now, I infer that current flows through these objects and the circuit is complete.

5. The bulb does not glow when the wooden scale, the plastic scale and the glass rod are connected. I infer that current does not flow through these materials and the circuit is incomplete.

Based on the observations of the above activity, we can classify materials as conductors and insulators.
4.5. CONDUCTORS AND INSULATORS

The materials that allow electric current to pass through them are conductors.

**Examples:** All metals like Copper, Iron, Silver, besides the Human body and the Earth.

The materials which do not allow electric current to pass through them are insulators.

**Examples:** Plastic, Wood, Rubber and Glass.

4.6. HEATING EFFECT OF ELECTRIC CURRENT

During rain storm, you must have seen bright flashes of light in the sky followed by sounds of thunder. We call these bright flashes of light as lightning. Lightning is nothing but a discharge of a huge spark of electricity between two charged clouds in the sky. When lightning strikes, it can burn trees and demolish buildings.

Burning of trees is due to the passing of electricity through them.

*In an electric wire, do we see the flow of current?*

In an electric wire, we do not see the flow of current. We only feel the effects of the flow of current.

Connect a thin wire between the two terminals of a battery. After a few seconds, touch it. How do you feel? Is it not hot? Yes. It is. Can we say that it has become hot due to the flow of current?

Yes we can. The current flowing through a wire produces heating effect. In higher classes you will learn, why the flow of current produces heat?

To Think...

*Why do electricians wear rubber gloves and shoes while at work?*
I need:

Three 1.5V cells, three pieces of wire, a small torch bulb, insulation tape, key or switch.

1) I strip the insulation at both ends of the three wires so that about 1cm of the metal portion is exposed.

2) I connect the negative end of the cell to one end of the key with a wire and the other end of the key to the threaded portion of the bulb with another wire. I secure both ends with insulation tape.

3) I connect the positive end of the cell to the bottom portion of the bulb with the third wire.

4) I find that the bulb glows, when the key is closed.

5) I touch the bulb, when the key is not closed.

6) I close the key and allow the current to flow for some time and then touch the bulb. I find that the bulb is hot.

I infer that the bulb gets heated due to the flow of current. I realize that current produces a heating effect.

7) I allow the current to flow for a longer time. I find the bulb hotter.

So I infer that the heat produced depends on the duration of the flow of current.

8) Then I connect two cells in the circuit so that more current flows through the bulb.

I find that the heat produced is greater. With three cells, the heat produced increases further.

From the above activity, we infer that the amount of heat produced depends on the duration and the quantity of current flow.

Shall we name a few appliances that work on the heating effect of current?

<table>
<thead>
<tr>
<th>Electric kettle</th>
<th>Electric bulb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used for boiling water to make tea or coffee.</td>
<td>Used to provide light.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electric iron</th>
<th>Electric toaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used for ironing or pressing clothes.</td>
<td>Used to toast bread.</td>
</tr>
</tbody>
</table>
How is heat produced in these appliances?

All heating appliances have a wire which produces heat, when current is passed. It is known as the heating element. This is the most important part of a heating appliance.

The element is a coil of wire made of a special material called nichrome which becomes very hot when current is passed. This heat is used to cook food (as in an electric stove), heat water (as in an electric kettle, electric heater) etc.

Inside an electric bulb, is a thin coil of wire made of tungsten called filament. It gets heated and glows, when the current flows.

**ELECTRIC FUSE**

What will happen when a large amount of electric current passes through an appliance?

The wires will get overheated and the appliance will get damaged.

This situation arises as a result of some fault in the circuit and can be extremely dangerous as it could cause fire.

To prevent electric appliances from getting damaged as a result of excessive flow of current through them, a safety device called fuse is used.

The fuse is a safety device used in an electric circuit.

**PRINCIPLE AND WORKING**

The electric fuse works on the principle of heating effect of electric current.

An electric fuse consists of a wire usually placed inside a glass or a ceramic cartridge. The wire is made of a material that melts easily when heated.

It is designed such that only certain amount of maximum current can flow through it. If the flow of current exceeds this maximum amount, the heating in the wire causes it to melt. This breaks the circuit and stops the flow of current in the circuit.

The common symbol for an electric fuse:
MINIATURE CIRCUIT BREAKER

A miniature circuit breaker is an automatically operated electric switch that protects an electric circuit during overload or short circuit.

Circuit breakers are available in different sizes, and can protect small household appliances as well as high voltage devices.

The circuit breakers have an advantage over fuses. They can be reset manually or automatically to restore normal position, whereas the fuses need to be replaced after every single operation.

4.7. MAGNETIC EFFECT OF ELECTRIC CURRENT

In the year 1820, Christian Oersted, a Danish scientist was giving a lecture in a classroom. He noticed that a magnetic needle kept on the table was not pointing in the North-South direction. He was surprised. On looking closely, he found that the needle was kept near a wire carrying current. When he took the needle away from the wire, it pointed in the North-South direction. He brought the needle near the wire once again and noticed that it deflected. Then he concluded that there is a magnetic field around the wire carrying current.

Magnetic compass

The picture shows a compass, which has a magnetic needle pivoted at its centre, so that it can rotate horizontally.

The pivoted magnetic needle will always point in the North-South direction.
**ACTIVITY 4.5**

**WE OBSERVE**

We need:

An empty matchbox, a compass needle, two cells, a key or switch, a bulb and connecting wires

1. Let us take an empty matchbox. Place a small compass needle inside the matchbox tray.

2. Wind an electric wire a few times around the tray. Now connect the free ends of the wire to a battery through a switch, as shown in the diagram.

3. Keep the switch in the off position. Bring a bar magnet near the compass needle. We see that the needle gets deflected.

4. When you remove the magnet, the needle will come back to its original position.

5. Allow the current to flow by keeping the switch in the **ON** position. Does the compass needle deflect? Yes, it does.

6. Move the switch to the **OFF** position. Does the compass needle come back to its initial position? Yes, it does.

*What does this experiment indicate?*

It indicates that a magnetic field is produced around a current carrying conductor.
4.8. ELECTROMAGNET

ACTIVITY 4.6  I DO

Are magnets and electricity related?

I need: Four 1.5V cells, a copper wire, an iron nail, a key or a switch, some paper pins and connecting wires.

1) I wind a copper wire around an iron nail.

2) I connect one end of the wire to one end of the battery and the other end to the other terminal of the battery through a key, as shown in the figure.

3) I bring some pins near the nail after closing the key. I see the pins get attracted to the iron nail. I conclude that the iron nail becomes a magnet, when current is passed.

4) I now open the key and again bring the pins near the nail. The pins do not get attracted. I infer that the iron nail loses its magnetic effect, when the flow of current is stopped.

5) I repeat the activity by increasing the number of turns. I observe that the iron nail attracts more number of pins.

6) I repeat the activity by increasing the amount of current passed (by using three or four cells). I see that the iron nail attracts more number of pins.

From the above activity, I come to the conclusion that the magnetic strength of the iron nail increases, when the number of turns and the amount of current that flows increases.

A material that becomes a magnet when current is passed is called an electromagnet.

Electromagnets are used in many appliances like electric motors, telegraphs, telephones, electric bells, etc.

Many toys have electromagnets inside.

Doctors use small electromagnets to remove tiny pieces of magnetic materials that accidentally enter our eyes.
4.9. ELECTRIC BELL (DOORBELL)

Have you visited any of your friend’s house recently? How did you let him know of your arrival?

Did you knock at the door or ring a bell? Wasn’t it much easier to ring the bell? Let us understand how the electric bell works?

The picture of an electric bell circuit is shown:

![Electric Bell Circuit Diagram]

**Working**

When the key is closed, current flows through the coil and the electromagnet gets magnetised. It pulls the iron strip and the hammer strikes the gong of the bell to produce a sound.

Now the circuit breaks and the current stops flowing through the coil. The electromagnet is no longer magnetized and the iron strip comes back to its original position. It touches the contact terminal again, completing the circuit and the process is repeated. The hammer keeps on striking the gong producing a ringing sound.

**MORE TO KNOW**

Huge electromagnets are used to remove iron scraps in the scrapyard.

**EVALUATION**

I. Choose the correct answer:

1. An electric cell converts ___________.
   a. chemical energy into electrical energy
   b. mechanical energy into chemical energy
   c. electrical energy into light energy
   d. light energy into heat energy
2. The electric current flowing through the conductor produces ______ around it.
   a. heat                 b. a magnetic field
   c. a mechanical force   d. all the above

   a. cannot be recharged  b. cannot be reused
   c. cannot be recharged or reused d. can be recharged and reused

4. Find the odd one out:
   a. electric toaster  b. electric fan
   c. electric iron    d. room heater

5. An electric fuse wire melts if the amount of current flowing through it is ______.
   a. more than a minimum amount  b. less than a minimum amount
   c. more than a maximum amount  d. less than a maximum amount

II. Fill in the blanks:
   1) A drawing of an electrical circuit with standard symbols is called a/an ________. (circuit diagram / electric diagram)
   2) Electric toasters and electric irons get hot when switched on because of the ______ effect of current. (magnetic/heating)
   3) A fuse is a _______ device. (safety / heating)
   4) The filament in an electric bulb is made of _______. (tungsten / nichrome)
   5) A pivoted magnetic needle will always point to the _______ direction. (east - west / north - south)

III. Match the following:
   1) Electric cell - a) flow of charge
   2) Fuse wire - b) source of electric current
   3) Insulator - c) electromagnet
   4) Electric bell - d) prevents damage of electric appliances
   5) Electric current - e) does not allow current to pass through them

IV. Correct the following statements:
   1) The longer line in the symbol for electric cell denotes the negative terminal.
   2) When current is continuously passed through a bulb, it becomes cold.
   3) A magnetic compass kept near a wire gets deflected.
   4) Conductors do not allow electric current to pass through them.
   5) Plastic from scrap can be removed with an electromagnet.
V. Give reasons for the following:
1) If we touch an electric bulb that has been kept switched on for sometime, it will be hot.
2) For a fuse wire, we should choose a wire, which would melt easily.
3) If we bring a magnetic compass near an electric circuit, the needle moves.
4) Iron filings, which are attracted to an electromagnet, drop down when the electromagnet is switched off.

VI. Find out and write down what is wrong with the pictures given below:

VII. You are given two cells - A and B. One is dead and the other works well. Suggest a way to identify which one is in working condition.

VIII. Observe the figures below and complete the sentences using the given options:
(will glow / will not glow/ a conductor/ an insulator)

(a)
(b)

i) In figure “a”, the bulb _______, as the rubberband is _________.
ii) In figure “b”, the bulb __________, as the metal key is __________.

IX.

Show how these four cells can be connected to form a battery by drawing lines.

X. The symbols of electric components are given below. Use some of them to make a circuit, so that the bulb glows.
XI. Study the circuit given:
Find out the changes required to make the bulb glow. Draw the correct circuit using symbols.

PROJECTS

1. You are provided with three cells and a bulb. Connect the bulb with one cell and form a circuit. See how the bulb glows. Do the same using two cells and three cells. See the variation in the glow of the bulb and record your observations by writing ‘bright’, ‘brighter’ and ‘brightest’ in the table.

<table>
<thead>
<tr>
<th>Number of cells used</th>
<th>Nature of glow</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td></td>
</tr>
</tbody>
</table>

2. You are supplied with a long iron nail, a long insulated copper wire, 3 cells and a box of steel pins.
Make an electromagnet with 50 turns and connect it to a cell. Bring the box of pins near it. Count the number of pins attracted by the electromagnet. Repeat the experiment by using two cells and three cells.

Enter your observations in the table given below:

<table>
<thead>
<tr>
<th>Number of cells</th>
<th>Number of pins attracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td></td>
</tr>
</tbody>
</table>

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2. Young Scientist - World Book, Inc.

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[http://www.dmoz.org/kidandteens/schooltime/science.com](http://www.dmoz.org/kidandteens/schooltime/science.com)
`I can, I did'  
Student's Activity Record

Subject:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Date</th>
<th>Lesson No.</th>
<th>Topic of the Lesson</th>
<th>Activities</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
SCIENCE

STANDARD SEVEN

Term III
Dear children, given above is a beautiful picture of a house with a garden in front. But you will be surprised to know that there are ten animals hidden in it. Shall we find them?

The picture shows a good relationship between plants and animals in a non-living environment.
1.1. ECO SYSTEM

“WILD ELEPHANTS STRAY INTO HUMAN HABITATION NEAR HOSUR”

On 24th March, 2010, wild elephants entered Kumudepalli village, in Krishnagiri District. They were driven into the Sanamavu Forest near Hosur on that day. Three male wild elephants strayed into human habitation near Hosur on Tuesday.

According to the forest officials, the elephants aged between fifteen and twenty strayed into Kumudepalli village in the morning. On information, the officials led by District Forest Officer V.Ganesan, Assistant Conservator of Forest K.Rajendran and Hosur Ranger R.Madheswaran drove the pachyderms to the nearby Sanamavu Reserve Forests with the help of the villagers by bursting crackers.

Wild elephants entering into the human habitations have become an order of the day for the past three to five months. They did not harm anybody during the operation. Of the three elephants one is sub male elephant with the age of fifteen. And the other two are about twenty, an official said.

The above information is a newspaper report. Why have these elephants come out of the forest? move into the areas where people live.

Elephants live in forests. Forest is an ecosystem. Forests are the natural habitats of elephants. People have been cutting down trees and reducing forest cover for cultivation and other purposes. The elephants lose their habitations in the reduced forest area. So they are forced to come out of their forest homes (ecosystems) and move in the areas where people live.
A community of living organisms with the physical environment of a definite geographical region form an eco-system.

Eco-systems may be natural or artificial. A pond, a grassland, a forest, a lake, a desert etc. are examples of natural eco-systems. An aquarium, a park, a paddy field, etc. are examples of artificial eco-systems.

Components of Eco-system

An eco-system consists of two main components. They are biotic (living) and abiotic (non-living) components.

Biotic Components

The living components are broadly classified into three categories.

1. **Producers**: They are green plants that prepare their own food by the process of photosynthesis.

2. **Consumers**: We know that animals eat plants and they in turn are eaten by other animals. Hence the food produced by green plants is directly or indirectly consumed by all kind of animals, which are called consumers. eg. Goat.

3. ** Decomposers**: They are organisms which feed upon dead matter to get energy and give back the nutrients to the soil. eg. bacteria and fungi.

Abiotic Components

These include the soil, water, air and climatic factors such as temperature, sunlight, humidity etc.
1.2. FOOD CHAIN

The sun is the ultimate source of energy to all living things. Green plants capture solar energy and convert carbon-dioxide and water into food by photosynthesis. This food energy is transferred to the primary consumer when they eat plants. Then the primary consumer is eaten by the secondary consumer which in turn is eaten by a tertiary consumer. So, in a given ecosystem, there is a process of organisms eating some others or being eaten by some other organisms. The path of energy transfer from one organism to another in a single direction is called a food chain.

1. Food chain in a grassland

1. _______________
2. _______________
3. _______________
If one link in a food chain is broken it would result in the extinction of a species.

In a food chain, each group of organisms occupies a particular position. The position of organisms in a food chain is called **trophic level**.

Plants are producers and form the first trophic level. The second trophic level comprises of plant eaters the herbivores. Carnivores which eat the herbivores form the third trophic level. The fourth trophic level is occupied by the large carnivores.
1.3. FOOD WEB

In a given ecosystem, a single food chain may not exist separately. An animal can eat more than one kind of food. For eg. an eagle can eat a rabbit, a mouse or a snake and a snake can feed on a mouse or a frog. So, many food chains get interlinked.

A network of interlinked food chains is called a food web.

1.4. FLOW OF ENERGY

The sun is the ultimate source of energy for all living things. At first, the solar energy flows from the sun to the surface of the earth. Green plants trap the solar energy and convert it into chemical energy (food).

The amount of energy decreases from one trophic level to another. The flow of energy is always in one direction only.
1.5. BIOME

We know that all organisms acquire energy from the sun directly or indirectly. But, does the sun have any other effect on us? Yes. The rotation of the earth around the sun has an effect on the climate of a place. You have already studied about ecosystem. An ecosystem may be small or big. When small ecosystems are put together, they form a vast geographical area which supports a wide variety of flora and fauna. At the same time such a vast area has a different type of climate. Such a vast geographical area is called **biome**.

**THE DIFFERENT BIOMES**

We can view our earth as various biomes based on their climate and also the latitude and longitude on which they are present. Based on the types of flora and fauna, the biomes are classified into many types.

1.5.1. TYPES OF FORESTS

1) **Tropical Rain Forest**: They are found in South America, Africa and Indo Malaysia region near the equator. The weather is warm (20°C-25°C). Rainfall is plentiful, 190 cm per year. In India, they

![Fig. 1.1. Tropical Rain Forest](image)

**ACTIVITY 1.3**

Divide the class into groups of four or five students each. Each group has to select any Biome and discuss its climate, flora and fauna found there.
are found in Andaman and Nicobar Islands, Western ghats, Assam and West Bengal.

2) Savannah: They are found in South Africa, Western Australia, North West India and Eastern Pakistan. They love a dry weather alternating with wet weather. The rainfall is about 25cm per year. Frequent fires occur during the dry season. In India, grassy plains are found in the Nilgiris, Khasi hills and Naga hills.

3) Deserts: They are found in Africa, Arizona in America and Mexican desert in Mexico. The days are hot and nights are cold. The annual rainfall is less than 25 cm. In India, it is found in Rajasthan (The Thar Desert).

4) Temperate Grassland: It is found in North and South America and parts of Europe. The annual rainfall is 25cm to 100 cm. They have two very severe dry seasons. They have windy hot summers and cold winters. In India, it is found in Uttar Pradesh.

5) Deciduous Forests: They are found in North America, Eastern Asia and Europe. They receive 75 to 100 cm of rainfall. The climate is moderate with mild winters. In India, it is found in Punjab, Tamil Nadu, Uttar Pradesh, Bihar, Odisha and Madhya Pradesh.

6) Taiga: It is found in Canada, Europe and Russia. They are also called Boreal Forests. The climate is of a short cool summer and a long winter with abundant snowfall. The annual rainfall is 20cm to 60 cm. Most of it is covered with snow and ice. It is found in Himachal Pradesh, Punjab and Kashmir in India.

7) Tundra: It is found south of the ice covered poles in the Northern hemisphere. Though it receives 25 cm of rainfall, it has permanently frozen soil. The climate is extremely cold and windy. The temperature is less than 10°C. In India, it is found in the Himalayas.

1.5.2. IMPORTANCE OF FORESTS

1. Forests are the sources for the formation of rivers.
2. They increase the rainfall.
3. They prevent soil erosion and floods.
4. They become habitats to animals.
5. They maintain the oxygen and carbon dioxide balance in nature.

Forests are considered as God’s first temples. They play an important role in our day-to-day life.

MORE TO KNOW

Vanamahotsav is an annual Indian tree planting festival celebrated in the month of July. It is to create an enthusiasm in the minds of people to conserve forests.
1.5.3. DIFFERENT FLORA AND FAUNA

Biomes have a variety of plants and animals. The flora and fauna found in one biome is completely different from that in the other biome due to the different climatic conditions. The kind of flora and fauna found in different biomes are given below: India is one of the 12 mega biodiversity centres in the world with immense flora and fauna.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>BIOME</th>
<th>FLORA</th>
<th>FAUNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tropical Rain Forest</td>
<td>Lofty trees like teak, rubber, lianas, epiphytes, orchids, ferns</td>
<td>herbivores, insects, rodents, monkeys, bats, birds, large cats, snakes</td>
</tr>
<tr>
<td>2.</td>
<td>Savannah</td>
<td>Grasses</td>
<td>birds, kangaroos, lions, zebras, giraffes, cheetahs, elephants, termites</td>
</tr>
<tr>
<td>3.</td>
<td>Desert</td>
<td>Succulent plants like cactus, acacia, calotropis, datepalm etc</td>
<td>chinkara, lizards, scorpions, camels</td>
</tr>
<tr>
<td>4.</td>
<td>Temperate grassland</td>
<td>Perennial grasses</td>
<td>wolves, bison, coyotes, antelopes, insects etc</td>
</tr>
<tr>
<td>5.</td>
<td>Deciduous forest</td>
<td>Oak, maple, mosses, acacia, pine, fir</td>
<td>squirrels, black bears, beetles, birds, small mammals</td>
</tr>
<tr>
<td>6.</td>
<td>Taiga</td>
<td>Spruce, fir, pine, aspen, birch, willows, mosses, lichens, fungi</td>
<td>porcupines, red squirrels, hares, grey wolves, insects etc</td>
</tr>
<tr>
<td>7.</td>
<td>Tundra</td>
<td>Sedge, broad leafed herbs, lichens</td>
<td>reindeers, owls, foxes, wolves, migratory birds, polar bears, penguins</td>
</tr>
</tbody>
</table>

**ACTIVITY - 1.4**

I match the product with its use.

1. Timber  | Pencil
2. Shelter | Neem
3. Music   | Wood
4. Tool    | Coffee
5. Medicine| Veena
6. Drink   | Palm Leaves

**ACTIVITY - 1.5**

Prepare a poster or logo or slogan or a notice related to deforestation.
EVALUATION

1. Pick out the correct answer:-

   a) Forest is an area with high density of __________ (trees / grass)
   b) _______ is an example of a natural ecosystem. (Paddy field / Desert)
   c) The third trophic level in a food chain comprises of _________________
      (herbivore / carnivore)
   d) A network of interlinked food chain is called a _________________
      (food web / food cycle)
   e) The festival of “Vanamahotsav” is celebrated in the month of _________.
      (June / July)

2. Rearrange the following words to form a food chain.

   (a) snake, mouse, paddy, eagle, grasshopper.
      ______> ___________> __________> ________> ___________
   (b) man, big fish, phytoplankton, small fish, insects.
      ---------> -----------------> -------------> -------------> -----------

3. Third Trophic level
   Carnivore
   Snake

   Herbivore
   Second Trophic level
   Mouse

   Plants
   Producers
   First Trophic level

   a) Suggest the common idea derived from these boxes.
   b) Analyse the data given above and make a food chain.

4. Differentiate between the following:-

   a) Consumers and decomposers
   b) Food chain and food web

5. Discuss the effects of deforestation on the following:

   a) Wild animals
   b) Environment
6. **Food web in a forest is given below:**

```
Top carnivore: Hawk

Carnivore: Crow, Owl

Herbivore: Snails, Woodlice, Worms, Rats, Mice, Squirrels

Producers: Fallen leaves, Living Leaves, Grasses, Seeds
```

a) From the diagram identify the following:

i) a Carnivore

ii) a Herbivore

iii) a Producer

b) Select four organisms from the food web and draw as many food chains as possible.

7. Match the following types of forests with their unique characteristic features.

Rain forest, Savannah, Desert, Grassland, Taiga, Tundra.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Characteristic feature</th>
<th>Types of Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Frequent forest fire</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Windy weather</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Snow and ice</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Hot days and cold nights</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>Ice covered frozen soil</td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td>Plentiful rainfall</td>
<td></td>
</tr>
</tbody>
</table>
8. Given below are a list of animals. Match it with the biome where they are found.

a) Snake - Savannah
b) Cheetah - Tundra
c) Camel - Tropical Rain Forest
d) Antelope - Taiga
e) Black bear - Desert
f) Grey wolf - Deciduous forest
g) Penguin - Grassland

**FURTHER REFERENCE**

**Books**
- Ecology - Shukla and Chandel, S.Chand & Company, New Delhi
- Environmental Science (9th edition) - Enger and Smith, McGraw Hill, New York

**Webliography**
- www.national geographic.com
- www.mongabay.com

**Places of scientific importance for visit**
1. Coral reefs in Mandapam, Ramanathapuram District
2. Mangrove forest in Pitchavaram, Cuddalore District
Children, shall we find out why we celebrate March 22 every year as World Water Day.

It is to arouse an awareness
2.1 AVAILABILITY OF WATER

Water is a natural resource that is vital for both plants and animals. Water exists in abundance on our planet Earth. However, only a very small fraction of it is fit for human consumption.

Most of the water that exists on the earth is found in the seas and oceans. Sea water and ocean water are highly salty and hence unfit for drinking. Most of the fresh water is frozen glaciers as in the polar regions and thus not readily available.

The United Nations states that “the amount of water for drinking, washing, cooking and maintaining proper hygiene is a minimum of 50 litres per person per day”. This amount is about two and a half buckets of water for a person for a day.

**ACTIVITY 2.1 I DO**

I collect clippings from newspapers and magazines on the news items, articles and pictures related to water shortage. I paste them in my scrapbook. I show and share the information with my teachers and friends.

**MORE TO KNOW**

**IMPORTANT DAYS**

- World Wetland Day - Feb 2
- World Forest Day - March 21
- Earth Day - April 22
- World Environment Day - June 5
- Natural Resources Day - October 5
- Nature Conservation Day - Nov 25

**ACTIVITY 2.1 I DO**

I collect clippings from newspapers and magazines on the news items, articles and pictures related to water shortage. I paste them in my scrapbook. I show and share the information with my teachers and friends.

**Water on Earth**

- Saline water 97%
- Freshwater 3%

**Fresh Water**

- Ground water 69%
- Glaciers & Ice cap 30.1%

**Fresh Surface Water**

- Swamp 11%
- Lakes 87%

**Surface water 0.3%**

**Others 0.6%**

**Fig. 2.2.**
2.2. SOURCES OF WATER

1. Rain water

Rain water is the purest form of water. Pure water evaporates under sunlight from the seas and rivers leaving behind the impurities. It rains due to the precipitation (condensation) of tiny water droplets present in the clouds. The first showers dissolve certain gases present in air and bring down them along with the suspended impurities. Subsequent showers contain only pure water.

2. Glaciers, ice and snow

Of the 3 percent of fresh water that is fresh, about three – fourths are tied up in glaciers, ice caps and snowfields. They occur only at high altitudes or high latitudes.

3. River water

The water in the rivers is obtained either from rainfall or melting of snow (glaciers) on the mountains.

4. Sea and Ocean water

Ocean is a large body of water. Million litres of water is present in Ocean, but the water is salty and is not fit for any domestic or agricultural use.

5. Lake and Pond water

Lakes are inland depressions that hold standing fresh water almost all the year round. Ponds are small, temporary or permanent bodies of shallow water. They are still a minor component of the total world water supply.

**ACTIVITY 2.2**

**WE DO**

Collect samples of rainwater, water from hailstones, river water, sea water and lake or pond water.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Sample</th>
<th>Purity</th>
<th>Colour</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>3.</td>
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<tr>
<td>4.</td>
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<tr>
<td>5.</td>
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</tr>
</tbody>
</table>
2.3. FORMS OF WATER

We already know that water exists in three states i.e. solid, liquid and gas. All the three states are reversible or interchangeable.

All the three states of water are also present in our natural environment at any given time.

1. **Solid**: Ice is the solid form of water. It can be found in the atmosphere in the form of ice crystals, snow, ice pellets, hail and frost. It is also found in the polar regions and on high mountain peaks.

2. **Liquid**: Rain and dew are in the form of water droplets. Also liquid water covers three quarters of the surface of the earth in the form of lakes, rivers and oceans.

3. **Gas**: Water vapour is the gaseous form of water and exists as mist, fog, steam and clouds.

---

**Fig. 2.5. (a)** Water freezes to ice at 0°C  
**Fig. 2.5. (b)** Water remains a liquid between 0°C and 100°C  
**Fig. 2.5. (c)** Water changes to steam at 100°C

---

**The continuous circulation of water in nature is called water cycle. It is also called the hydrological cycle**

---

**Fig. 2.6. Water cycle**
2.4. GROUND WATER

- Precipitation in the form of rain or snow provides fresh water to our earth.
- Most of the fresh water returns to the oceans through rivers.
- A small portion of rain water seeps into the soil and is stored as underground water.
- Underground water is also called an **aquifer**.

**MORE TO KNOW**

A World Bank report says, “India is the largest user of groundwater in the world and its underground aquifers are being depleted at an alarming rate”.

- The top level of this underground water is called the water table. If we dig a hole in the ground near a water body we find that the soil is moist there.
- The moisture in the soil indicates the presence of underground water.
- If we dig deeper and deeper, we would reach a level where all the space between the particles of soil and the gaps between rocks are filled with water. The upper limit of this layer is called the **water table**.
- The water table varies from place to place and it may even change at a given place.
- Water in the aquifers can usually be pumped out with the help of tube wells or hand pumps.
2.5. DEPLETION OF WATER

1. Natural forces

Scanty rainfall and hot winds are natural forces that may deplete the water table.

2. Human causes

Deforestation, increased population, rapid urbanization, overgrazing by cattle, excess tapping of ground water are human causes.

3. Salt water intrusion

Many parts of the world are losing freshwater sources due to saltwater intrusion. Over use of underground freshwater reservoirs often allows salt water to intrude into aquifers and affect the water table.

4. Commercialization of water resources

Some of the private companies suck a large quantity of water from rivers and underground aquifers.

5. Sand grabbing from rivers

Some rivers are deeply affected by sand grabbing. eg. Palar river

2.6. DISTRIBUTION OF WATER

Water availability in India depends greatly on the seasonal monsoons. The monsoons bring heavy rains over most of the country between June and September, except Tamil Nadu, which receives over half of its rain in October and November. India has places of dry condition of deserts. (Thar desert) and places with rainforest climate (North Eastern States) too. In general, the northern half of the country is subjected to extremes of rainfall. India has a large network of rivers too. The three major rivers the Indus, the Ganga and the Brahmaputra originate in the Himalayas and drain nearly two-thirds of the land area.

During the monsoon, water level in rivers increase greatly that some times it may result in floods. On the other hand, during the dry season, water level goes down quite a bit in most of the large rivers. Smaller tributaries and streams generally dry up completely.

To regulate water flow in these rivers and to distribute water more evenly throughout the year, large dams have been built across a number of rivers.

MORE TO KNOW

- India receives nearly 4 per cent of the global precipitation and ranks 133 in the world in terms of water availability per person per annum.
- The total renewable water resources of India is estimated at 1,897 sq km per annum.
- By 2025, it is predicted that large parts of India will join countries or regions having absolute water scarcity.
2.7. SCARCITY OF WATER

Scarcity of water is defined as a situation where there is insufficient water to satisfy normal requirements.

Though water is a renewable resource, we, the humans, are using it at a faster rate than it is being replenished.

**Factors contributing to the depletion of water table.**

- Growing population has resulted in a growing demand for houses, offices, shops, roads etc. As a result, open areas like parks and playgrounds are used for construction of buildings. This reduces the seepage of water into the ground.

- Growing population has also resulted in an increase in the number of industries. Water is used in almost every stage of production of things that we use.

- As we already know India is an agricultural country and farmers have to depend on rains for irrigating their fields. However, erratic monsoons result in excess use of groundwater thereby decreasing the underground water.

- Uncontrolled use of bore well technology for extracting groundwater.

- Pollution of freshwater resources. This is due to the flow of untreated sewage from homes, toxic chemicals from industries and of pesticides and insecticides used by farmers into water bodies

- No effective measures for water conservation.

**ACTIVITY 2.3**

*WE DO*

Given here is the rainfall map of India. It gives the average annual rainfall in different regions of our country.

1. We locate on the map the place we live in.
2. Are we blessed with sufficient rainfall?
3. We discuss about the necessary steps to be taken to increase the rate of rain fall.

**MORE TO KNOW**

A design of a toilet in which human excreta are treated by earthworms has been tested in India. It has been found to be a novel technique. Toilets that required little water is safe for processing of human waste. The conversion of toilet waste is very simple and hygienic. The human excreta are completely converted to vermicakes – a resource much needed for soil.

Fig. 2.9. Water is vital for the survival of all organisms on earth
2.8 WATER MANAGEMENT - RAIN WATER HARVESTING

The activity of collecting rainwater directly or recharging it into the ground to improve ground water storage in the aquifer is called rain water harvesting. To recharge the groundwater, rainwater that falls on the terrace of the buildings and in the open space around the buildings may be harvested. Roof top rain water can be diverted to the existing open / bore well. Rainwater available in the open spaces around the building may be recharged into the ground by simple but effective methods. The Government of Tamil nadu leads the nation in implementing rainwater harvesting programme. It has been made mandatory for all houses and buildings in the state to install rainwater harvesting facility

**Rain water harvesting techniques**

There are two main techniques of rain water harvesting.

1. Storage of rainwater on the surface for future use.
2. Recharging the ground water.
   - Surface water is inadequate to meet our demand and we have to depend on ground water.
   - Due to rapid urbanization, infiltration of rain water into the sub-soil has decreased drastically and recharging of ground water has diminished.

**Advantages of rainwater harvesting**

- Rainwater harvesting can reduce flooding in city streets.
- Sea water intrusion in coastal areas can be arrested.
- The ground water can be conserved.
- Rainwater Harvesting can reduce top soil loss.
- It can improve plant growth.
Icebergs are pieces of glaciers that have drifted into the ocean and would otherwise melt and become saltwater. Icebergs are mostly white because the ice is full of tiny air bubbles. The bubble surfaces reflect white light giving the iceberg an overall white appearance. Ice that is bubble free has a blue tint which is due to the same light phenomenon that tints the sky. Drinking iceberg water is one of the most environmentally conscious methods of meeting the world’s increasing demand for clean fresh water. It is a noteworthy fact that all the North Indian Rivers originate in the glaciers of Himalayas.

There are two very positive environmental impacts from the use of drinking water from icebergs:

1. It decreases human dependency on traditional watersheds such as rivers and lakes, and therefore decreases human impact on these delicate and overstressed ecosystems.

2. It helps to reduce rising sea levels, which have been caused by polar icecap melting. Since most of the glaciers were formed thousands of years ago from falling snow, and snow results from condensed water vapour in the atmosphere, the water from icebergs is quite pure. Icebergs are comprised of pure fresh water.
2.9.2. DESALINATION OF SEA WATER

Desalination is an artificial process by which saline water (sea water) is converted into fresh water.

The most common desalination processes are:

1. **Distillation**
   The process in which both evaporation and condensation go side by side is called distillation.

2. **Reverse Osmosis**
   The process of forcing water under pressure through a semi-permeable membrane whose tiny pores allow water to pass but exclude most salts and minerals is called reverse osmosis.

The State Government of Tamil Nadu has taken up a venture to convert sea water into potable water by the Reverse Osmosis process to solve the problem of water scarcity in Chennai.

**The Minjur Desalination Plant**

It is the largest desalination plant in India. It is located in Kattupalli village near Minjur, about 35km north of Chennai. The plant is established on a 60-acre site at a cost of Rs.600 crore. It consists of 8,600 Sea Water Reverse Osmosis (RO) membranes to convert sea water into potable water. The RO technology of the plant produces 100 mld (million-litres-a-day) of freshwater from 273 million litres of sea water. The Minjur Desalination Plant supplies 100 mld of fresh water to the Chennai Metro Water Corporation at the rate of Rs.48.66 per 1,000 litres. The Desalination Plant serves potable water to an estimated population of 5 lakh in Chennai.

**The Nemmeli desalination plant**

The State Government has decided to alleviate the freshwater problems by the desalination of sea water. Besides the Minjur plant, the Chennai Metropolitan Water Supply and Sewage Board (CMWSSB) is also constructing a Desalination Plant at Nemmeli at a total cost of Rs.908.28 crore. The plant has a capacity to convert 100 million litres per day as

---

**MORE TO KNOW**

Water obtained through distillation is called distilled water. This water is normally pure enough for use in school science lab and medical laboratories.
potable water from sea water. Water from the Nemmeli plant would be carried over 40 km to the city, to be supplied to its residents.

**2.9.3. SWEET WATER ON EARTH**

1. The 2006 Mumbai “sweet” seawater incident was a phenomenon during which the residents of Mumbai claimed that the water at Mahim Creek had suddenly turned “sweet”. Mahim Creek is one of the most polluted creeks in India that receives thousands of tonnes of raw sewage and industrial waste every day.

2. Within few hours of the Mumbai “sweet” seawater incident, residents of Gujarat claimed that seawater at Teethal beach had turned sweet as well.

**MORE TO KNOW**

All oceans and seas have salty water. The saltiest of all is the Dead sea. It is called “dead” because the high salinity prevents any fish or other visible aquatic organisms to live in its water. Imagine 300 grams of salt in one litre of water. Interestingly, even if a person does not know how to swim, he would not drown in this sea. He would only float in it.

**ACTIVITY 2.5 I DO**

I calculate the amount of water I use daily.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>AMOUNT OF WATER USED IN LITRES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking</td>
<td></td>
</tr>
<tr>
<td>Cooking</td>
<td></td>
</tr>
<tr>
<td>Bathing</td>
<td></td>
</tr>
<tr>
<td>Washing</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2.13. Teethal Beach (Gujarat)

Geologists at the Indian Institute of Technology in Mumbai offered the explanation that water turning sweet is a natural phenomenon. Continuous rainfall over the preceding few days had caused a large pool of fresh water to accrue in an underground rock formation near to the coast. Then this water discharged into the sea as a large “plume”, as fractures in the rocks widened. Because of the differences in density, the discharged fresh water floated on top of the salt water of the sea and spread along the coast. In course of time, the two would mix to become normal sea water once more.

Water is a resource. Water is essential for the hygienic well being of all human beings. So water must be used optimally.
EVALUATION

1. Pick out the correct answer.
   a. Water exists in abundance on the planet -------------- (Earth/ Mars).
   b. -------------- are a huge store of water. (Oceans / Ponds)
   c. -------------- is the gaseous form of water. (Rain / Water vapour)
   d. Desalination is an artificial process by which -------------- is converted to fresh water. (sea water / river water)

2. Given below are some sources of water. Arrange the jumbled words in the right order and fill in the blanks

   INAR    RAIN        OWNS  ___________    RRVIE__________
   ASE    ___________    AKEL  ___________    NOPD  ___________

3. The diagram of a water cycle is given. Use the following words in the right place; sea, cloud, evaporation, rain

4. Why is supply of water essential to humans?

5. a) Why has urbanisation occurred? List the ways in which urbanisation
   i) benefits human
   ii) harmful to wild life.
   b) Suggest one way in which the effects of urbanisation can be reduced.

6. Advise class leaders on water conservation in your school. You can give them the following instructions;

   a) Close the water tap after use.  
   e) _________________________
   b) _________________________  
   f) _________________________
   c) _________________________  
   g) _________________________
   d) _________________________  
   h) _________________________
7. All of us use water every day. Fill in the table according to your observation:-

<table>
<thead>
<tr>
<th>S.No.</th>
<th>IN SCHOOL</th>
<th>AT HOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Source of water</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Number of taps</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Taps that leak</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Water wasted by leakage every day in litres</td>
<td></td>
</tr>
</tbody>
</table>

8. Visit the following places to observe rain water harvesting and state why rainwater harvesting is essential in these places.
   i) Temple
   ii) School building
   iii) Government office
   iv) House

9. The State Government of Tamil Nadu has taken up a venture to convert sea water into potable water. Name the two desalination plants setup in connection with this idea
   a) ______________
   b) ______________

FURTHER REFERENCE

Books

1. **Framework of Science** - Paddy Gannon, Oxford University Press, New Delhi

Webliography

[www.rainwaterharvesting.org](http://www.rainwaterharvesting.org)
[http://www.worldwaterday.org](http://www.worldwaterday.org)

Places of scientific importance for visit:

1. The Desalination Plant, Minjur, Thiruvallur District
2. The Desalination Plant, Nemmeli, Kanchipuram District
3. Sathanur Dam, Thiruvannamalai District
In the Stone Age, people never knew the use of fire. They ate raw food. Accidentally they discovered that by rubbing two stones together, they could produce fire. Later they used fire for cooking, getting light and for safeguarding their lives from animals. Fire is obtained by the rapid oxidation of a substance in the chemical process of combustion, releasing heat, light and various other products.

3.1. COMBUSTION AND ITS TYPES

Combustion is the burning of substances in air or oxygen to release heat and light. The substance that undergoes combustion is called fuel.

ACTIVITY 3.1

Aim: To know about the various substances that are used as fuel.

We use various kinds of fuel for various purposes at home, in industries and for running automobiles. Let us name a few fuels.

1. 
2. 
3. 

There are many substances that can burn. They can be classified depending on their state state as solid, liquid and gas. Cowung, coal and firewood are solid fuels. Kerosene and petrol are liquid fuels. LPG, coal gas, natural gas and bio-gas are gaseous fuels. You have learnt that magnesium burns to form magnesium oxide and produces heat and light. You can perform a similar activity with a piece of charcoal. What do you observe? You will find that coal burns in air producing carbon dioxide, heat and light. This process is an example of combustion. The substances that undergoes combustion are called combustible substances.
**ACTIVITY 3.2**

**Aim:** To differentiate combustible and non-combustible substances

**We need:** straw, wood, iron, nail, kerosene, a piece of stone, charcoal, match sticks, glass, burner, tongs

**Procedure:**
- Light the burner
- Using tongs, hold a piece of straw over the flame.
- What happens to the straw? Record the observation in the table given below.
- Repeat the above procedure with other substances and record your observation in the table.
- If combustion takes place, mark the substance as combustible, otherwise, mark it as non-combustible.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Combustible</th>
<th>Non-Combustible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron nail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerosene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone piece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charcoal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matchsticks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the above activity, we infer that substances like paper, straw, wood, matchsticks, etc. are combustible substances. Substances like stone, glass, iron nails, etc. do not burn on being exposed to flame. Such substances are called **non-combustible** substances.

Let us investigate the conditions under which combustion takes place.
ACTIVITY 3.3
WE OBSERVE

Aim: To show air is necessary for combustion

We need: chimney, candle, match box, wooden blocks, glass plate

Procedure:
(Caution: Be careful while handling the candle)
- Fix a lighted candle on a table.

Case 1
- Place a glass chimney over the candle and rest it on a few wooden blocks in such a way that air can enter the chimney.
- Observe what happens to the flame.

Case 2
- Now, remove the wooden blocks and let the chimney rest on the table.
- Again observe the flame.

Case 3
- Finally, place a glass plate over the chimney.
- Watch the flame again.
- What happens in the three cases?
- Does the flame flicker off?
- Does it flicker and give smoke?
- Does it burn unaffected?
- Can you infer anything about the role played by air in the process of burning?

The candle burns freely in case 1 when air can enter the chimney from the bottom. In case 2, when air does not enter the chimney from the bottom, the flame flickers and produces smoke. In case 3 the flame finally goes off, because the air is not available. Therefore you can easily understand that air is necessary for combustion.

TO THINK
You might have heard that when the clothes of a person catch fire, the person is covered with a blanket to extinguish the fire. Can you guess why?

Fig 3.3
Air is essential for burning

COMBUSTION AND FLAME