4. Nutrition in Living Organisms

Let's recall.

1. What is malnutrition?
2. Which are the ways to prevent malnutrition?

Nutrition

Some life-processes go on continuously in living organisms. Substances which are **digested** and **assimilated** for obtaining energy and for the growth and health of our body are called foodstuffs.

We get several types of nutrients from foodstuffs. Nutrients can be classified into two types, namely, **macro-nutrients** and **micro-nutrients**.

Nutrients like carbohydrates, proteins and fats are required in large quantity. These are macro-nutrients. Minerals and vitamins are required in very small quantity. They are called micro-nutrients.

The process of taking in and using food, which takes place in living organisms is called **nutrition**.

Need for nutrition

1. To supply the energy required for doing work.
2. Growth and development of the body.
3. To replace the damaged cells and repair tissues.
4. To fight diseases.

Autotrophic nutrition

Some organisms can produce their own food and thus nourish themselves. This is called **autotrophic nutrition**.

Heterotrophic nutrition

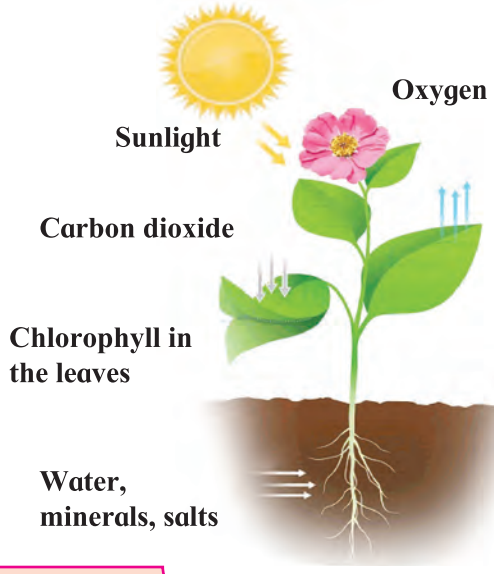
Some organisms depend on other organisms, plants or animals, for their food. This is called **heterotrophic nutrition**.

Autotrophic plants

Can you tell ?

How do plants produce their own food?

Plants also need food for their growth. They can produce their own food. With the help of sunlight and **chlorophyll**, plants make their food in their leaves, using water and nutrients from the soil and carbon dioxide from the air. This process is called as **photosynthesis**.



4.1 Photosynthesis

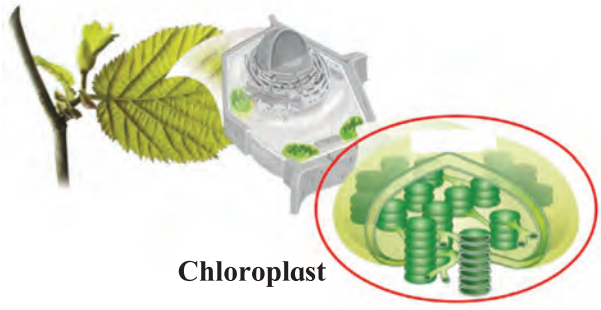
Carbon dioxide + water $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$ food (glucose) + oxygen

$6\,CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$

Plants convert light energy into chemical energy and store it in the form of food.

Water, minerals and salts are absorbed by roots from the soil. The stem transports them up to the leaves. The leaves have microscopic openings called stomata through which they take in the CO_2 from the air. The chloroplasts present in the leaves contain chlorophyll, which absorbs sunlight, helping to convert carbon dioxide and water into food. Oxygen is given out in this process.

Besides leaves, photosynthesis takes place in some other parts like green stems, too, as they contain chlorophyll.



4.2 Chloroplasts in a leaf

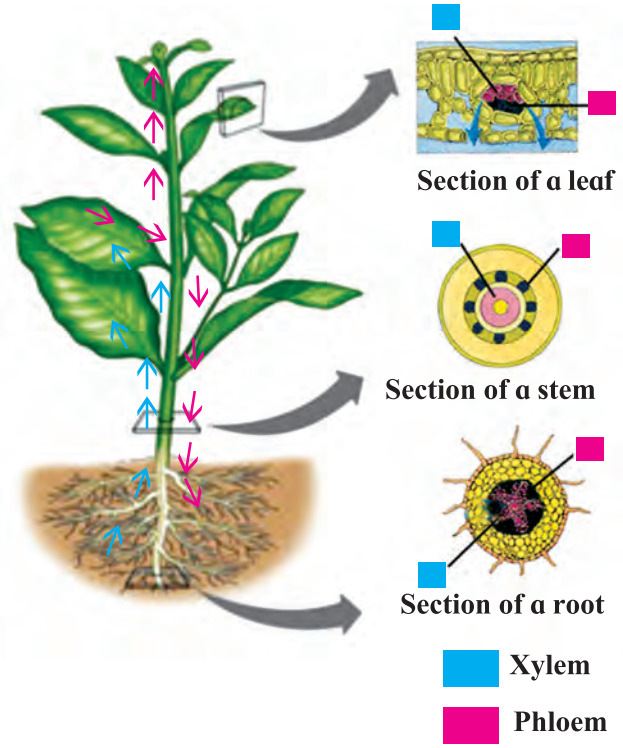
Find out.

How does photosynthesis occur in dark red or purple coloured leaves?

Transport system in plants

Take a pumpkin stem having 2-3 leaves. Cut it under water with a sharp blade. Take some water in a conical flask and add 7-8 drops of ink to it. Put the pumpkin stem vertically in that flask. Observe the changes that take place in it and discuss them in the classroom.

The transport system of plants consists of the **xylem** and the **phloem**. The xylem transports minerals and water from the root to all aerial parts of the plant. The phloem transports the food (glucose, etc.) from the leaves to other parts of the plant where it is either consumed or stored. Though the plants have a transport system, they do not have a separate digestive or excretory system.



4.3 Transport system in plants

Find out.

What is chemosynthesis? Which plants produce their food by chemosynthesis?

Let's recall.

Which are the different substances excreted by plants? Why?

Plants produce carbohydrates by the process of photosynthesis. Carbohydrates are made from carbon, hydrogen and oxygen. Proteins are made from carbon, hydrogen, oxygen and nitrogen. How do plants obtain the nitrogen necessary for the synthesis of proteins?

4.4 Roots of a leguminous plant

Air contains gaseous nitrogen. However, plants cannot utilize gaseous nitrogen. It needs to be fixed i.e. converted into compounds. Fixation of nitrogen occurs by biological and atmospheric methods.

Biological fixation of nitrogen

Two different types of micro-organisms can bring about biological nitrogen fixation. Root-nodules of leguminous plants contain the rhizobium micro-organisms. These micro-organisms absorb atmospheric nitrogen and convert it into its nitrate, a compound.

Micro-organisms like azotobacter are present in soil. They also convert atomspheric nitrogen into nitrates.

Do you know?

Atmospheric fixation of nitrogen : Lightning (thunderbolts) occur in the rainy season. This causes atmospheric nitrogen and oxygen to react with each other to form nitric oxide (NO) which is again oxidized to form nitrogen dioxide (NO_2).

The nitrogen dioxide dissolves in rainwater and is converted into nitric acid (HNO_3) which gets added to the soil along with the rain-water. Plants use this nitrogen for their growth.

4.5 Lichen

Symbiotic nutrition

In some cases, two or more than two different types of plants live together to fulfill their needs of nutrition, protection, support, etc. with each others' help. This type of nutrition is called **symbiotic nutrition**.

Some fungi grow around the roots of some other plants. These plants supply nutrients to the fungi and in turn, fungi supply minerals and water to the plants. Some fungi and algae live together. The fungi provides water, minerals as well as shelter to algae. In return, the algae provide food to the fungi. **Lichen** is an example of a symbiosis between algae and fungi.

Heterotrophic plants

Heterotrophic plants do not contain chlorophyll. How do the heterotrophic plants live? From where do they get food?

Have you seen a yellow, wire-like, leafless climber plant growing on a big tree? What is its name?

The plants that grow on the body of other plants to obtain food are called as parasitic plants, for example, loranthus, cuscuta, etc.

Due to the absence of chlorophyll, the *cuscuta* is completely dependent on the host plant. Hence, it is said to be a completely parasitic plant.

You must have also noticed loranthus that grows on trees.

4.6 Loranthus

Use your brain power!

1. Which part of the loranthus plant carries out photosynthesis?
2. From where do they obtain minerals and water?
3. Why is loranthus known as a partially parasitic plant?

Insectivorous plants

We have seen how some plants feed upon insects to obtain nutrients. These insectivorous plants generally grow in soil or water deficient in nitrogen compounds. The plant body of the Drosera burmanii has a flower-like appearance. It grows close to the ground. Its leaves are attractively pink or red in colour with hairs at the margin. Droplets of a sticky subtance found at the tips of the hairs attract insects. The scientist Johannes Burman identified this plant in Sri Lanka in 1737. Hence, the plant is named after him.

4.7 Drosera burmanii

Use your brain power!

Why does the pitcher plant feed on insects even though it produces food by photosynthesis?

Saprophytic plants

Plants which obtain the food from dead and decaying bodies of other organisms are called saprophytic plants.

Various types of fungi like mushrooms and yeast are saprophytes. Fungi secrete digestive enzymes on the dead remains to digest or breakdown the carbon compounds they contain. The resulting solution is absorbed to obtain nutrients.

4.8 A saprophytic plant

Always remember –

Food gets spoiled due to some fungi. Some fungi cause diseases or illness while some fungi have medicinal properties.

Yeast and some mushrooms are useful. Yeast is used in fermentation processes and for making bread. Mushrooms are a rich source of iron and vitamins.

Role of nutrients and effects of their deficiency on plants :

Nutrient	Function	Effects of deficiency
Nitrogen	Important component of protiens, chlorophyll and cytoplasm.	Retarded/stunted growth, yellowing of leaves.
Phosphorus	Conversion of light energy into chemical energy.	Early leaf-fall, late flowering, slow growth of roots.
Potassium	Necessary for metabolic activities.	Weak stem, wilting of leaves, failure to produce carbohydrates.
Magnesium	Production of chlorophyll	Slow/retarded growth, yellowing of leaves.
Iron	Production of chlorophyll	Yellowing of leaves
Manganese	Production of main plant hormones	Retarded growth, spotted leaves
Zinc	Production of hormones and their intermediates	Retarded growth, yellowing of leaves

★ **Observe the plants around you and diagnose the nutrient deficiency, if any.**

Nutrition in animals

This concept refers to the body's need for nutrients, mode of ingesting food and its use in the body.

Let's recall.

Which are the various nutrients in food? For what purpose are the nutrients used?

Nutrients necessary for various activities of the body are obtained from food. They are supplied to the various parts of body through blood. The food that we consume does not mix with blood as it is. It needs to convert into soluble forms that can easily mix in blood. Nutrition in animals involves various steps from ingestion to egestion.

Steps in nutrition

1. Ingestion - Food is taken into the body.
2. Digestion - Conversion of food into simple soluble forms.
3. Absorption - Transfer of soluble food to the blood.
4. Assimilation - Utilization of absorbed food by cells and tissues for energy production, growth and repair.
5. Egestion - Removal of waste products and undigested food from body.

Observe the animals around you and complete the following table.

No.	Name of animal	Type/Name of food	Method of ingestion
1.	Cow		
2.	Frog		

You must have observed that there are different methods of ingestion of food in different animals, like swallowing, chewing, sucking, scraping, gnawing, etc.

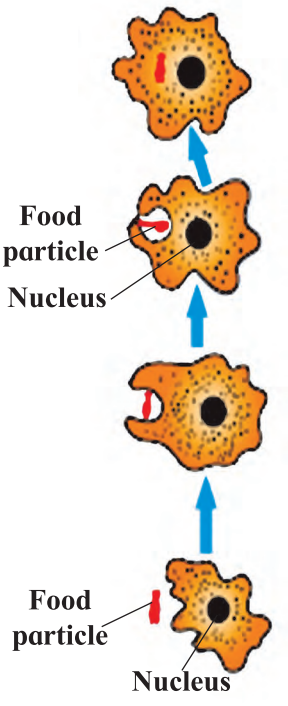
Types of nutrition in animals

(A) Holozoic nutrition

Can you tell ?

How does ingestion occur in unicellular animals like *Amoeba*?

Amoeba does not have organs like hands and mouth. It is a unicellular animal. It can take in food through any part of the surface of its unicellular body. It surrounds the food particle from all sides to take it into the cell. After that, it digests the food with the help of different enzymes. Undigested food is left behind as the amoeba moves further with the help of pseudopodia. In unicellular animals like amoeba, euglena, paramoecium, etc. all the steps of nutrition occur within their unicellular body.

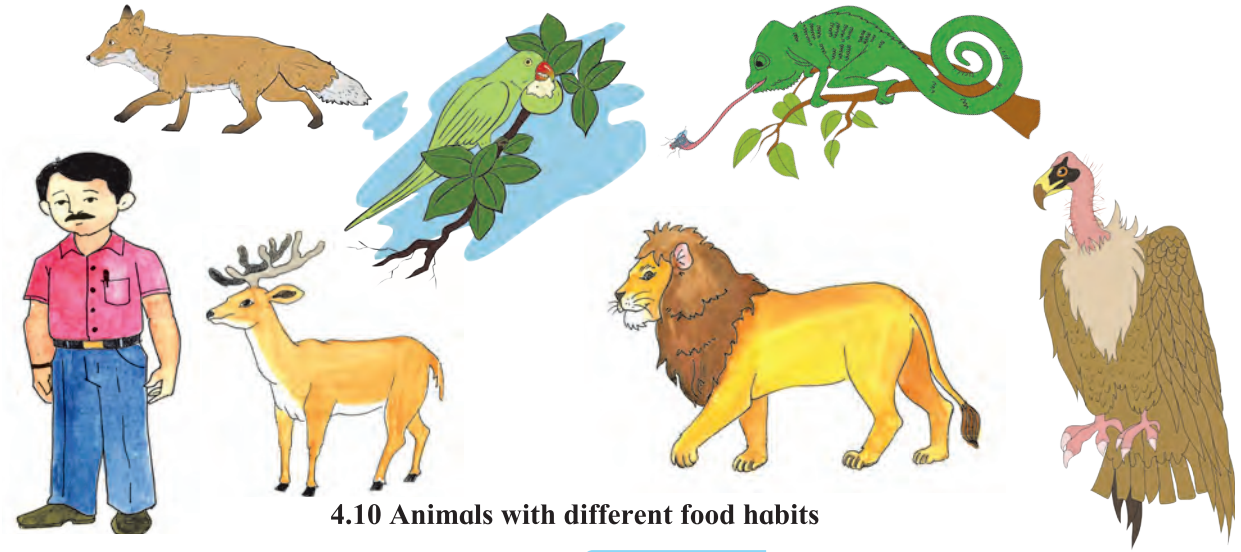


4.9. Amoeba

Insects have mouth-parts for ingestion of food. For example, insects like the cockroach and grasshopper which nibble have jaw-like mouth-parts. Butterflies suck food with a a tube-like proboscis. Mosquitoes and bedbugs use a needle-like mouth part to pierce and a tube-like mouth part to suck blood or other fluids.

Observe and discuss.

How will you classify the following animals according to their food-type?

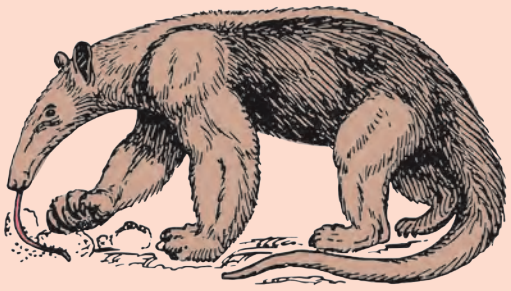


4.10 Animals with different food habits

According to the type of food, animals can be classified as -

1. Herbivores : Herbivores use plants directly as their food. Example are grazing animals, granivores (seed-eaters), frugivores (fruit-eaters), etc.

2. Carnivores : Animals that depend on other animals for their food are carnivores. Carnivores are indirectly dependent on plants for food. Examples are animals that feed on herbivores (predators), animals that feed on insects (insectivores).



The anteater is found in Central and South America.

The bobcat or *udmanjar* is an ant-eating animal found in India. Obtain its pictures from the internet.

3. Omnivores : Animals that obtain their food from both plants and animals are called omnivores. Examples are monkey, chimpanzee, human, etc.

Some of the organisms around us perform the function of cleaning and conserving the environment by the very act of feeding themselves. They are called **scavengers** and **decomposers**.

4. Scavengers obtain their food from dead bodies of animals, for example, vulture, crow, hyena, etc.

5. Decomposers are some microbes which obtain their food by decomposing the dead bodies of organisms or other materials.

(B) Saprozoic nutrition

Some insects, unicellular animals, etc. obtain the nutrients by absorbing the liquid organic material from the dead bodies of other animals or from the environment. This is saprozoic nutrition. Example, houseflies, ants, spiders, etc.

(C) Parasitic nutrition

1. Have you seen small animals on the bodies of animals like dogs and buffaloes? Which are those small animals?

2. From where do these little animals obtain their food?

4.11 Parasites

3. From where do the worms in the intestine obtain their food?

Some animals depend upon other animals for food. They can obtain the food only from animals on whom they are dependent. This is called as **parasitic nutrition**.

Some animals live on the body surface of other animals and obtain their food by sucking their blood. This is called **ectoparasitic nutrition** and such animals are called ectoparasites, for example, louse, bed-bug, tick, etc. Animals like tapeworm and roundworms live inside the body of other animals and obtain their food. This is **endoparasitic nutrition** and these animals are known as endoparasites.

Exercise

1. Classify according to food-type.

tiger, cow, vulture, bacteria, deer, goat, human, fungus, lion, sparrow, buffalo, frog, cockroach, tick.

2. Match the pairs.

Group 'A'	Group 'B'
(1) Parasitic plant	(a) Mushroom
(2) Insectivorous plant	(b) Lichen
(3) Saprophytic plant	(c) Drosera
(4) Symbiotic plant	(d) Cuscuta

3. Answer the following questions in your own words.

(a) Why do living organisms need nutrition?

(b) Explain the process of production of food in plants.

(c) What is meant by parasitic plants? Name their different types with examples of each.

(d) Explain the various steps of nutrition in animals.

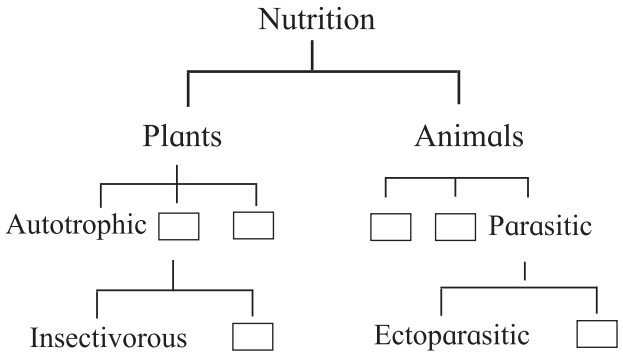
(e) Name some unicellular organisms in which all life-processes take place within their unicellular body.

4. Give reasons.

(a) Insectivorous plants are attractively coloured.

(b) Butterflies have a long tube-like proboscis.

5. Prepare and complete the flowchart according to type of nutrition.



6. Think and answer.

(a) We prepare a variety of foodstuffs and dishes at home. Are we then autotrophic organisms?

(b) Which organisms are greater in number - autotrophs or heterotrophs? Why?

(c) The number of heterotrophs found in desert regions is smaller. However, they are found in greater numbers in the sea. Why is this so?

(d) What damage or harm do ectoparasitic and endoparasitic animals cause?

(e) Why is plant food not produced in any other parts of the plant except the green ones?

Project :

1. Many heterotrophic organisms live on one and the same plant. Observe one such plant in your neighbourhood and find out about the heterotrophs that depend upon it for their food. Observe and make notes about other organisms that use these heterotrophs as their food.
2. Prepare a power point presentation on the topic 'Nutrition in Living Organisms'.

♦ ♦ ♦

5. Food Safety

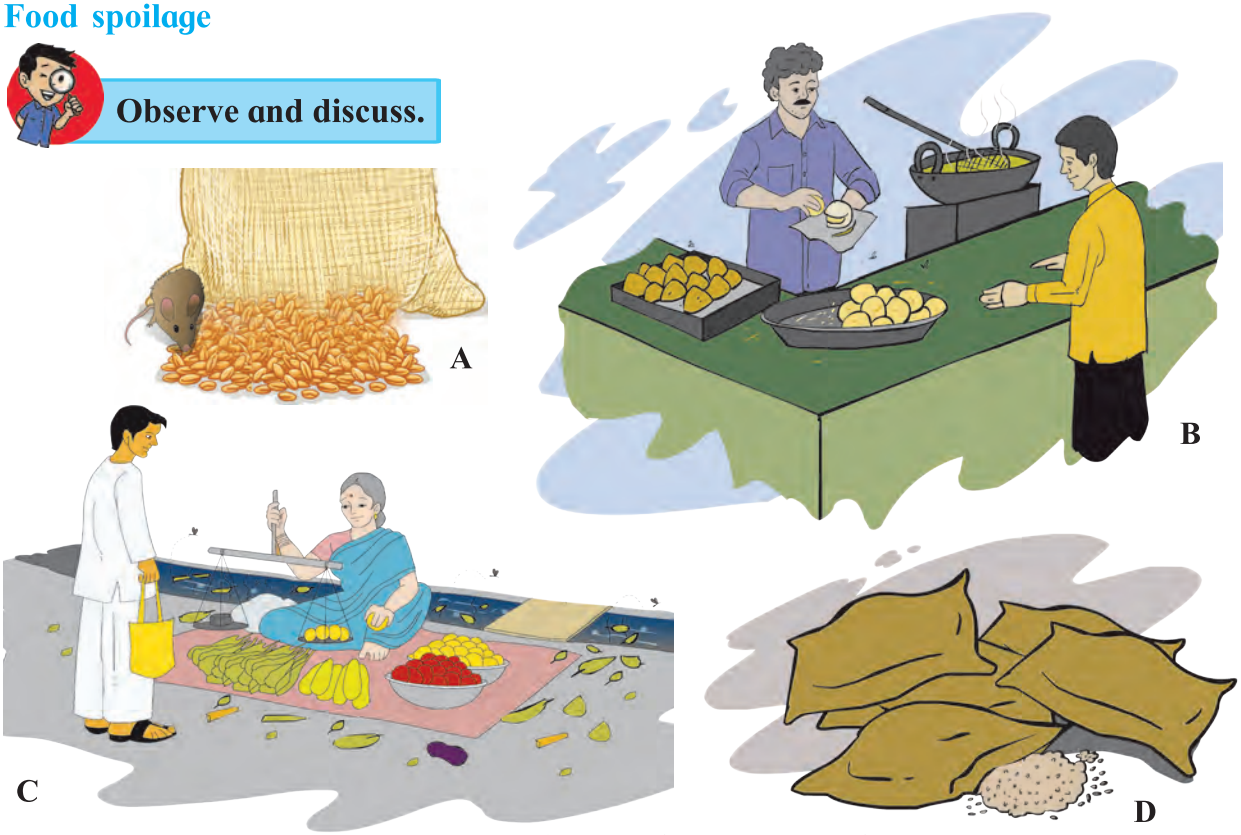
Let's recall. Complete the following chart with the correct information.

Sr. No.	Food / Source	Nutrients obtained	Function in body
1.	Jowar, wheat, millet (bajra), rice		
2.	Beans and pulses		
3.	Oil, ghee, etc.		
4.	Fruits and vegetables		

All constituents of food-carbohydrates, fats, proteins, vitamins, minerals, fibre and water are necessary for the proper growth of the body. We get these nutrients from food materials like wheat, jowar, pulses, rice, vegetables, fruits, etc. However, what will happen if these food materials are infested by insects or spoiled in any way?

Food spoilage

Observe and discuss.



5.1 Events in our surroundings

Factors responsible for food spoilage

Sometimes, fruits or their skins turn black. Some foodstuffs give out a foul or bad odour. Such foodstuffs are not suitable for us to eat. Sometimes, naturally available food materials are spoiled by wrong handling as when they are over-cooked, or improperly stored, say in a damp place. In such cases, the quality of the food materials deteriorates. They may also be spoiled during transportation. Can you give more such examples of food spoilage?

The foodstuffs we consume, whether of animal or plant source, must be of the best quality. Otherwise, we may fall prey to disease or illness. Food is said to be spoiled if there is a change in its colour, odour, texture, quality, taste and there is a loss of its nutrient content.

Observe and discuss.

5.3 Our favourites

On a day out with our friends or family we enjoy mouth-watering dishes like *pani-puri*, *shev-puri*, *pav-bhaji*, *vada-pav*, pizzas, burgers. But, have you ever given a thought to how or where they were made? Were they displayed and served hygienically? What was the source of the water used for preparing them? Discuss all these matters with your science teacher.

Observe.

Which fruits in the picture appear to be good to eat? Why?

5.3 Fruits

Various kinds of changes occur in food materials. For example, fruits turn black or change taste, meat becomes sour or peanuts become rancid. All these changes occur due to factors within the food materials.

Often, food grains, etc. produced in farms are damaged due to various reasons like improper handling, improper storage, improper transportation, etc. Some foodstuffs like meat and milk are either acidic or alkaline. They may get spoiled due to chemical reactions on contact with metals. Sometimes, foodstuffs may be spoiled due to contamination by micro-organisms or insects from the surrounding air, water or soil.

Can you give some other examples of factors that cause spoilage of food?

Food wastage

Can you tell ?

How and where is food wasted?

With the help of science and technology, India has shown great progress in the production of various foodstuffs like cereals, fruits, vegetables, fish as well as milk and milk-products. Even so, many people in our country and all over the world face the problem of hunger. Many do not get even one meal a day. Hence, it is our duty to prevent wastage of food wherever it takes place.

Quantitative wastage of food : Wrong methods of farming like hand sowing of seeds, inadequate threshing, improper storage and wrong methods of distribution are some reasons for quantitative wastage of food. Besides, much food is wasted as a result of the custom of offering and serving too much food to guests at traditional feasts or banquets. Had it not been wasted, all this food could have met the need of many others.

Qualitative wastage of food : Using wrong methods of protecting food, excessive use of food preservatives, over-cooking, washing the vegetables after cutting them, mis-handling of fruits like grapes and mangoes, mis-calculation of the time required to transport food from producers to consumers, are some of the causes of qualitative wastage of food.

What can you do to prevent food wastage and spoilage?

1. Serve yourself only as much as you can eat.
2. Avoid over-cooking food.
3. Avoid throwing away left-over food. Re-use it in a proper way.
4. Buy only as much grain, vegetables, fruits, milk, etc. as you need. Avoid the temptation to make excessive purchases.
5. Store grains and other perishable foodstuffs like vegetables, fruits, milk, etc. using proper methods.
6. Check the expiry date of bottled, canned, packed food and use within that time.
7. Eat all the food that you have served yourself.

Observe and discuss.

What can we do to avoid use of rice grains as '*akshata*' and to prevent wastage of food during wedding feasts?

16th OCTOBER
WORLD FOOD DAY
To work towards food security and avoid food wastage.

Food storage and preservation

We have learnt about various methods of safe storage of food like freezing, drying, boiling, air-tight packing, etc. These different methods prevent the growth of micro-organisms in food and thereby save the food from spoiling.

Food protection and food preservation

Food protection : Prevention of food spoilage by microbial growth and infestation by pests is called food protection.

Food preservation : Use of various preservatives to prevent, for a long period of time, food spoilage due to internal factors is called food preservation.

National Institutions

Food and Drug Administration

This is a government organization that controls production and distribution of food and drugs by their standardization. Food Safety and Standardization Authority of India (FSSAI) has been established as per the Food Safety and Standardization Act-2006.

Web addresses : www.fssai.gov.in
www.fda.maharashtra.gov.in

Methods of Food Protection

Freezing

Biological and chemical reactions in food materials are slowed down at low temperature. As a result, food remains in good condition for a longer duration. That is why, refrigerators are used in the kitchen.

Smoking

Food is preserved with the help of smoke. Aluminium phosphide is used in this method.

Use of insecticides

Melathion is sprayed on the gunny bags containing foodgrains.

Irradiation

In this method, food is exposed to ionizing radiations such as high energy electrons emitted by accelerators, X-rays, gamma-rays emitted by radioactive isotopes, etc. This process destroys the microbes, insects, etc. Shelf-life of fruits increases due to increase in ripening period. The shelf-life of potatoes and onions increases due to slowed-down sprouting.

Use of insert gas

Nitrogen gas is filled in air-tight packets of potato wafers and other food products thus preventing the growth of fungus and insects in them.

Use of preservatives

Natural preservatives

Some naturally available materials like salt, sugar, oil are used as preservatives in pickles, jams, *murabba*, *petha*, etc.

Chemical preservatives

Acetic acid (vinegar), citric acid, sodium benzoate and some nitrate and nitrite salts are some examples of chemical preservatives. They are used in sauces, jellies, jams, and in packaged ready-to-cook vegetables and ready-to-eat foods, etc. These preservatives keep the food safe for a very long duration.

Pasteurisation

This method involves heating the milk or other similar foodstuffs up to a certain temperature, e.g., milk at 80° C for 15 minutes and cooling it quickly. This destroys the microbes present in the milk and it keeps for a longer duration.

Do you know?

In Maharashtra, irradiation plants have been installed at Lasalgaon for onions and potatoes and at Navi Mumbai for spices and condiments.

Great Scientists

The microbiologist, Louis Pasteur developed the technique of preserving the quality of food by raising its temperature to prevent microbial growth in the food.

Let's recall. What is meant by adulteration of food?

Complete the following table.

Sr. No.	Foodstuff	Adulterant
1.	Milk	----------
2.	Red chilly powder	----------
3.	----------	Seeds of papaya
4.	Ice cream	

The health of all people, young and old, poor or rich, is endangered by food adulteration. Different types of adulterants affect our health in different ways. Some adulterants cause abdominal discomfort or poisoning, while some may affect the functioning of some organs if consumed over a long period of time, or even cause cancer.

Food is adulterated in this way too!

1. Removal of some important components of food; e.g., removal of fat content of milk, essence of cloves, cardamoms, etc.
2. Mixing of a low quality inedible or cheaper material or a harmful colour with food.
3. Mixing of some harmful materials like small stones, fine sand, iron filings, urea, dung of horse, sawdust, etc.

Think a little!

Each one of us should think about what we eat every day and about the nutritive value and quality of the food we eat.

How will you find out if food has been adulterated?

Food material	Adulterant	Test	Conclusion
Milk	Water	Put a drop of milk on a glass slide and slightly incline it to spread the drop.	If the spread-mark of milk does not appear milky white, water must have been added to it.
Red chilly powder	Brick dust	Take a spoonful of chilly powder in a beaker, add water up to half of the beaker, stir it and leave it undisturbed for a few minutes.	If a red layer is seen settled at the bottom of the beaker, it must have been adulterated with brick dust.
Turmeric powder	Metanyl yellow	Take a pinch of turmeric powder in a test tube, add a small quantity of water to it, shake the mixture and add a few drops of conc. HCl.	The mixture becomes red on addition of conc. HCl and the red colour does not disappear if metanyl yellow is present.
Rava	Fine iron filings	Pass a magnet through the *rava*.	Iron filings adhere to the magnet.

My friend, the internet!

Watch the video-clips about food adulteration on www.youtube.com and make an identification kit for detecting food adulteration.

Books, my friends!

Collect books which give more information about food adulteration. Read and try to identify food adulteration.

Do you know?

In 1954, Parliament passed the Prevention of Food Adulteration Act. It has been amended from time to time and the amendment of 1976, provides for 'life imprisonment' for the person involved in adulterating food with a harmful substance. There are clear directions that food should be properly stored, packing material should not endanger the food or medicines and there should clear and legible information on it about the manufacturing date, expiry date, and instructions for storage.

Always remember –

1. Some chemicals are injected into fruits to make them more attractive and tasty.
2. Milk vendors add urea to the milk so that it appears to have higher fat content.
3. Shopkeepers change the 'Expiry date' of the food packets and air tight containers to avoid a financial loss.
4. Calcium carbide and some other chemicals are used to make fruits look more attractive, e.g., bright yellow bananas.
5. Frequently, harmful chemicals like carbonated soda, phosphoric acid, etc. are mixed with cold drinks.

Exercise

1. Complete the following statements by using the correct option from those given below.

(Irradiation, dehydration, pasteurization, natural, chemical)

(a) Drying the food grains from farms under the hot sun is called ..... .

(b) Materials like milk are instantly cooled after heating up to a certain high temperature. This method of food preservation is called ..... .

(c) Salt is a ..... type of food preservative.

(d) Vinegar is a ..... type of food preservative.

2. Answer the following questions in your own words.

(a) How is milk pasteurized?

(b) Why should we not consume adulterated food materials?

(c) What precautions do your parents take to keep foodstuffs safe?

(d) How does food spoilage occur? Which are the various factors spoiling the food?

(e) Which methods of food preservation would you use?

3. What shall we do?

(a) There are vendors selling uncovered sweetmeats in open places in the market.

(b) A '*pani-puriwalla*' is serving the *pani puri* with dirty hands.

(c) We have purchased a large quantity of fruits and vegetables.

(d) We need to protect foodstuffs from pests like rats, cockroaches, wall--lizards, etc.

4. Find the odd-man-out.

(a) salt, vinegar, citric acid, sodium benzoate

(b) *lakhi* dal, brick dust, metanyl yellow, turmeric powder

(c) banana, apple, guava, almond

(d) storing, freezing, settling, drying

5. Complete the chart below.

S.No.	Foodstuff	Adulterant
1.	-----	Metanyl yellow
2.	Black pepper	-----
3.	-----	Iron filings
4.	Honey	-----

6. Explain why this happens and suggest possible remedies.

(a) Qualitative wastage of food.

(b) The cooked rice is underdone.

(c) The wheat that was bought is a bit moist.

(d) The taste of yoghurt is too sour/slightly bitter.

(e) Cut fruits have turned black.

7. Give reasons.

1. Food remains safe at 5° Celsius.
2. Nowadays, food is served buffet style during large gatherings.

Project :

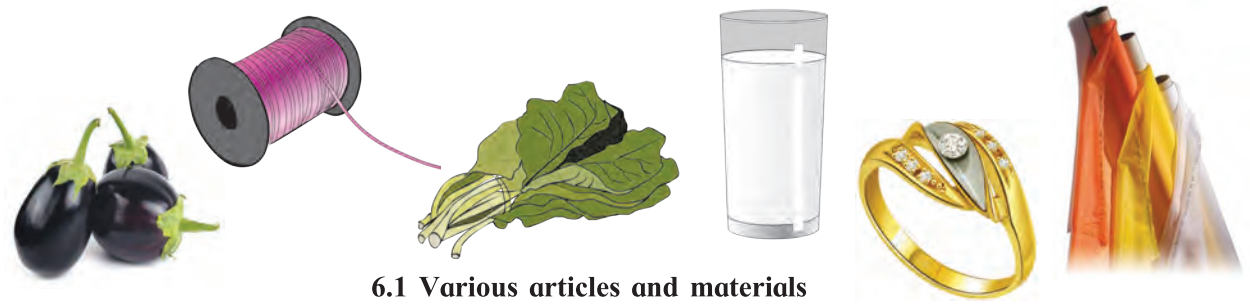
1. Go to your kitchen and take notes about the food safety measures and the food wastage you see there.
2. In a science exhibition demonstrate the various methods of detecting food adulteration.

♦ ♦ ♦

6. Measurement of Physical Quantities

Observe and discuss.

How are the various articles and materials, shown in the picture measured?



6.1 Various articles and materials

Physical quantity

In day-to-day life, we measure many things such as the weight of fruits, vegetables, food grains, temperature of the body or some liquids, volume of liquids, density of various substances, the speed of vehicles, etc. Quantities such as mass, weight, distance, speed, temperature, volume are called **physical quantities.**

A value and a unit are used to express the magnitude of a physical quantity. For example, Swarali walks two kilometres everyday. In this example, 'two' is the value and 'kilometre' is the unit used to express the magnitude of the distance which is a physical quantity.

Scalar quantity

A quantity that can be completely expressed by its magnitude alone is called a scalar quantity. For example, only magnitude, i.e. a value with a unit, is used to express quantities such as length, breadth, area, mass, temperature, density, time, work, etc. Thus, we say that the length of a tunnel is two kilometres, the fever (temperature) is 101° Farenheit, etc.

Vector quantity

The quantity that is expressed completely only when magnitude and direction are both given is called a vector quantity.

Displacement, velocity are vector quantities. For example, a displacement of 20 kilometres towards the north, the aeroplane flying at a velocity of 500 km/hr towards Mumbai.

Mass

The amount of matter present in a substance is called mass. Matter has a natural tendency to resist a change in its state, which is called inertia. **Mass** is the qualitative measure of the inertia of an object. The larger the mass, the greater is the inertia. **Mass is a scalar quantity**. It does not change from place to place anywhere in the world. The quantities mass and weight are, however, different. Gram and kilogram are the units of mass.

When we use the two-pan common balance in a shop, we compare two masses.

Weight

What we measure in grams, kilograms is mass, and not weight. The gravitational force that acts on this mass is called its **weight**. The gravitational force by which the earth attracts an object towards its centre is called the weight of the object. Therefore, **weight is a vector quantity**. It is different at different places on the earth.

Use your brain power!

1. Why would the weight of an object be maximum at the poles and minimum at the equator?
2. Why is the weight of an object at a high altitude less than its weight at the sea-level?

Will it be possible to use one and the same unit to measure physical quantities such as mass, weight, distance, velocity, temperature?

In everyday affairs, we measure many different physical quantities. As these physical quantities are different from each other a specific unit is used to measure each quantity. Therefore, different units are used while measuring different quantities.

Try this. **Standardized measurement**

1. Take a ball of string. Let one student from the class measure four hand-spans of the string and cut it there. Let each of the other students in the class cut four hand-spans of the string, too. Now hold all the pieces together by one end. Are they all of the same length?

2. Now, measure the length of a bench by means of the span of your hand. Ask your friends to do the same. Did each of you obtain the same measure for that bench? What could be the reason?

Standardized measures are required for measuring things. Such measures are called standard units.

We have to measure many physical quantities accurately. To measure any quantity, we use the unit specified for it.

For example, the metre (m) is the specified unit for measuring length. A certain distance has been accepted as the standard for 1.0 metre. Why is there a need for such a standard unit? Suppose, the span of a hand is accepted as the unit for measuring length. With this unit, we can measure lengths of cloth as two hand-spans, three hand-spans, and so on. However, the lengths of the cloth measured by each one of us will come out to be different. That is why a 'hand-span' cannot be a standard unit for measuring length.

Do you know?

Our body has weight because of the gravitational force of the earth. The gravitational force of the moon being less, our weight will turn out to be less there. Our mass, however, is the same at both the places.

Always remember –

Prevailing systems of measurement

1. MKS System : In this system distance is measured in metres, mass in kilograms and time in seconds.

2. CGS System : In this system distance is measured in centimetres, mass in grams and time in seconds.

In the MKS system of measurement, distance, mass, and time are accepted as the fundamental quantities. These three quantities are used to measure all other quantities.

Complete the following table.

Physical Quantity	M.K.S.	C.G.S.
Mass	Kilogram	Gram
Distance		
Time		
Speed		

There are many physical quantities but a majority of them are related to each other. For example, you have learnt that the quantity 'speed' is the ratio of the quantities 'distance' and 'time'.

Try this.

Work out the area of your classroom. Which quantities are taken into account to calculate the area?

Fundamental quantities : It is enough to select a few out of the many quantities and standardize their units. You can see from the above examples, that units of the quantities length and time need to be standardized. Such quantities are called fundamental quantities and their units are called standard units. Of course, a standard fundamental unit must be available to all, and it must not be variable.

International system of units : An international system of units based on seven fundamental units, called the System International (SI), is currently used all over the world. It is also called the **metric system**.

The names and symbols of the units of the fundamental quantities, length, time and mass, in this system, are given in the following table:

Quantity	Name of the unit	Symbol of the unit
Length	metre	m
Mass	kilogram	kg
Time	second	s

Standards of the fundamental quantities

As the standard of mass a solid cylinder made of a platinum-iridium alloy is kept in the International Bureau of Weights and Measures at Paris. As per the international agreement, this mass is called one kilogram. Official accurate copies of this prototype are kept in the standardizing laboratories/institutes all over the world.

Two fine lines are engraved on a platinum-iridium bar kept in the International Bureau of Weights and Measures at Paris. The distance between these two lines is accepted as the standard metre. Accurate copies of this prototype are made and distributed to standardizing laboratories/institutes all over the world.

The time required for one revolution of the earth is measured by means of an accurate device. This time is taken as 24 hours. To standardize one second, one hour is considered to have 60 minutes and one minute, 60 seconds.

Find out.

1. What is an atomic clock? Where is it kept?
2. How is the velocity of light used for determining the standard metre?

Great Scientists

When man felt the need to measure things, he started by using the parts of his own body for the purpose. In Egypt in ancient times, the distance from a man's elbow to the tip of his middle finger was called a 'cubit'. This measure would differ from person to person. Therefore, the cubit of the King was considered as the standard. In olden times, we weighed gold in a unit called *gunj*. An 'hour glass' was used for measuring time. Have you seen one?

Observe and discuss.

Identify the wrong methods of measurement shown in the picture and explain why they are wrong.

6.2 Various methods of measurement

Importance of accurate measurement

How accurate a measurement must be depends upon its purpose. Accordingly, an appropriate device has to be used for the measurement. Measurement of substances that are precious, of great importance and used in very small quantities, is done meticulously and accurately. Due to advancements in technology, devices that measure very small magnitudes of quantities like distance, mass, time and temperature, are available now, for example, distance and time in connection with very important sports competitions, mass of gold, body temperature, etc.

Major causes of errors in measurement

1. Not using the appropriate device.
2. Not using the device properly.

Make a list of possible errors other than these.

Do you really get as many litres of petrol as the petrol pump indicates? To ensure this, it is necessary to check it against a standard measure from time to time. This is called standardization. Similarly, it is necessary to standardize the weights and measures used in the market.

While buying things at grocery shops, the vegetable market, remember to look out for the following and tell your guardians to do so, too.

1. Does the balance carry the stamp of standardisation by the department of weights and measures ?
2. Is the balance stable? Is the pointer of the balance upright?
3. Is the weight made of metal? How is the balance held?
4. Has the underside of the pan of the balance been tampered with?

To prevent consumers from being cheated, a Weights and Measures sub-division functions as part of the Food, Urban Supply and Consumer Protection Division of the Government. Officers of this sub-division visit different places from time to time, and ascertain whether the weights and balances being used are proper or not. It is binding by law to use standard weights and measures. It is also a function of the Weights and Measure sub-division to grant licences for the production, sales and repairs of weights and measures.

My friend, the internet!

1. www.legalmetrology.maharashtra.gov.in
2. **The standards of the six fundamental units, namely, metre, kilogram, second, Kelvin, Ampere and Candela are kept in the National Physical Laboratory at New Delhi.** www.nplindia.org/npl-charter

Do you know?

During the rainy season, you might have heard, seen and read, news regarding how much water is collecting in the dam, how much water is being released and about the present stock of water in the dam. Do you know the following terms in this connection?

1 TMC means one thousand million cubic feet.

1 cubic foot means 28.317 litres.

1 TMC = 28316846592 litres, that is about 28.317 thousand million litres.

My friends, newspapers

What is the capacity of the various dams in Maharashtra ? Collect information about the discharge of water from various dams during the month of August, September and October and of the consequences of the discharge.

1. Write answers to the following questions in your own words.

(a) Why is the weight of the same object different on different planets?

(b) What precautions will you take to make accurate measurements in day-to-day affairs?

(c) What is the difference between mass and weight?

2. Who is my companion?

Group 'A'	Group 'B'
(1) Velocity	(a) litre
(2) Area	(b) kilogram
(3) Volume	(c) metre/second
(4) Mass	(d) kilogram/cubic metre
(5) Density	(e) square metre

3. Explain giving examples.

(a) Scalar quantity

(b) Vector quantity

4. Explain, giving examples, the errors that occur while making measurements.

5. Give reasons.

(a) It is not proper to measure quantities by using body parts as units.

(b) It is necessary to get the weights and measures standardized at regular intervals.

6. Explain the need for accurate measurement and the devices to be used for that.

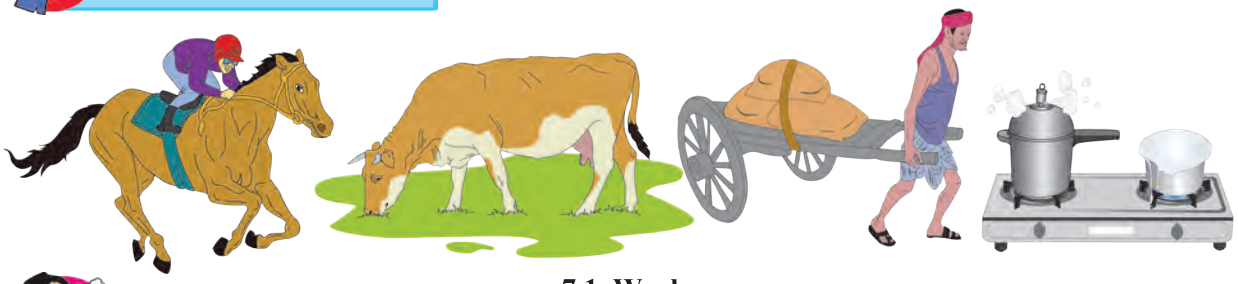
Project :

Collect information about various physical quantities used in day-to--day life and the devices used for their measurement.

♦ ♦ ♦

7. Motion, Force and Work

Observe and discuss.



7.1 Work

Let's recall.

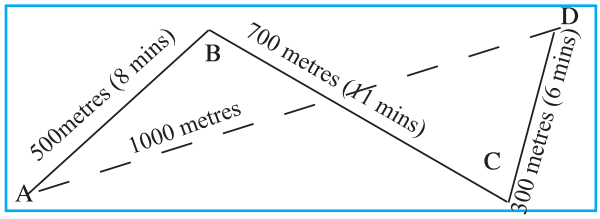
What is meant by motion?
What causes a change in motion?

We have seen that a change occurs in the motion or the shape of a body when a force acts on it. Now let us see how work is done when a force acts.

Distance and displacement

Ranjit's house is at place A. The figure alongside shows the distance traversed by Ranjit to reach his school at D. If we do not take direction into account, we find that Ranjit traversed a distance equal to AB+BC+CD. However, on doing this, his displacement was equal to AD. Ranjit's displacement from his house to the school is shown in the picture with the broken line AD. AD is the minimum distance along a straight line from Ranjit's house to the school.

The minimum distance traversed in a particular direction along a straight line is called displacement.



7.2 Distance and displacement

Speed and velocity

1. What is meant by speed?
2. What is the formula for calculating speed?

When we say that the speed of a car is 40 km per hour, there is no need to specify the direction, but, to predict whether a storm will reach a particular place or not, a mention of its direction is essential.

Distance : The length of the route actually traversed by a moving body, irrespective of the direction, is called distance. Distance is a scalar quantity.

Displacement : The minimum distance traversed by a moving body in one direction from the original point to reach the final point, is called displacement.

In displacement, both distance and direction are taken into account. Therefore, displacement is a vector quantity.

The unit of measurement of distance and displacement is the metre, in the SI as well as in the MKS system of measurement.

Velocity : Velocity is the distance traversed by a body in a specific direction in unit time. The velocity of a body can be calculated by the following formula:

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Period of time required for the displacement}}$$

Let's find the unit.

Task	Speed	Velocity
Write the formula	Speed =	Velocity =
Write the units of the quantities	Distance : Time period :	Displacement : Time period:
Insert the units instead of quantities in the formulae. You will get the unit of speed and velocity.		

The unit of speed or velocity is written as metres/second (m/s)

Let us now use the above formulae to find out Ranjit's velocity and speed when he goes to school as shown in the figure 7.2.

The actual distance traversed by Ranjit from home to school

= AB + BC + CD

= 500 m + 700 m + 300 m = 1500 m.

Total time from home to school = 8 minutes + 11 minutes + 6 minutes = 25 minutes

Ranjit's displacement from home to school, AD = 1000 metres

Thus, Ranjit's velocity when going from home to school

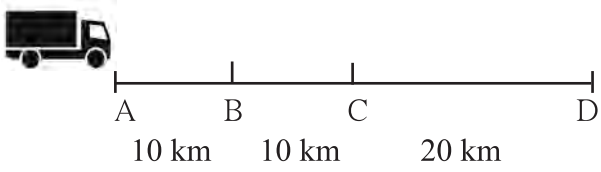
$$\text{Velocity} = \frac{\text{Displacement}}{\text{Total time}} = \frac{1000 \text{ metres}}{25 \text{ minutes}} = \frac{40 \text{ metres}}{60 \text{ seconds}} = 0.66 \text{ metres/second}$$

Ranjit's speed while going to school

$$\text{Speed} = \frac{\text{Distance traversed}}{\text{Total time}} = \frac{1500 \text{ metres}}{25 \text{ minute}} = \frac{60 \text{ metres}}{60 \text{ seconds}} = 1 \text{ metre/second}$$

Ranjit did not take the straight route of minimum distance while going to the school. Therefore, the magnitudes of his velocity and speed came out to be different. Had Ranjit actually gone by the straight route AD, then the magnitude of his velocity and speed would have been the same.

Average velocity and instantaneous velocity : The velocity of an object can change even while it is moving along a straight line. Suppose that a truck is covering a distance of 40 km from A to D in a straight line. That is, its displacement will be 40 km.



7.3 Displacement

If it requires altogether 1 hour for this, its average velocity is 40 km/hour. However, if the truck traverses the 10 km distance AB in 10 minutes, BC in 20 minutes and CD in 30 minutes, then

$$\text{Velocity for the distance AB in km/hr} = \frac{10 \text{ km}}{10 \text{ minutes}} = \frac{60 \text{ km}}{60 \text{ minutes}} = 60 \text{ km /hr}$$

Now deduce the velocities for the distances BC and CD. We see that the velocity of the truck is different in the different segments of the road AB, BC and CD. However, the average velocity for the entire route AD is 40 km/hour. The velocity at a particular moment of time is called instantaneous velocity. The instantaneous velocity can be different at different times.

Acceleration

In the previous example, the truck covered the distance AB at the velocity of 60 km/hour, BC at 30 km/hour and CD at 40 km/hour. It means that the velocity for the distance CD is greater than the velocity for the distance BC. From the number of seconds required for this change in velocity to take place, the change in velocity per second can be deduced. This is called acceleration. What is the cause of acceleration?

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken for change}}$$

You know that the truck driver increases or decreases the velocity of the truck by means of the accelerator. You might have seen a toy car that runs on a clockwork spring. When it is released on a flat floor, after winding up the spring, it goes in a straight line. However, when it is hit on one side, it changes direction and keeps going. If it collides into a wall, it stops. It means that its velocity changes. How did this change take place? It happens because the car comes into contact with something external to it. On a football ground, how does the direction of the ball moving in a straight line, change? We see some player changing its direction by kicking it. When its direction changes, the velocity of the ball changes, that is to say, an acceleration takes place. The interaction that brings about the acceleration is called force. Force acts on a body.

Use your brain power!

The unit of acceleration is m/s^2. Verify this.

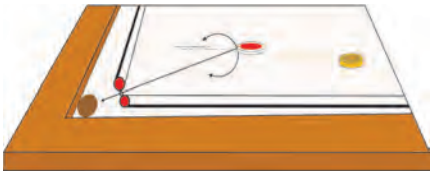
Force and accleration

Try this.

Take a glass marble and let it roll on a big smooth tabletop. After some time its velocity will decrease and it will stop. On a carrom board, too, the carrom coin, pushed by a striker will move forward some distance, and then come to a stop. If the coin is pushed after applying talcum powder to the carrom board, it will keep moving for a longer time and then come to a stop.

What can we infer from this?

The velocity of the coin decreases due to the force of friction, and the coin stops. If the friction between the carrom board and the coin is reduced, the coin keeps moving for a longer time. It would mean that, if no force of friction is acting on a moving body, it will keep on moving with a constant velocity.



7.3 Force and acceleration

The scientist Sir Isaac Newton was the first to study force and the resulting acceleration.

Newton's First Law of Motion : If no force is acting on a body, its velocity does not change, i.e. the body does not accelerate. In other words, if a body is stationary, it will remain stationary. If it is in motion, it

will continue moving with the same velocity and in the same direction.

You have learnt what is meant by force. You have seen that a body is accelerated due to force. Suppose, you place the 1 kilogram standard weight (See the chapter on 'Measurement'.) on a surface with no friction and pull it with an acceleration of $1 m/s^2$, the force applied is called 1N (1 Newton).

Use your brain power!

Acceleration is a vector quantity. Is force a vector quantity, too?

Try this. Place a weight of 1 kilogram on a smooth wooden table. Spread some talcum powder evenly on the table. Now pull the 1 kg weight with an acceleration of 1 m/s^2. Again pull it with an acceleration of $2m/s^2$. It means that, now, you have applied a force of 2N. You will have to take many trials for this experiment.

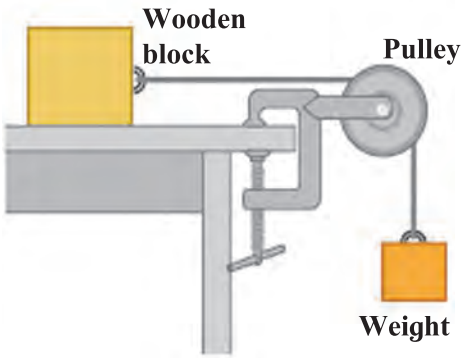
Force is measured by the acceleration that it produces.

We have learnt about the relationship between the displacement of a body resulting from the force applied to it and the work done. We have also learnt about the work-energy relationship and that the ability to do work is called energy.

Force, displacement and work

In the figure alongside, a string, attached to a wooden block on a table, is passed over a pulley and tied to a weight. On applying a sufficient weight, the block will be seen to move.

Which force is being applied here? How can this force be increased? What will happen on applying more force? When can we say that work is done by the applied force?



7.4 Work

If the block moves forward, we can say that it has been displaced. Due to the displacement, we say that the force has done some work. Can we measure this work? We know that work done depends on the force and the displacement. The following formula expresses this relationship :

Work (W) done by the force = force (F) applied to the body × displacement (s) of the body that takes place in the direction of the force,

$W = F \times s$

In the SI system, the unit of work is Joule (J), while the unit of force is Newton (N) and the unit of displacement is metre (m). In the CGS system the unit of work is erg.

If a force of 1N parallel to the surface of the table is applied to a wooden block on the table, and the block is displaced by 1 metre, then it can be said that the force has done 1 Joule of work. In this example, the displacement is in the direction of the force.

Exercise

1. Fill in the blanks with the proper words from the brackets.

(stationary, zero, changing, constant, displacement, velocity, speed, acceleration, stationary but not zero, increases)

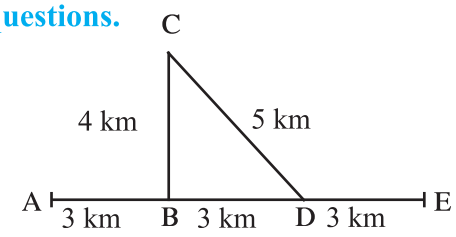
(a) If a body traverses a distance in direct proportion to the time, the speed of the body is ..... .

(b) If a body is moving with a constant velocity its acceleration is ..... .

(c) ..... is a scalar quantity.

(d) ..... is the distance traversed by a body in a particular direction in unit time.

2. Observe the figure and answer the questions.



Sachin and Sameer started on a motorbike from place A, took the turn at B, did a task at C, travelled by the route CD to D and then went on to E. Altogether, they took one hour for this journey. Find out the actual distance traversed by them and the displacement from A to E. From this, deduce their speed. What was their velocity from A to E in the direction AE? Can this velocity be called average velocity?

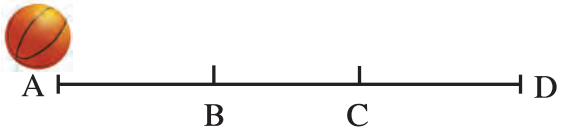
3. From the groups B and C, choose the proper words, for each of the words in group A.

A	B	C
Work	Newton	erg
Force	Metre	cm
Displacement	Joule	dyne

4. A bird sitting on a wire, flies, circles around and comes back to its perch. Explain the total distance it traversed during its flight and its eventual displacement.

5. Explain the following concepts in your own words with everyday examples : force, work, displacement, velocity, acceleration, distance.

6. A ball is rolling from A to D on a flat and smooth surface. Its speed is 2 cm/s. On reaching B, it was pushed continuously up to C. On reaching D from C, its speed had become 4cm/s. It took 2 seconds for it to go from B to C. What is the acceleration of the ball as it goes from B to C?



7. Solve the following problems.

(a) A force of 1000N was applied to stop a car that was moving with a constant velocity. The car stopped after moving through 10m. How much is the work done?

(b) A cart with mass 20 kg went 50m in a straight line on a plain and smooth road when a force of 2N was applied to it. How much work was done by the force?

Project :

Collect information about the study made by Sir Isaac Newton regarding force and acceleration and discuss it with your teacher.

♦ ♦ ♦

8. Static Electricity

Let's recall.

Do you have experience of the instances given below? What is the cause of these effects?

1. A plastic comb or ruler rubbed on dry hair attracts pieces of paper.
2. If we pass near a polyester curtain again and again, it gets attracted towards us.
3. If we rub a blanket with our hands and take it near a metal object, a spark is seen in the dark.

Do you know of other such instances?

Electric charge

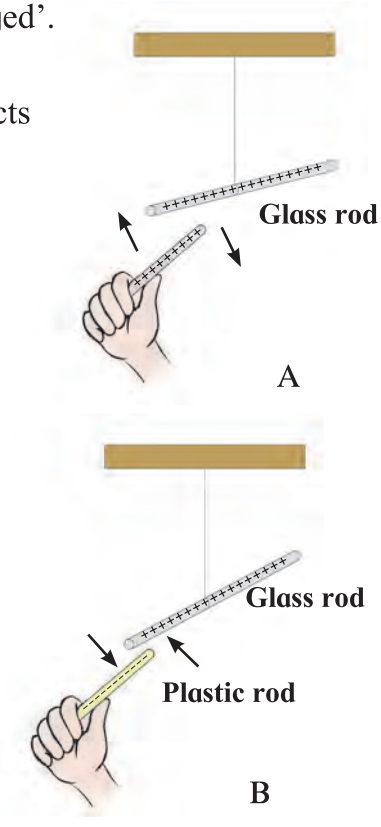
What do the above observations tell us? These examples are just a glimpse of the 'electric charge' that all objects in our surroundings hold in abundance. Electric charge is stored even in our own bodies. All substances are made of very tiny particles. Electric charge is an intrinsic property of these particles. Though, in this way, electric charge is abundantly present, it is always in a hidden state. This is because two opposite types of charges are present in equal numbers in all these substances. When the positive charge (+) and negative charge (-) on an object are balanced, the object is neutral, i.e. there is no net charge on the object. If these charges are not balanced, the object is said to be 'charged'.

Try this.

How would two charged objects interact with each other?

Rub one end of a glass rod against a silk cloth. Due to the rubbing a small charge will get transferred from one object to the other. As a result both the objects will become somewhat charged. Suspend this rod freely in air with the help of a thread. Now charge another glass rod in the same manner and bring it near the suspended rod. What do you see? The two rods push each other away. Now take a plastic rod. Rub one of its ends against a woollen cloth. Bring that end near the suspended glass rod. Now what do you see? The two rods are pulled towards each other.

What did you find in the first experiment? Two rods carrying similar charges push each other away. This is called **repulsion**. We learn from the second experiment that rods carrying opposite types of charges get pulled towards each other. This is called **attraction**.



8.1 Repulsion and attraction

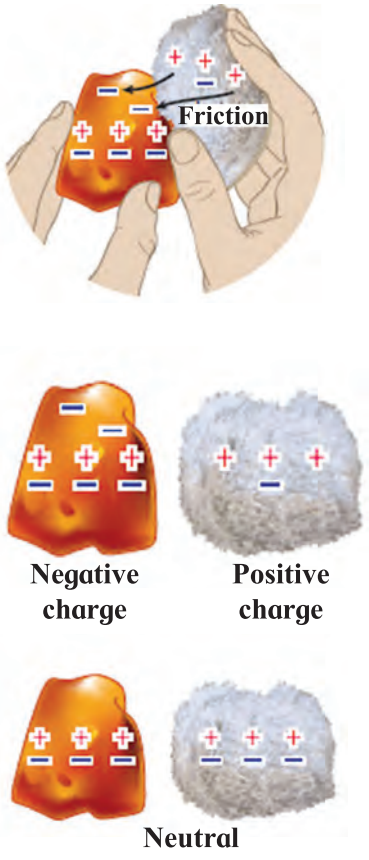
The scientist Benjamin Franklin named the electric charges positive charge (+) and negative charge (-).

What is the origin of an electric charge?

All substances are made up of particles, and these particles are ultimately made up of very tiny atoms. We shall be looking at the details of atomic structure later. At this stage, it is sufficient to know that each atom contains a stationary positive charge and moving negative charges. These two charges being perfectly balanced, an atom is electrically neutral.

All objects are made up of atoms, which means that they are electrically neutral. Then, how do objects become electrically charged?

For some reason, the balance of electrically neutral atoms gets disturbed. For example, when certain objects are rubbed against each other, the negatively charged particles on one object go to the other object. The object to which they go, becomes negatively charged due to an excess of negatively charged particles. Similarly, the object from which the negatively charged particles go away becomes positively charged due to a deficiency of negatively charged particles. It means that, of the two objects being rubbed, one becomes positively charged and the other, negatively charged.



8.2 Electric charge

Try this.

Materials : Paper, polythene, nylon cloth, cotton cloth, silk cloth, etc.

Procedure : First take the objects mentioned in the chart near some small pieces of paper and observe what happens. Then rub each of these objects in turn against one of the given materials and take it near the pieces of paper. Record your observations in the chart.

Material used for rubbing:		
Object	Whether paper pieces get attracted? Yes / No	Does the object get charged? Yes / No
1. Balloon		
2. Ball pen refill		
3. Eraser		
4. Wooden ruler		
5. Steel spoon		
6. Copper strip		

Repeat this procedure with each of the given materials.

Always remember –

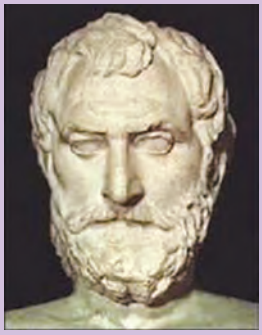
Each atom is electrically neutral. It has equal amounts of positive and negative charge. If for some reason, the negative charge decreases, the atom becomes positively charged.

Use your brain power!

Do all objects get charged by rubbing?

Do you know?

About 2500 years ago a Greek scientist named Thales found that feathers are attracted towards a rod of yellow coloured amber which had been rubbed against a woollen cloth. Amber is called 'elektron' in the Greek language. Therefore, this property of amber to attract things was named 'electricity' by Thomas Browne in 1646 A.D.



Thales

Thomas Browne

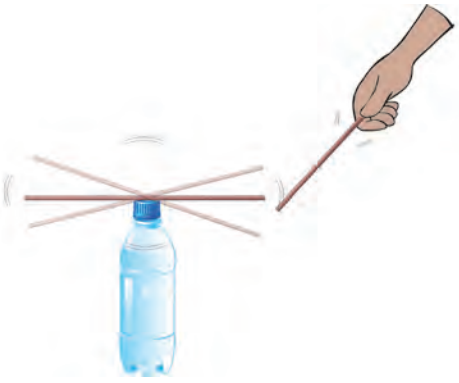
Frictional electricity

The electric charge generated by friction is called frictional electricity. This charge is produced only at the place of friction. Hence, it is called static electricity. It remains on the object for a short duration. The charges of static electricity are absorbed in moist air. That is why these experiments should be performed in dry weather, particularly in winter.

Try this.

Apparatus : A few straws, woollen cloth (socks or gloves), glass bottle.

Procedure : Place a straw on a bottle. Take another straw near it. Observe what happens. Leave the straw on the bottle as it is. Rub the other straw against a woollen cloth and take it near the straw on the bottle. Observe what happens. Now take two straws and rub them against woollen cloth at the same time. Keep one of the straws on the bottle and take the other near it. See what happens. Keep the rubbed straw on the bottle as it is. Take the woollen cloth on which it was rubbed, close to it.



8.3 Changes in the straw

Record your observations in each of the above procedures in the chart.

Procedure	Repulsion / Attraction	Inference
A charged straw is taken near the uncharged straw.		
Two straws carrying similar charges are brought near each other.		
A charged straw and the oppositely charged cloth which was used for rubbing are brought near each other.		

Electrically charged objects attract uncharged objects. There is repulsion between like electric charges. There is attraction between unlike electric charges. Hence, repulsion is used as a test for identifying an electrically charged object.

Observe and discuss.

Take thermocol balls or mustard seeds in a bottle and shake the bottle vigorously. The seeds try to move away from each other, but stick to the bottle. Why does this happen?

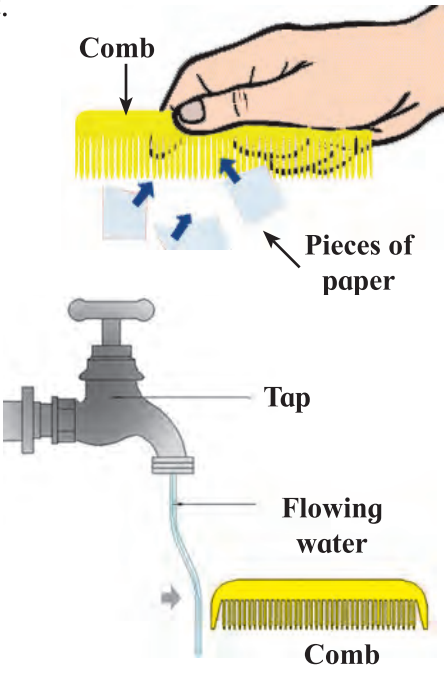
Try this.

1. To charge an object by contact.

Rub a plastic comb against paper. Touch this comb with another uncharged comb. Take the other comb near some pieces of paper. What happens?

2. To charge an object by induction.

Rub a comb or a balloon on your hair. As shown in the picture, take the comb near a thin trickle of water from a tap. See what happens. Now draw the comb away from the trickle and observe what happens.



8.4 Generation of electric charge

Mark your observation with a tick (✓) :

1. When the charged comb is brought close to the flowing water, water gets attracted/repelled/remains as it was.

2. When the charged comb is taken away from the flowing water, it gets attracted/repelled/remains as it was, initially.

At first, the flow of water is not charged. When a negatively charged comb comes near the flowing water, the negative particles in it nearest the comb are pushed away. That part becomes positively charged due to a deficiency of negative charge. The comb has negative, and the water has positive charge. Due to the attraction between these opposite charges, the flowing water is attracted towards the comb. When the comb is taken away, the negative particles in the flowing water come back to their original position and positive and negative charges become equal in number. As a result, the water becomes uncharged again, and stops getting attracted to the comb.

Use your brain power!

Why does a charged balloon stick to a wall?

Always remember –

1. The number of positive and negative charges are equal on an uncharged or neutral object.
2. The electric charge generated by induction stays only as long as the charged object is near to it.

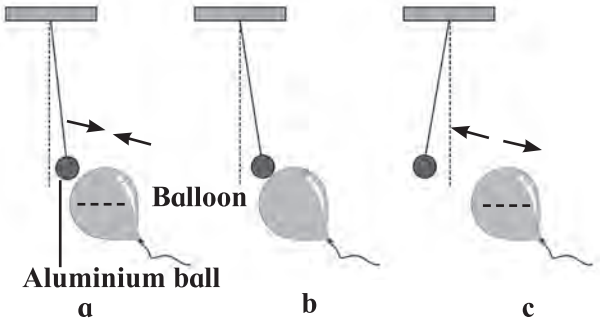
8.5 A balloon sticking to a wall

Try this.

1. Keep a spent tubelight in a dark place. Rub it vigorously with a thin polythene bag. What happened ? Why ?

2. When an uncharged aluminium ball is brought near a negatively charged balloon, the following things happen.

- As shown in figure A, an opposite charge is generated in the other object by induction and both the objects get attracted to each other.
- As shown in figure B, on touching, both the objects become similarly charged.
- As seen in figure C, the like charges repel each other.



8.6 Effects of electric charge

Gold leaf electroscope

This is a simple device to detect the electric charge on an object. It consists of a copper rod which has a metal disc at the upper end and two thin gold leaves at the other. The rod is placed in a bottle so that the disc is above the bottle. When an uncharged object is taken near the disc, the leaves remain closed. When a charged object is taken near the disc, both the leaves are charged by the same electric charge, and repel each other, i.e. move away from each other, or open up. When we touch the disc with our hand, the leaves collapse, because the charge in the leaves goes into the earth through our body, and the leaves get discharged.

Use your brain power!

Can we use leaves of some other metal instead of gold, in the electroscope? Which properties must that metal have?

Great Scientists

In the year 1752, Benjamin Franklin conducted an experiment of flying a kite with his son William. The kite was made using silk cloth, deodar wood and a metal wire. The metal wire was joined in such a way that its one end was at the top of the kite and the other end was joined to the string of the kite. There was lightning in the sky on the day they flew the kite. When the metal wire touched the clouds, the electric charge got transferred from the clouds to the kite. Then the loose string of the kite became taut and the electric charge reached the earth through the string. A spark was seen where the string touched the earth. Thus, he showed that lightning is a form of electric charge.

Atmospheric electric charge

We have experienced clouds, thunder and lightning. Sometimes we hear or read that lightning struck a tree or a building and some people or animals were killed. How does this happen? How can we prevent such injury or death?

What is it that actually happens when there is lightning in the sky and when lightning strikes the earth?

8.7 Lightning

Lightning

Where air and clouds rub against each other in the sky, the upper part of some clouds on the upper side becomes positively charged and the lower sides become negatively charged.

The science behind lightning and a lightning strike is complicated. Let us, therefore, consider a cloud in the sky with a negatively charged base above a plain ground. When this negative charge on the bottom of the cloud becomes much larger than the charge on the ground, it starts flowing towards the ground in stages. This happens very fast, in much less than a second, and heat, light and sound energy are produced along with the electric current.

A lightning strike

You probably know that, when there are electrically charged clouds in the sky electricity is attracted towards a tall building or tree. When lightning strikes, an opposite electric charge is generated on the roof of a building or on the top of a tree by induction. Due to the attraction between the opposite charges on the cloud and the building, the charge on the cloud flows towards the building. This is called a lightning strike.

Use your brain power!

1. What kind of damage is caused by a lightning strike?
2. What measures will you take to prevent the damage caused by lightning?

Do you know?

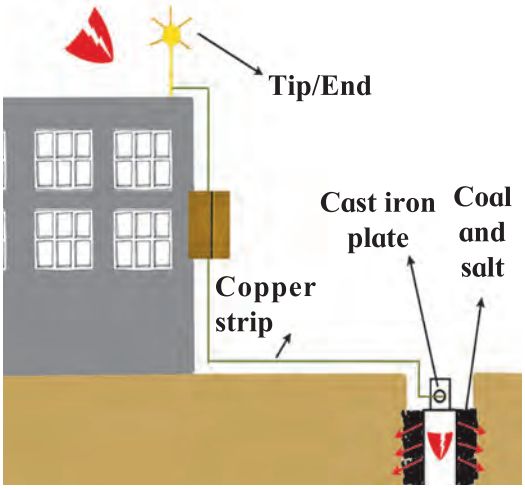
1. Due to the tremendous heat and light generated by lightning, a chemical reaction occurs between nitrogen and oxygen in the air and nitrogen oxide gas is formed. It mixes with the rain water, comes down to the earth, and supplies nitrogen to the soil thus improving its fertility.

2. Due to the energy of the lightning, the oxygen in the air is converted into ozone. This ozone gas protects us from the harmful ultra violet rays coming from the sun.

Lightning conductor

The lightning conductor is a device used for protection from a lightning strike.

It consists of a long copper strip with one end forked. This end is at the highest part of the building. The other end of the strip is connected to a plate of cast iron. A pit is dug in the ground, coal and salt are filled into the pit and the iron plate is placed upright in the pit. There is also a provision for pouring water into it. This helps to spread the electric charge quickly into the ground and prevent damage.



8.8 Lightning conductor

Whenever an electrically charged cloud passes over the building, the electric charges flowing towards the building are conducted into the ground through the copper strip, and damage to the building is prevented. When such a lightning conductor earthing is fixed on a tall building, the surrounding area is also protected from lightning. You will get more information about how to get protection from lightning in the lesson on disaster management.

Use your brain power!

1. Why is the upper end of the lightning conductor pointed?
2. Why are coal and salt added to the pit in the ground?

1. Choose the correct option and fill in the blanks.
(always repulsion, always attraction, displacement of negative charge, displacement of positive charge, atom, molecule, steel, copper, plastic, inflated balloon, charged object, gold)

(a) There is …… between like charges.

(b) …….. is responsible for generation of electric charge in an object.

(c) A lightning conductor is made of a …….. strip.

(d) ……. does not get electrically charged easily by rubbing.

(e) There is …… when opposite electric charges come near each other.

(f) A ..... can be detected with an electroscope.

2. Explain why it is not safe to go out with an umbrella when there is heavy rain, lightning or thunder.

3. Answer in your own words.

(a) How will you protect yourself from lightning?

(b) How are charges generated?

(c) In the lightning conductor, what provision is made for spreading the electricity into the ground?

(d) Why do farmers stick an iron staff into the ground while working in the field in rainy conditions?

(e) Why is lightning not seen everyday during the rainy season?

4. What are the characteristics of a static electric charge?

5. What is the damage caused by lightning? How will you create awareness to prevent it?

Project : Make an electroscope yourself by using a thin aluminium foil and check which substances become electrically charged.

♦ ♦ ♦