SCIENCE AND TECHNOLOGY

GRADE 10

PART - II

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The National Anthem

Sri Lanka Māthā
Apa Sri Lankā Namō Namō Namō Namō Māthā
Sundara siri barini surandi athi sōba māna Lankā
Dhānya dhanaya neka mal palathuru piri jaya bhoomiya ramyā
Apa hata sapa siri setha sadanā jeevanaye māthā
Piliganu mana apa bhakthi pooja Namō Namō Māthā
Apa Sri Lankā Namō Namō Namō Namō Māthā
Oba vē apa vidyā
Obamaya apa sathyā
Oba vē apa shakthi
Apa hada thula bhakthi
Oba apa ālōkē
Apa ge anu prānē
Oba apa jeevana vē
Apa mukthiya oba vē
Nava jeevana deminē nithina apa pudubu karan māthā
Gnāna veerya vadawamina ragena yanu mana jaya bhoomi kara
Eka mawakage daru kala bawinā
Yamu yamu wee nopamā
Prema wada sama bhēda dhuraradā
Namo Namo Māthā
Apa Sri Lanka Namō Namō Namō Namō Māthā

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ஒரு தாய் மக்கள் நாமாவோம்
ஒன்றே நாம் வாழுமில்லம்
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நலமே வாழ்தல் வேண்டுமன்றோ

யாவரும் அன்பு கருணையுடன்
ஒற்றுமை சிறக்க வாழ்ந்திடுதல்
பொன்னும் மணியும் முத்துமல்ல - அதுவே
யான்று மழியாச் செல்வமன்றோ

ஆனந்த சமரகோன்

FOREWARD

This book is the English translation of the text book **විදුව හා තාක්ෂණවේදය 10 - 2 වන කොටස** which was originally produced by the National Institute of Education and Published by the Educational Publications Department.

It is noteworthy that special care has been taken to use the appropriate words and language expressions to suit the grade level of the students who will be using this book.

I appreciate very much the contribution made by the panel of translators and editors towards compiling this book within a very short period. I am also greatful to all those who helped in this publication, during its production cycle.

P. H. P. Geeganage
Commissioner General
Educational Publications

Educational Publications Department,
Isurupaya,
Battaramulla.

22nd August 2005

Message from the Director General

Preparing and providing new syllabuses and textbooks according to these syllabuses is an important of the New Education Reforms process. This textbook has been prepared in accordance with this process.

This textbook prepared in accordance with the National Education goals and basic competencies provides opportunities for the student to engage in a student-centred learning-teaching process.

In using this textbook it is the teacher's major responsibility to motivate the student to engage in a lifelong learning process by identifying the interests and problems of the student, and guiding him-her along an active learning path through self-study.

Parents and adults should assist by looking into the day to day educational activities of their children. They can provide an active participation to the child and the teacher.

I express my gratitude to all those who pioneered in the production and publication of this work.

Prof. Lakshman Jayathilake
Director-General
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CONTENTS

07. Transport of substances within the body

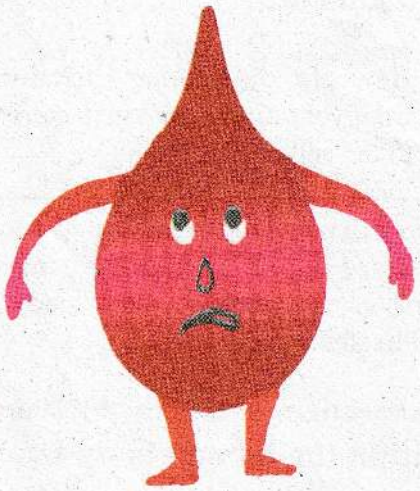


Figure 7.1

Blood

★ Is not imported from abroad.

★ Is not manufactured in factories.

★ No other substance that could take its place has ever been invented until today.

"A considerable amount of blood is required to save the life of some patients. If you get an opportunity to donate a little blood, you will indeed become a noble citizen who has saved a life during your life time".

Figure 7.2 - An instance of blood donation

You may have experience instances where requested have been made for blood, to save the life of a person who had met with an accident or to save the life of a mother during instances of excessive bleeding during certain childbirths or to save the life of some other patient.

How does blood save a life?

Blood is the transportation medium of the body.

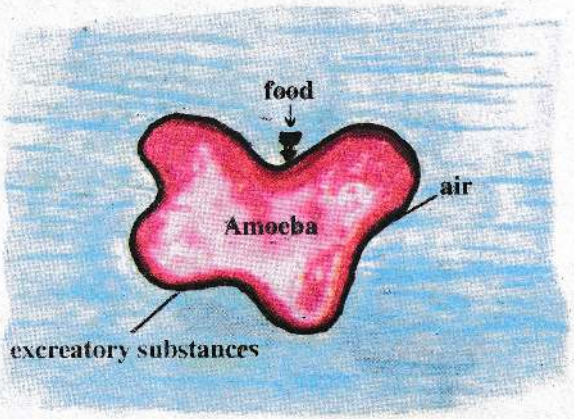


Figure 7.3 - Amoeba exchanges substances by diffusion

Every living cell requires food, water and air to maintain its life. A unicellular animal such as amoeba obtains these substances from the environment in which it lives, by means of simple diffusion. Similarly the byproducts produced within the cells could be removed from the body in the same manner. A multi cellular livingbeing like the man cannot obtain the above substances or dispose them to all the cells by simple diffusion alone.

Think .....

How are the nutrients obtained from your digestive system carried to the cells of the brain?

You will now understand that a specially designed system is necessary to transport substances within the body of multicellular organisms.

Substances are transported within the human body by means of the blood vascular system.

The blood circulatory system that transports blood throughout the body basically consists of blood which is a fluidform tissue, blood vessel and the heart that acts as a pump.

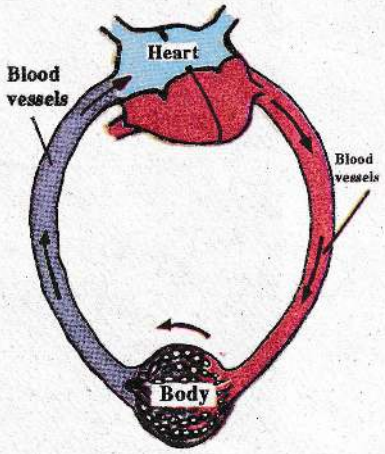


Figure 7.4 - Distribution of blood throughout the body by the heart and blood vessels.

How has blood being formed?

A little blood is taken into a test-tube and a chemical such as sodium citrate added to prevent it from coagulating. When this test tube is centrifuged, the blood contained in it will appear to be separate into two protons.

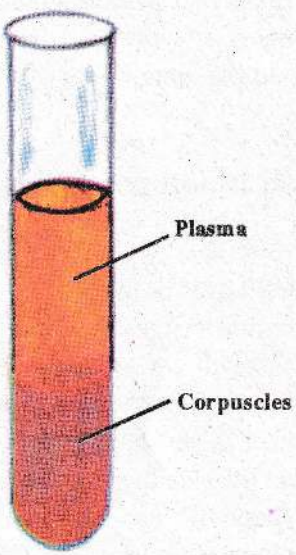


Figure 7.5 - A blood sample subjected to centrifuging

The red coloured substance that accumilate in the bottom of the test-tube is known as corpuscles.

The transparent straw coloured substance seen on the surface is the blood plasma. Corpuscles are suspended within the blood plasma.

Blood Plasma

It was mentioned earlier that, blood carries out a transport function mainly. The substance thus transported is either dissolved or suspended within the plasma. 90% of the blood plasma is water. The remainder comprises the substances transported by the blood.

What are the substances transported by the blood?

★ The nutrients absorbed into the body from the food taken by you.

Eg: Glucose, Glycerol and fatty acids, amino acids, mineral salts, vitamins.

★ Oxygen taken in through the lungs during respiration.

★ Harmones produced by the endocrine glands.

★ Byproducts such as CO_2 and urea given out by the cells.

★ Germs entiring the body, white blood corpuscles that fight diseases, antibodies etc.

★ Blood proteins such as fibrinogen and albumin.

Corpuscles

In order to see the corpuscles suspended in the blood plasma, a blood smear should be prepared and observed through

the microscope. Have you seen how a blood smear is being prepared in a medical laboratory?

Preparation of a blood smear

★ The finger is picked with a sterilized needle.

★ A drop of blood is taken on to a microscope slide.

★ The edge of another slide is placed on the drop of blood and the slide pushed forward so that the blood spreads in the form of a thin membrane on the entire surface of the slide.

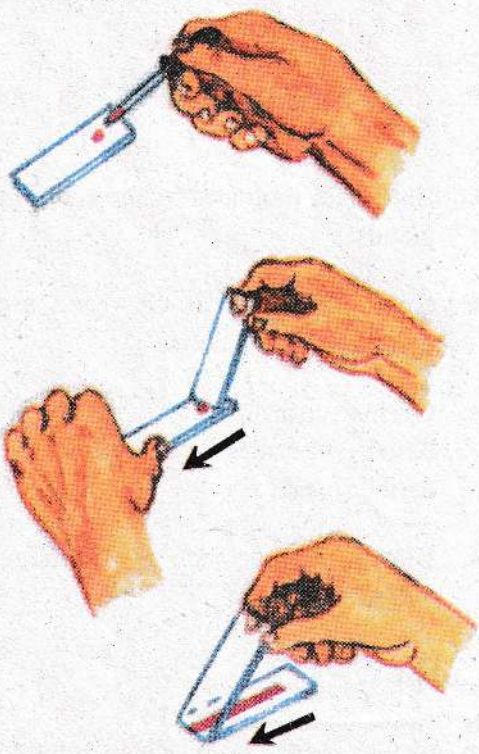


Figure 7.6 - Preparation of a blood smear

The slide with the blood smear is then stained. When examined under the microscope the blood cells could be identified.

Two main typos of blood cells are found in a blood smear stained on a slide. They are known as the red blood corpuscles and white blood corpuscles. In addition to these two types of cells, the blood also contain a type of corpuscle known a blood platelets.

Red blood corpuscles

These are produced in the red bone marrow. After degeneration, they are broken down within the liver. When looking from above, red blood cells appear disc shaped and when looking from the side they appear to be biconcave in shape. Human red blood corpuscles do not have a nucleus. They are red coloured due to the pigment known as haemoglobin present within the cells. Haemoglobin helps in the transport of oxygen. In the blood, red blood corpuscles are more in number. The ratio of red blood corpuscles to white blood corpuscles in the blood is about 600: 1. A cubic millimetre of blood contains about 5 million red blood corpuscles.

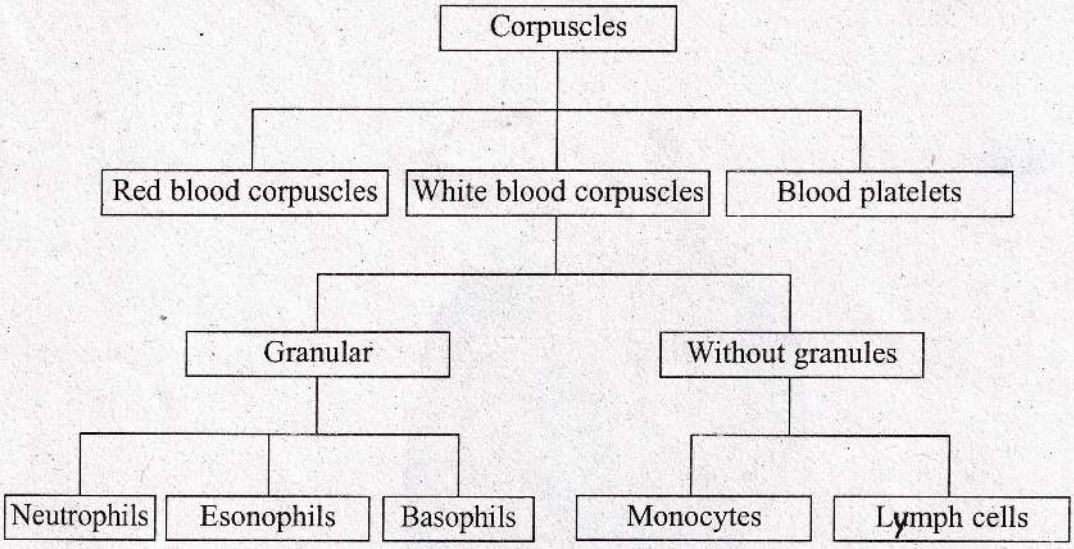


Figure 7.7 - Corpuscles

White blood corpuscles

These contains nucleii. They are larger in size than the red blood corpuscles. These blood corpuscles that are produced in the bone marrow help to destroy the germs that enter the body. A cubic millimetre of blood may contain about 7000 to 11,000 white blood corpuscles.

White blood cells can be categorised into two main groups according to the nature of the cytoplasm contained in the white blood corpuscles.

That is as white blood corpuscles with granules in the cytoplasm and white blood corpuscles without granules. These two types can be further clasified.

Percentages of different types of white blood corpuscles

White blood corpuscles with granules	neutrophils	50% - 70%
	esonophils	1% - 4%
	basophils	0% - 1%
White blood corpuscles without granules	lymph cells	20% - 40%
	monocytes	2% - 8%

Platelets

These may be described as small portions that have been broken off from cells. The platelets play an important role during the clotting of blood.

Figure 7.8 - The external appearance of the heart

Heart

An examination of a vertical section of the heart will show that it consists of four chambers. Among these the two chambers situated above are known as the auricles or atria and the two chambers below are known as the ventricles. In the human heart, there is a wall separating the left side from the right side. This is known as the auricular / atricular - ventricular septum.

The right auricle in the heart opens into the right ventricle while the left auricle opens into the left ventricle. The tricuspid value is situated between the right auricle and the right ventricle and the bicuspid valve is situated between the left auricle and the left ventricle. These valves prevent the flow of blood entering the ventricles, back to the auricles. The ventricular walls are relatively thicker than the auricular walls. The wall of the left ventricle is thicker than the wall of the right ventricle.

Do you know?

The bicuspid valve situated between the left auricle and the left ventricle is so named because it is made up of two flaps. It is known as the mitral valve or the left auricular ventricular valve. Similarly the tricuspid valve situated between the right auricle and the right ventricle is so named as it consists of three flaps. It is also known as right auricular ventricular valve.

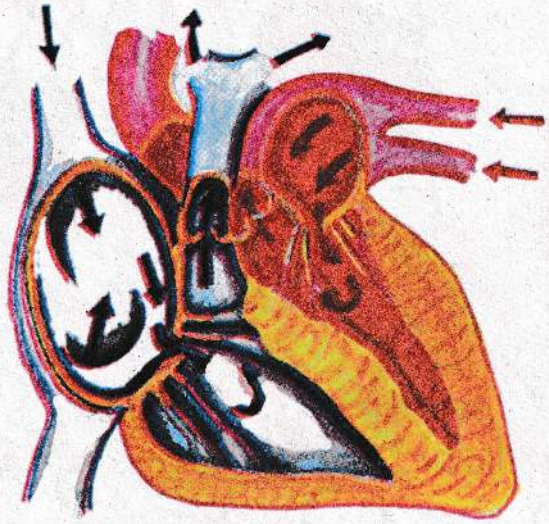


Figure 7. 9 -A vertical section of the heart

Question 1

Can you think of as to why the ventricular walls are thicker than the auricular walls?

The vessels that bring blood to the heart are known as veins. Blood is brought to the right auricle by the superior vena cava and the inferior vena cava. Blood in the superior or upper part of the body is brought by the superior vena cava and the blood in the inferior or lower part of the body is brought by the inferior vena cava. The blood brought from the lungs is carried by the pulmonary veins to the left auricle of the heart.

Blood is carried away from the heart by means of the arteries. Blood in the right ventricle is carried by the pulmonary artery to the lungs and the aorta carries the blood in the left ventricle, throughout the body. The flow of blood contained in the pulmonary artery and the aorta back to the right and left ventricles is prevented by the semi lunar valves.

The heart works like the working of a pump. The pumping action of the heart takes place according to the contraction and relaxation of the heart muscles. This can be considered as a process taking place in two stages.

The auricular ventricular systole and diastole

With the contraction of the auricles filled with blood from the superior and inferior vena caval the bicuspid and tricuspid valves open. Hence blood flows through the opened up valves to the ventricles. The contraction of the auricles is known as atrial systole. When the ventricles contract, the bicuspid valves in the dorsal aorta and the pulmonary arteries close. Hence the flow of blood from the dorsal

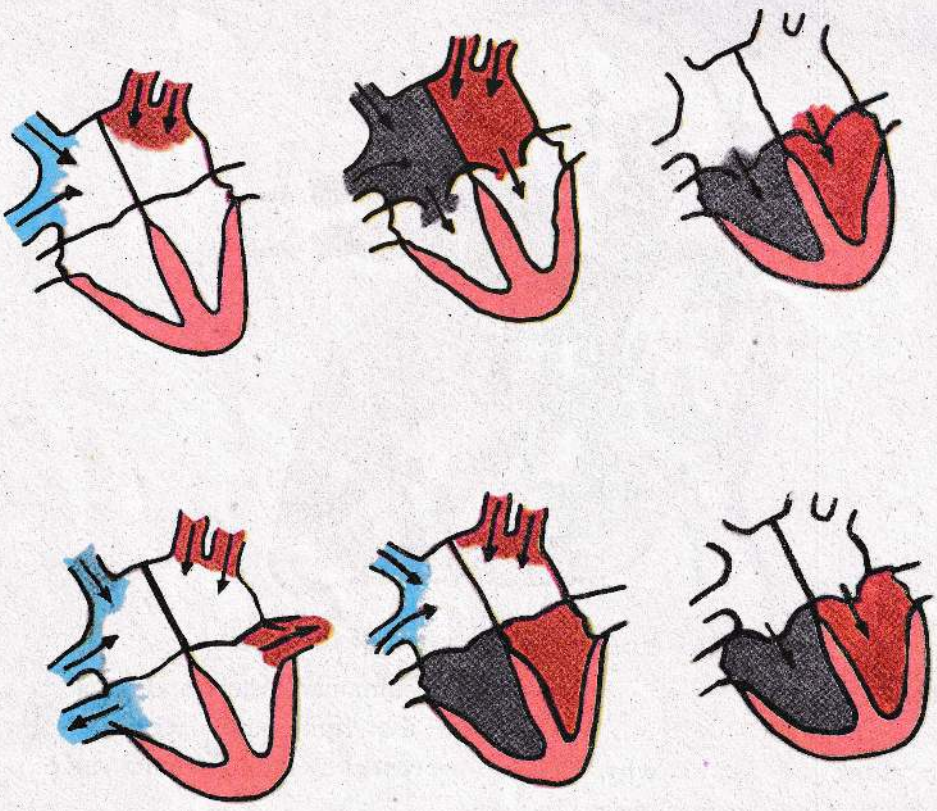


Figure 7.10 - Working of the heart

aorta and the pulmonary artery back to the ventricles is prevented.

Figure 7.11 - Examining the heart beat

Next moment, the ventricles filled with blood contract. At the same time the bicuspid valves open, and the blood in the left ventricle enter the dorsal aorta and the blood in the right ventricle enter the pulmonary artery. Along with this the bicuspid and tricuspid valves close, thus preventing the flow of blood back to the auricles. The contraction of the ventricles is known as ventricular systole.

Afterwards for a slight moment (0.4 seconds), the auricles and the ventricles remain relaxed. This is known as the auricular ventricular diastole or complete cardiac diastole.

Blood pressure

This can be defined as the pressure exerted by the blood within the blood vessels, on the walls of the blood vessels. As the flow of blood through the arteries takes place under the influence of pressure exerted by the heart, the blood pressure within the arteries is higher than the blood pressure within the veins.

Do you know?

The pressure that arises when the left ventricle contracts and blood is pushed into the dorsal aorta is known as the systole blood pressure. In an adult this is 110-120 mm Hg. Since the heart is at

rest during complete cardiac diastole, the pressure within the blood vessels is known as the diastole blood pressure. In an adult this is 70-80mm Hg. During medical work, blood pressure is indicated as : B.P = 120/80 Hg

The contraction and relaxation of the heart in this manner is known as the heart beat. When the ear or stethoscope is placed on the chest the opening and closing of the valves during the heart beat could be heard. This is known as the "lub-dub" sound.

Doctors use the stethoscope to examine the heart beat and identify diseases. When at rest the heart beat rate of a healthy individual is generally between 60 to 80 times per minute. This is known as pulse. During an illness or after exercise the pulse increase.

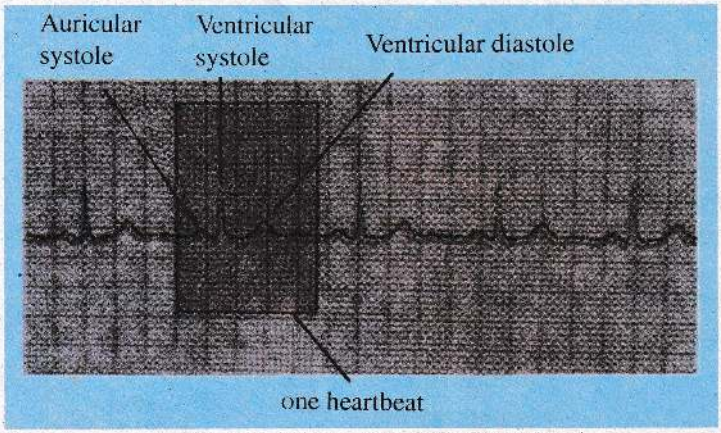


Figure 7.12 - An ECG report

Question 2

Can you think of the reason as to why the rate of heart beat increases after exercise? Explain.

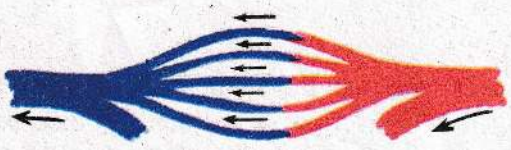


Figure 7.13

Figure 7.13 - The manner in which blood flowing through the arteries flow to the veins.

According to this arrangement, you will understand that the blood circulatory system is not an open system but a closed system. Details about the structure and functions of the various blood vessels are indicated in Table 7.1.

Table 7.1

Arteries	Veins	Blood Capillaries
Blood is carried out of the heart under high pressure	Blood is carried towards the heart under low pressure.	Blood is carried very slowly from the arteries to the veins.
 **Figure 7.14 (i)**	 **Figure 7.14 (ii)**	Consists of very thin walls made up of a single cell layer. As the walls are thin, various substances diffuse through them.
Thick walls.	Thin walls.	
Elastic. Resist pressure.	Valves that open only towards the heartare present in the veins.	
Situated much deeper within the body. Reddish in colour.	Situated towards the surface of the skin. Bluish in colour.	
All the arteries except the pulmonary artery carry oxygenated blood.	All the veins except the pulmonary vein carry blood containing a less counteraction of O_2.	

Close to the place where the superior vena cava enter the right auricular wall, is a small mass of specialized cells. This is known as the pace-making. The pace maker controls the rate of heart-beat. The pace maker can stimulate the heart to beat 60 times per minute without any influence by the nervous system. During an instance where the pace maker becomes weak an artificial pace maker could be fixed by means of a surgery and the heart beat brought back to normal.

Arteries, veins and blood capillaries

Three types of blood vessels carry blood throughout the body. Arteries carry blood away from the heart. Inside the various organs of the body these arteries divide into arterioles. These divide further to form blood capillaries. The capillaries meet to form sub capillaries which in turn join to form veins.

Double circulation

Blood with a low oxygen concentration entering the right auricle is sent to the lungs and oxygenated. This oxygenated blood enters the left side of the heart and by means of the left ventricle is distributed throughout the body via the dorsal aorta.

The ventricular walls of the heart are thicker than the auricular walls because the force required to transport blood under high pressure throughout the body, by means of the ventricles is being produced.

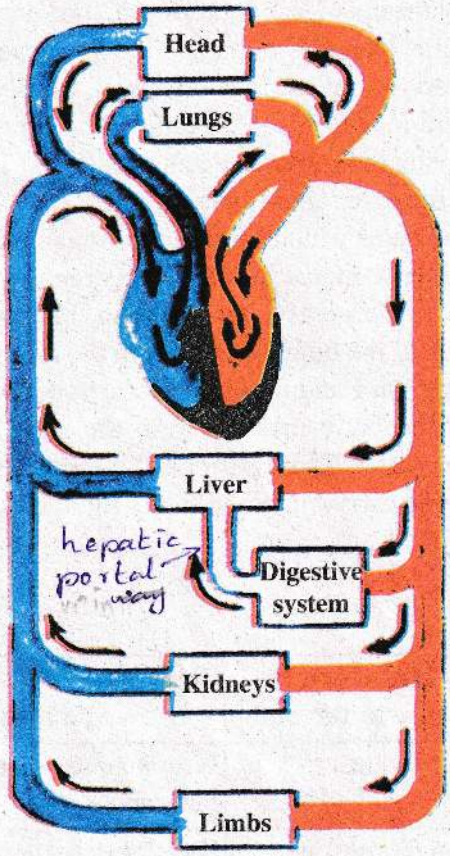


Figure 7.15 - The blood circularly system

The transportation of blood, through the heart twice, before being distributed throughout the body is known as a complete double circulation.

Arterial and venous systems

Blood is carried away from the heart by means of two main arteries. The pulmonary artery carries blood containing a lesser concentration of oxygen contained in the right ventricle to the lungs. Blood contained in the left ventricle is carried away from the heart

by means of the dorsal aorta. The dorsal aorta branches and supplies oxygenated blood to the various organs of the body. Within the main organs, the arteries divide in to arterioles and capillaries. The capillaries later meet to form venules and veins which carry blood containing a lesser concentration of oxygen away from the organs. The veins in the lower part of the body meet to form the inferior vena cava and the veins in the upper part of the body meet to form the superior vena cava. The superior and inferior vena cavae carry the blood to the right auricle of the heart.

Figure 7.15 shows the arteries and veins that carry blood to and away from a few main organs of the body.

When blood travels through the capillaries, water and most of the soluble substances move out through the capillary walls and collect in the organs while certain substances that are removed from the organs enter the blood through the capillary walls. Hence changes occur in the composition of the blood.

Table 7.2

The organ or tissue in the body	Substances that add in to the blood	Substances removed from the blood
All tissues	Nitrogenous waste substances	Nutrients, hormones and water.
Small intestine	Salts, water, vitamins, glucose, amino acids.	
Liver	Urea, glucose	Glucose (for storage) excess amino acids and dead red blood cells
Kidneys		Urea, water, salts
Bones	Red blood cells and white blood cells	Iron (for the formation of haemoglobin) Calcium and phosphate ions (for bone development)
Skin	Vitamin D	Salts and water (given out as sweat)
Endocrine organs such as the pituitary and thyroid	Hormones	

Table 7.2 indicates the changes that take place in the blood inside the various organs. The exchange of oxygen and carbon dioxide takes place at every stage. This table does not indicate the details.

How the exchange of substances take place

Every tissue in the body is bathed with a fluid known as the tissue fluid. It is a colourless fluid. The composition of the tissue fluid is similar to the blood plasma to a great extent. However the tissue fluid does not contain blood plasma.

When blood travels through the capillaries substances such as oxygen and glucose diffuse into the cells, through the tissue fluid. Carbon dioxide and other waste substances that collect in the cells diffuse into the tissue fluids. From the tissue fluid, oxygen and nutrients diffuse into the cells and carbon dioxide and other waste substances diffuse into the blood capillaries.

Blood does not carryout only a transport function. It carries out a variety of functions.

Clotting of blood

Although blood does not clot while it travels through the blood vessels, you may have seen that when blood vessels are injured blood flows out from the vessels and that after sometime the blood clots.

Question 3

What would happen if the blood that is given out during injury does not clot?

Clotthing of blood is a complex process that occurs in a few steps. The blood platelets take an initiative here.

Blood groups and blood transfusion

The giving of blood from one person to another is known as blood transfusion. Blood transfusion for the first time has been reported in the year 1818 A.D. However during the period although there was no clear knowledge about the nature of blood, certain blood transfusions, done were fortunately successful. Many blood transfusions that were done in this manner during a later time were not successful.

Carl Landesteines (1920 A.D.) discovered that there are four main blood groups. According to his classification people in the world are divided into 4 main groups designated as A, B, AB and O.

In blood transfusion the person receiving blood (patient) is known as the **recipient** the person giving the blood is known as the **donor**. A blood transfusion could be done only when the donors blood group tallies with the blood group of the recipient.

Those with the AB blood group can accept blood belonging to any group. Hence they are known as universal recipients. Similarly the blood of people belonging to the Group O could be given to any person. They are known as universal donors.

Table 7.3 - Tallying of blood groups for blood transfusion.

Donors blood group	Recipients blood group			
	A	B	AB	O
A	✔	✘	✔	✘
B	✘	✔	✔	✘
AB	✘	✘	✔	✘
O	✔	✔	✔	✔

Table 7.3 indicates the manner in which the blood groups tally during blood transfusion. The blood groups that tally are indicated as ✔ and the groups that do not tally are indicated as ✘.

Although, those with group AB are designated universal recipients and those with group O are designated universal donors, there are other factors in addition to the main blood groups that affect blood transfusion.

The Rh factor is one such factor. Many people have the Rh factor in their blood while some people do not have the Rh factor in their blood. If transfusion of blood containing the Rh factor is done on a person who does not have the Rh factor, clotting may occur.

Other requirements that a blood donor should possess

- ★ Should be between 21 to 55 years of age
- ★ Should weigh above 45 kilograms
- ★ The haemoglobin content should be above 80%
- ★ Has not contacted diseases such as jaundice, diabetes epilepsy, typhoid aids and other social diseases and typhoid

Diseases associated with the blood circulatory system

Anaemia

This disease condition may arise due to decrease in the haemoglobin content or decrease in the red blood cells in the blood. An anaemic condition may arise as a result of excessive bleeding or due to a nutrition deficiency. Especially when the iron and folic acid content in the food is low the production of haemoglobin is disturbed. When there is a dearth in the haemoglobin content the transport of oxygen is disturbed, a result of which the production of energy within the cells is reduced. As a result disease symptoms such as paleness in the body, and lethargy may occur.

Leukemia

This is also considered as blood cancer. An unusual increase in the number of white blood corpuscles in the blood is the

cause of this disease. Due to this a relative decrease in the number of red blood corpuscles is seen. No specific cause for the anaemic condition and no permanent cure for this have so far been found.

Haemophilia

These patients do not have in their blood, a factor that causes clotting. Even a slightest would in such people, item will cause heavy bleeding. In the past there were many instances where haemophilia patients dead due to excessive bleeding. However now there is a possibility of introducing blood clotting factors into their blood.

Thrombosis

The stoppage or arrest of the blood supply to a particular organ of the body due to the formation of a blood clot in the vessel supplying that organ is known as thrombosis. If due to thrombosis, there is a stoppage of the blood supply to a part of the brain the functions controlled by that part of the brain too come to a standstill. When thrombosis occur in a vessel supplying blood to the heart the particular heart muscle weakens and may even result in heart failure.

High blood pressure

The cavities of the arteries narrow down due to the deposition of a substance known as cholesterol within the internal walls of the blood vessels. When this happens the supply of blood to various parts of the body is reduced. Hence the heart needs to pump blood at a high pressure. The pressure thus increased is known as high blood pressure.

Identifying certain diseases by laboratory tests on the composition of blood

When subjected to certain diseases the composition of blood may be different from that of a healthy individual. During such instances doctors instruct the patient to bring a blood report from a laboratory.

SPECIMEN OF BLOOD

(1) W. B. C. ...6600... Per cu. m. m.

Differential Count

Neutrophils ... 35 ... %

Lymphocytes ... 50 ... %

Eosinophils ... 15 ... %

Monocytes ... %

Basophils ... %

Blood Picture —

(2) E. S. R. 1st hour ... mm.

2nd hour ... mm.

Signature of M. L. T. Signature of M. O.

Figure 7.16 - A blood report

Figure 7.16 indicates a blood report on a blood sample, given by a medical laboratory. What are the tests indicated in it?

White Blood Cell Count / Differential Count W.B.C. / D.C.

A cubic millimetre of blood of a normal person may contain between 7000 and 11000 white blood corpuscles. However during an infection this white blood count may increase to about 15000. During a disease condition such as Leukemia. This white blood cell count rises unusually higher than this.

Many diseases can be identified by preparing a blood smear and taking a differential count of the white blood cells. For example during a bacterial infection there will be a great increase in the percentage of lymphocytes.

E.S.R. or Erythrocytic Sedimentation Rate

When a blood sample is taken into a narrow tube and left aside, the red blood cells suspended in it may form a sedimation or deposit at the bottom of the tube.

The Erythrocyte Sedimentation Rate depends on the viscosity of the blood. As the composition of blood changes during certain diseases, the Erythrocyte Sedimentation Rate also vary. The height of the clear liquid coloumn above the cells sedimented in the bottom of the tube is considered as the ESR. The normal value of this is between 0 mm and 50 mm per hour during a bacterial infection it is about 0 mm. When subjected to diseases like tuberculosis too this value is very high.

Percentage of haemoglobin

A normal individual has between 13.5 and 17.5 grams of haemoglobin in 100 millilitres of blood. During anaemia, this values is very much less.

Blood Glucose

A normal healthy individual has about 90 milligrams of glucose in a cubic millimetre of blood. When subjected to a disease like diabetes this value becomes very high.

Only a few of the tests related to blood that could be performed in a medical laboratory have been mentioned above. In addition there are various other tests that are done in a laboratory.

Assignment 1

Collect information and make a booklet about the different blood tests that are being done in a medical laboratory.

Lymphatic System

Earlier you learnt that the cells in the various tissues of our body are bathed in the tissue fluids. You may know the manner on which substances given out from the cells and the substances given out from the blood capillaries enter the tissue fluid. You also know the manner in which the exchange of substances between the cells and the blood takes place across the tissue fluids. Although various substances add onto the tissue fluid and various substances are removed from the tissue fluid its concentration remains constant to a great extent. Most of the tissue fluid enters a collection of narrow vessels spread throughout the body. These narrow tubes are known as the lymph vessels. The tissue fluid entering the lymph vessels is known as lymph. Fatty acids and glycerol absorbed into the lacteals of the digestive system too enter the fluid in the lymph vessels. The composition of the lymph is similar to the composition of the plasma to a great extent. However lymph does not contain blood proteins. The narrow lymph vessels on the left side of the body join to form a large lymph vessel known as the thoracic duct.

The lymph vessels on the right upper half of the body join to form the right lymph vessel. The thoracic duct opens into the left subclavian vein bringing blood from the left arm and the right lymph vessel opens into the right subclavian vein. The lymph in the lymph vessels travels towards the heart. However in the lymph system, there is no pump like the heart. The lymph is pushed towards the heart by the pressing that takes place due to the contraction of the muscles. The suction action that arises during the inspiration and expiration mechanism also helps in the transport of the lymph. The valves situated in the lymph vessels prevent the reverse flow of lymph. Lymph glands are located in the main lymph vessels. The groin region, the armpit and the region below the ear are few places where the lymph glands are located. When germs enter the body, lymph cells are produced in the lymph glands. Since these lymph cells act to destroy the germs within the lymph glands the glands swell. The

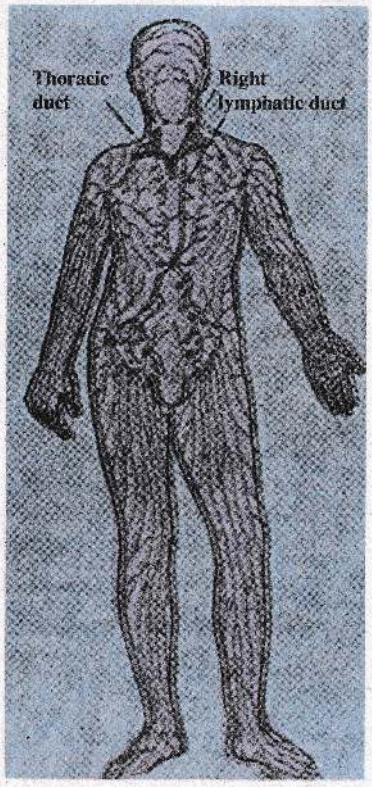


Figure 7.17 - The lymphatic system

lymph glands that swell out thus are known as nodules. You may now understand the manner in which the lymphatic system helps in the control of germs entering the body.

Summary

- ★ The transport system of the human body is the blood circulatory system.
- ★ The blood circulatory system consists of the heart, arteries, veins and blood capillaries.
- ★ In addition to the transport function other functions such as the destroying of germs, regulating the body temperature too are carried out by the blood.
- ★ During blood transfusion in addition to the tallying of blood groups there are several other facts to be considered.
- ★ The lymphatic system plays a very important role in the control of germs.
- ★ Various diseases related to blood can be identified through various tests carried out in the medical laboratory.

Now you should be able to

- ★ Describe the functions of blood.
- ★ Identify the structure of the blood vessels.
- ★ Explain the structure and functioning of the heart.
- ★ Explain how blood circulation takes place.
- ★ Identify that there are various blood groups among humans.
- ★ State the requirements to be fulfilled during blood transfusion.
- ★ Understand the functioning of the lymphatic system.

Exercise

1. Write the respective path traversed by blood entering the right auricle of the heart of the left auricle o the heart.

2. Mention a damage that may happen if a hole forms in the wall between the right auricle and left auricle of the heart.

3. Mention three factors you should pay attention to during blood transfusion.

4. Mention one substance that adds to the blood and one substance that is removed from blood in each of the organs mentioned below.

   (a) liver
   (b) kidneys
   (c) small intestine

08. Classification of Elements

Periodic Table

By considering the diversity of elements, different types of classifications have been introduced to facilitate the identification and studying them. Periodic table can be considered as a successful result of such a classification. It was introduced by a Russian Scientist called Mendaleev. The periodic table introduced by him in 1869, had been improved according to the facts that revealed later. A part of the table is shown below.

If you look into the facts given in the periodic table carefully, you will be able to identify 8 columns and 4 rows denoted by Roman Numerals.

The longitude columns are known as Groups while horizontal rows are known as periods.

Beryllium (Be), Magnesium (Mg) and Calcium (Ca) are found in the same vertical coloumn or group.

i	ii	iii	iv	v	vi	vii	
1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca						

Figure 8.1 - Part of Periodic Table

Electronic configurations of those elements can be shown as follows :

Be - 2, 2

Mg - 2, 8, 2

Ca - 2, 8, 8, 2

How many electrons are there in the last energy level of each element.

Likewise, consider Boron and Aluminium which are in the same group (iii)

Boron B - 2, 3

Aluminium Al - 2, 8, 3

Consider Fluorine and Chlorine in the same manner. Electrons are arranged as shown below :

Fluorine F - 2, 7

Chlorine Cl - 2, 8, 7

According to the above findings the last energy level of the Group II elements has 2 electrons. Last energy level of the Group VII elements has 7 electrons. While group III elements has 3 electrons in the last energy level.

Table 8.1

	Number of the Group of the elements	Number of electrons in the last energy level
1.	II	2
2.	III	3
3.	VII	7

Likewise, examine other elements for any possible relationship with the number of electrons in the last energy level and the group number. Then you will understand that the elements having an equal number of electrons in the last energy level are included in the some group.

Is this valid for He, Ne and Ar?

In what energy level is the last electron in the Beryllium atom?

In what energy level is the last electron in the Phosphorous atom?

After finding this for potassium and other elements you will get the energy level where the last electron is situated.

Beryllium - Be - 2, 2

Phosphorous - P - 2, 8, 5

Potassium - K - 2, 8, 8, 1.

Beryllium (Be) is situated in the second period.

Phosphorous (P) is situated in the third period.

Potassium (K) is situated in the fourth period.

You will see from the above details that there is a proper relationship between the electronic configuration of the elements and the position of the element in the periodic table. The number of electrons in the outer most energy level of an atom of the element is equal to the Group number in the periodic table. Hence beryllium is found in Group 2. Phosphorous in Group 5 and potassium in Group 1 of the periodic table number of energy levels found in the atom of an element is equal to the period number of those elements.

Assignment 1

Write down electronic configurations of the elements having atomic numbers 1 - 20, and prove how far they match with group numbers and period numbers.

Do you know?

Scientists have discovered about 110 elements up to now.

Dmithri Mendeleev was born in Russia in 1834 and was the youngest of the family of 17 members. At the age of 32 years he was installed as professor of chemistry in St. Petersburg (Leningrad at present) University.

After sometime in 1869 he introduced the Periodic table to the world. His services to chemistry had been tremendous as he had a special desire to teach chemistry.

A museum called Mendeleev Museum was established in Leningrad in his honour.

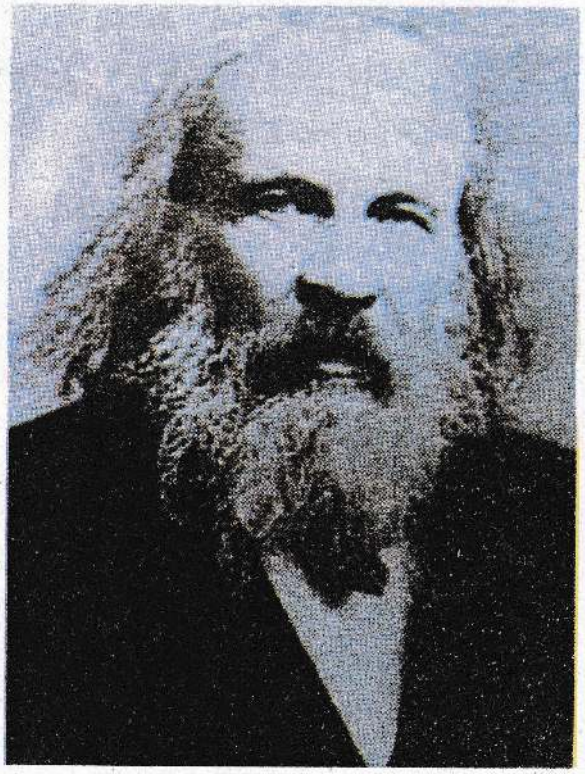


Figure 8.2

MP - Melting Point
BP - Boiling Point

H MP - 25g BP - 253 Gas							He MP 270 BP 269 Gas
Li MP 180 BP 1330 Solid	Be MP 1280 BP 2450 Solid	B MP 2030 BP 2550 Solid	C MP 3550 MP 4830 Amophorm	N MP 210 BP 196 Gas	O MP 219 BP 180 Gas	F MP - 240 BP - 188 Gas	Ne MP 248 BP 246 Gas
Na MP 98 BP 390 Solid	Mg MP 650 BP 1100 Solid	Al MP 660 BP 2400 Solid	Si MP 1410 BP 2478 Solid	P MP 44 BP 280 Solid	S MP - 113 BP - 415 Solid	Cl MP-101 BP 35 Gas	Ar MP 189 BP 186 Gas
K MP 64 BP 70 Solid	Ca MP 850 BP 1440 Solid						

Figure 8.3 - A chart showing some properties of elements.

A sketch of the periodic table showing the boiling point, melting point, state of the element under ordinary temperature and the properties of metals and non-metals is produced herewith.

It will be evident when examining the table, the elements which show metallic properties are found to the left of the periodic table and elements which show non-metallic properties are situated to the right of the periodic table.

Let us find out how the melting point of the elements in the third period changes.

Table 8.2

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Boiling Point	98	650	660	1410	4	113	-101	189

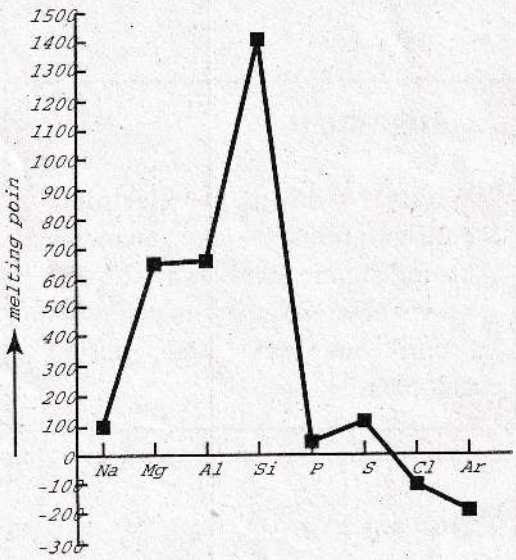


Figure 8.4 - The manner in which the melting point of elements vary through a period.

As shown in Table 8.2 going from the left towards the right along a period of the periodic table the melting point increases until group four. From group 4 to 5 there is a great decrease of melting point and with a small increase at group 6 there is a gradual decrease again till group O could such a pattern be seen in the other periodic too?

Table 8.3 - Elements of Group 7

Element	Symbol	Boiling Point °C
Fluorine	F	-188
Chlorine	Cl	-35
Bromine	Br	50
Iodine	I	184

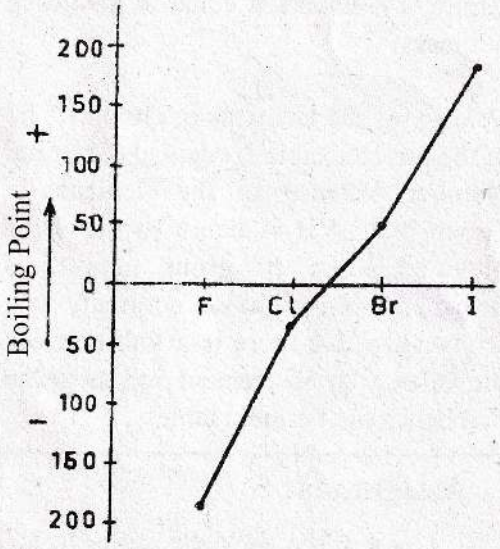


Figure 8.5

Since elements possess different melting points and boiling points, do you know that the natural state of them changes?

Chlorine, oxygen and high gases (inert gases namely: helium, neon and argon) exit as gases under room temperature and normal pressure conditions, since they possess low melting and boiling points. Bromine exists as a liquid as its melting point is low. Mercury too exist as a liquid.

As the melting points of iron and aluminium are highly they exist as solids under room temperature and normal pressure conditions.

Assignment 2

Draw a graph of recognize the pattern of changes in the melting points and boiling points of the elements in the second period.

Assignment 3

Prepare cards showing the electronic configuration of elements and arrange them according to the number of electrons in the outermost shell and compare the overall structure with the periodic table.

Let us find out the manner in which the boiling point of elements change going along a period from top to bottom.

When going along Group VII elements room top to bottom, it is seen that there is a quick increase of boiling point. Examine whether any pattern could be seen with the other groups too.

Bromine (Br) and iodine (I) are not included in the 20 elements you study. But they were used to draw the graph in Figure 8.5 to illustrate the increase in the boiling and melting points.

Assignment 4

Draw a graph to recognize the pattern of changes of melting points and boiling points of Group 4 elements. Necessary data were given in Figure 8.3

Let us find out whether there is a link between the valency and group number of elements. Carbon is situated in Group IV of the periodic table. Valency of carbon is 4. Valency of carbon is equal to the group number. Number of electrons in the outermost shell of carbon is four. Hence the valency of carbon is four.

See for any possible link, with regard to magnesium (Mg). Will it be true for Potassium (K) ?

Consider oxygen. Oxygen is positioned in Group VI. Electronic configuration of oxygen is 2, 6. What is the valency of oxygen? Recall the things you studied in lesson 6 - "compounds by elements".

How did the valency of oxygen happen to be 2 ?

There are 6 electrons in the outermost energy level of oxygen. Oxygen atom needs 2 electrons to receive a stable electronic configuration. Therefore the valency of oxygen is 2.

Let us consider element chlorine.

Chlorine is situated in Group VIII. Its electronic configuration is 2, 7. Chlorine has 7 electrons in the external (shell) energy level. Chlorine atom needs one electron to receive stable electronic configuration. Therefore the valency of chlorine is one. Examine other elements for any possible link. Accordingly it is seen that the group number of the element should be deducted from eight (8) to decide the valency of elements from Group V to Group VII.

Atoms of helium, neon and argon contain the maximum number of electrons in their external energy level. Valency is zero (0) since they possess a stable electronic configuration. Valency of Group O elements is equal to the group number.

Velency of the elements in Group I - IV of the periodic table is equal to the Group Number. Velency of the elements in Group V to VII is equal to the value obtained when the group number is deducted from eight. Accordingly you will realize that there is a link between the valency of an element and its group number in the periodic table.

Assignment 5

1. Find the link between the valency and the group number of Boron (B).
2. Find the link between the valency and group number of phosphorus (P).

Activity 1

Examine whether the properties used to separate metals and non-metals could be used to identify and classify the elements. Carry out the following activities with the following elements :

Aluminium, iron, zinc, copper, magnesium, sulphur, carbon and iodine. Mention the observations in the table as shown.

Element	Physical Properties				
	(Lustre) Shine	Resounding Noise	Malleability	Conduction of Heat	Electrical Conduction
Iron	.....	.....	.....	.....	.....
Copper	✔	✔	✔	✔	✔
Aluminium	.....	.....	.....	.....	.....
Magnesium	.....	.....	.....	.....	.....
Zinc	✔	✔	✔	✔	✔
Sulphur	.....	.....	.....	.....	.....
Carbon	.....	.....	.....	.....	.....
Iodine	✔	✘	✘	✘	✘

According to the observations obtained at the end o the experiment you will notice that the physical properties mentioned with regard to iron, copper, aluminium, magnesium and zinc are almost identical. These elements are called metals. It will become clear, on examining the physical properties of sulphur, carbon and iodine, that they are different from metals. They are called non-metals.

Generally metals show high melting points and boiling points. Non-metals have low melting and boiling points. Most of them exist as gases. Melting and boiling points of sodium and potassium take a relatively high value.

Do you know?

The metal that exists as a liquid under room temperature is mercury.

Metals are good heat and electrical conductors. Non-metals are weak conductors of heat and electricity. Non-metal carbon in graphite form conducts electricity. Though iodine is a non-metal it has a luster. You will understand that some elements in the periodic table show

metallic properties and a few show non-metallic properties, while some elements show both metallic and non-metallic properties.

Activity 2

Study of changes that take place in given metals when they are heated in air.

Heat magnesium, aluminium, iron, copper, sulphur and carbon in air. Observe any changes and examine the products obtained with moist red and blue litmus; then compare the observations with the following table.

Element	Before Heating	While Hating	When moist red / blue litmus is placed in the product or its aqueous solution	
			Moist blue litmus	Moist red litmus
Magnesium	Shining metal	Burned with a bright flame leaving a white powder	-	turns blue
Aluminium	Shining metal	glittering fads away	-	-
Iron	Shining metal	turns brown	-	turns blue
Zinc	Shining metal	loses brightness	-	-
Copper	Bright copper colour	blackens	-	-
Sulphur	yellow-coloured solid	burns and emits white fumes	turns red	-
Carbon	black solid	emits white fumes	turns red	-

You will realize from the above observations that when the above elements are heated in air and moist blue and red litmus are added to the product or its aquareous solution. The substances closer to the left side of the periodic table or oxides of the metals turn moist red litmus into blue while the oxides of the elements closes to the right side of the periodic table turn blue litmus into red.

Let us write balanced chemical equations for the above reactions.

Let us consider reaction that occurs when magnesium is heated in air. Magnesium burned with a very bright flame leaving behind a white powder. It is magnesium oxide.

When the equation for the reaction is shown in words :

Magnesium + oxygen ⟶ magnesium oxide

When it is written using formula;

(magnesium) (oxygen) (magnesium oxide)

$$Mg + O_2 \longrightarrow MgO$$

When it is balanced, we get

$$2\,Mg + O_2 \longrightarrow 2\,MgO$$

It can be written for sulphur as above

Sulphur + oxygen ⟶ sulphur dioxide

$$S + O2 \longrightarrow SO_2$$

This equation is already balanced.

Now you can construct balanced chemical equations for all the above reactions mentioned in the table.

Note : Sulphur dioxide is a poisonous gas

Assignment 6

Write balanced equations for the reactions you have executed in the above activity.

Do you know?

- ★ Sodium (Na) is kept in paraffin oil.
- ★ Phosphorus (P) is kept in water.
- ★ Bromine occurs in the liquid form. It is poisonous.

It is imported in sealed brown-coloured glass bottles.

Uses of the periodic classification

1. Easy to study as the properties of elements are summarized.
2. Could identify the patterns of the properties of elements.

3. Could find the valency of the elements.

4. Could predict the properties of elements.

5. Could get an idea as to the natural existence of elements.

6. Could get an idea about the extraction of elements.

Summary :

Mendeleev introduced the periodic table for the classification of elements.

There is a link between the classification of elements and the electronic configuration of elements. There is also a relationship between the classification and properties of the elements. Properties of elements change according to certain patterns along the periods and groups. Difficulties arise in the classification of elements as metals and non-metals. There are many uses of the periodic table although they are limited.

Now you should be able to

★ Identify the periods and groups where elements are situated in the periodic table according to the electronic configuration.

★ Understand that properties of elements in the present - form of Mendeleev, periodic table change according to a pattern.

★ Assess the uses of the classification of elements and understand its limits.

★ Idetify the difficulties that arise in the classification of elements as metals and non-metals.

★ Explain the changes that occur when metals and non-metals are heated in air or oxygen.

09. Photosynthesis

In fulfilling their requirements of food, what the animals consume directly or indirectly is food manufactured by plants. The green plants manufacture their own food. Therefore green plants are said to be autotrophic. Since animals depend on food manufactured by plants animals are heterotrophic.

The main nutrients

The main nutrients we get from plants are carbohydrates proteins and lipids. Two kinds of carbohydrates are often present in our food. They are starch and sugar. The sugar we take for food is sucrose. Glucose is another kind of sugar. Recall the activities you have done in Grade 8 to identify the there main types of nutrients.

What are the parts of plants that we take as food?

These can be fruits, seeds, yams, stems, leaves or flowers. In testing whether these parts contain the three main nutrients, the presence of the green colour in leaves becomes an independent. The cause for the green colour is the pigment called chlorophyll. Therefore chlorophyll must be removed before the experiment.

Experiment 1

(I) Removing the chlorophyll from leaf

Method

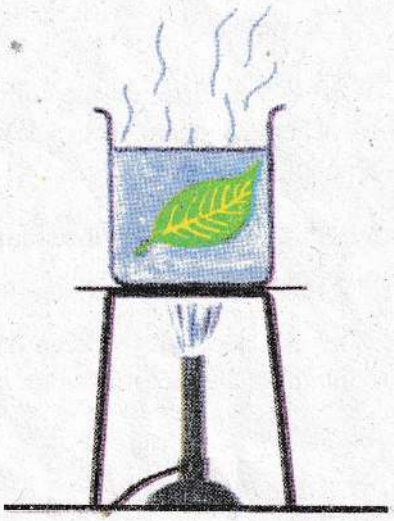


Figure 9.1 - Remove a leaf exposed to sun light and boil it in water for about a minute.

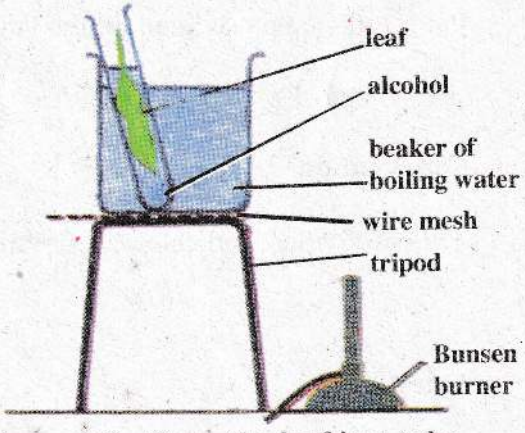


Figure 9.2 - Place the leaf in a tube containing alcohol immersed in a water bath and heat until the green colour is removed from the leaf.

Observation

The boiled leaf lost its green colour and the solution of alcohol became green in colour.

Questions

1. What is expected from boiling the leaf in water?
2. What is the reason for the boiled leaf to be boiled again in a solution of alcohol?

   What is the reason for the solution of alcohol turning green?
3. Why is it necessary to keep the tube containing alcohol in a water both?

(II) Testing for starch

Method

Put a little iodine solution on the boiled leaf.

Observation

The parts, which had chlorophyll, turned blue.

Question

1. Why did the parts of the leaf, which had chlorophyll, turn blue?

Experiment 2

Identifying the main nutrients in various plant parts.

Materials required

A raw fruit (eg. a raw banana), a ripe fruit, a kind of grain, an edible stem such as sugar cane, edible white flowers such as kathurumurunga (Sesbania grandifloa), a few leaves which had been exposed to sun light from which the chlorophyll had been removed, Benedict solution, copper sulphate solution, sodium hydroxide solution, iodine solution, mortar and pestle, few test-tubes, a support for test tubes, a test-tube holder, spirit lamp, white paper.

Method

Prepare the plant parts as required for the various tests and test them for starch, glucose, proteins and lipids.

Question

1. Does a food contain only one kind of nutrient?
2. Are there different materials which contain the same nutrient?

You would have seen from experiment 2 that there are different plant parts which contain the same nutrient and that there are plant parts which contain several nutrients. Although there are nutrients in various parts of plants, the main organ which manufacturers food is the leaf.

How is food manufactured in plant leaves?

When leaves from which chlorophyll was removed were tested for starch it was revealed that they contain starch. Let us find out what factors should be present in plant leaves for the manufacture of starch. How can we get a clue for this?

Any kind of flour such as wheat flour and rice flour contains starch. Is it possible to find what materials were used to produce starch by looking at flour or examining it under the microscope?

Do you know?

Starch is made up of the elements carbon (C), hydrogen (H) and oxygen (O). The chemical formula of starch is $(C_6H_{12}O)$. When starch is burnt in air, carbon dioxide gas and water vapour are given out and energy is also produced.

Let us express the chemical change that takes place when starch is burnt.

Starch + Oxygen ⟶ Carbon dioxide + water (vapour) + energy.

According to this equation, if starch is to be regained carbon dioxide, water and energy must be combined again.

Basing on this can we build up a few hypotheses as to the factors necessary for the formulation of starch and the process of formation?

Carbon dioxide gas is necessary to produce starch.

Water is necessary to produce starch.

Energy is necessary to produce starch. (Plants obtain the necessary energy from sunlight).

Let us test the hypotheses one by one

Before using plant leaves for testing the hypotheses, it is necessary to make them free of starch. For this the leaves should be placed so that they do not receive sunlight. In this way they do not get the opportunity of producing fresh starch and time is made available for starch already produced to be transported away.

Experiment 3

How long should a plant leaf be placed without receiving light so that it becomes free of starch?

Method

Place potted plants in a dark cupboard or a box and test the leaves for starch after 12 hours, 24 hours and 48 hours respectively. (If there is no cupboard cover the entire plant with black paper). Cover some leaves of a plant in the garden with black paper and test leaves out of them for starch after intervals of 12, 24 and 48 hours respectively.

Tabulate your observations.

Question

What is the minimum period of time in which a leaf should be kept in the dark for it to be completely free of starch?

Experiment 4

Testing the hypothesis that carbon dioxide gas is necessary for manufacturing starch.

Method

Choose two leaves from a plant kept in the dark until the leaves are free of starch and make a set up as in Figure 9.3. Keep the set up open to sunlight for 4 to 5 hours. Now pluck the two leaves in the polythene bags and test them for starch.

Observation

The leaf kept in bag A turned dark blue while the leaf kept in bag B did not.

1. What is the reason for using polythene bags here?
2. The presence of starch was seen on which leaf?
3. State 3 factors which must be similar in the leaves A and B
4. By which factor do A and B are dissimilar?
5. What is your conclusion?

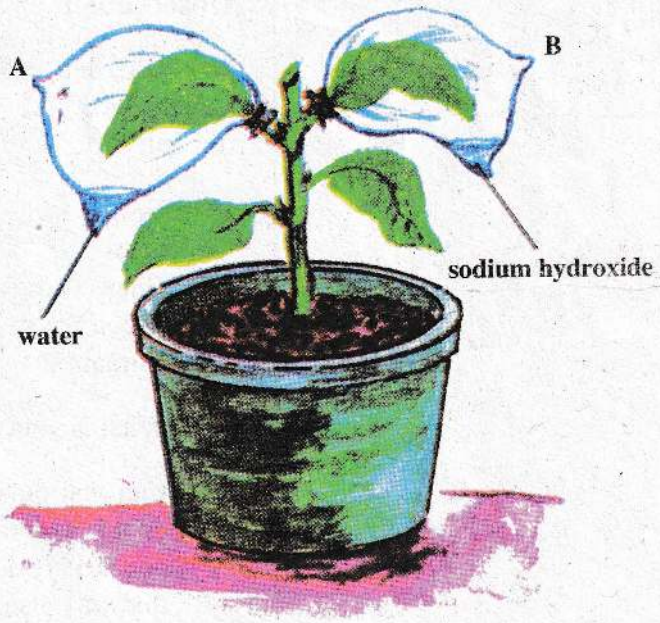


Figure 9.3

It is clear from experiment 4 that the hypothesis that carbon dioxide gas is necessary for the manufacture of food in a plant leaf is true.

No experiment can be conducted in the laboratory to find out whether water is necessary for the manufacture of food. The reason is that when the leaf to be used is completely dehydrated the leaf dies.

Do you know?

It has been established that water is necessary for the manufacture of starch by experiments with a plant supplied with water containing isotopic oxygen.

Experiment 5

Testing the hypothesis that sunlight (solar energy) is necessary for the manufacture of starch.

Method

Choose two leaves from a plant kept in the dark until the leaves are completely free of starch. Cover both sides of one leaf with black paper. Let the other leaf be as it is keep the plant in the sun for about 4 hours and then pluck the two leaves and test them for starch.

Observation

The leaf left open to sunlight turned dark blue while the other did not.

Questions

1. What is the factor here in which the two leaves are not similar
2. What is your conclusion?
3. Can you device a method to do this experiment using only one leaf. Do the experiment that way also.

The experiment makes it clear that sunlight (solar energy) is necessary for the manufacture of starch in a plant leaf.

Do you know?

White light is made up of seven colours. Out of these colours what contributes most for the process of manufacture of starch are the blue light and red light. When the 7 colours obtained through a prism are passed through an extract of chlorophyll, it is the blue light and the red light that are absorbed by chlorophyll.

Experiment 6

Testing the hypothesis that oxygen is given out as a by-product during the manufacture of starch in a plant leaf.

Method

Using aquatic plants arrange a set-up in Figure 9.4. Place the set-up in a place under direct sunlight.

Observations

Bubbles of gas are given out from the plant. They rise up the funnel stem and collect in the test-tube.

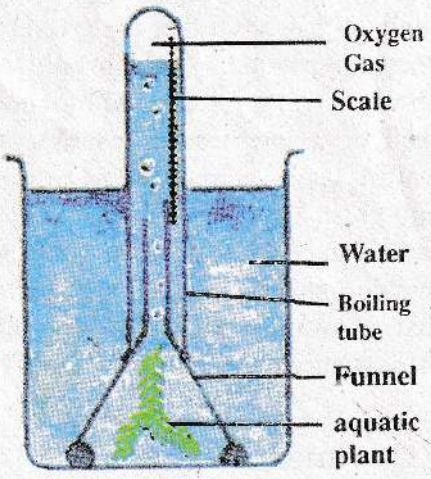


Figure 9.4

1. Why is it not possible to use a land plant for this?
2. Why is an aquatic plant suitable for this?
3. For comparison how can a set-up be arranged without the relevant factor?

During the manufacture of starch in a plant leaf, oxygen is released as a by-product. During day-time bubbles of gas can be seen emanating from aquatic plants in wells ponds and reservoirs. That is oxygen gas.

Land plants cannot be used in the above experiment since the collection of the gas is problematic.

Question 1

It can be seen that banana planters cover the banana bunches with blue polythene to get larger fruits. Explain what is expected by this.

When plants do not receive sufficient sunlight, it is seen that the green colour becomes faded. You would have observed that grass covered by a coconut shell or a log become whitish. These whitish leaves when exposed to sunlight turn green again. This shows that for the maintenance of the plant the green colour or chlorophyll is important. It is possible that chlorophyll plays a part in the manufacture of starch.

Experiment 7

To find out whether chlorophyll plays a part in the manufacture of food in a plant.

Method

Place a potted plant having leaves with white areas in the dark for the leaves to be free of starch. Now expose the plant to direct sunlight for about 4-5 hours. Choose two or three leaves and make drawings of them marking the colour pattern. Remove the chlorophyll from these leaves and test for starch.

Observation

The areas of the leaves which were green in colour turned blue with iodine solution while the white areas did not turn blue.

Figure 9.5

Questions

1. Was the presence of starch seen in the leaves where it was green and had chlorophyll or where it was white and had no chlorophyll?

2. What is your conclusion from it?

It is seen that there is no starch where there was no chlorophyll. What can be concluded from this is that chlorophyll is a necessary factor for the process of food manufacture.

Solar energy is absorbed by chlorophyll.

In the food manufacturing process in the green leaves of plants, solar energy is engaged and carbon dioxide and water are used as raw materials. 'Photo' is synonymous with the word 'light'. Hence the process of the synthesis of food in a green plant in the presence of photo-energy is called photosynthesis.

The factors necessary for photosynthesis are :

- ★ Carbon dioxide,
- ★ Water,
- ★ Chlorophyll, and,
- ★ Sunlight.

Products of Photosynthesis

What we identified as the product of photosynthesis in a green leaf is starch. Before the formation of starch it is the simple sugar glucose that is formed. It was found by the above experiment that in addition to glucose, oxygen is also obtained as a product.

Thus the photosynthetic reaction can be expressed by a word equation in the following form.

carbon dioxide + water $\xrightarrow[\text{(Chlorophyll)}]{\text{sunlight}}$ glucose + oxygen

What happens to the glucose produced in photosynthesis?

Glucose produced by the photosynthetic process is made use of in various ways within the plant. It is used to obtain energy as well as for producing other nutrients. The balance is stored up. The fate of glucose in detail is as follows.

- ★ Some of the glucose is used up to produce energy required by the cells of the leaf.
- ★ Another portion is transported to other parts of the plant where food manufacture does not take place such as stem, roots and flowers.
- ★ Yet another portion is converted to starch and deposited in the leaves themselves.
- ★ Another portion is utilized to form other carbonic compounds required by the plant such as proteins for growth, cellulose for cell walls, and lipids.
- ★ Excess glucose is converted to starch, proteins or lipids and are deposited in seeds, fruits, yams, underground stems etc.

Do you know?

In some plants the glucose formed in photosynthesis is not converted to starch. This is the reason for the sweet taste of the leaves of the onion family. In the sugar-cane stem, food is stored not as starch but as sucrose. There is stored sucrose in beet also. That is why sugar-cane and beet are used in sugar production.

How are the leaves organized to perform the function of photosynthesis?

In a plant the main photosynthesizing organ is the leaf. The leaf must be organised to receive the factors sunlight, carbon dioxide and water necessary for the function of photosynthesis at an optimum level.

Assignment I

Go to a place in the garden where there are various plants. Observe how the plant leaves are arranged to receive maximum sunlight and make a report.

A number of adaptations can be seen in leaves so as to receive optimum sunlight necessary for the function of photosynthesis.

★ The leaves are broad and flat. (This increases the surface area of the leaf so that more of sunlight can be received).

★ The leaves are thin (This makes it easy for sunlight to penetrate into the leaf).

★ The arrangement of the leaves on the stem and branches (phyllotaxis) is such that they do not overlap. (Therefore more of sunlight is received).

★ The leaf stalk is attached to the stem and the veins are spread all over the leaf blade. (Therefore the supply of water is plentiful).

How is the structure of the epidermis and the interior of the leaf organised to perform the function of photosynthesis?

Since we cannot see the structure of the epidermis and the interior with our naked eye we have to use a microscope. How can we obtain fine parts from the leaf to be observed under the microscope?

Experiment 8

Preparing a transverse section of a leaf and observing it.

Materials required

A plant leaf, manioc pith, sharp razor blade, a watch glass, water, a fine brush, a slide, a cover slip and a microscope.

Method

Get a transverse section of a leaf as shown below and observe under the microscope.

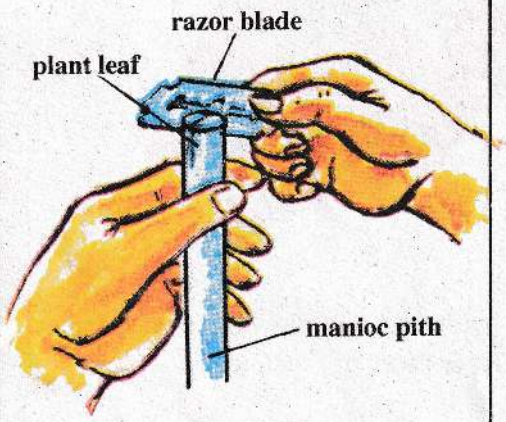


Figure 9.6

Draw a diagram of the transverse section you observed.

Questions

1. Are all the internal cells of the leaf similar? How many types of cells are there?
2. How is the interior of the plant leaf organised for the photosynthetic function?

Experiment 9

Preparing epidermal peelings of plant leaves and observing them.

Method

Obtain upper and lower epidermal peelings of several leaves and observe them under the microscope.

Hold a bean leaf with its under surface uppermost firmly round your index finger

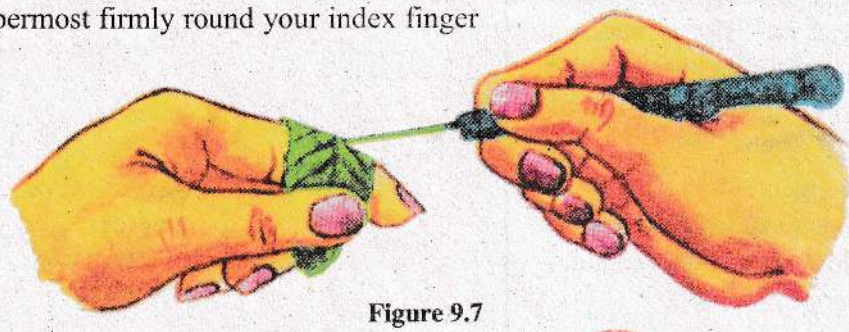


Figure 9.7

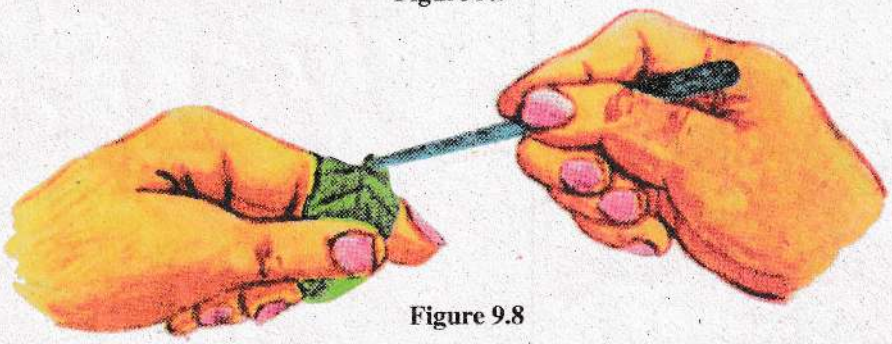


Figure 9.8

Grasp the epidermis tightly with a pincer and peel off a large piece of the epidermis.

Figure 9.8

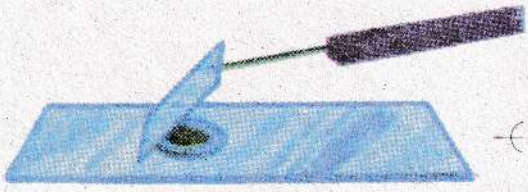


Figure 9.9

Mount the epidermal peel in a drop of water on a glass slide

Figure 9.9

Draw diagrams of the lower and upper epidermal cells in the peelings you observed.

Questions

1. Are all epidermal cells you observed similar? Are there cells of different forms?
2. Are the upper epidermis and lower epidermis similar? If not, in what ways do they differ?

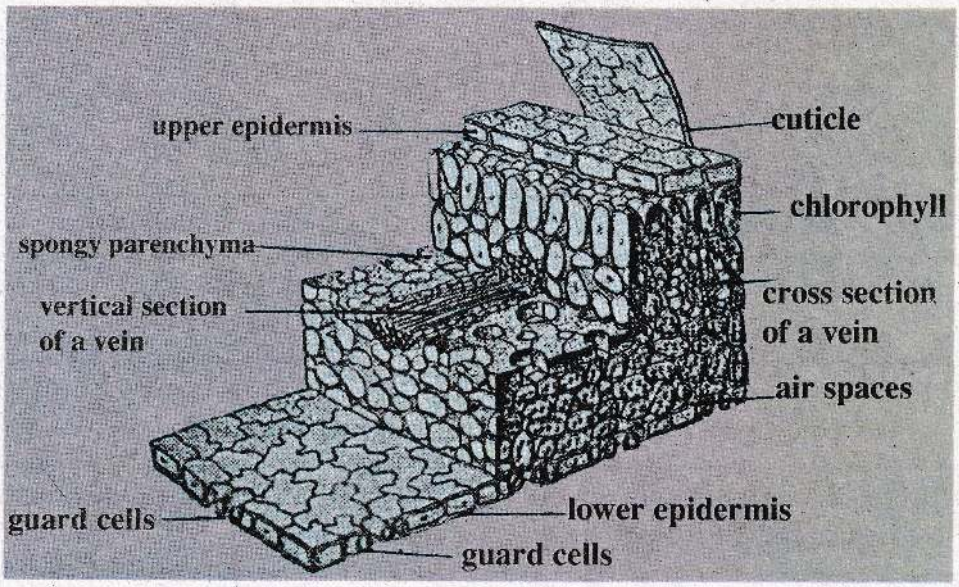


Figure 9.10 - Structure of a cross section of a leaf of a dicotyledonous plant (three dimensional).

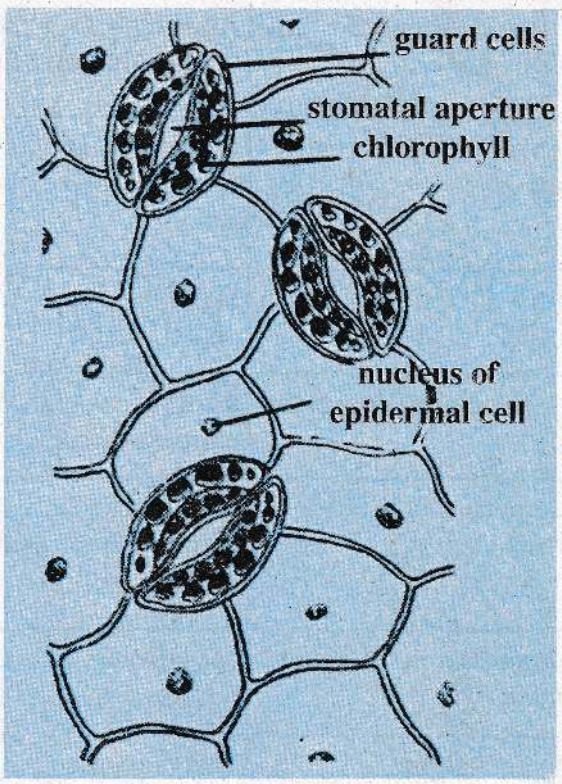


Figure 9.11 - How stomata are arranged on an epidermal peel

Compare your observations with those in Table 9.1

Table 9.1

Adaptations	Functions
1. Stomata placed in the lower epidermis	Providing entrance for CO_2 and exit for O2 into and out of the leaf.
2. Presence of air spaces among the cells of the spongy parenchyma.	Allowing CO_2 to reach the cells and O_2 to move out of the cells.
3. Absence of chlorophyll from the epidermal cells.	Make it easy for sunlight to penetrate into the interior of the leaf.
4. Presence of chloroplasts in the cells of the palisade parenchyma.	Manufacturing food using sunlight CO_2 and H_2O.
5. Presence of air spaces among the cells of the palisade parenchyma.	Allowing CO_2 to reach palisade cells and O_2 to move out of them.
6. Palisade parenchyma situated close to the upper epidermis.	Providing sunlight well to the tissue specially adapted for photosynthetic action.
7. Xylem of the veins placed very close to the spongy cells.	Supplying water necessary for photosynthesis.
8. Phloem of the veine placed very close to the spongy cells.	Carrying away the products of photosynthesis.
9. Presence of chloroplasts in the cells of the spongy parenchyma.	Absorbing solar energy necessary for photosynthesis and increasing the efficiency of food production in the leaf.
10. Presence of chloroplasts in the guard cells of the stomata.	Manufacture of glucose to obtain energy necessary to open and close the stomata.
11. Presence of a larger number of stomata.	Carryout gaseous exchange efficiently.

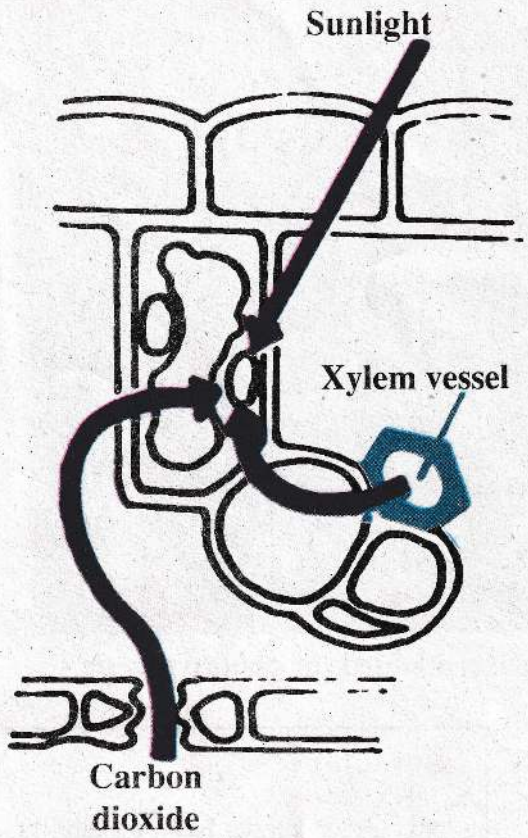


Figure 9.12 - How carbon dioxide gas, water and sunlight reach a palisade parenchyma cell in a leaf.

Assignment 2

Using easily available materials construct a three dimensional model of a leaf.

Question 2

If a green leaf is equated to a food manufacturing factory,

- ★ What are the raw materials used?
- ★ What is the form of energy used?
- ★ What is the principal product?
- ★ What is the by-product?

What are the adaptations shown by other parts of plants apart from leaves, for the process of photosynthesis?

What should be the colour of the plant parts where photosynthesis is carried out? Make a search to see whether there are parts of plants other than leaves where photosynthesis takes place.

Assignment 3

Visit several places and search for parts other than leaves which are green in colour in various plants and make a report.

Compare your observations in assignment 3 with the observations stated below.

Plant	Green part of plant (except leaves
All plants	Apex of the stem
Young rubber plants	Greater part of the stem
Young bean plant	Cotyledons
Cactus	Fleshy stem
'Daluk' (Euphorbia antiquorum)	Stem
'Hatavariya' (Asparagas)	Branches
'Heerassa palu' (Cissus quadrangularis)	Stem
'Navahandi' (Euphorbia tirucalli)	Stem
'Kasa' (Casuarina)	Branches

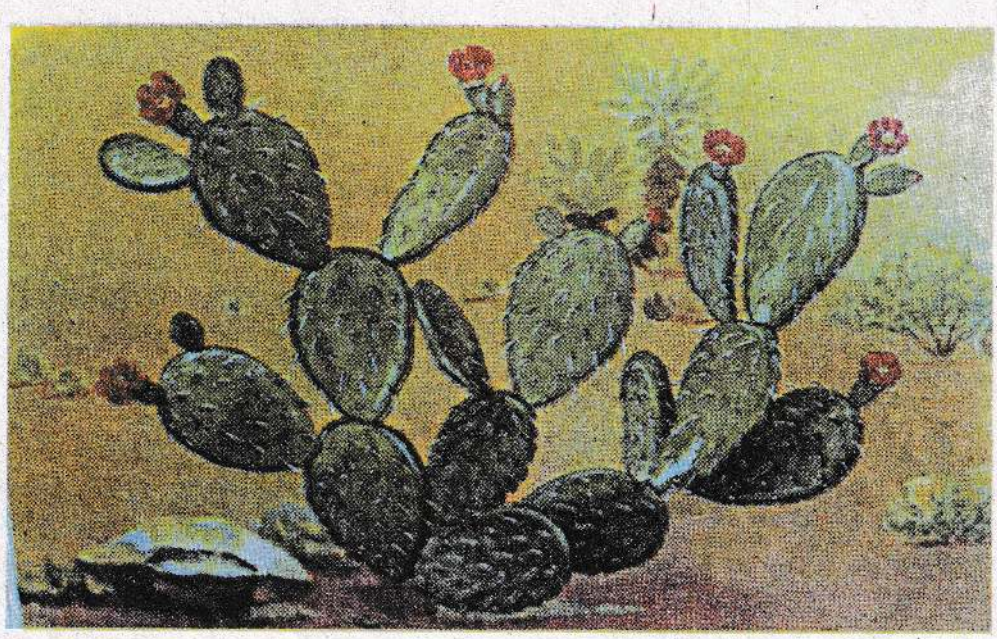


Figure 9.13 - Plants with other parts adapted for photosynthesis

The importance of photosynthesis for the existence / survival of the living world

It is the green plant that supplies the food required by the living world. That is why the green plant, which is the first link in all the food chains, is called the primary producer. Since green plants use up carbon dioxide and give out oxygen during photosynthesis it has become possible to maintain the balance of carbon dioxide and oxygen in the atmosphere unbroken.

If green plants were to disappear some day from the earth no living thing would be left.

Summary

- ★ Green plants have the ability to manufacture food.
- ★ The process by which green plants manufacture food is called photosynthesis.
- ★ Since animals do not have the ability to photosyntheis they have to depend on plants.
- ★ Plant leaves are organized to function as production chambers for the process of manufacturing food.
- ★ Plant leaves contain factors such as chlorophyll necessary for manufacturing food.

- ★ There are parts of plants other than leaves which are adapted to manufacture food.
- ★ The food manufactured with the help of energy in sunlight and using carbon dioxide from the atmosphere and water absorbed by the roots is the simple sugar called glucose.
- ★ The factors necessary for photosynthesis and its by-products can be identified by simple experiments.
- ★ The food manufactured by photosynthesis is converted to fats, proteins and starch and stored in other parts of plants such as roots, stem and seeds.
- ★ All animals including man depend directly or indirectly on plant products as grains, fruits, vegetables, etc.
- ★ The survival of the living world depends on the survival of green plants.
- ★ It is the bounden duty of each and everyone to refrain from deforestation, burning of forests and other activities harmful and damaging to the environment and safe-guard green plants.

Now you can

- ★ Understand the process of photosynthesis.
- ★ State the factors necessary for photosynthesis.
- ★ Describe the principal organ in which photosynthesis takes place in a plant and its adaptations.
- ★ Mention the products and by-products of photosynthesis.
- ★ Conduct experiments to confirm them.
- ★ Understand that all animals including man are dependant directly or indirectly on plant products.
- ★ Understand that the green plants are essential for the survival of the living world.

10. Electric Current

What is Electricity?

You have been able to identify electricity in two forms, namely, static electric charges and electric currents. Have you notice that charges accumulates on insulators or on conducts that are not earthed and that electric currents flow along conductors? What is the reason for it?

You know that positively charged particles called protons and negatively charged particles called electrons are present in atoms and that sometimes electrons can be removed from atoms. Can you think of the relationship between electrons, protons, static electricity and electric currents?

Exchange of Electrons

What happens in charging bodies by rubbing is an exchange of electrons between the bodies.

When a drinking straw is rubber with a piece of cotton cloth some of the electrons of the atoms in the cotton cloth get transferred to the straw. The straw gets negatively charged. Apart from that there is a reduction of electrons from atoms in the cotton cloth. Hence it is now positively charged.

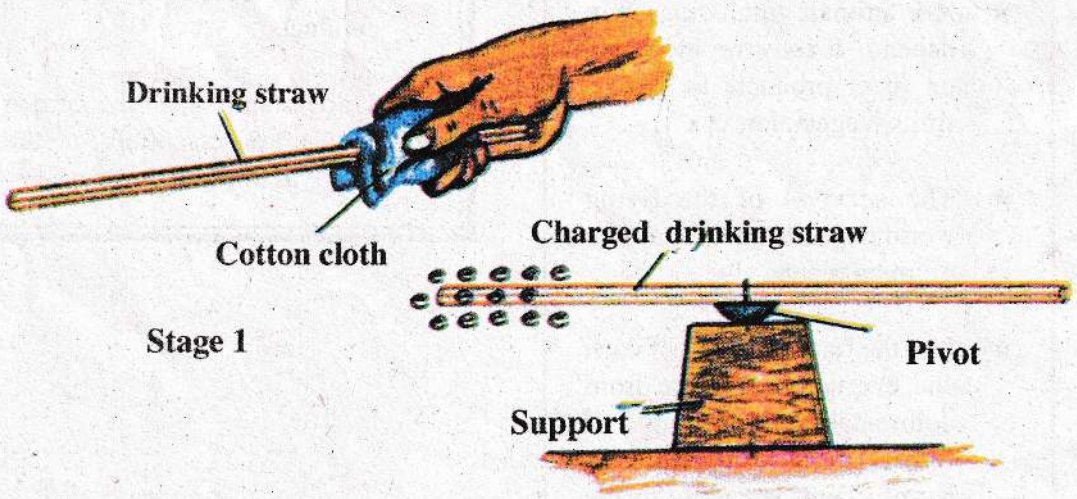


Figure 10.1

Do you know why metals and plumbago (one form of the element carbon) act as electric conductors? They contain a large number of free electrons, free electrons move about randomly. When they are directed to flow in one direction an electric current is produced.

An electric current is a flow of a stream of electrons through a conductor.

An Electric current flows when there is a difference in the electron pressure between two points of the conductor. What you understand by the voltage is the difference in the electron pressures between two points. A small difference in the voltage helps to produce a current in the conductor.

When the voltage difference is very high electricity can flow through moisture through the bodies of organisms and through air. Sometimes electrons and sometimes positive and negative ions flow through them. Any stream of charged particles is known as an electric current.

Perform the activity given below with the assistance of the teacher.

Activity I

Obtain drinking straw, cotton handkerchief gold-leaf electroscope, a glass rod (insulator) and a metal rod (conductor). Apparatus as well as your hands should be very clean and dry.

Charge the drinking straw. It receives a negative charge. Using it charge the electroscope by induction then the electroscope receives a positive charge. Now the gold leaves of he electroscope are seen too have diverged. Using the glass rod make contact with the disc of the electroscope. There will be no charge in the gold leaves. Touch the disc of the electroscope with the metal rod. The gold leaves will collapse. (Figure 10.3).

What is the hypothesis you can build up from the above activity?

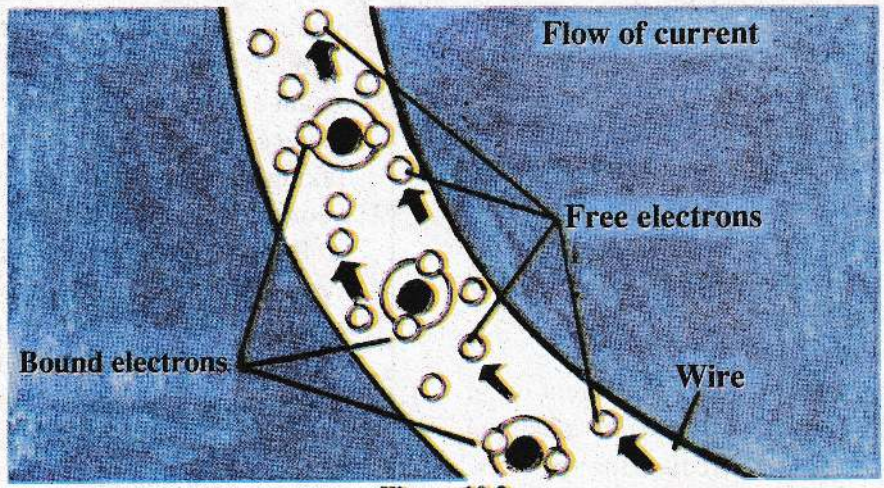
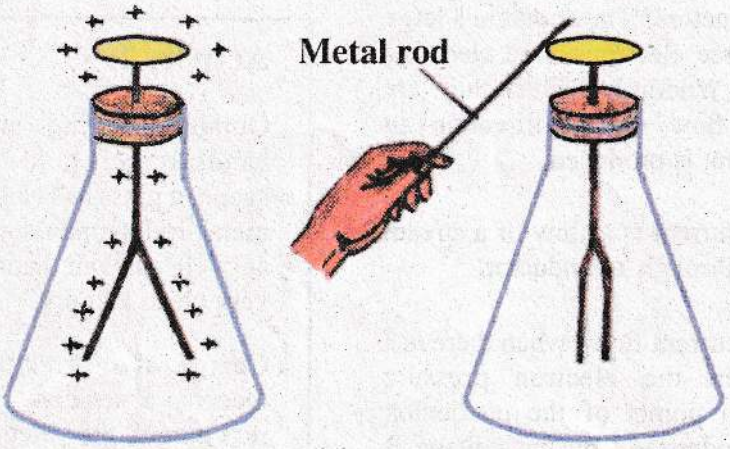


Figure 10.2

The glass rod is an insulator. No electrons will pass through it.



Gold-leaves are positively charged due to a reduction of electrons

Electrons flow from the earth to neutralize the charges

Figure 10.3

Metal rod is a conductor. Electrons flow through the metal rod from the earth to the electroscope. Due to it charges on the electroscope get neutralized and the gold leaves collapse.

You can test whether the above hypothesis is true or not by charging the electroscope again and touching the disc of the electroscope with Neon tester instead of a metal rod. The instant lighting of the neon tester can be seen clearly, especially when the surroundings is dark.

You may wonder why there is no closed circuit in this case.

It is only an instantaneous current or an electrical pulse that can be obtained without a closed circuit. How can you obtain a continuous current?

Do you know?

It is said that the American Scientist Benjamin Franklin (1706 - 1709) sent a kite to the sky during strong weather with a key attached to the lower end of the thread to obtain electricity from a thunderstorm. He was able to obtain a spark with the help of the charges flowing along the thread. Taking this experience as a guide George Richman of St. Petersburg of Russia conducted experiments by holding a stick with a pointed wire vertically during a storm. Unfortunately he died of electrocution when the electrical charges flowed through his body during a lightning flash.

Simple Cell

Activity 2

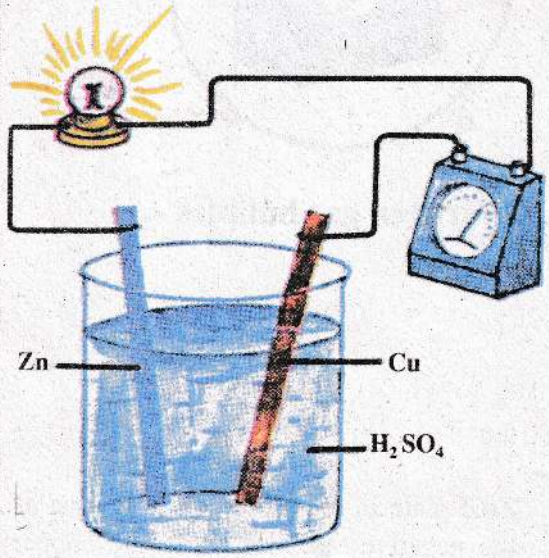


Figure 10.4

Obtain dilute sulphuric acid, a beaker, zinc plate about 3 cm x 10 cm in area, a copper plate of the same size, connecting wires, a small electric bulb and a holder, a galvanometer, piece of wooden strip of thickness 1 cm, clips and pasting tape.

Clear the two metal plates by scraping and connect onto the two wires of the bulb holder. Fix the two metal plates on to the wooden strip so that they are parallel to each other and close together without touching. Fix the bulb on to the holder and immerse the two plates in the beaker of acid. The bulb will light up but the intensity will be gradually reduced and become extinguished. Then cut one wire in the middle and connect on to the terminals of a galvanometer. You will notice that a small current flows continuously.

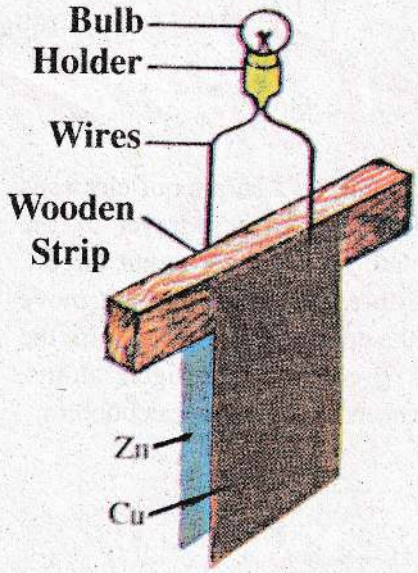


Figure 10.5

What you have constructed is a simple electric cell. Did you know that an electron pressure difference or potential difference can be created without charged bodies?

There are hydrogen ions (H^+), sulphate ions (SO_4^{2-}) and hydroxyl ions (OH^-) present in the acid solution. Zinc is more active than hydrogen. In the acid solution Zn^{+2} (Zinc ions) are released to the solution from the Zinc plate.

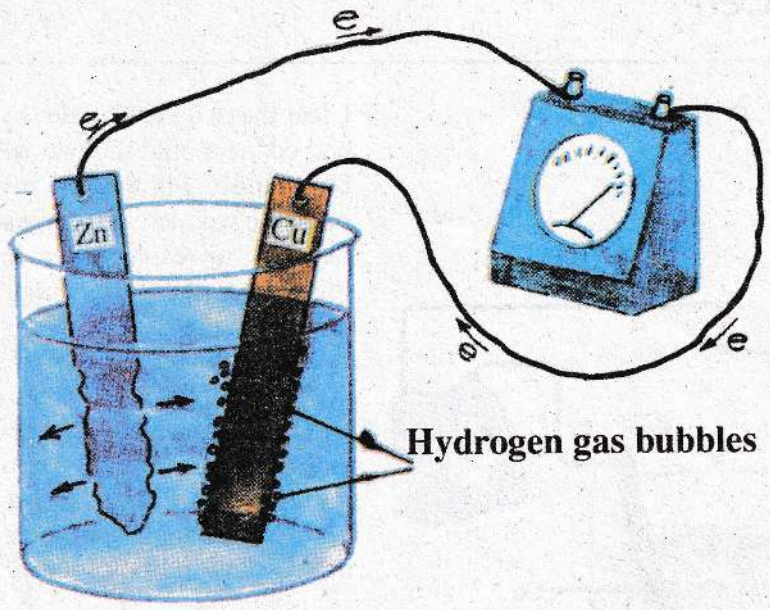


Figure 10.6

$Zn \longrightarrow Zn^{+2} + 2e$

Then there will be a surplus of electrons in the zinc plate. They travel to the copper plate along the external circuit. H^+ (ions) present in the solution move towards the copper plate and acquire the electrons producing hydrogen atoms. They are seen to evolve as gas bubbles.

$H^+ + e \longrightarrow H$

$H + H \longrightarrow H_2\uparrow$

At the above mentioned charges take place at the same time. The law regarding the attraction and repulsion of electrostatic charges you have studied in Grade 8 will help you to understand the above process.

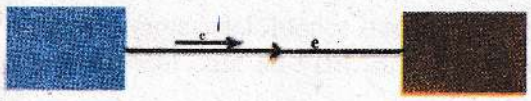
Zinc plate of a simple cell is known as the negative terminal while the copper plate is known as the positive terminal. Electricity flows in the external circuit from the negative terminal to the positive terminal as a current of electrons. Can you explain how electricity flows within the solution?

Standard Current

Observe the way the direction of the flow of electrons is indicated in the external circuit shown in Figure 10.6. You know that it is a negative electric current scientists learnt about the working of the electric current before they identified the electron. Those days they thought that a positive electric current flows from the positive terminal to the negative

terminal. Figure 10.7 (b) shows how it was indicated in diagrams. Even today we indicate the discretion of the current in the same way. The current that is considered to travel from the positive terminal to the negative terminal known as the **standard current**. When it is necessary to mention about the electrons in same form as known shown in Figure 10.7 (a).

(a) Indicating the direction of the electron current



Negative Terminal — Positive Terminal

(b) Indicating the direction of the standard current

Negative Terminal — Positive Terminal

Figure 10.7

Do you know?

Italian Scientist Lui Galvani was engaged in dissecting a frog in 1780 when he observed that whenever his dissecting knife touched a nerve in the leg of the frog the leg jerked.

He conducted experiments to check whether there is electricity in the muscles of the frog. Galvani thought that when two metals touch electricity is delivered from the body of an animal. So he called the electricity animal electricity.

Another Italian called Alecsandro Volta heard about the above incident. (By this time he had invented the electrophorous to store charges)Volta too conducted experiments similar to that of Galvani and came to the conclusion that electricity is obtained from the contact of metals and not from the animals' body. He called it metallic electricity.

This theory survived for a long time. Galvani died in 1798. In 1800 Volta discovered a process to obtain electricity continuously later it came to be known as the Volta pile.

Activity 3

Attempt to construct something similar to the Volta Pile.

Obtain same numbers (5 each would be sufficient) of pieces of copper plate, zinc or aluminium plates and paper of the same size. Pack them in the order of copper, paper, zinc, copper paper, zinc. Fasten two connecting wires to the plates at the ends. Wrap all the plates tight with a thread and tie the thread. Immerse this bundle (pile) in a salt solution or in a Vinegar solution and keep a bulb at the ends of the two wires and observe what happens when the paper pieces are soaked properly remove the pile from the solution. This can use for a period of time.

You will be able to learn about different types of chemical cells that provide electricity more easily than the above cells. Dry cell and the Lead-acid cell are two such cells.

Production of electricity by motion

You know that electricity to the National Grid is not supplied by charged bodies or cells. Another method of generating electricity is described below.

A model of a dynamo-motor set can be seen in your school laboratory. If not available you may be able to construct one.

A and B are two small motors their rotating axles are joined together and mounted on a board. When A is supplied with electricity it begins to work. Its rotating part is called the armature. Since

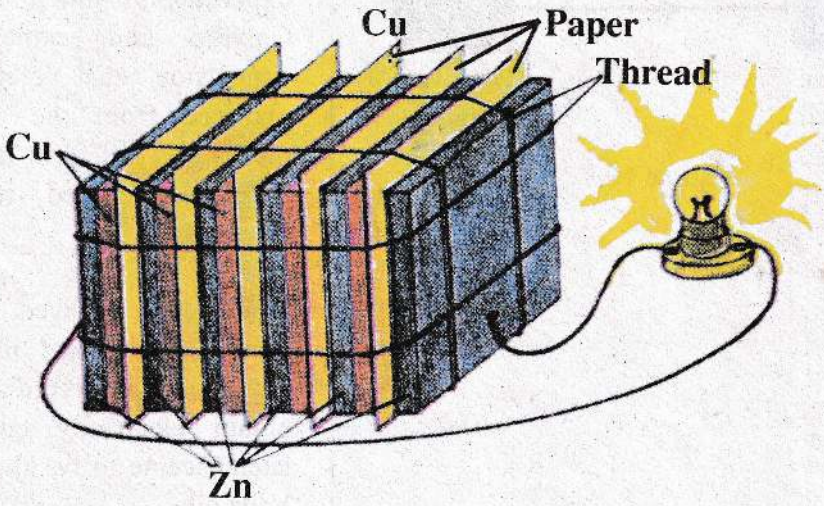


Figure 10.8 - Model of a Volta Pile

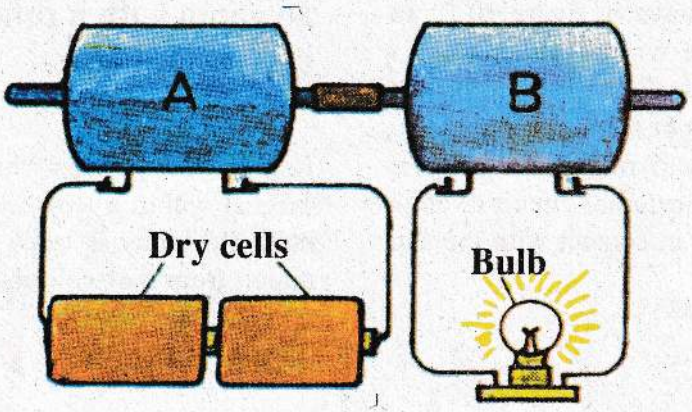


Figure 10.9

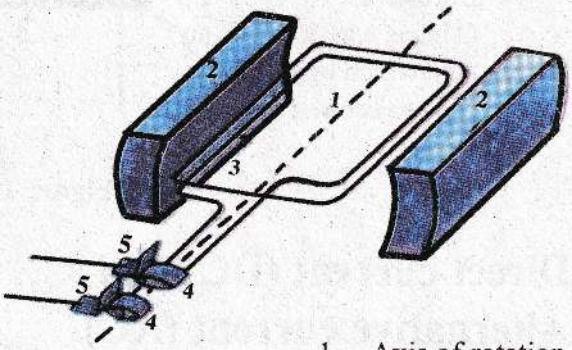
the axles are connected armature of B too rotates without a supply of electricity. Then the bulb connected to B lights up. How did the bulb receive electricity?

The bulb received electricity from B. Electricity is produced in B. When an equipment such as A or B is supplied with electricity motion is the result (output). When motion is the input electricity becomes the output. Equipment A which performed the first action is called the motor. Equipment B which performed the second action is called the dynamo. But you must keep in mind that some dynamos do not behave as motors and some motors do not behave as dynamos.

Dynamos of different sizes and different designs are in use today for various activities. You can prepare a list of instances where dynamos are used.

Shown below are two simple dynamos and their designs.

A dynamo with a rotating coil



1. Axis of rotation
2. Magnets
3. Coil
4. Slip rings
5. Brushes

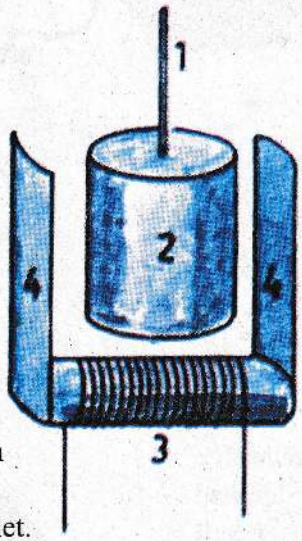
Figure 10.10

(Core of coil and rotor wheels are not shown in the figure)

In the design shown in figure 10.10 an insulated coil of wire is mounted in a strong magnetic field able to rotate freely. Terminals of the coil are soldered on to the two slip rings. Electricity is delivered to the external circuit through the two brushes in contact with the slip rings.

Dynamo with a rotating magnet

In a bicycle dynamo what rotates is the magnet within a lengthened core of the coil. Electricity is taken to the external circuit from the two ends of the coil.



1. Rotating axis
2. Magnet
3. Coil
4. Core of the Coil (This is a safe coil from tape which bends at the ends to centre the magnet.

Figure 10.11

Direct current (DC) and Alternative current (AC)

Turn the rotor wheel of a bicycle dynamo slowly with your hand. You can feel a tightness and looseness alternatively. Along with the increase and decrease of the tightness electric current produced by the dynamo too will increase and decrease the direction of the current also changes from time to time. By connecting the dynamo to a centre - zero galvanometer and turning the dynamo by hand the increase and decrease of the current and the change of direction of the current can be observed in the galvano meter from the behaviour of its indicator.

Unless special devises are used to offset the change of direction of the current flowing to the external circuit the current that is obtained from a rapidly rotating dynamo is a current which changes its direction in very short time intervals. Such electric current is called alternating current. An electric cells is called a direct current.

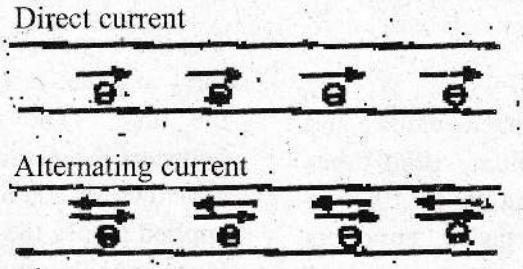


Figure 10.12

When a direct current flows in a conductor electrons move in one direction continuously. When there is an alternating current flows in the conductor free electrons keep on vibrating forwards and backwards.

Investigate the current-time graph in each case. Positive and negative signs marked on the graph do not indicate the type of charge. When the value of the current flowing in one direction is considered positive the value of the current flowing in the opposite direction is considered negative.

For purposes like lighting bulbs direct currents as well as alternating currents can be used. Fluorescent lamps are lit by alternating currents. Although your eyes are not sensitive enough to notice, tube lights keep lighting and extinguishing at a very high rate try to obtain evidence to confirm that observation. To operate radio and television sets direct current is necessary. When an alternating current supply is used for that purpose accessories to convert it to a direct current are used. Alternatively current is used to operate transformers that are used vary the voltage whenever required.

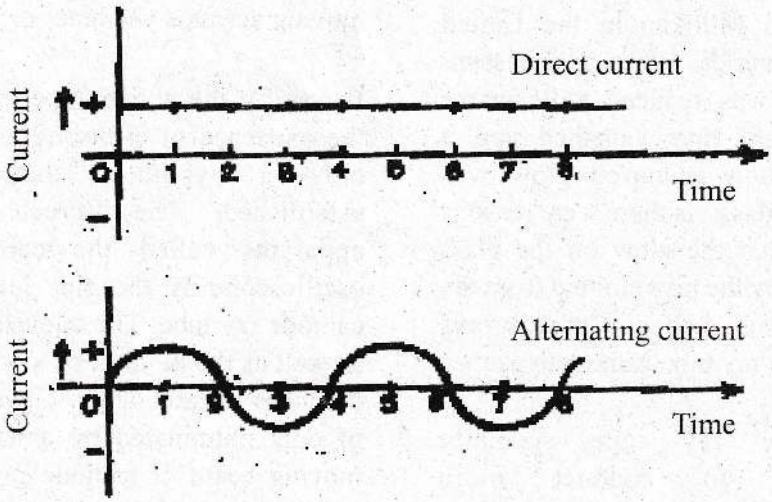


Figure 10.13

Do you know?

English scientist Michael Faraday and French Scientist Coulomb used tubes similar to that shown in Figure 10.14 to find out whether gases conducts electricity. Two electrodes are fixed at the ends of the tube. When a potential difference greater than 50,000V is applied to the electrodes strong electric discharges were produced. When the pressure of the gas was gradually reduced by operating the vacuum pump the strong discharge turned to a coloured light beam with a flickering effect. When the type of gas in the tube was changed colour of the light too changed. It is after this discovery that neon lights different colours came to be used in advertising boards.

Further experiments were conducted regarding this by Sir William Crookes and Sir J.J. Thomson in England, Rongen in Germany, Rutherford in Canada, and Millikan in the United States of America. When the pressure of the gas was reduced still further coloured light rays vanished and a greenish-yellow coloured glow was seen on the glass. As there were reasons to believe that the glow on the glass was caused by the rays emitted from the cathode, terms such as Cathode rays and Cathode ray tube came into use.

A Cathode ray tube specially constructed to conduct more experiments is shown in Figure 10.15.

The end opposite to the Cathode in the form of a disc is known as the "face of the tube". The thin metallic cross between the Cathode and the face is turned down and an electric potential is applied across the electrodes. Then the face gets illuminated with a greenish yellow light. When the cross is turned upwards a clear dark shadow of the cross flab on the face. This confirms that Cathode rays propagate in straight lines.

When a magnetic pole was brought near the tube the illuminated area got displaced to a side. Similarly it was possible to displace the illuminated area by positively and negatively charged bodies. It was seen that Cathode rays move away from a negative charge but move towards a positive charge. It was possible to show by other experiments that cathode rays possess kinetic energy. Hence cathode rays are a current of negatively charged particles moving across a vacuum.

It was by the above experiments that the existence of electrons, which was only a hypothesis before, was established. The 'screen' of the apparatus called the cathode ray oscilloscope is the flat face of the cathode ray tube. The television screen as well as the monitor of a computer is the faces of cathode ray tubes. A series of dots illuminated by a narrow fast moving beam of cathode rays creates pictures and the visual records.

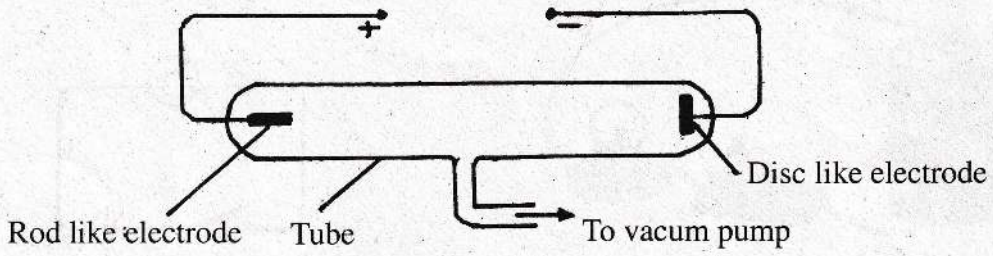


Figure 10.14

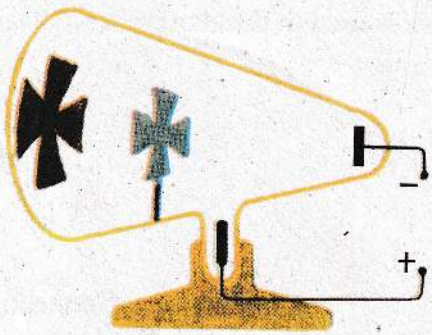


Figure 10.15 - Crooke's Tube

Drawing circuit diagrams

You are aware that symbols are used to communicate most details easily. You may have seen that electrical circuits are expressed by circuit diagrams using standard symbols.

Example : A circuit including a cell and a bulb.

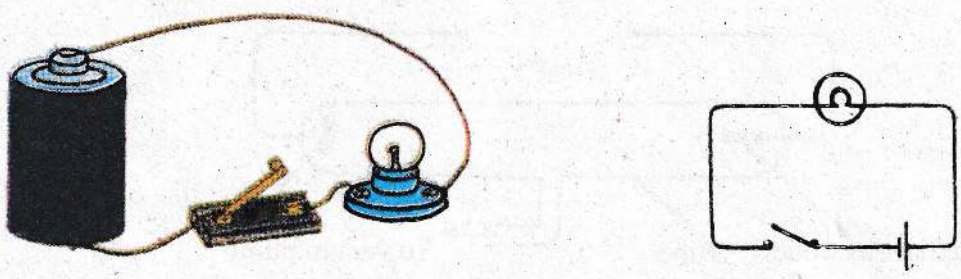


Figure 10.16

Identify the standard symbols used in the above circuit diagram.

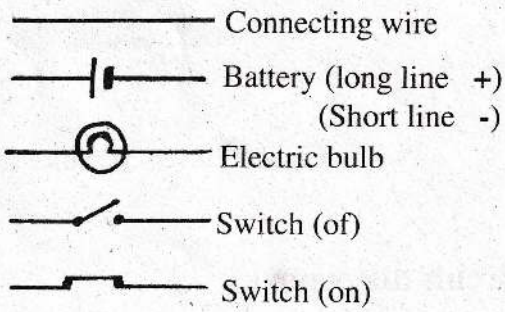


Figure 10.17

(Some of the standard symbols used for other electrical apparatus are given at the end of this chapter.)

Measuring the potential difference

You know that electricity flows between points of different electric levels or potentials. The potential of neutral bodies is considered as zero. The unit of measuring electric potential is the Volt (V). The difference in potential between two points is called the potential difference.

Voltage is the difference of the potentials

The voltmeter is used to measure the potential difference between two points of an electric circuit. The way it is connected to the circuit can be understood from the diagram given below.

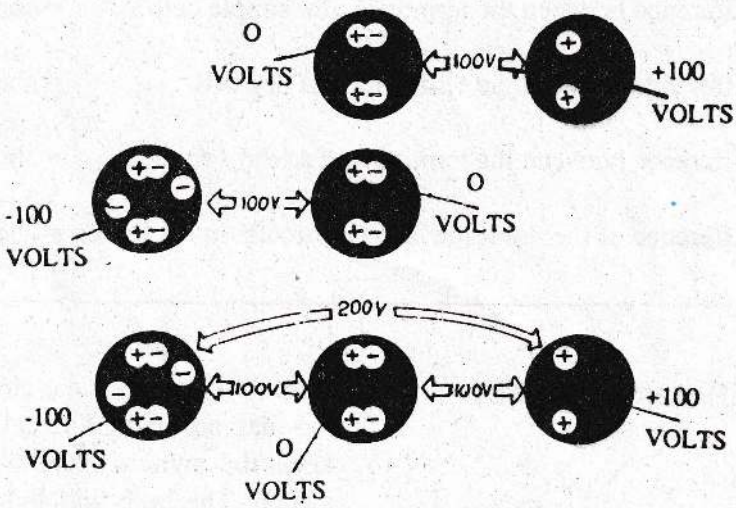
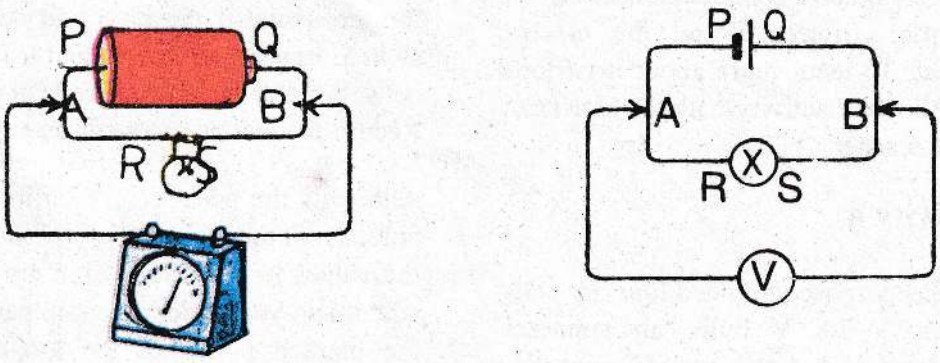


Figure 10.18



Apparatus diagram **Circuit diagram**

Figure 10.19

Potential from Q to S does not change. The potential from R to P too does not change. Therefore potential difference between A and B can be considered as the potential difference between the terminals of the cell.

Do you know?

Potential of the earth	= 0V
Potential of the charged part of a thunder cloud	= about $\pm$ 1000000 V
Potential difference between the terminals of a simple cell	= about 1 V
Potential difference between the terminals of a dry cell	= about 1.5 V
Potential difference between the terminals of a lead / acid cell	= about 2 V
Potential difference of the domestic electric circuits in Sri Lanka	= about 230 V

Potential difference and the current

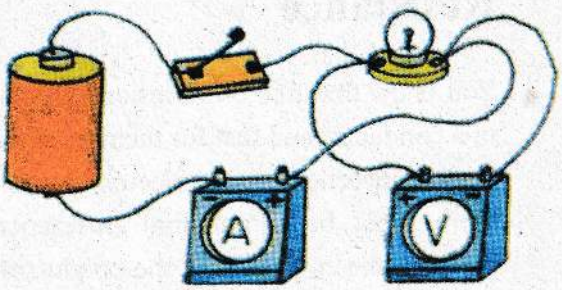
If an electric current is created due to the potential difference, you may think that there should be a connection between the potential difference and the electric current. To learn more about it perform the following activity with the assistance of the teacher.

Activity 4

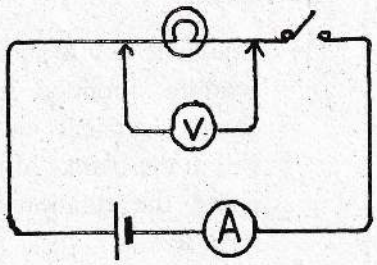
For this purpose you need four dry cells, switch, a 3.8 V bulb, an ammeter, voltmeter and 6 pieces of connecting wire. A bulb holder and cell holders too are useful.

First of all prepare the circuit shown in the diagram using one cell. In doing so keep the switch open. Next close the switch. The bulb will light up. Quickly record the current flowing through the bulb and the potential difference between the terminals of the bulb and open the switch. Repeat the experiment using two cells, three cells and four cells at a time. Record the results in a table as shown.

Although the values in the first three columns of the table differ considered by the values in the last column are nearly equal. Did you notice a certain pattern in the marked points of the graph? The relationship shown by that pattern is known as the proportion in mathematics.



Apparatus diagram

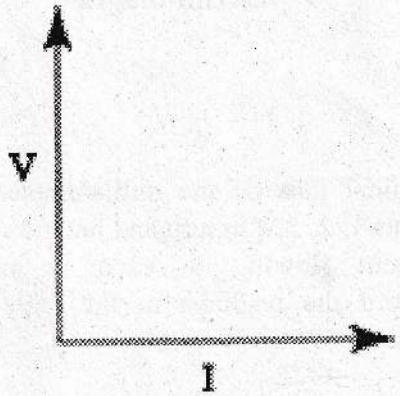


Circuit diagram

Figure 10.20

Table 1

Number of cells	Potential difference (V)	Current (I)	Potential difference (V) / current (I)
1			
2			
3			
4			



Prior to the invention of the voltmeter, the German Scientist George Ohm in the 19th century discovered the relationship between the potential difference at the ends of a conductor and the current flowing through it.

It was stated as follows :

For the same conductor,

$$\frac{V_1}{I_1} = \frac{V_2}{I_2} = \frac{V_3}{I_3}$$

Exercise 1

(1) The table below shows some reading obtained from the same electrical equipment. Fill in the blanks of the table using the relationship you have learnt.

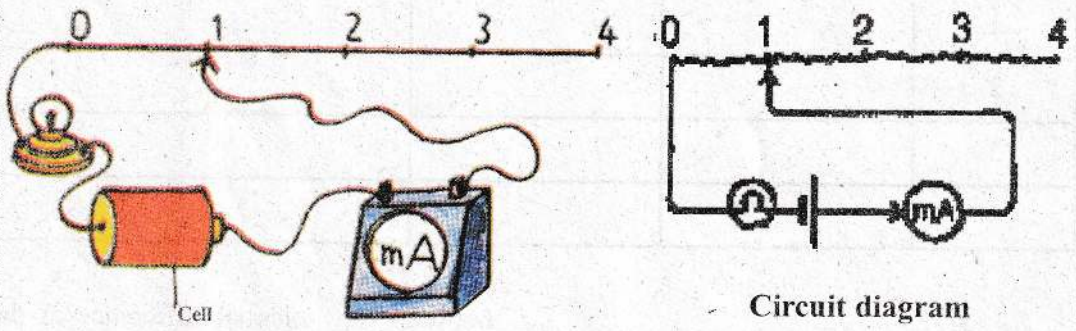
Potential difference	3.0V	4.5V	6.0V	7.5V	-	-	-
Current	0.5A				0.25A	1.5A	2.0A

(2) Show the information in the completed table by a graph.

Resistance

You know that free electrons are present in a conductor and that for them to move in one direction as an electric current there must be a potential difference between the two ends of the conductor. Perform the following activity to find out whether the magnitude of the current varies when the same potential difference is applied across different conductors.

Activity 5



Apparatus diagram

Circuit diagram

Figure 10.21

Obtain a narrow GI (galvanized iron) wire of about 30 cm in length. Mark parts of equal length on it. As shown in figure 10.21, connect one terminal of the cell to the point O of the wire through a bulb. Connect the other terminal through the milliammeter to points 1, 2, 3, 4 in turn and measure the current flowing in each instance. Record the readings in the table as shown.

Portions of the wire included in the circuit	1	2	3	4
Current flowing in milli amperes				

What do you observe from the set of readings? Even though the potential difference was the same the current was seen to decrease as the length of the wire was increased. Why was it so?

It shows that when the length of wire is increased there is some hindrance for the electrons to flow. Even with a short length of wire there must be a slight hindrance. The opposition to the flow of current in a conductor from within the conductor itself is called the resistance of the conductor.

When the length of a wire increases the resistance too increases. You will be interested to find out whether the thickness of a wire (cross-sectional area) has an effect on the resistance.

You may think that to obtain a wire with twice the thickness of a particular wire it is necessary to solder two strands of wire together. Actually such a soldering is not necessary. Using two wires of the same thickness is equivalent to one wire of twice the thickness.

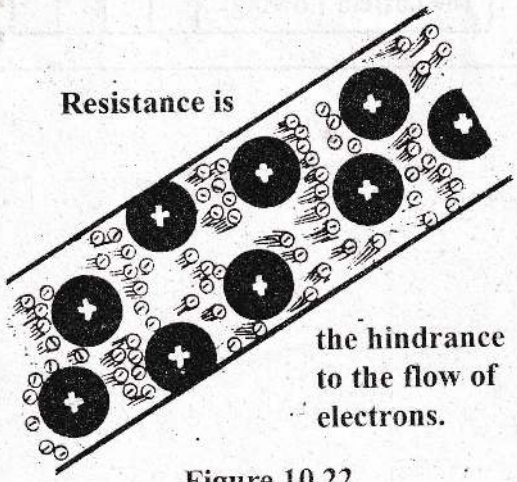


Figure 10.22

You will notice that the strength of the current flowing in the wire increases with increasing thickness of the wire. The reason for this is that when the thickness increases it becomes more easier for the electrons to flow in the wire. In other words the resistance of the wire decreases.

This can be compared to a crowd of people moving along a broad road in one hour being greater than a crowd moving along a narrow road in the same time. On a narrow road movement is more difficult when compared to a broad road.

Now you may wonder why we are considering the resistance of the AB portion only why do not we talk about resistances of the wires connected to A from the cell and the wires connected to the two sides of the milliammeter. Your thinking is correct. In an electric circuit all the wires and the instruments have resistance. But the resistance varies from marked to material. When the resistance is large the flow of current is so small it can be neglected. Then we assume that no current flows. On the other hand, when the current flows easily the resistance is very small and can be neglected.

There is a measure to compare the resistance of different conducting materials. It is known as the **Resistivity**. You will get the opportunity to learn about it later.

Activity 6

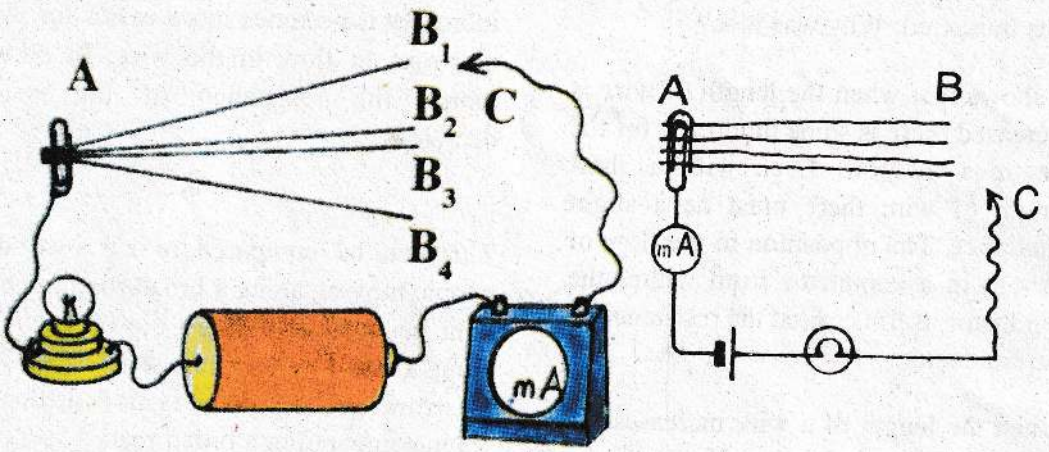


Figure 10.23

Taking four strands of the same GI wire twist together one end of each wire at one end. Let us call that common end A. Mark the points B1, B2, B3 and B4 on the four pieces of wire at equal distance from A. Now arrange the circuit shown in Figure 10.23. Record the current indicated by the milliammeter by touching the point B1 with the end of the wire C. Repeat the experiments by keeping the points B1 and B2 together, B1, B2, B3 together and finally B1, B2, B3, B4 together. By keeping the points together we get conductors of different thickness. Record the currents in a table as shown below.

Thickness of the wire	1	2	3	4
The current flowing				

There are instances where resistors are used to control the current. You will come across various types of accessories such as permanent resistors, variable resistors resistor wires and carbon resistors in your activities.

Resistance can be defined correctly as the ratio $\frac{V}{I}$. When the symbol R is used to denote resistance.

$$R = \frac{V}{I}$$

Do you know?

When the temperature increases the resistance of most of the wires increases. When cooled, resistance normally decreases. Scientists believe that at the temperature of absolute zero (-273°C or O°K) the Resistance should come down to zero. But it is not practicable to reach that temperature. Scientists are involved in searching for materials that have near zero resistance at high temperatures. Such materials are called super conductors. If we can find materials that behave as super conductors at normal temperatures there will be a revolution in electricity.

There are three factors that affect the resistance of a wire when the temperature remains constant. They are,

1. Length of the wire
2. Cross sectional area of the wire
3. The kind of material the wire is made of

Ohm's law

Ohm discovered that when the temperature and other physical conditions remain unchanged, the resistance of a conductor takes a constant value.

$$\therefore R = \frac{V}{I}$$

When the temperature and other physical conditions remain unchanged the current flowing through a conductor is directly proportional to the potential difference across the ends of the conductor.

The international unit of measuring the resistance

The international unit of measuring resistance is the Ohm. Its symbol is Ω.

Definition of the Ohm

When the potential difference between the two ends of a conductor is one volt and if a current of one ampere flows through it then the resistance of that conductor is one Ohm.

Do you know?

Resistance of some cylindrical conductors of diameter 1 mm and length 1 m is as follows :

Silver	-	0.021 Ω
Copper	-	0.022 Ω
Aluminium	-	0.036 Ω
Plumbago sample	-	1.273 Ω
Nichrome	-	1.400 Ω

The resistance of some copper wires of different lengths and 1 mm in diameter are given below.

Length (m)	0.5	1.0	1.5	2.0
Resistance (Ω)	0.011	0.022	0.033	0.044

Resistances of some Nichrome wires of length 1 m and different diameters are as follows :

Diameter (mm)	0.25	0.05	0.75	1.00
Resistance (Ω)	22.4	5.6	2.5	1.4

Exercises 2

(1) Calculate the resistance of the bulb making use of the readings showing the circuit diagram.

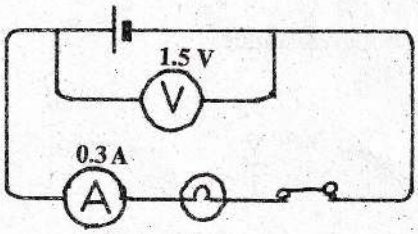


Figure 10.24

(2) When a potential difference of 3.0 V is applied to the bulb what is the current flowing through the bulb ?

(3) Voltage of 230 V is supplied to an electric lamp of a house. If a current of 0.5 A flows through it what is the resistance of the lamp ?

(4) The resistance of the heating element of a 230 V electric oven is 55 Ω. What is the current flowing through it?

(5) For a current of 0.3 A to flow through a 15 Ω resistance, what should be the potential difference that has to be applied to it?

Ohmmeter and the Multimeter

Now you know how to use an ammeter to measure the current flowing through a circuit and to measure the potential difference between two points in circuits. Current and potential difference is characteristics of electricity. Resistance is a characteristic of a conductor. To measure the resistance of a conductor it should be connected to a circuit with constant potential difference. Therefore the instrument called the Ohmmeter used to measure the resistance has cells within to supply a constant potential difference. Hence when the resistance is measured no other current should flow through the resistance.

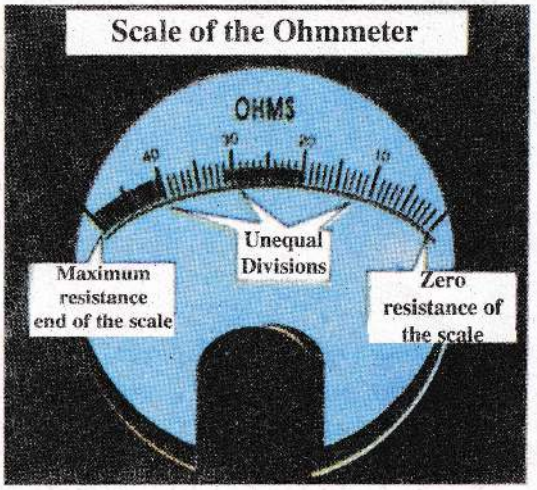


Figure 10.25

You know that the current is zero when the resistance is infinite and that the current is maximum when the resistance is zero. When the Ohmmeter is not operating what it shows is the reading infinite (∞) and not the zero (0). Hence recognize how the Ohmmeter scale differs from other scales studying the above Figure 10.25.

One instrument has been developed so that it can be adjusted to measure current, potential difference and resistance as well as to test transistors. This instrument is known as the **Multimeter**. There are no cells placed inside the multimeter. It can be used as a milliammeter, DC voltmeter or AC voltmeter. It can be used as an Ohmmeter by introducing cells internally. The face of the instrument contains a number of scales to measure different quantities. The same scale can be adjusted to measure different ranges. It is important to adjust the zero value after each adjustment when using to measure resistance. Your teacher will show how to do it.

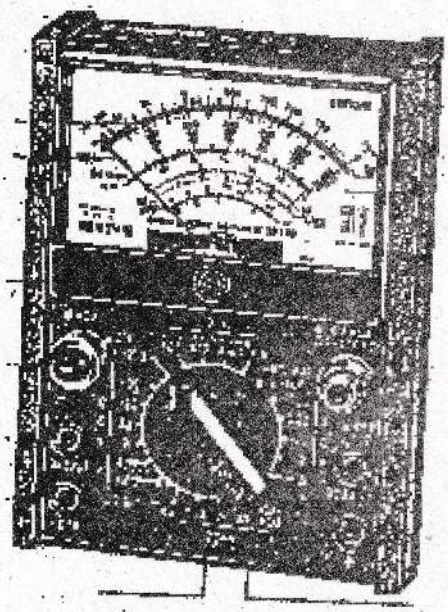


Figure 10.26 - Multimeter

Assignment

Measure the quantities given below using a multimeter.

In various circuits containing cells and bulbs,

1. The current flowing through the lighted bulb
2. Potential difference between the terminals of the lighted bulb
3. Resistance of the bulb when no current passes through it.

More complex circuits

Lighting a number of bulbs together is more complex than lighting a bulb using a battery (collection of cells). For that purpose many types of circuits can be adopted. Observe the circuits below which have four bulbs lighting at the same time.

Connecting bulbs (resistances) as shown in Figure 10.27 (a) is called the series connection. Connecting bulbs (resistance) as shown in (b) is known as the parallel connection, (c), (d), (e), (f) figures show different combinations of the above two methods.

Compare the two methods of connecting resistances.

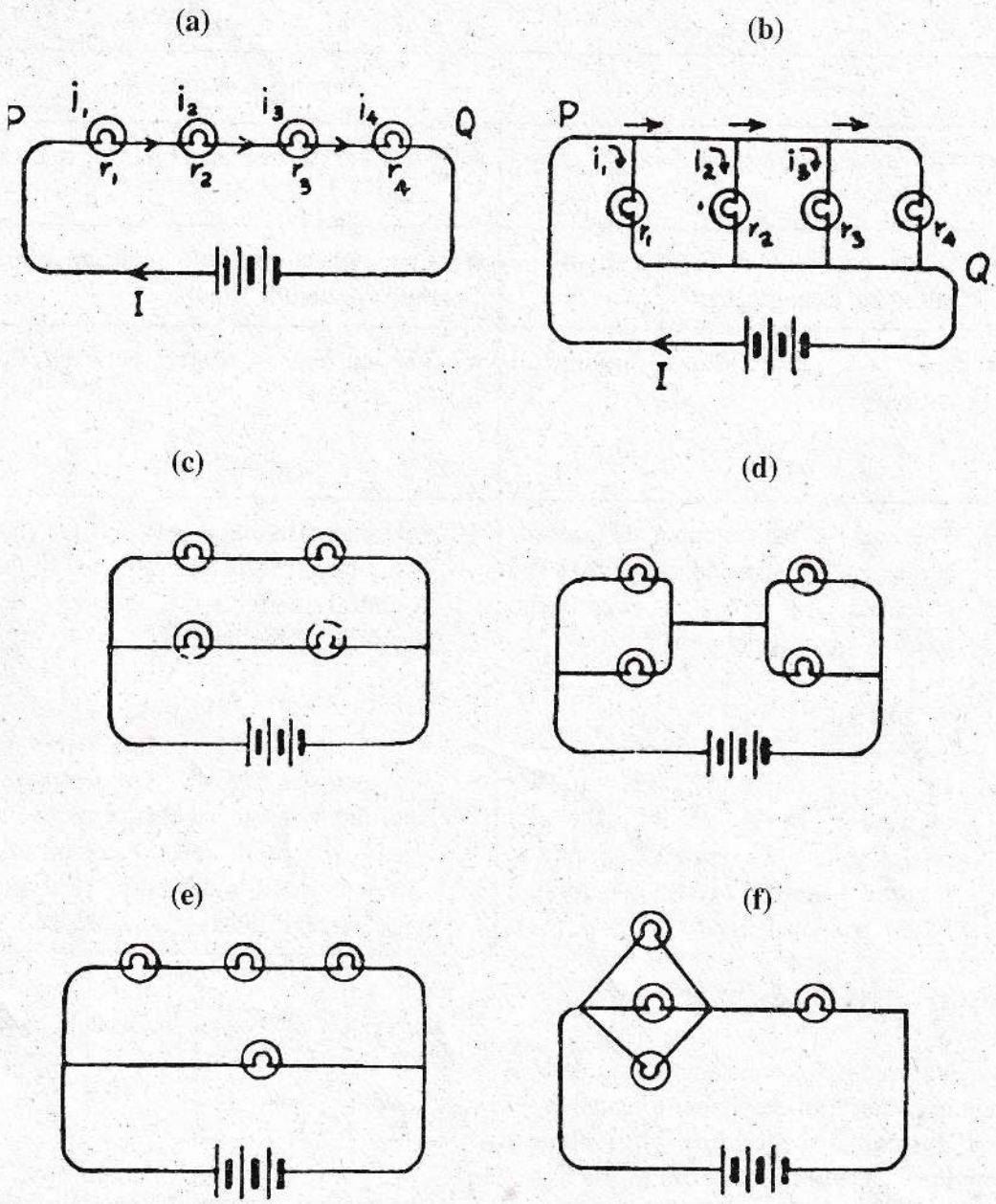


Figure 10.27

Series Connection	Parallel Connection
★ Only one switch is necessary.	★ Separate switches can be fitted to each bulb.
★ When one bulb is fused rest of the bulbs are extinguished	★ Even when one bulb is fused other bulbs remain lighted.
★ The same current flows through all the bulbs. $I = i_1 = i_2 = i_3 = i_4$	★ The current is shared between the bulbs. $I = i_1 + i_2 + i_3 + i_4$
★ The sum of the potential differences across each resistance is equal to the potential difference between the terminals of the battery. $V = V_1 + V_2 + V_3 + V_4$	★ Potential difference between the two ends of each resistance is equal to the potential difference between the terminals of the battery. $V = V_1 = V_2 = V_3 = V_4$
★ Just as resistance increases with the increase in length of the wire, the total resistance of the external circuit is increased. Hence the current delivered by the cell is small.	★ Just as resistance of a wire decreases with the increase in thickness of the wire, the total resistance of the external circuit is decreased. Hence a large current flows through the cell.

Equivalent Resistance

When a number of resistances are joined together, the total resistance created by that system is called the **equivalent resistance.** Of the resistances in the two circuits shown in figure 10.27 (a) and (b), the equivalent resistance of the four bulbs is the resistance between the points P and Q.

Suppose the values of the resistance of the four bulbs are r1, r2, r3 and r4 in order and the equivalent resistance of the four bulbs is R.

Then in the series connection the relationship between R and r is as follows.

$$R = r_1 + r_2 + r_3 + r_4$$

In the parallel connection the relationship between R and r is as follows "

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \frac{1}{r_4}$$

Think how the above two equations can be applied to any number of resistances.

Exercises 3

(1) Find the equivalent resistance of each of the system of resistances given below (Figure 10.28).

(2) (i) Obtain two carbon resistors and find their resistances using an Ohmmeter.

(ii) Calculate the equivalent resistance when the two are in

(a) Series connection

(b) Parallel connection

(iii) Measure the equivalent resistance when the two are in

(a) series connection

(b) parallel connection

(iv) Compare the results obtained in

(ii) and (iii) above.

(3) When each of the systems in question (1) is connected to a 3 V battery

(i) Calculate the current flowing through the battery in each instance.

(ii) Calculate the current flowing through each of the resistance.

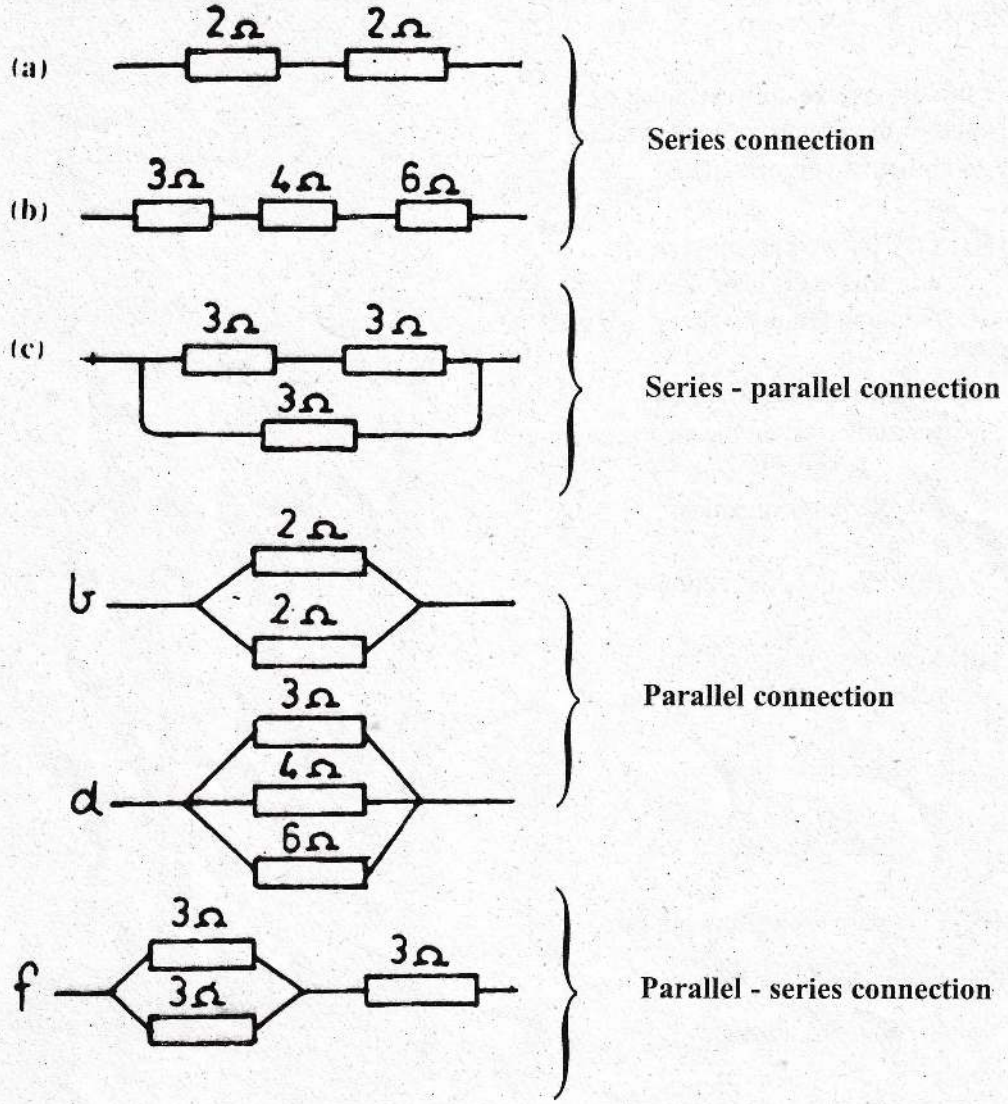

(a)
2Ω
2Ω
(b)
3Ω
4Ω
6Ω
Series connection
(c)
3Ω
3Ω
3Ω
Series - parallel connection
b
2Ω
2Ω
3Ω
4Ω
6Ω
d
Parallel connection
f
3Ω
3Ω
3Ω
Parallel - series connection

Figure 10.28

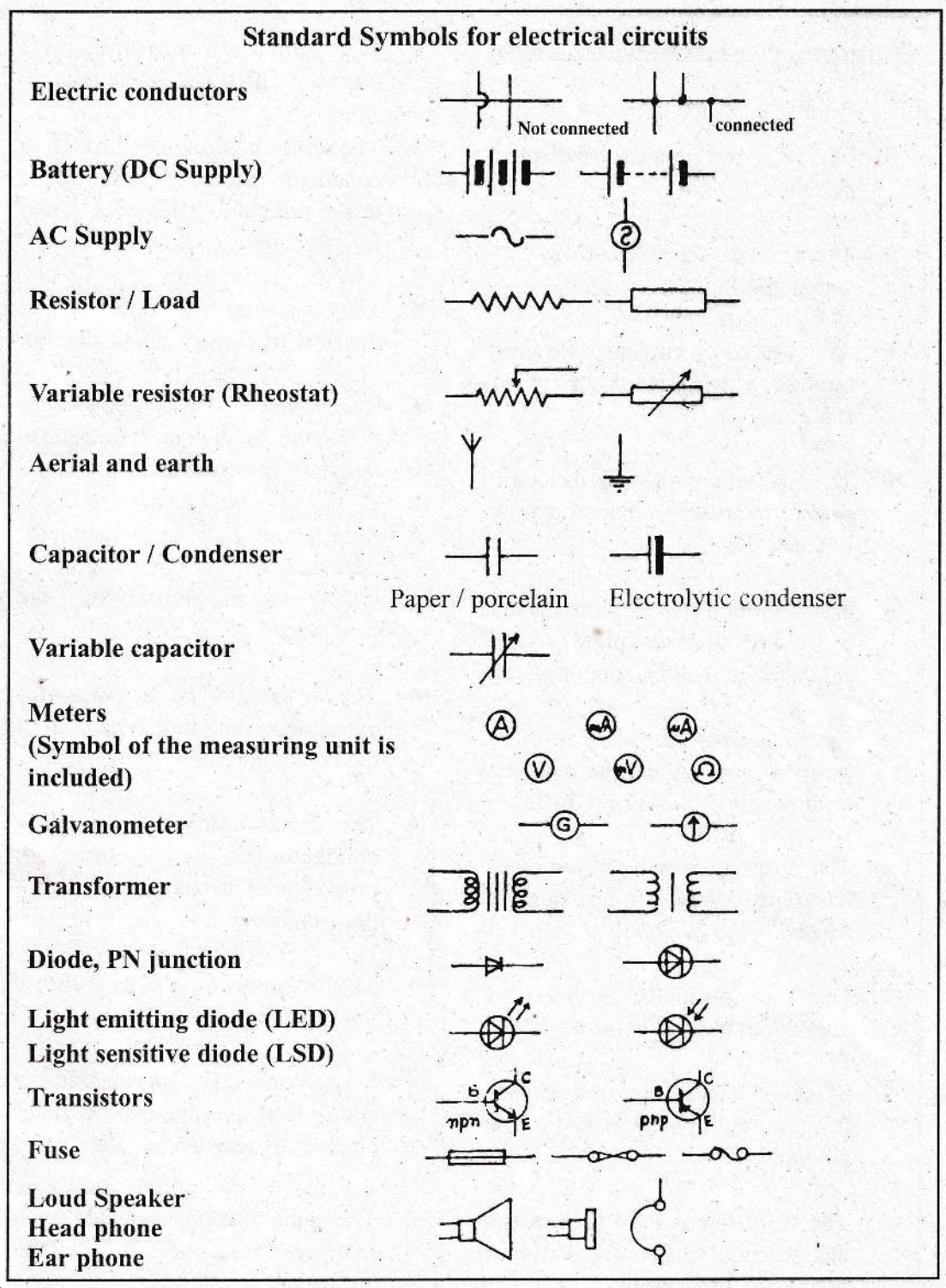


Figure 10.29 - Some standard symbols used in circuit diagrams

Summary

★ Electrons and protons are electric particles.

★ There are free electrons in conductors

★ An electric current flowing through a wire is a current of electrons.

★ The direction of a standard electric current opposite to that of a flow of electrons.

★ A simple cell can be constructed by using a zinc plate dilute sulphuric acid and a copper plate.

★ Ionic reactions take place near the position terminal and the negative terminal OF A SIMPLE CELL.

★ The instrument which produces electricity when the armature is rotated is the dynamo.

★ Dynamos normally produce an alternating electric current.

★ Standard electric current flows from a high potential to a low potential.

★ The voltmeter is used to measure the potential difference between two points in a circuit.

★ The unit of measuring the potential difference is the volt.

★ The current flowing through a conductor is directly proportioned to the potential differences across its two ends.

★ The resistance is the opposition to the flow of current in a conductor

★ Resistance of a conductor increases with the increase in length of the conductor.

★ Resistance of a conductor decreases with the increase in the cross-sectional area of the conductor.

★ The resistance of a conductor varies according to the material of the conductor.

★ The current flowing through a conductor is inversely proportional to the resistance of the conductor.

★ The instrument used to measure the resistance is the Ohmmeter.

★ Series connection and the parallel connection are the two ways of connecting resistances.

★ The total resistance created by a number of resistances is called the equivalent resistance.

Now you can

- ★ Explain what is meant by an electric current.
- ★ Explain the working of a simple cell.
- ★ Show the direction of an electron current and the direction of the standard current in a circuit.
- ★ Compare the workings of a dynamo and a motor.
- ★ Explain what is meant by direct current and alternating current.
- ★ Explain how the current varies according to the change in the potential difference of a circuit.
- ★ Solve simple problems connected to potential difference and current.
- ★ Explain how the resistance of a conductor changes according to its length, cross sectional area and the material it is made.
- ★ State Ohm's law.
- ★ Solve simple problems applying Ohm's law.
- ★ Calculate the equivalent resistance of resistances connected in series and in parallel.
- ★ Light a Neon tester by electrostatic charges.
- ★ Construct a simple cell and light a bulb.
- ★ Construct a Volta pile and light a bulb.
- ★ Draw simple circuit diagrams using standard symbols.
- ★ Draw the structures of a dynamo with a rotating coil and dynamo with a rotating magnet and label them.
- ★ Represent graphically direct current and alternating current.
- ★ Arrange circuits according to simple circuit diagrams.
- ★ Measure the potential difference between two points in a circuit.
- ★ Measure resistance using a Multimeter.

11. Effects of an Electric-current

Heating effect of an electric current

Electric current is used to transmit energy from place to place. Apart from operating machines, electricity is also used to obtain heat and light. Figure 11.11 shows some electric heating equipment used in the home.

Copper wires are used to supply electricity to these appliances. Nichrome wires are used for heating elements present in them. Resistivity of Nichrome is greater than that of copper.

Energy supplied to light filament electric lamps is first converted to heat. This heat makes the filament white-hot resulting in the emission of light. Tungsten wires are used as filaments in these lamps. Tungsten is a metal which has a greater resistivity than that of copper. Tungsten has a very high melting point. Therefore the tungsten filament can be heated to a temperature high enough to emit bright light before reaching its melting point.

But heated tungsten burns in the presence of air.

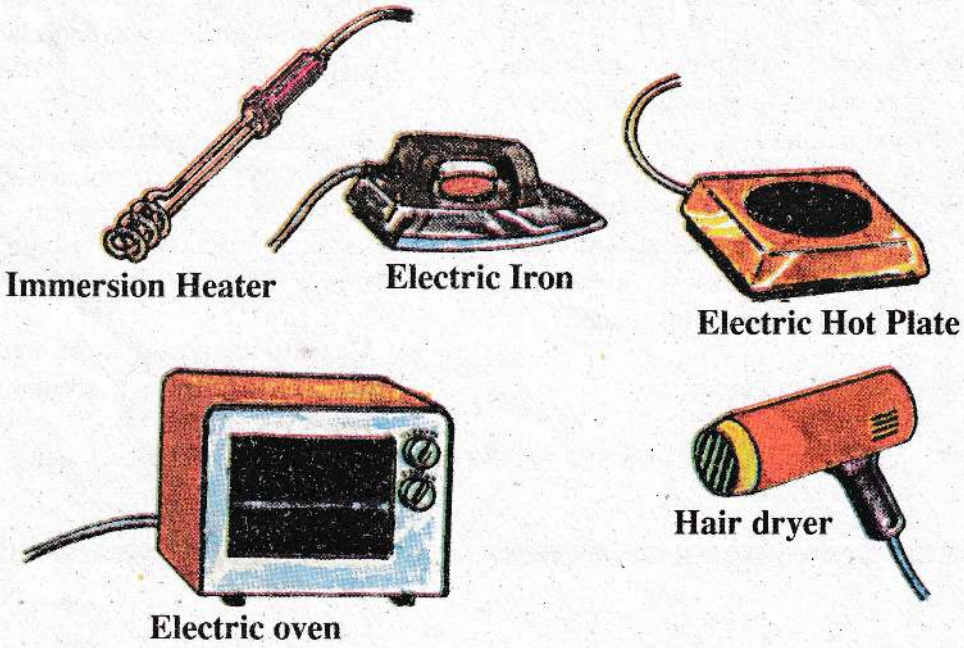
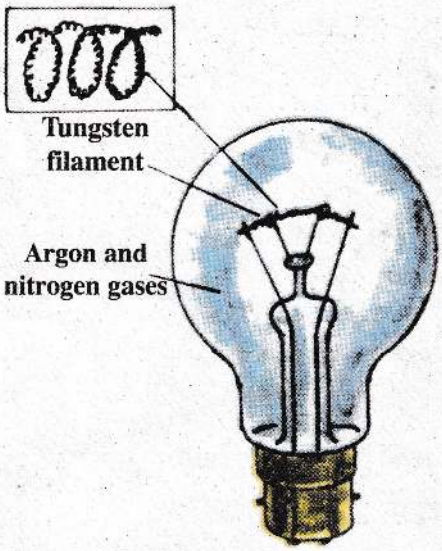


Figure 11.1



(i) Tungsten is used in filament electric lamps

(ii) Nichrome wires are used in heating coils

Figure 11.2

Do you know?

Melting point of Tungsten is 3380°C.

Explain the reasons

Filament lamp bulbs are filled with Argon and nitrogen gases at low pressure.

Electric heating components are also used for technical work. Electric welding machines and electric ovens can be considered as examples.

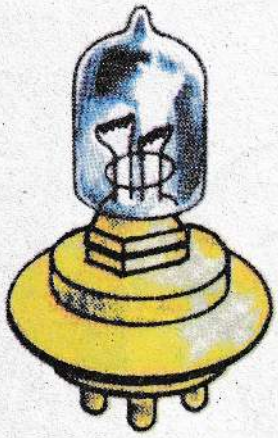
When metals are welded the heat generated at the points of contact of the metallic parts is very high. Due to the large amounts of heat metal parts at the point of contact melt and get connected.

Power or the rate of dissipation of energy of an electrical instrument is denoted by its watt value.

Table 11.1 gives the watt values of some widely used heating instruments.

Appliance	Power (Watt value)
Immersion heater	1000 W, 1500 W
Electric iron	750 W, 1000 W
Electric hot plate	1000 W, 1500 W, 2000 W
Electric oven	2500 W
Hair dryer	1000 W

Table 11.1



60 W / 55 W double filament motor car bulb.

Figure 11.3

When the watt value of an electric heating instrument increases the amount of energy converted to heat per unit time too increases. Filament electric bulbs of 60 W, 75 W, 100 W values are used in head lamps of motor cars. The current for such electric bulbs is supplied by a 12 V battery.

Table 11.2 gives the data about two electric filament bulbs working with the same power.

From the data given in Table 11.2 it is clear that the amount of energy converted to heat in one second by an electric heating instrument depends on the resistance of the heating element, magnitude of the current flowing and the voltage applied to the instrument.

The amount of energy converted to heat in a current carrying conductor is decided by the following factors :

i. Magnitude of the current

ii. Resistance of the conductor

iii. Time the current flowed.

Type of bulb	Power	Voltage required	Magnitude of current	Resistance of the filament
Bulbs used in domestic electric circuits	60 W	230 V	0.26 A	881.6 Ω
Bulbs used in head lamps of motor vehicles	60 W	12 V	5 A	2.6 Ω

Table 11.2

When the current (I) is measured in amperes, resistance (R) of the conductor in Ohms, time (t) the current flowed in seconds and the amount of energy (H) converted to heat in joules, the relationship between them in given by the equation

$$H = I^2Rt \quad \ldots\ldots\ldots\ldots\ldots\ldots (1),$$

When the potential difference (V) across the two ends of the conductor is in volts, the current (I) flowing is in amperes and the resistance (R) of the conductor is in ohms, then by ohm's law

$$R = \frac{V}{I}$$

If you substitute $\frac{V}{I}$ for R in the equation $H = I^2RT$, we get the equation

$$H = I^2\frac{V}{I}t$$

$$\therefore H = IVt \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

By Ohm's law we can write the relationship between V, I and R as

$$I = \frac{V}{R}$$

When $\frac{V}{R}$ is substituted for I in the equation,

$H = IVt$, we get the equation

$$H = \frac{V}{R}Vt$$

$$\therefore H = \frac{V^2}{R}t \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Example 1

When an electric bulb whose filament has a resistance of 45 Ω is lit a current of 1.5 amperes flows through it. What amount of heat is liberated when the bulb is lit for two minutes?

Resistance of the filament,
$R = 45\ \Omega$
Current flowing through the bulb,
$I = 1.5\ A$
Time the current flowed,
$t = 2 \times 60\ s$
Amount of heat liberated,
$H = I^2Rt$
$= 1.5 \times 1.5 \times 45 \times 120$
$= \underline{\underline{12150\ J}}$

Example II

When a filament electric bulb was connected to a 250 volt electric supply the current that flowed through it was 0.4 amperes. When the bulb is lit for 5 minutes what is the amount of heat liberated by the filament?

Voltage of the electric supply,
$V = 250\ V$
The current flowed,
$I = 0.4\ A$
The time the current flowed,
$t = 5 \times 60\ s$
Heat liberated,
$H = VIt$
$= 250 \times 0.4 \times 300J$
$= \underline{\underline{30000\ J}}$

Example III

The resistance of the heating coil of an electric oven is 62.5 Ω . When this oven is connected to a 250 volts electric supply for 3 minutes, calculate the quantity of heat liberated.

Resistance of the heating coil,

$R = 62.5\ \Omega$

Voltage applied,

$V = 250\ V$

Time the current flowed,

$t = 3 \times 60\ s$

Quantity of heat liberated,

$$H = \frac{V^2 t}{R}$$

$$= \frac{250 \times 250}{62.5} \times 100\ J$$

$$= 180000\ J$$

Exercises

1. The resistance of the filament of an electric bulb is 32 Ohms. When it is connected to an electric supply the current flowing through it is 0.5 ampere. Fin d the amount of heat liberated. When the bulb is lit for those minutes.

2. When a filament electric lamp is connected to an electric supply of potential difference 12 V, the current flowing through it is 1.75 amperes. Find the amount of heat liberated. When the bulb is lit for 8 minutes.

3. The current flowing through filament electric bulb is 0.7 A. When the bulb was lit for 5 minutes 2940 joule of heat energy was liberated. Calculate the resistance of the bulb filament.

4. When a hot plate was connected to an electric supply a current of 6 A flows through it. When the hot plate was connected to an electric supply for 4 minutes 36000 joules of heat energy was liberated. Calculate the potential difference applied.

5. The resistance of the heating coil of an electric iron is 76.8 Ohms. Calculate the quantity of heat liberated in 2 minutes when it is connected to a 240 V electric supply.

6. When a filament electric bulb was connected to a 12 V electric supply for 5 minutes 7200 joules of heat energy was liberated. Calculate the resistance of the filament of the bulb.

Explain the reasons

1. Copper and aluminium metals are used to make electric cables.

2. In transmitting electrical energy very small currents of high voltage are used.

3. When two conductors of different resistance are connected in series to a circuit and a current passed through them the conductor with the greater resistance will liberate a greater amount of heat. But if the conductors are connected in parallel the conductor with the smaller resistance will liberate a greater quantity of heat.

Magnetic effect of an electric current

You have studied in Grade 9 about electro-magnetic and their uses, Dawish National O'ersted in1819 conducted an experiment which revealed that an electric current creates a magnetic effect. You too can conduct that experiment.

Activity 1

Place a straight copper wire in the North-South direction. Connect it to a battering through a switch. Place a magnetic compass under the copper wire and very close to it. When the compass needle comes to rest in the North-South direction, close the switch for a moment and observe the behaviour of the compass needle.

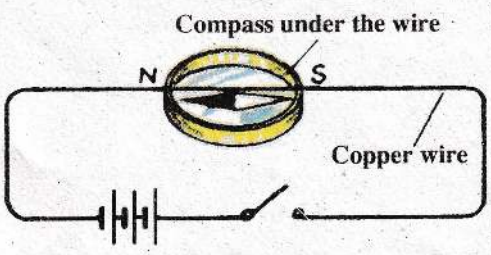


Figure 11.4

Repeat the experiment by changing the terminals of the battery and connecting to the circuit.

A magnetic field is present in the neighbourhood of a current carrying conductor. The direction of the lines of the magnetic field is decided by the direction of the current.

The experiment described below will help you to understand the pattern of the magnetic field produced in the neighbourhood of the current carrying conductor.

Activity II

Make a small hole at the centre of a piece of cardboard and place it on a horizontal support. Pass a straight copper wire trough the hole so that it is perpendicular to the plane of the cardboard. Place four small compasses around the wire close to it. Connect the two ends of the wire to a battery through a switch (Figure 11.5).

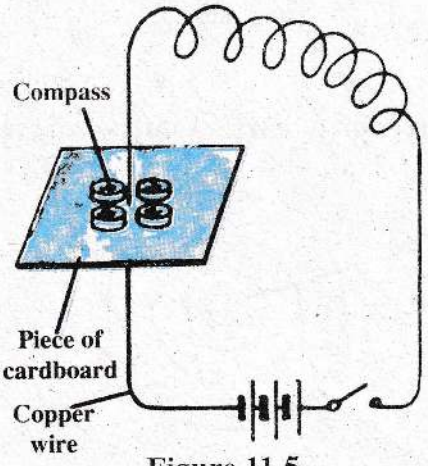


Figure 11.5

Close the switch for a moment and observe the behavior of the compass repeat the experiment. Note down your observations (If the switch is closed for long time the battery may become weak).

The patterns of the magnetic fields produced around a current carrying conductor and very close to it when viewed from above are shown in Figure 11.6 and 11.7. The patterns of the magnetic field that forms when the current is flowing from top to bottom is shown in Figure 11.7. Figure 11.6 shows the pattern that forms when the current is flowing from the bottom to the top.

Direction of current from the page outwards

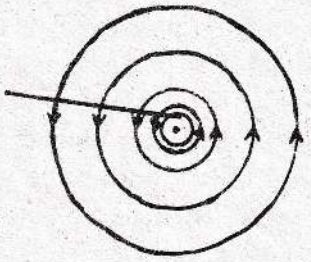


Figure 11.6

Direction of current into the page

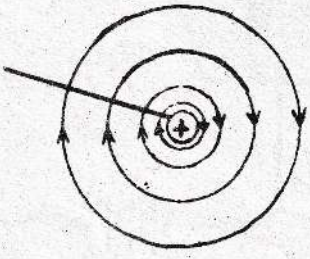


Figure 11.7

In both cases the magnetic field pattern is the same. But in the first instance the direction of field is anticlockwise while in the second instance the direction of field is clockwise.

The right hand rule can be used to find the direction of the magnetic field according to the direction of current.

Pointing your thumb in the direction of the current flowing in the conductor hold the wire with your right hand clenching your fingers round the wire. Then the direction your fingers point is the direction of the magnetic field lines (Figure 11.8).

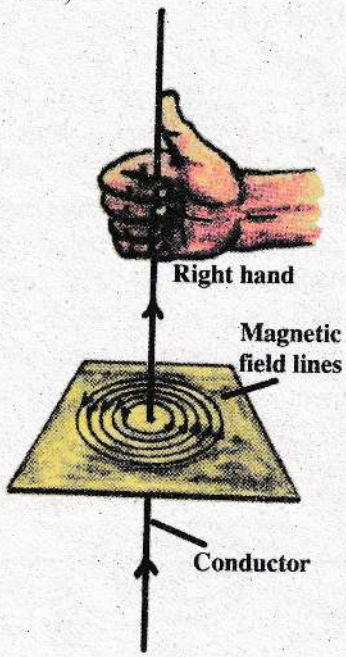


Figure 11.8

Figure 11.9 shows the magnetic field pattern that forms when a current is passing through a coil of wire of one turn.

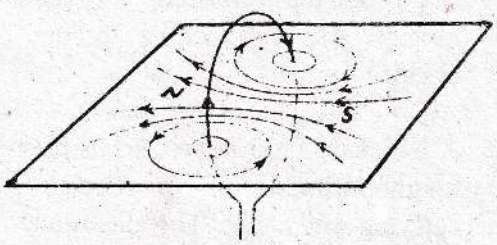


Figure 11.9 - Magnetic field patterns around a single circular loop of wire.

The magnetic field pattern around a small portion of the loop of wire and close to it is the same as the magnetic field pattern around a current carrying straight conductor. Magnetic field lines outside the coil extend from one face towards the other face in curves the magnetic field pattern is similar to the field pattern around a very short bar magnet. One face of this coil acts as a magnetic north pole while the other face acts as magnetic south pole.

Electro-magnetic

By winding a number of turns of insulated copper wire on a soft iron core and sending an electric current through the coil an electro magnet can be constructed. When the flow of current is stopped magnetic properties vanish. When soft iron is paced in a magnetic field it gets easily magnetized.

When the magnetic field is eliminated the magnetic properties induced in the soft iron vanishes. For this reason soft iron is used for electro-magnets.

Assignment 1

- ★ Construct electro magnets by using insulated copper wire of length 1 m and 2 m, and as the cores iron nails, tin plates, wire needles.
- ★ Provide electricity to the electro magnets by connecting one dry cell and two dry cells at a time.
- ★ Compare the magnetic strengths of the electro magnets in each case by using suitable methods.

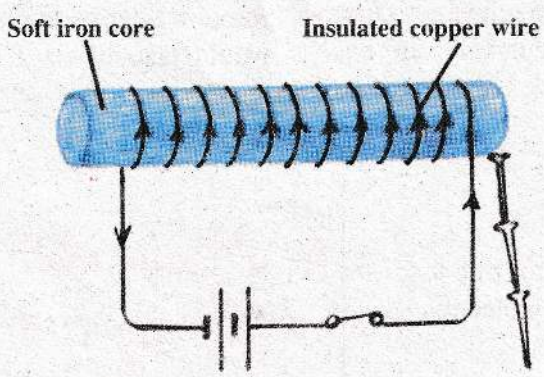


Figure 11.10

Identification of the poles of an electro magnet

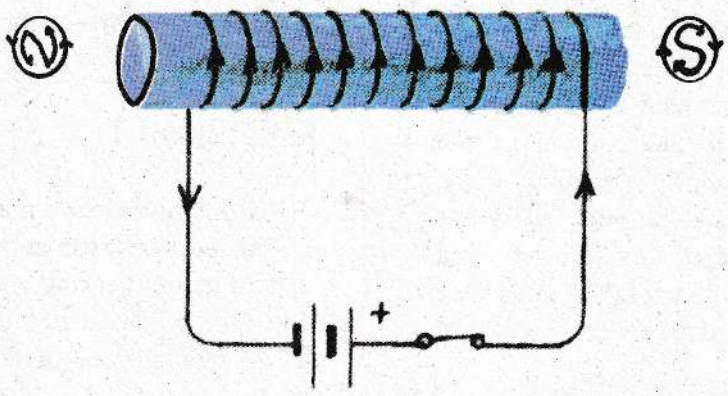


Figure 11.11

Look along the axis of the coil. If at the near end of the coil the current flows clockwise through the turns of the coil, then that end is the south pole of the electro magnet. If the current flows anticlockwise then that near end is the north pole of the electro magnet.

As shown in Figure 11.11, if arrow heads are applied to the ends of the letters S and N, then the magnetic pole relevant to the direction of flow of current can be identified.

Assignment 2

Can you present another rule to identify the poles of an electro magnet?

The behaviour of a conductor carrying a direct current placed in a magnetic field.

You have learned that a magnetic field exists around a conductor carrying a direct current. If such a conductor is placed in a permanent magnetic field forces act on the conductor. Due to these forces a relative motion of the conductor would take place if it is able to move freely.

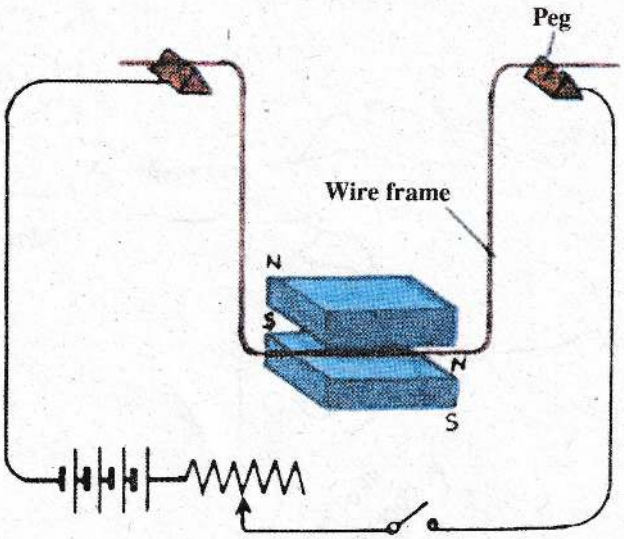


Figure 11.12

Activity III

Support on two pegs a copper wire bent in the shape of a U so that it can swing freely. Connect the wire frame through the pegs to a circuit containing a battery, rheostat and a switch place a permanent magnetic pole below the horizontal arm of the wire frame and very close to it. As shown in Figure 11.12, place another magnet above the horizontal arm so that opposite poles face each other.

I. Close the switch for a moment and observe the behaviour of the wire frame.

II. Observe the behaviour of the wire frame, when

a. The current in the circuit is changed by adjusting the rheostat.

b. The terminals are changed

c. The directions of the permanent magnetic field lines are changed.

When a current is made to flow in a freely movable conductor placed in a magnetic field, the conductor will move.

The direction the conductor moves depends on :

I. The direction the current flows in the conductor, and

II. The direction of the magnetic field lines,

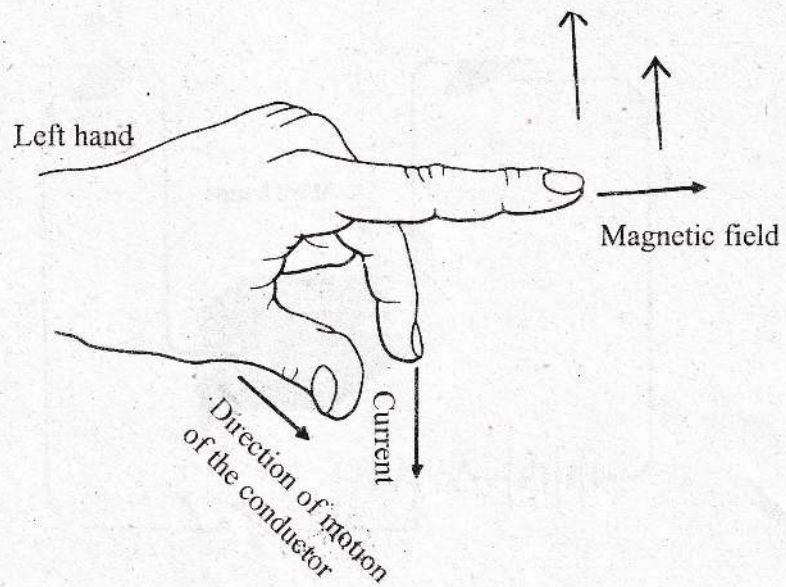


Figure 11.13

The speed of movement of the conductor depends on :

I. The magnitude of the current flowing through the conductor

II. Strength of the magnetic field.

To find the direction of motion of the conductor when the direction of the current and the direction of the field of the permanent magnet are known, Fleming's Left Hand Rule can be used (Figure 11.13).

Fleming's Left Hand Rule

Keep the thumb, index finger and centre finger of the left hand perpendicular to each other. Twin the hand so that the centre finger points in the direction of the current and the index finger in the direction of the magnetic field. Then the thumb will point in the direction of motion of the conductor.

Fleming's Left Hand Rule

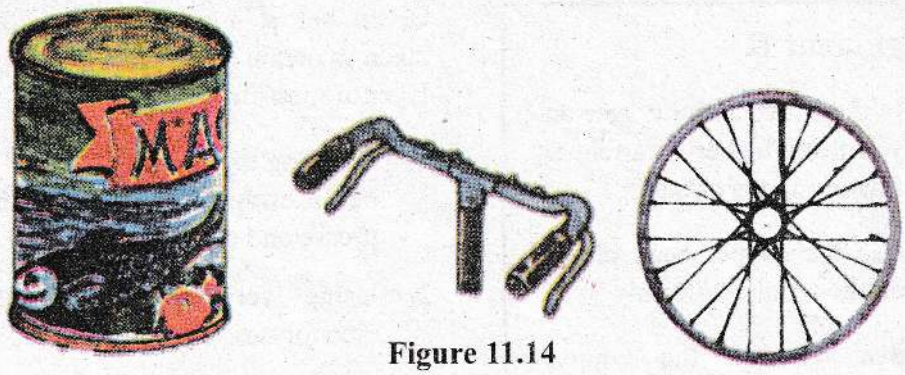


Figure 11.14

Most of the metallic articles we use are made of cheep metals such as iron. Metallic vessels used to store food stuffs are made of tin coated iron sheets. When iron plates are coated with tin they acquire a bright shine. Also they get protection from rusting temporarily. Bicycle handles, rims etc. are made of iron but plated with chromium. Because of the chromium plating such parts retain a shiny surface for a long time. They are also protect from rusting. Imitation gold jewellery is made by gold plating articles made out of silver or other cheap metals plating other metals on metallic articles is done by using electric currents. Plating metals by using electric currents is called **electroplating**. This process is also known as electrolysis. Copper plating a metallic article by the electrolytic method can be done with ease.

Activity IV

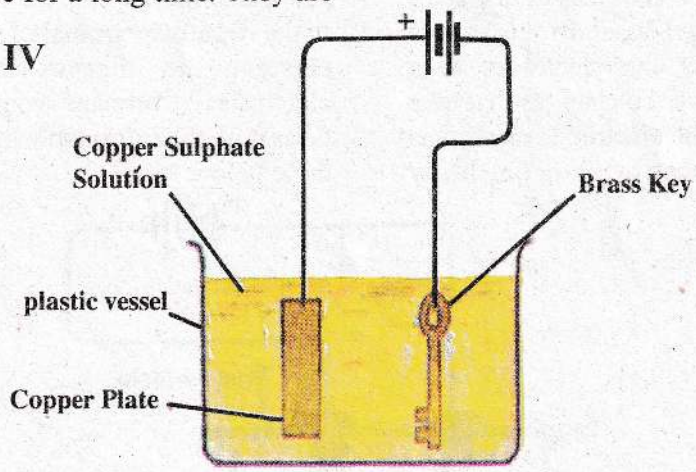


Figure 11.15

Put some copper sulphate solution into glass or plastic vessel. Connect a copper plate onto the positive terminal of a battery and the metallic article to be plated with copper to the negative terminal of the battery. Immense both in the copper solution or some time and disconnect the battery. Remove the article from the solution and examine it. You can see that copper has plated on it. Examine the copper lager closely.

Assignment II

1. In the above activity, how do you test whether a current is flowing in the circuit?
2. Has the copper been plated on the article uniformly?
3. See whether the copper plating gets removed when wiped with a piece of paper
4. For this activity can you use a metallic vessel instead of a glass or plastic vessel? Give reasons for your answer.

Given below are some steps that are taken to obtain a permanent and uniform layer of metal in electroplating.

1. Cleaning the surface of the article to be electroplated by removing oil grease and oxide layers.
2. Using very small currents for electrolyses.
3. Stirring the electrolyte frequently
4. Maintaining the temperature of the electrolyte at an optimum level.

A simple understandings of electroplating by electrolysis can be obtained from the activity given below.

Activity V

Immerse two carbon electrodes in a copper sulphate solution put in a glass or plastic vessel as shown in figure 11.16. Connect the electrodes to a battery. Observe the changes that take place around the electrodes marked as A and B. Repeat the experiment by connecting the B electrode to the positive terminal and the A electrode to the negative terminal of the battery. Observe the changes around the electrodes. Compare your observations with the information given in the table below.

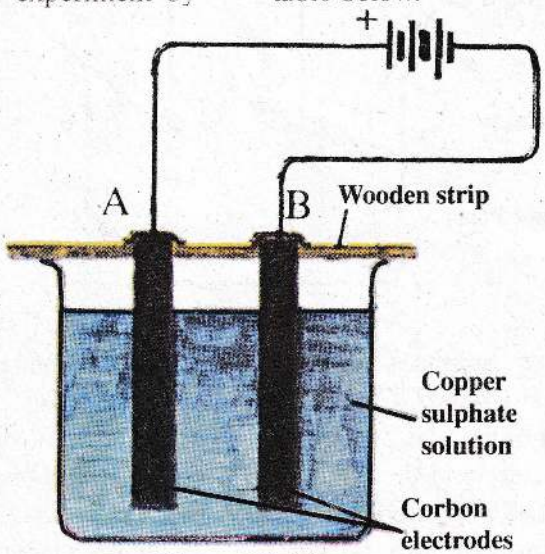


Figure 11.16

First Stage

Electrode A connected to positive terminal of battery	B electrode connected to negative terminal
Oxygen gas is evolved	Copper is deposited
Colour of the Copper sulphate solution decreases	

Second Stage

Electrode A connected to negative terminal of battery	B electrode connected to positive terminal of battery
Copper is deposited	Copper layer deposited earlier is removed
Colour of the Copper sulphate solution remains unchanged	

In both instances mentioned above copper was deposited on the Cathode for that purpose copper ions present in the solution were used. In the first case the colour of the solution decreased with the decrease in copper ions in the solution. In the second case since the copper layer on the anode moved into the solution as ions the colour of the solution remained unchanged.

In electroplating, a salt of the metal for plating is used as the electrolyte. The article to be electroplated is used as the cathode while the metal for plating is used as the anode. Only in the case of chromium plating a different metal is used as the anode. To improve the quality of electroplating various materials are added to the electrolyte.

Some liquids and aqueous solutions conduct electricity. You can test whether a liquid or an aqueous solution conducts electricity or note by performing the activity given below.

Activity VI

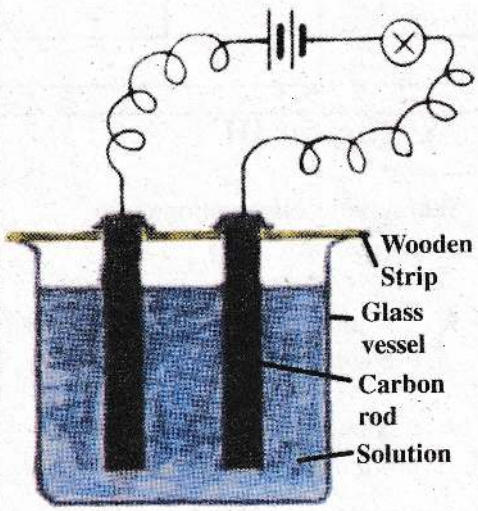


Figure 11.17

Fix two carbon rods to a wooden strip as shown in Figure 11.17. Connect the two carbon rods to a circuit with a battery and a bulb.

Put the liquids and the solutions that need to be tested into beakers immerse the two carbon rods in the liquid or solution under test and see whether the bulb is lit. The carbon rods must be washed with water and wiped properly after each test.

Liquid/ Solution	Bulb lights / does not light	Electricity is conducted / is not conducted
1. Salt solution		
2. Sugar solution		
3.		
4.		
5.		

Assignment III

Taking your observations into consideration

★ Name three solutions that conduct electricity.

★ Name three solutions that do not conduct electricity.

Different instances where the electrolytic method is made use of :

1. Electroplating
2. Brightening metallic objects
3. Filling up metallic parts wasted in machines
4. To obtain metals in the purest form
5. Production of chemical substances

Summary

★ The rate of dissipation of energy in electrical appliances is denoted by its watt value.

★ In a current carrying conductor the quantity of energy converted to heat depends on the magnitude of the current, the resistance of the conductor, the potential difference applied across the ends of the conductor and the time the current flowed.

★ If the current flowing through the conductor is I amperes, the resistance of the conductor is R Ohms, potential difference across the ends of the conductor is V volts, time the current flowed through the conductor is t seconds and the amount of energy converted to heat in the conductor is H joules, then

$H = I^2Rt$

$H = VIt$

$H = \frac{V^2}{R} t$

★ A magnetic field exists around a current carrying conductor.

- ★ The direction of the magnetic field is decided by the direction of current.
- ★ The direction of the magnetic field lines around a current carrying conductor can be found using the right hand rule.
- ★ When a conductor able to move freely is placed in a magnetic field and a current is passed the conductor moves.
- ★ When a conductor able to move freely is placed in a permanent magnetic field and a current is passed through it, Flemings' Left Hand rule can be used to find the direction of motion of the conductor when the direction of the magnetic field and the direction of the current are known.
- ★ Some solutions conduct electricity.
- ★ Metals can be plated using electric current.

Now you can

- ★ Name electric heating apparatus.
- ★ Calculate the amount of heat in an electric heating appliance.
- ★ State the factors that affect the amount of energy that is converted to heat by an electric current.
- ★ State the nature of the magnetic field that exists around a current carrying conductor.
- ★ Construct an electromagnet.
- ★ Identify the poles of an electro magnet.
- ★ State the direction a freely movable conductor placed in a permanent magnetic field moves when a current is passed through it.
- ★ Identify liquids or solutions that conduct and do not conduct electricity.
- ★ Copper plate a metal using an electric current.

12. Waves - Light and Sound

Instances where machinery is used to do work are quick common in our environment. Different types of vehicles too are included in this category. When they are functioning at can be observed that the machine parts do shake.

As long as a vehicle engine continues to function from the moment engine is started, you know the parts of the engine, door and other parts do shake when it is shutters motion or stationery. No doubt you have felt the speedy rhythmic throbs when a vehicle travels at high speed. Such rhythmic throbs are called vibrations.

Vibration Phenomena

Working of an electric bell is a common example of vibrations. We can see the vibrations of spring blades, spiral springs etc. parts of a clock too vibrater. The Oscillation of the pendulum of a clock too is such a motion can the needle of a sewing machine moving up and down be considered a vibration?

Amplitude and Frequency

A hacksaw blade fixed on to a table by a clamp as shown in Figure 12.1 can be used to study vibrations.

Hacksaw blade can be made to vibrate by pressing it down with a finger and releasing the finger. The displacement made by the vibrating hacksaw blade from the original position upwards and downwards can be studied. This displacement can be measured and is called the **amplitude** of the vibration. Vibrations can be made with different amplitudes. The amplitude gradually diminishes and the vibration stops.

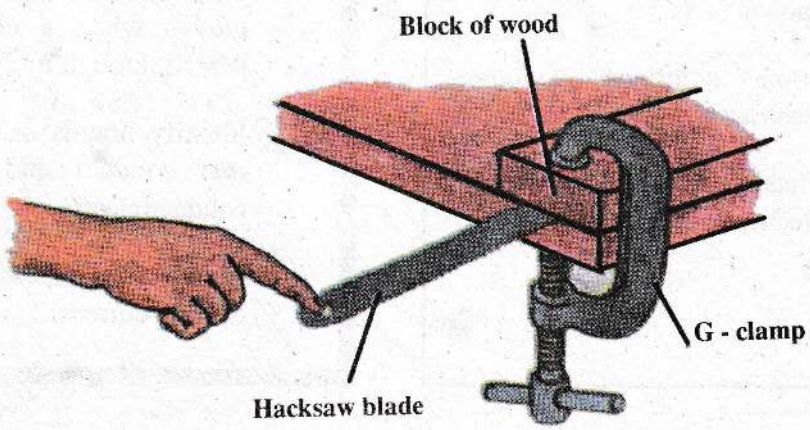


Figure 12.1 - Commencement of vibration of a hacksaw blade

The hacksaw blade is said to move from the original position to both sides periodically.

The rhythmic movement of an object or a system to both sides from the original position is called a vibration. Figure 12.2 shows the two end positions of a vibrating hacksaw blade relative to the original position.

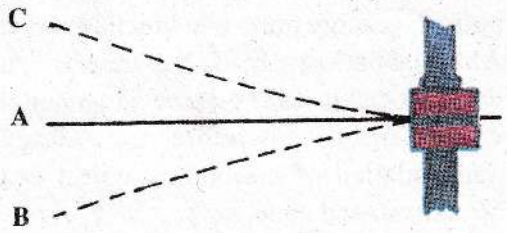


Figure 12.2 - The limits of the vibration of a hacksaw blade

When the end of the hacksaw blade as pressed down to the position B and released, it goes through A till the position C then again to position B through A covering one complete vibration. (Then the vibration movement is BACAB) likewise starting from A it can complete a vibration as ACABA or ABACA.

CABAC is another vibration movement. The number of vibrations completed during a period of one second by a hacksaw blade is called its vibration **frequency**.

The number of complete vibrations made by a vibrating object in one second is called the frequency.

If the frequency is one vibration per second, the standard way of expression is 1 Hz. It can state as one Hertz. The standard unit of measuring frequency is the Hertz. Symbol of the unit is Hz. If the hacksaw blade makes 25 complete vibrations per second its vibration frequency is indicated as 25 Hz.

Activity 1

Tie a weight to one end of a thread to make a simple pendulum. Oscillate it keeping it at a suitable length.

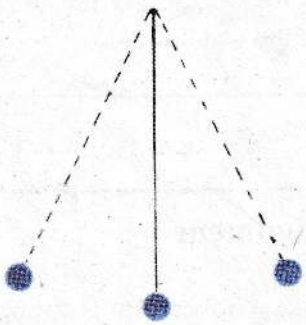


Figure 12.3 - Simple pendulum

(i) Does it oscillate in the same rhythm throughout?

(ii) Does the amplitude decrease gradually?

(iii) How many times does it oscillate in 10 seconds?

(iv) How Many times does it oscillate in one second?

a. Note down the oscillating frequency accordingly.

(v) Reduce the length of the pendulum and note down the frequency by counting the number of oscillation made in 10 seconds.

Did the frequency increase, decrease of remain the same when the length of the pendulum, was reduced?

(vi) Obtain more observations to investigate the connection between the oscillating frequency and the length of the pendulum.

Assignment 1

Get a ticker-timer from the laboratory operate it (by mains current or battery) while drawing a strip of paper through it for 10 seconds and obtain a dotted strip.

Count the number of dots and find out the number of vibrations made by the ticker-timer. Find out from it the vibration frequency of the ticker-timer and make a note of it. Repeat this and compare the results of the two cases.

Energy Exchange and Vibration

Hacksaw blade bends when a force is applied to it to commence a vibration. You can experiment this. Potential energy gets stored in the hacksaw blade on bending as it is an elastic object. When the movement starts upon releasing the bent hacksaw blade, the potential energy turns into kinetic energy. After the hacksaw blade has travelled to the meet end it stops by scoring potential energy again. Therefore the energy transportation of a vibrating object can be summarised as follows.

Potential energy $\rightleftharpoons$ kinetic energy $\rightleftharpoons$ potential energy.

This energy from a vibrating object or a system is transmitted to the surrounding.

When the speaker of a radio functions it vibrates continually. When a few polystyrene balls are placed on the paper-cone of the vibrating speaker they are repeatedly thrown up Figure 12.4.

What happens here is that after kinetic energy is transmitted to the polystyrene balls by the vibrating diaphragm, their kinetic energy is transformed into gravitational potential energy as the polystyrene balls are thrown upwards.

Anything that can vibrate has a natural vibration frequency, i.e., it has an independent vibration frequency. The natural vibration frequency is decided according to the length of the portion of

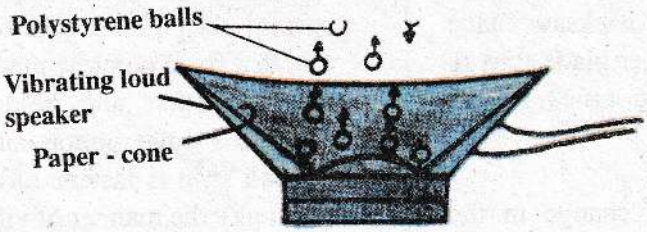


Figure 12.4 - Transmission of energy by vibrations

the hacksaw blade which is vibrating. Natural vibration frequency of a stretched string depends on its length, breadth and the tension (force) acting along the string. Even a bridge, a glass vessel or a building that is free to vibrate has a natural vibration frequency.

Have you seen a set of tuning forks in the laboratory? Vibration frequency is marked an each tuning fork. (Figure 12.5).

Figure 12.5 - Tuning fork having frequency of 256 Hz

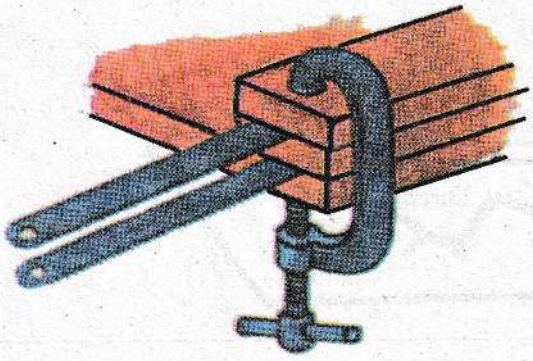


Figure 12.6

Resonance

When a tuning fork of frequency 256 Hz is vibrated near a stretched string having a natural vibration frequency of 256 Hz, the string starts vibrating in a few moments. This phenomenon is an example of resonance. When the energy of the vibrating tuning fork is transmitted to the stretched string which has the same natural frequency, the stretched string starts to resonate.

Activity 2

Obtain two equal hacksaw blades. Fix the two blades on a table by means of a E-clamp as shown in Figure 12.6, so that equal lengths project outwards.

Vibrate any blade of the two. Observe whether the other blade begins to vibrate after some time (It is assumed that the equal hacksaw blades with equal vibrating lengths have equal frequencies). Reduce the exterior length of one blade. (Then the natural frequency will vary from each other).

Now vibrate one hacksaw blade again. Will the other blade start to vibrate after some time? Report four observations.

There will be no change in the observations when the two hacksaw blades touch each other or kept at short a distance apart.

What is the phenomenon you come across here? Is it not a case of vibration of another object by a vibrating object having the same natural vibration frequency as that of the vibrating object. Name the phenomenon.

Wave motion

As shown in Figure 12.7 a small chain is spread on a table. Hold one end and vibrate it rhythmically. You will see here, as if a disturbance travels along the chain. Such a disturbance starts due to the vibration of the parts of the chain. These disturbances are called a group of waves. The ripples seen on a distributed water surface are called water waves.

When one end of a slinky (a long spiral spring) placed on a table or on the floor tied to a fixed point by means of a thread and the other and held by hand is vibrated a wave motion could be seen. It a small strip is fastened to one place of the slinky the manner of vibration can be easily seen.

Transverse Waves

As shown in Figure 12.8 the vibration is clearly seen at the place (like other places) where the strip is tied. The waves appear to travel along a direction perpendicular to the vibration. The waves that appear to travel along a direction perpendicular to the vibration are called **transverse** waves.

What can you tell of water waves? Water surface vibrates vertically up and down. Water waves travel horizontally. Waves travel perpendicularly to the vibration. Therefore water waves too are transverse waves.

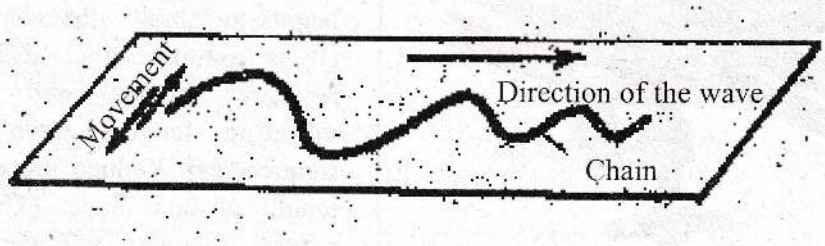


Figure 12.7 - Formation of waves in a vibrating chain.

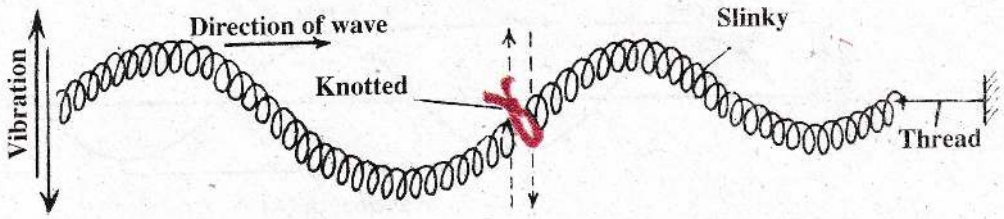


Figure 12.8 - Transverse waves produced in a slinky

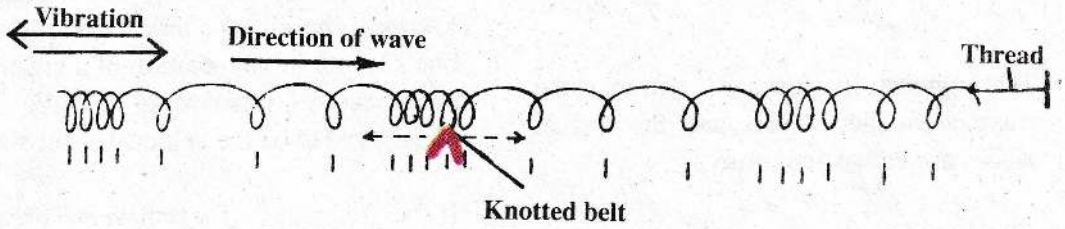


Figure 12.9 - Longitudinal waves produced in a slinky

Longitudinal Waves

When a slinky is placed as shown in Figure 12.9 on a label or floor fixed at one end and the other free end is moved foreward and backwards there sum to move forward a different mode of waves. The vibration of adjoining coils can be explained by forward and backward vibration of the tied strip. The waves that travel along the direction of vibration are turned **longitudinal** waves.

Longitudinal waves or transverse waves formed due to the vibration of particles of the water surface, links of a chain, coils in a slinky or particles of any other kind of matter are called mechanical waves. Accordingly these may be mechanical transverse waves and mechanical longitudinal waves.

Sound is transmitted from one place to another by mechanical longitudinal waves formed by the particles of the medium.

Generally, a transverse wave can be illustrated as shown in Figure 12.10

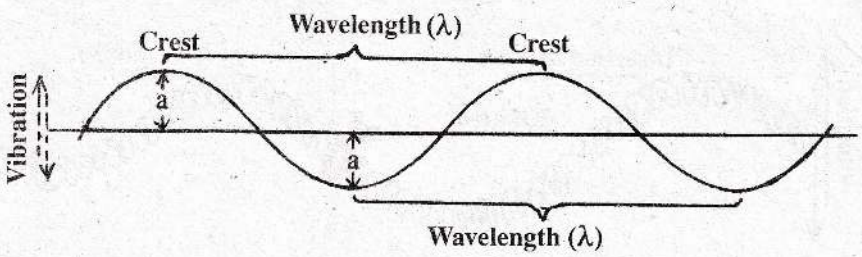


Figure 12.10 - Motion of transverse waves

Wave Length, Frequency and Velocity

The uppermost places of a transverse wave are called **crests** and the lowest places are called **troughs**.

The distance between two consecutive crests or troughs of a transverse wave is considered as the wave length. Wave length is symbolized by Lambda (λ). In a series of particles the displacement (a) from the original position (central line) to the highest point or the displacement (a) from the original position to the lowest point is called the **amplitude** of the wave.

A wave that travels forwards is known as a **progressive** wave. It is easy to consider the motion of a transverse wave based on a crest. The change that takes place in one second in the position of a crest in a progressive transverse wave is considered to be the velocity of the wave.

If the frequency of a transverse wave is 10 Hz, it is considered to form 10 crests and 10 troughs in one second.

If the wave length of a wave is 0.2 m and 10 such lengths travel in a second, then the velocity of the wave will be 10 x 0.2 ms^{-1}.

We can build a mutual link between these quantities as

Wave velocity = frequency x wave length.

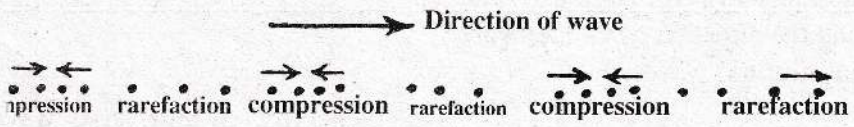


Figure 12.11 - Motion of longitudinal waves

This link is common to any wave motion. The successive positions of a series of particles at any movement when a mechanical longitudinal wave is produced can be shown as in Figure 12.11.

The places in a longitudinal wave where the particles are closely situated are called **compressions** and the place where the particles are at a distance are called **rarefactions**.

In a compression the vibrating particles move to the centre from both sides. They are at that moment moving from the centre of the rarefaction to the exterior.

The distance between two consecutive compressions or two consecutive rarefactions is the wave length of a longitudinal wave.

There is a particular type of waves called electromagnetic waves. Vibration of particles does not take place in electromagnetic waves. These waves transmit across a vacuum at a velocity as high as 3×10^8 ms^{-1}.

Heat, light and other radiations emitted from the sun transmit energy in the form of electromagnetic waves. They take the form of transverse waves.

As water waves could be sun, they are used to study the behaviour of waves. An apparatus called the ripple-tank shown in Figure 12.12 is used for this purpose.

This apparatus is used to observe the reflection of waves that occur in water when they collide with a smooth straight barrier.

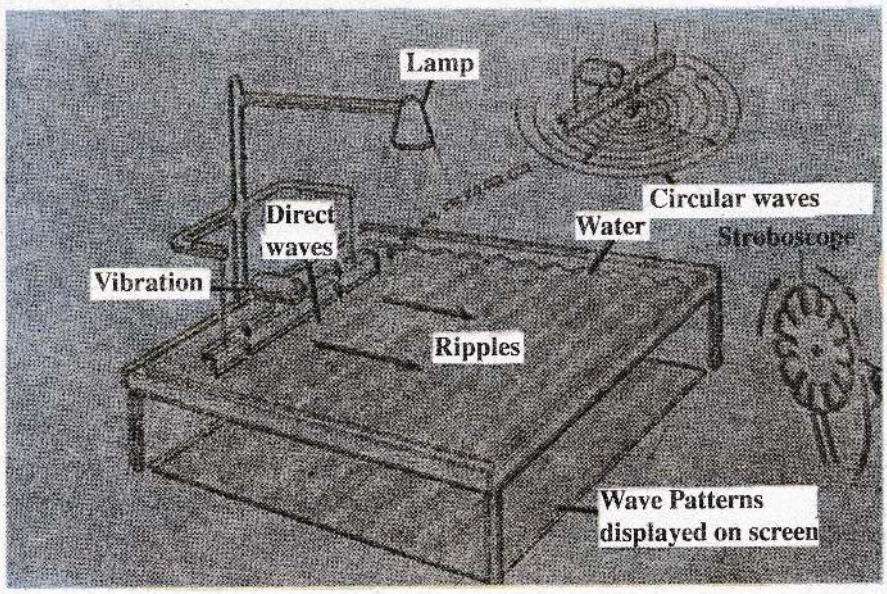


Figure 12.12 - Ripple Tank

It is found that the velocity of water waves decreased when they reach a shallow area from a deep area. The change of direction of waves at the boundary where the velocity decreases (or increases) is called refraction. Refraction of water waves could be observed by this set-up. It is easy to detect the bahaviour of other wave through these observations.

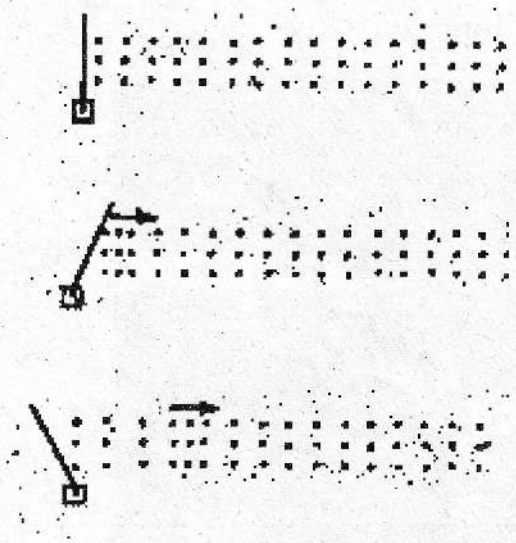
The particles of a series of compressions and rarefactions formed in air (or any medium) cause by the vibration of a sound source too vibrate with the same frequency as the source. Such a series of compressions and rarefactions can be considered as a sound wave.

It a sound wave formed in the above manner is sensitive to the human ear then it is an audio sound wave.

The frequency range of the sound waves audible to the human can spreads from 20Hz to 20000 Hz. The normal speed of the sound waves traveling through air is about 340 ms^{-1}.

Do you know?

The bat can hear the sound, having a frequency above 20000 Hz. Animals like cats can hear sounds wave below 20Hz and above 20000 HZ.



Before vibration starts the air particles occur in equal distance.

It one moment of the vibration some particles on one side of the air layer closest to the source are subjected to a compression.

At another moment of the vibration some particles on the same side considered above of the air layer closing to the source and subjected to rarefaction and while compression moves forward.

Figure 12.13

Sound waves travel in solids, liquids, air as well in other gaseous mediums. You know that there are no particles in a vacuum. Therefore sound waves neither originate nor travel in a vacuum. That was discovered with the help of a setup shown in Figure 12.14. When the air inside the bell-jar is removed by using a vacuum pump no sound is heard even though the electric bell is seen to vibrate.

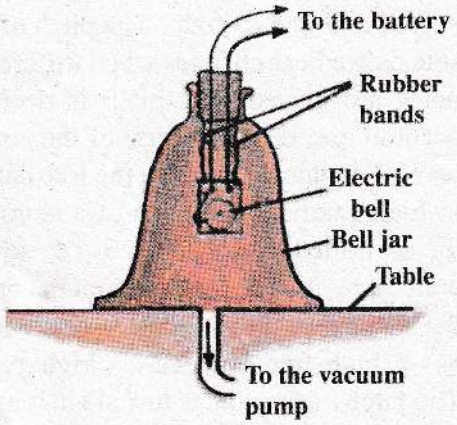


Figure 12.14 - Sound waves do not travel in a vacuum

Sound waves belong to the category of mechanical longitudinal waves. Pay attention again to resonance introduced in this chapter. Resonance can be created by sound waves too (Figure 12.15 (a) (b).

Figure 12.15 (a)

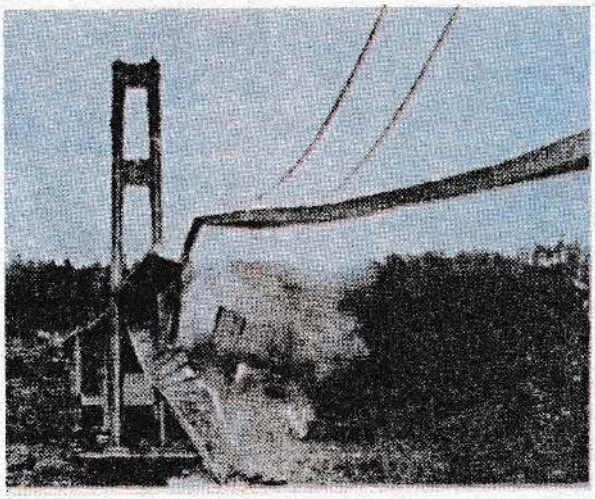


Figure 12.15 - (b) Unpleasant results of resonance

Activity 3

Experiment and report the procedure adopted to produce sound by the following sources.

(i) A string / wire under tension

(ii) Tambourine

(iii) Flute

(iv) Metallic vessel

(v) Tuning fork

After carrying out the activity 3, you must have understood what should be done to obtain sound from a source. You would have realized that sound can be generated by subjecting each source to vibrate. When a flute produces sound not only the tube but the air column too vibrates.

Do you know?

Under normal conditions the velocity of sound in air is about 330 ms-1. When a source emitting fumes and a sound simultaneously is kept at a suitable distance. The time taken by sound to travel the distance can be found by noting down the time interval between seeing the fumes and hearing the sound. Fairly correct value for the velocity of sound in air can be found by this method.

The Pitch and the Note

You must have identified that a flute can produce difference sounds unlike a tuning fork. The sound generated by vibrating a tuning fork is only a single sound. Sounds with differences notes can be produced by a musical instrument.

In eastern music these notes are basically named ස රී ග ම ප ද නි. The pitch of the sounds we hear changes when difference notes are played. The pitch is decided according to the frequency of the sound waves. Producing the note the low nature or high nature of the pitch of a note can the identified by listening to the sound emitted by the musical instruments or by the singer. For instance, the note is which has a high frequency has a high pitch. The pitch of the note is low since it has a low frequency.

A musical scale is built by using seven notes from the order of ascending pitch or descending pitch.

Accordingly

ස රී ග ම ප ද නි is a musical scale.

(C D E F G A B in western music).

Activity 4

Get a musical instrument from which a note can be easily identified and played. Play the following groups of notes one at a time and listen. Play more than once, listen and note down whether the pitch of the particular group ascends or descends.

(i)	ස රි ග	C D E
(ii)	ග ම ප	E F G
(iii)	ම ග රි	F E D
(iv)	ස ප ධ නි	C G A B
(v)	නි ධ ප ම	B A G F

Nature of Light, Colours and Spectrum

You know that objects in the dark are not visible. What is the reason for it? To make objects visible light must be directed onto them. Therefore its is evident that light helps us to see things.

Scientists felt the need to understand the nature of light to explain its different behavioural forms. Accordingly many theories were developed to explain the nature of light.

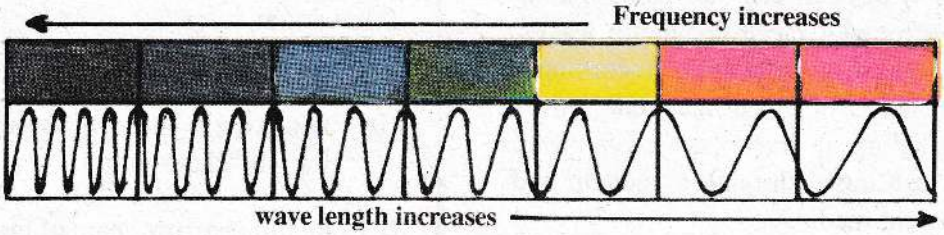


Figure 12.16 - Visible spectrum

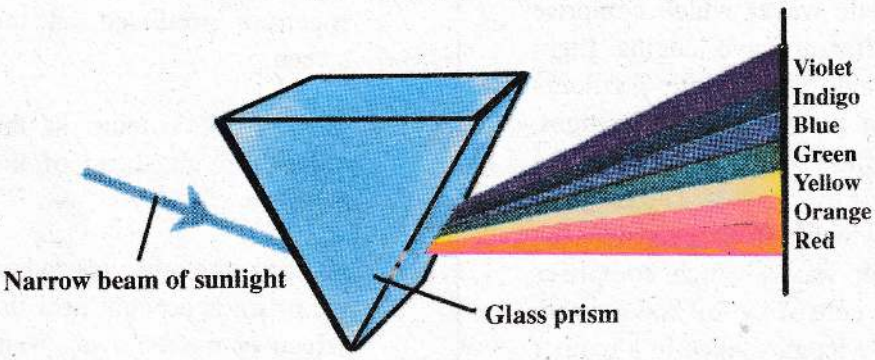


Figure 12.17 - Obtaining a visible spectrum by using a glass prism.

Wave theory of light is the presently accepted theory. Christian in 1690 Huyshens enunciated this theory. Accordingly to this theory,

- ★ Light is transmitted in the form of waves.
- ★ A medium is not necessary for the transmission of light.
- ★ Light travels through a vacuum or in air at a velocity of 3×10^8 ms^{-1}.
- ★ When light travels through a transparent medium such as water and glass its velocity becomes less than the above value.

Waves with such characteristics belong to the group of electromagnetic waves. They are transverse waves. Accordingly light consists of electromagnetic waves which belong to transverse wave group and if can travel through a vacuum and transparent media.

Electromagnetic waves which comprise light have different wave lengths. Light can be separated mainly into 7 colours depending on the wave length ranges. The colour of the light is decided on the wave length of the weaves. The range of light waves which comprises visible the range of light waves which comprises visible light consisting of waves with different wave lengths taken in a regular order is called the **visible spectrum.**

When a rainbow appears you are seeing a naturally formed visible spectrum. Can you make such a spectrum artificially? A spectrum can be produced on a screen using a triangular glass or Perspex prism as shown in Figure 12.17.

We can identify the colours in a regular order after getting spectrums on a screen. It is observed that the light deviated (bent) most is violet and the least deviated light is red.

Activity 5

Obtain a visible spectrum on a screen in the classroom by means of the set-up shown in Figure 12.17. Pay your attention to the following matters.

(i) Directing a beam of sunlight into the classroom.

(ii) Getting narrow beam of light.

(iii) Identify the colours in the spectrum produced on the screen.

(iv) Identify the colours in the order from the head of the prism.

(v) Identify the changes when the prism is brought near the screen or moved away from the screen.

Activity 6

Keep a plane mirror inside a water vessel at angle as shown in Figure 12.18 and aim a narrow beam of sunlight at the mirror. Place a screen above the water surface and move it about until a spectrum is obtained.

Observe the spectrum

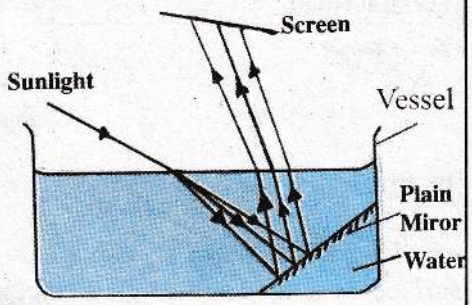


Figure 12.18

The path of the narrow beam of light is illustrated by a straight line when drawing ray diagram. Such a straight line showing the path is called a ray of light. Have you known before any activity to decide the way (path) by which light travels from a light source?

The path of a beam of light produced by vehicle lamp or a torch in the night is clearly seen.

When there is smoke in the kitchen, a beam of sunlight can be seen which enters through a hole in the roof. The path of a light beam can be seen. When light travels through smoke, dust or mist. An easy method to see the path of light is shown in Figure 12.19. Accordingly when a light beam is aimed along a plane surface the path of light can be seen.

Activity 7

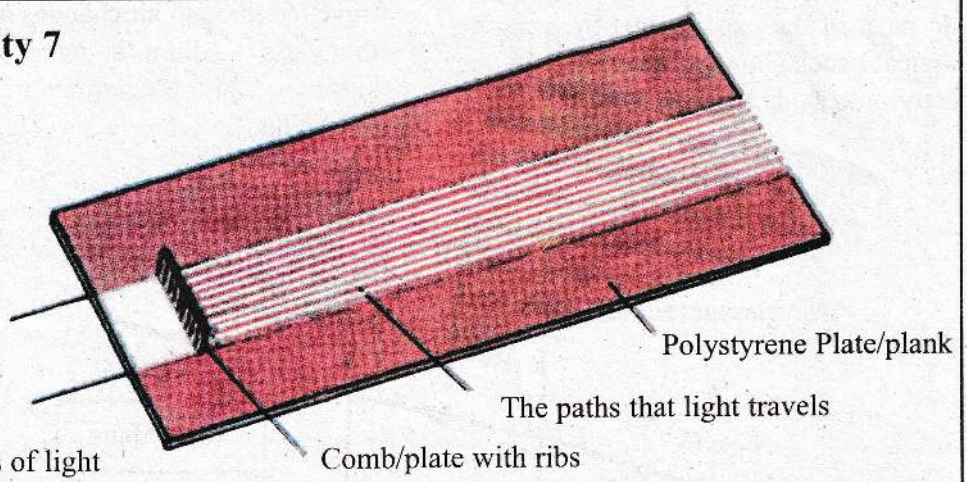


Figure 12.19 - Appearance of rays of sunlight on a plank after passing through ribs of a plate (or a comb) Figure 6.3

Aim a beam of sunlight into a room somewhat dark and direct it along a smooth plane surface. Obtain a clear strip of light by adjusting the position of the plank / plate. Place a comb or a ribbed-plate in a suitable place and observe.

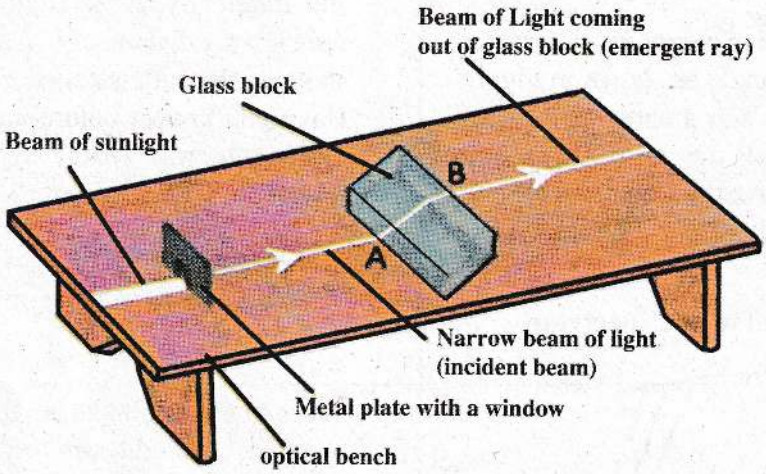


Figure 12.20 - Refraction of light through a glass prism

Refraction of Light

Now you know a method to decide the path of a light beam. It is convenient to do most of the experiments by using an optical bench shown in Figure 12.20. An activity to study the deviation of the path of a light beam aimed at an angle to the surface of a rectangular glass block or Perspex block is shown in Figure 12.20. The direction of the path of light which travelled through air changes on entering the glass medium at an angle to the surface. This phenomenon is called refraction.

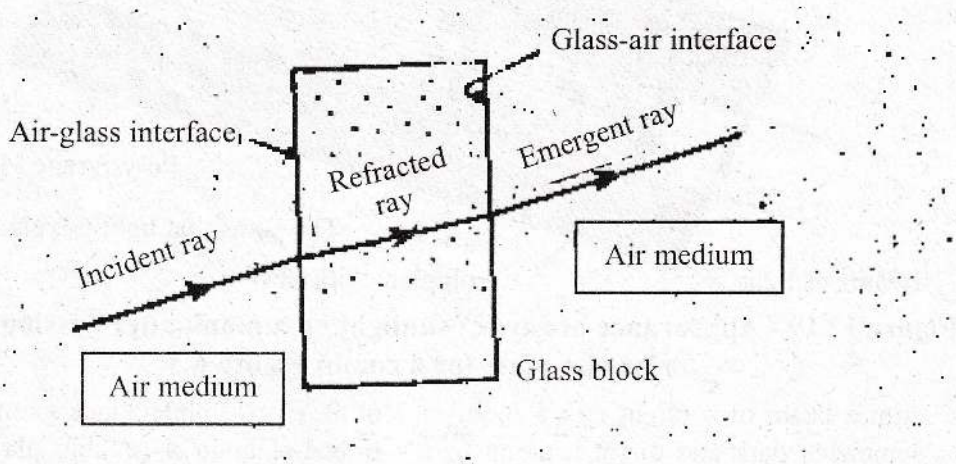


Figure 12.21 - When the medium through which light travels ■ changes refraction of light occurs.

Light has travelled through the glass block along the line AB.

If a light beam is aimed perpendicular to the glass surface by turning the glass block suitably it will be observed that the direction of the path of light is not changed.

The diagram shown in Figure 12.21 illustrates the refraction of light.

Light refraction through a triangular glass block or perspex block can be obtained by using the set-up shown in Figure 12.22.

Activity 6

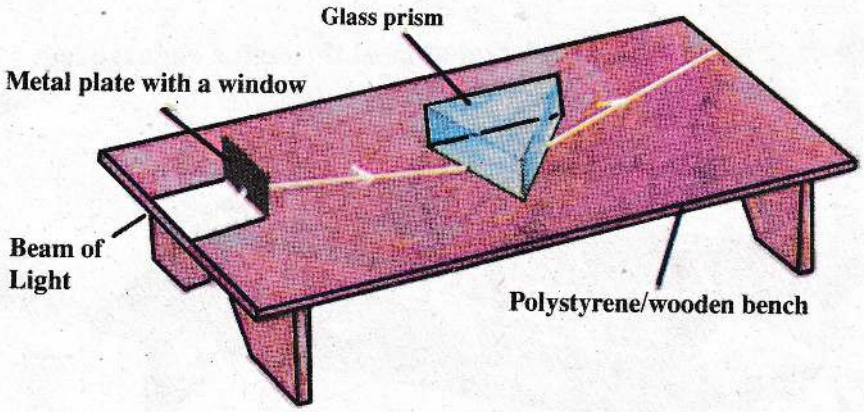


Figure 12.22 - Refraction of light through a prism

Arrange the set-up shown in Figure 12.22 in the classroom and aim a unicolour light beam to the prism. Arrange the set-up to facilitate the observation of rays along the surface of the bench. Place a half-sheet of paper and mark the rays. Mark the boundaries of the prism on the paper. Construct the path of the light by using the diagram which shows the incident ray, emergent ray and the boundaries of the prism.

Figure 12.23 -Shows the refraction of light y a prism as mentioned in activity 6.

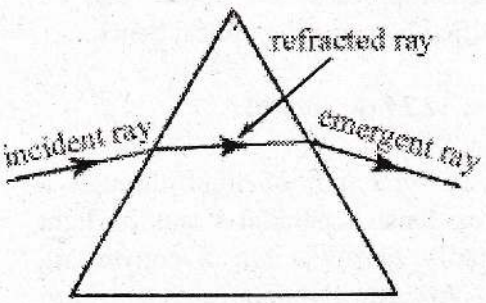
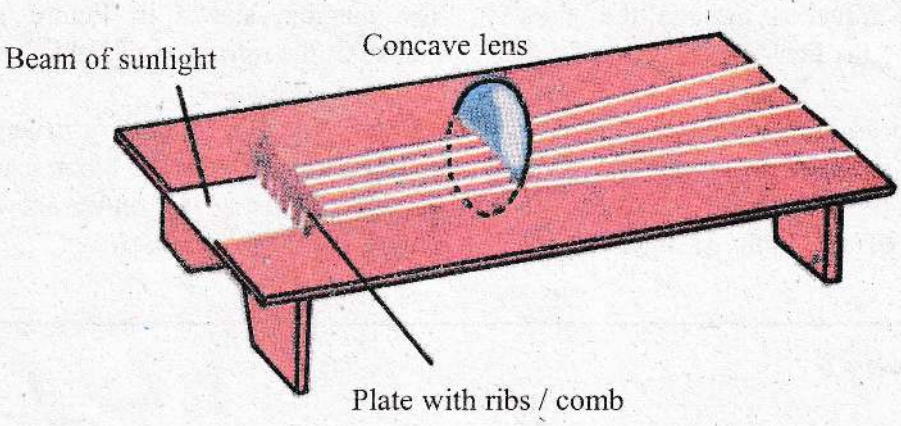
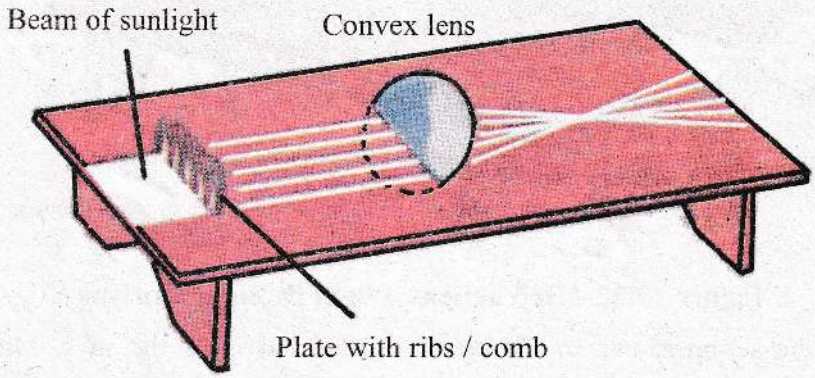


Figure 12.23 - Refraction of light through a glass prism



(A) Divergence of a parallel beam of light through a concave lens.



(B) Convergence of a parallel beam of light through a convex lens

Figure 12.24

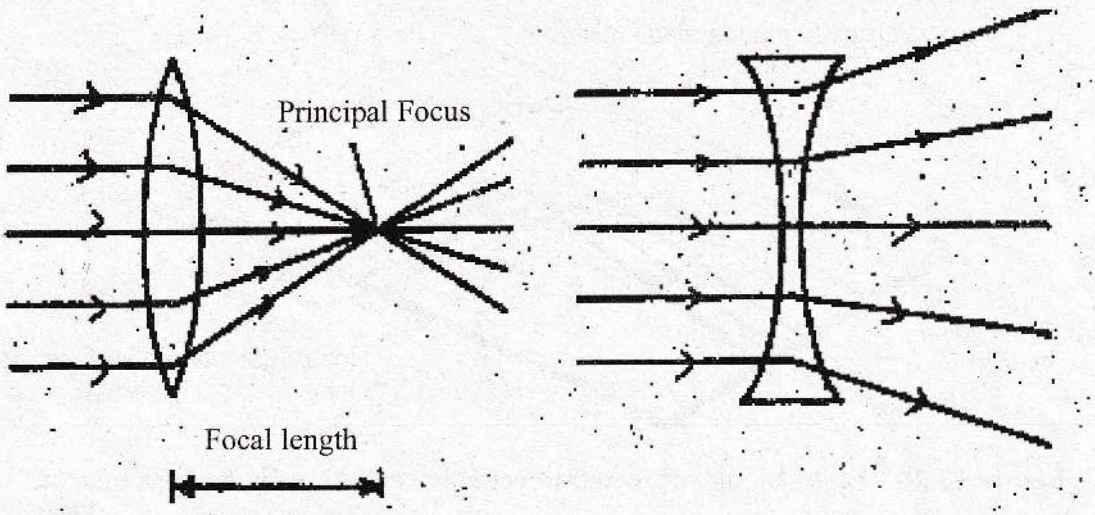
When light travels through lenses the refraction process that occurs can be identified by using the optical bench.

Figure 12.24 (a) and (b)

Due to refraction of light through a convex lens, a parallel beam of light gradually narrows into a converging beam. Accordingly a convex lens is also called a converging lens.

When light passes through a concave lens the refraction occurs. A parallel beam of light becomes a diverging beam (scattering gradually). Therefore a concave lens is also called a diverging lens.

In the above diagrams (A) & (B) light rays are aimed at the lenses symmetrically.



(a)
Convergence of a parallel beam of light by a convex lens.

(b)
Divergence of a parallel beam of light by a concave lens

Figure 12.25 - Refraction of light by lenses.

A parallel beam of light which enters a convex lens symmetrically converges to a point which is termed the **principal focus** of the lens. The distance from the lens to this point is called the **focal length.**

Reflection of Light

Let us recall the things we studied in an earlier chapter about reflection of waves light waves that fall upon a plane mirror are subjected to regular reflection.

The plane surface used to observe narrow light beams is also used to observe reflection of light by a plane mirror. (Figure 12.26)

Reflection of Light by Curved Mirrors

Light is also reflected by concave mirrors and convex mirrors.

Assignment 2

Take a plank as shown in figure 12.19 and cut a window in the plank to immerse a curved mirror. At first place a concave mirror and later replace it with a convex mirror and aim a narrow beam of sunlight to each mirror to study the behaviour of light draw suitable diagrams to show the behaviour.

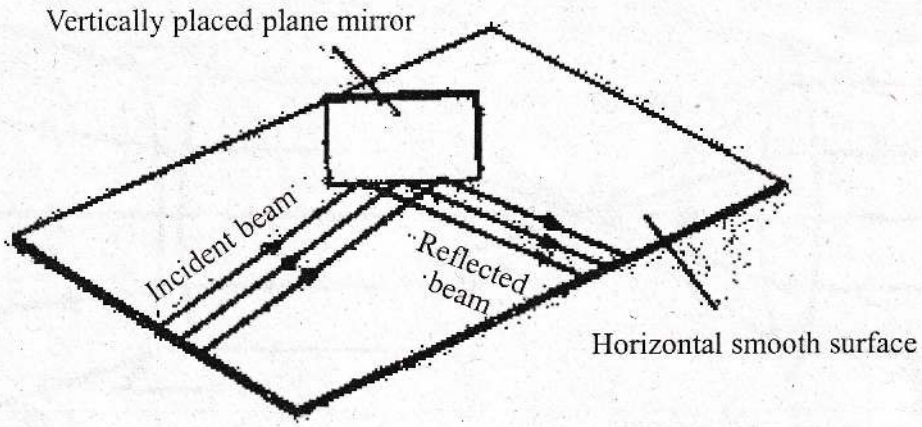
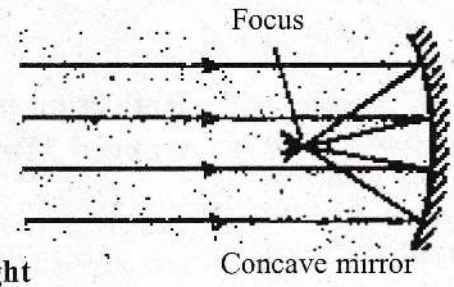
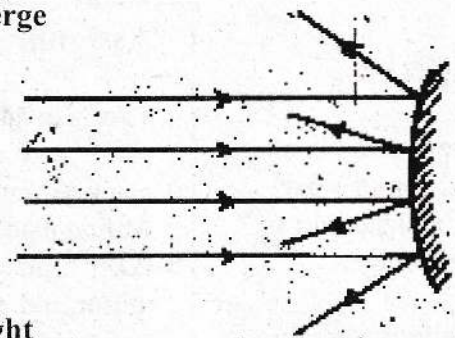


Figure 12.26 - Light being subjected to regular reflection by a plane mirror.

The diagrams drawn with reference to assignment No.2 are shown in Figure 12.27. Parallel light beams falling upon concave and convex mirrors and their reflections are illustrated in these diagrams.



(a) Parallel beam of light reflected and converge



(b) Parallel beam of light diverge after reflecting

Figure 12.27- Reflection of light by curved mirrors

As shown in Figure 12.27 (a), a parallel beam of light after reflection from a concave mirror meets at the principal focus of the mirror. The distance from the mirror to focal point is the focal length of the concave mirror.

You must have understood how prism lenses and mirrors changes the direction of propagation of light waves. Let us now inquire into the effects caused by the changes in the behaviour of light.

Formation of Images by Curved Mirrors

What do you see when you are in front of a plane mirror? You will see your image in the mirror. You life-size image is formed in it.'

When you place a concave mirror close to your face what sort of an image will you see? An enlarged, erect image of your face will be seen.

When you place a convex mirror in front of you face a small image compared to your face it, a diminished and erect image is seen.

Image of a distance object could be projected to a wall or a screen with the help of a concave mirror (Figure 12.28). Such an image which can be obtained on a screen is a real image.

It is diminished and inverted. The distance from the concave mirror to the image is equal to the focal length of the mirror. The forcus on shown in Figure 12.27 (a). Distance from the focus to the mirror is the focal length of the mirror.

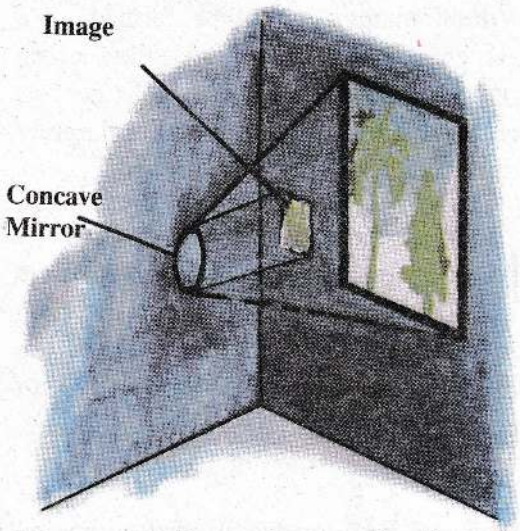


Figure 12.28 - An image of a distant object is formed on the wall by the concave mirror.

Activity 7

Keep a burning candle as an object in a fairly dark room and observe the different images formed by keeping the mirror at different places before the flame. See whether inverted images could be projected on a screen observe the nature and the position of the image.

Study and report the nature and position of the image when the object (flame) is taken away from the mirror. Likewise, study and report the images formed in different places when the flame is brought towards the mirror.

Can you identify that the images become enlarged and erect when the object is brought very close to the mirror. Is it possible to get them on a screen? If not, why?

Virtual images cannot be formed on a screen. On describing the nature of an image. It must be mentioned whether it is real / virtual, erect inverted or enlarged / diminished should be mentioned.

Two types of images are formed by concave mirrors. One type is virtual erect and enlarged. Other type is real and inverted. Real images may be diminished, equal or enlarged. But convex mirrors can produce only virtual, erect and diminished images.

Concave mirrors are used for making shaving mirrors, the end-portion of the instrument which is like a spoon used it examine the month by dentists is made as a concave mirror. Concave mirrors are used as light reflectors too.

Convex mirrors are used as the side-mirrors of vehicles.

Formation of Images by Lenses

You have studied in Grade 9 that different types of images of objects are formed by convex lenses. (Refer to Grade 9 text book for magnifying glass, microscope, telescope and spectacles.

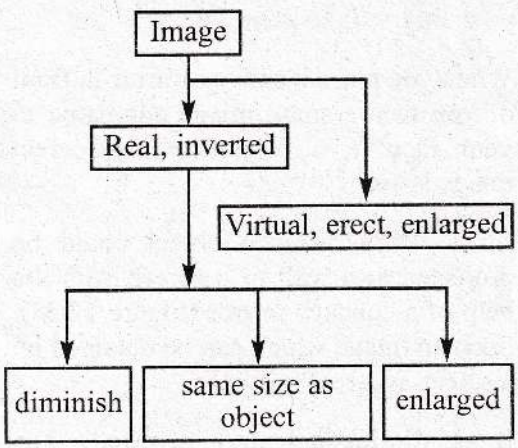
Now let us examine further about these lenses enlarged and erect images can be seen when observing near objects by keeping a convex lens close to the eye. Since light does not travel through these images they cannot be projected on a screen. Therefore these images are virtual.

When distance objects are observed keeping a convex lens at a fair distance from the eye, inverted and diminished images of them can be seen. They can be obtained on a screen. i.e. They are real images.

Activity 8

Keep a convex lens vertically on a table in a fairly dark room. Make use of a candle flame as the object. Place the candle flame in different positions in front of the lens and observe their images. Obtain the inverted images on a screen placed on the other side of the lens. Identify the different types of real images seen by observing their nature and prepare a report.

A Classification of Images formed by a Convex Lens is shown below.



The nature and position of images formed by a convex was relative to the position of an object can be summarized by means of experimental details. The

position of the image of an object is mentioned relative to focal length (f) and twice the local length (2f).

Table 1

The nature and position of images formed by a convex lens was relative to the position of the object

Position of Object	Position of Image	Nature of Image	Uses relevant to the situation
Distance less than f	Behind the object	Virtual, erect enlarged	Magnifying glass
At the distance f (on the focus)	Not seen (formed at infinity)	Cannot be seen	To get parallel beams of light
Between the distance side f and 2f	Opposite to the object at distances greater than 2f	Real, inverted enlarged	Projectors
Distance of 2 f (twice the focal length)	Opposite side of the oibject at a distance of 2 f	Real, inverted same size as the object	--
At distance greater than 2f	Opposite side of the object between f and 2 f	Real, inverted diminished	Fixed-focus camera

Activity 9

Take a convex lens. Obtain an image of a distance object such as a distance mountain or cloud, on a screen. Measure the distance from the image to the lens. This distance is approximately equal to the focal length of the lens. Note down this distance.

Next, keep a luminous object (eg. A candle flame) before the lens at distances less than f, at f, between f and 2f, at 2f and more than 2f and observe the images obtained for each position. Get real images on a screen. Compare the observations with the details of the table 1 shown.

Only one type of images is formed by concave lenses. An erect diminished, virtual image is seen when looked through a concave lens.

Assignment 3

Get the patronage of a few persons wearing spectacles and examine the pairs of spectacles. Inquire from them for what sort of eye-defects they use spectacles. Include the details in the following table. Note whether the lens is convex or concave under the column used for the details of spectacles in the Table.

Instructions

Look at closely-held printed letters through the centre of the lens to identify the nature of a lens. If the letters look magnified, then the lens is convex diminished letters are seen through a concave lens.

Some lenses of the spectacles may be unusually thick. Note down such properties under the column for "other details".

Details of the spectacles				The eye-defect of the wearer	Other details
Left lens		Right lens			
Upper part	Lower part	Upper part	Lower part		

★ What are the patterns that can be identified from the completed table?

★ What are the characteristics of the spectacles used for reading?

★ What are the properties of the spectacles used to see distance very clearly?

★ What are the eye-defects of those who wear thick lenses?

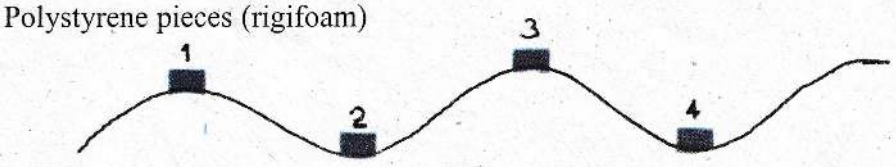


Figure 12.29

Exercises :

1. The time shown by a mechanical wall clock operated by a swinging pendulum will become more or less due to the increase or decrease of the frequency of the swinging pendulum. Should the length of the pendulum be increased or reduced to remedy the defect of a wall clock which shows an increased time than the correct time? Give scientific reasons for your answer.

2. A glass window of a vehicle which is stopped but the engine is working, vibrates because of resonance. When the vehicle starts to move the vibration of the window cannot be identified. Cite scientific reasons for this.

3. Positions of some polystyrene (rigifoam) pieces which float on a ripple tank water surface are shown in Figure 12.29. If the wave movement persists, in which direction of does the

   (a) Polystyrene piece No. 1
   (b) Polystyrene piece No. 2

4. If the velocity of sound in air is 340 ms^{-1} calculate the wavelength of the sound wave produced by an object vibrating with a frequency of 680 Hz.

5. Write the following group of notes in ascending order of the pitch. Assume that the notes belong to the same musical scale

   (a) ගරිනිධපම
   (b) පනිසගරි
   (c) ගමපනිධ

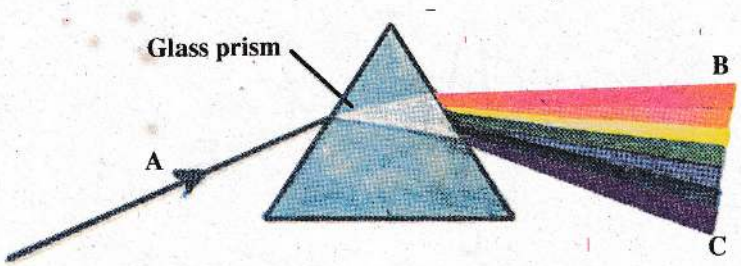


Figure 12.30

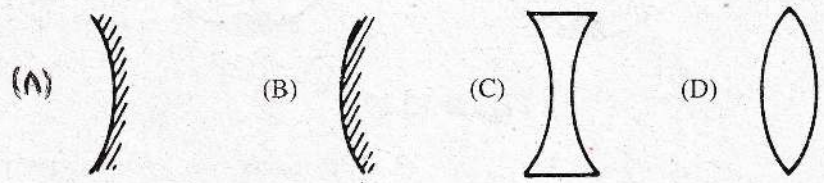


Figure 12.32

6. Re-arrange and write the following waves of different colours in order of the visible spectrum.

   orange, yellow, green, red, violet, blue, indigo

7. It is shown in Figure 12.30 how a visible spectrum is formed when sunlight is directed at a prism. The colour of the light waves which travelled along rays are illustrated by A, B, C.

   Name the colours of A, B, and C.

8. The incidence of a ray of red light on a prism is shown in Figure 12.31. Complete the passage of the ray.

9. Name what is illustrated by (a), (b), (c), (d) Figure 12.32.

10. To mention what should be used out of a, b, c, d of Figure 12.32 for

    (i) Convergence of a parallel beam of light by the reflection of light.

    (ii) Divergence of a parallel beam of light by refraction of light.

    (iii) Forming real images by reflection of light.

    (iv) Marking of enlarged virtual images by refraction of light.

    (v) Obtaining erect diminished images by refraction of light.

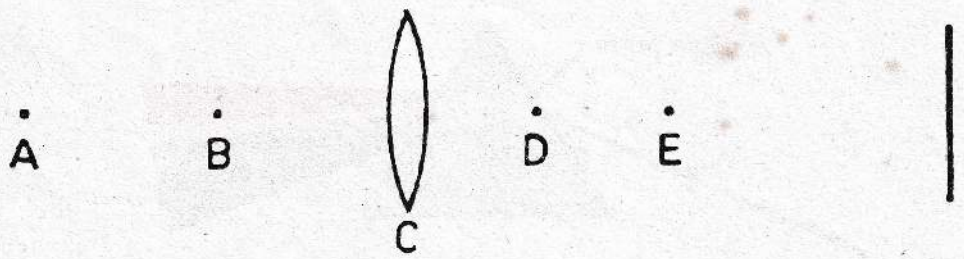


Figure 12.33

11. Four points situated on the two sides of lenses are named A, B, C, D, and E in Figure 12.33.

BC = CD = focal length (f)
AC = CE = twice the focal length (2f)

(i) Name the position of a luminous object that has to be placed in order to get a clear image on a screen by the lens.

(ii) What is the nature of the image formed on the screen?

(iii) Name the place or the boundary the screen must be kept in order to get a clear image, when a luminous object is placed at the position of the screen. Explain the nature of the image formed.

Summary

★ There are many instances of vibrations in our surrounding.

★ There is an amplitude and a frequency with regard to vibration.

★ Waves are formed due to vibrations.

★ Energy is transmitted through waves.

★ Resonance is caused by vibrations and waves.

★ There are two forms of waves depending on the nature of vibrations in a wave.

★ Sound and light are two forms of waves.

★ Water waves as well as other waves are subjected to reflection and refraction.

★ Human beings hear sounds having a frequency range between 20Hz and 20000 Hz.

★ Note of a sound has a pitch relevant to it.

★ White light consists of a number of difference types of electro magnetic waves.

★ Light waves are subjected to refraction when they travel through prisms and lenses.

★ Light waves reflect when they fall on mirrors.

★ Mirrors make images by reflection of light while lenses make images by refraction of light.

★ Mirrors and lenses are used in different instruments and set-ups.

You should be able to .....

- ★ Identify phenomena comprising vibrations
- ★ Describe amplitude and frequency of vibration.
- ★ Explain the exchange of energy in a vibration and resonance.
- ★ Explain the movements of particles in a transverse wave.
- ★ Explain the movements of particles in a longitudinal wave.
- ★ Identify compressions and rarefactions, crests, troughs frequency and wave length of a wave.
- ★ Identify the nature of sound and production of sound.
- ★ Explain the pitch and note pertaining to sound.
- ★ Explain the nature of light, colour, and spectrum.
- ★ Explain the behaviour of a light ray passing through a prism.
- ★ Explain the behaviour of a light ray passing through a lens.
- ★ Explain the behaviour of light when if reflects from a curved mirror.
- ★ Find the position and nature of the image formed of an object by curved mirrors.
- ★ Solve problems with regard to frequency, wave length and velocity.
- ★ Find the position and the nature of the image formed by a thin lens.

13. Coordination and Homeostasis

Stimuli and receptors

Think of some experiences that brought your happiness or pain. The sight of trees and plants swaying in the wind, the sound of the singing of birds, the sight of flowers of various colours, the smell of a ripe mango, the taste of a ripe gauva fruit are a few experiences that brought you happiness. You would have experienced pain when you knocked your foot on a rough stone or when a mosquito stung you.

You had experiences as those mentioned above because you were sensitive to them. You gained this ability due to the sense organs present in your body. Let us now identify the sense organs related to a few of your experiences (Table 13.1).

Organs that help to identify senses are known as receptors. Our body has five receptors. They are the eyes, ears, nose, tongue and the skin.

Your receptors received the senses due to changes that occurred in the environment. Changes taking place in the environment are known as stimuli. Receptors become activated by stimuli.

We will next consider as to what stimuli could be received by each receptor.

Receptor	Stimulus
eye	light
ear	sound
nose	smell
tongue	taste
skin	warmth / cold / touch / pain / pressure

Table 13.2

Experience / Phenomenon	Sense	Sense organ
Seeing the swaying of trees and creepers	Vision	Eye
The singing of birds	Hearing	Ear
Feeling the scent of flowers	Feeling the scent	nose
Experiencing the taste of a ripe guava fruit	Experiencing the taste	Tongue
Knocking the foot on a stone	Feeling the pressure	Skin

Table 13.1

Let us identify receptors and effectors

Think of an instance where your mouth watered when you tasted a piece of ripe mango. The reaction that resulted when the tongue received the stimulus of taste was the salivation or secretion of saliva to the mouth. The reactions towards a stimulus are known as responses. The organs that show responses towards a stimulus are known as effectors.

Our body has two types of effectors that being about responses toward a stimulus.

Muscles : Example : skeletal muscles
Glands : Example : Salivary glands
tear glands

Assignment 1

Complete the table given below using the facts you learnt so far.

Phenomenon	Stimulus	Receptor	Response	Effectors
1. Salivation or watering of the mouth at the sight of a ripe mango.	sight	eye	salivation	Salivary glands
2. A person jumping away from the road as he sees a fast approaching vehicle.				
3. Moving the foot away when a thorn or something pricks				
4. A person taking a deep breath, as he feels the smell of a perfume.				
5. Closing the ears the moment you hear thunder.				

The assignment 1 indicated instances where man responds towards stimuli. You may have no doubt questioned yourself as to whether other organisms too respond to stimuli.

Assignment 2

Investigating about other organisms that respond towards stimuli.

Go out to your school garden or home garden and find out about the responses shown by plants and animals towards stimuli such as light, sound and touch. Record your observations in a suitable manner.

Assignment 2 may have indicated that there are plants and animals that respond towards stimuli.

Example

The snail - towards light and touch.
The Mimosa plant - towards touch.

How are impulses transmitted from receptors to effectors?

The impulse produced when a stimulus is received by a receptor should be transmitted to the effectors in order to show a response. The receptors and effectors are connected by the central nervous system.

Recall what you learnt about the nervous tissue in an earlier lesson.

★ The building unit of the nervous tissue is the neurone.

Do you know?

★ Living organisms cannot respond to all stimuli. No living organism, can respond towards radio waves. Similarly organisms can respond only toward stimuli that have a certain minimum intensity. This is why we do not feel the difference in taste of a glass of water in which a small crystal of salty has been dissolved. The minimum intensity that should be present in a stimulus is known as the threshold of the stimulus. Although man cannot respond to sounds below 20 Hz and above 20000 Hz, dogs have the ability of responding to these sounds.

★ Certain artificial flavouring agents present in the market reduce the threshold value relevant to the sense of taste.

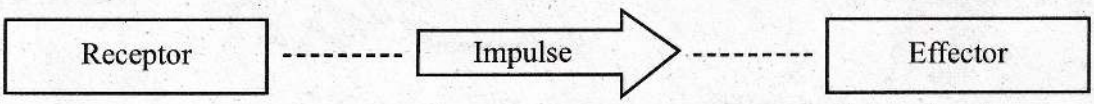


Figure 13.1 (a)

★ A neurone is formed by a cell body with a nucleus and a number of projections.

★ The projections joining the receptors are known dendrites and the projections connected to the effectors are known as axons.

★ The cell bodies in a neuron are located in the brain, spinal cord and ganglia.

★ The nervous system consists of the central nervous system and the peripheral nervous system.

★ The central nervous system consists of the two parts known as the brain and the spinal cord.

★ The nerves joining the central nervous system to the receptors and effectors belong to the peripheral nervous system.

★ A nerve is formed by the joining together of a number of nerve fibres.

★ A nerve fibre is an axon or a dendrite which is a part of a neuron.

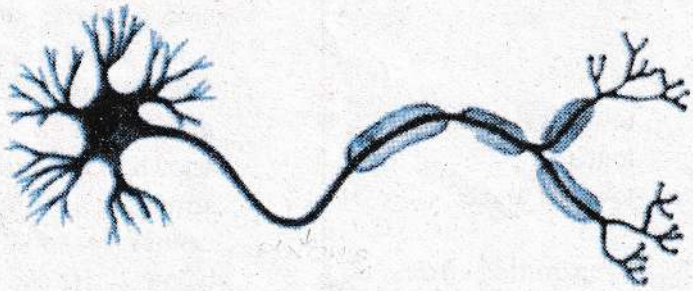


Figure 13.1 (b) - A nerve cell or neuron

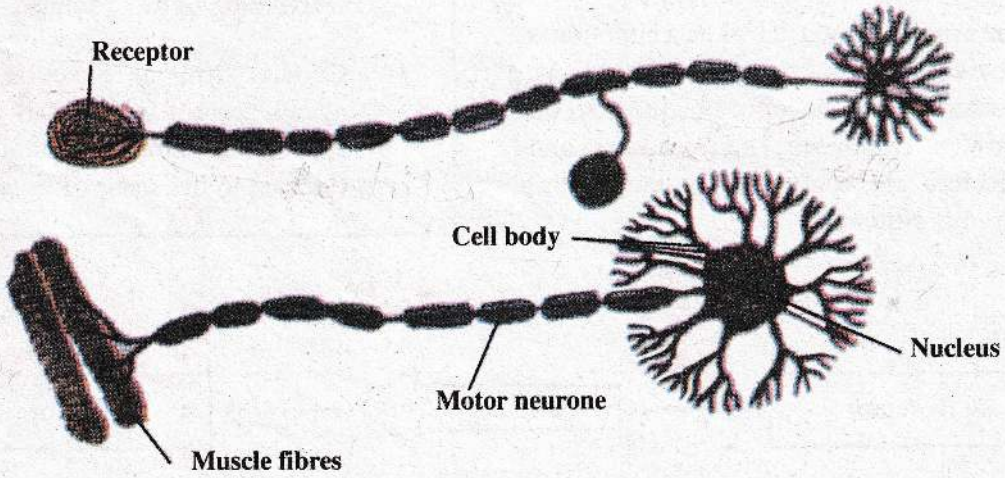


Figure 13.2 - A sensory neurone and a motor neurone

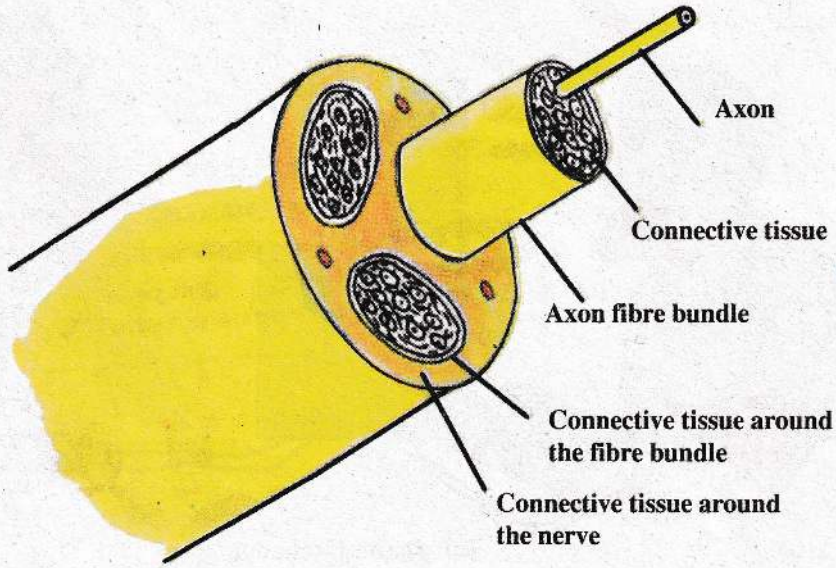


Figure 13.3 (a) - A cross section of a nerve. See the manner in which the nerve fibres comprise of axon or dendrites are arranged in the form of bundle by means of connective tissue.

A nerve impulse originating from a receptor travels along an afferent nerve fibre or sensory neuron and reaches the central nervous system where it selects the impulse and reaches the relevant effector or effectors along an efferent nerve fibre or motor neuron.

How is the central nervous system arranged?

When the impulse received from the receptors reach the central nervous system, they are selected and sorted out there and referred to the relevant effectors for responding. Accordingly the central nervous system could be compared to a telephone exchange.

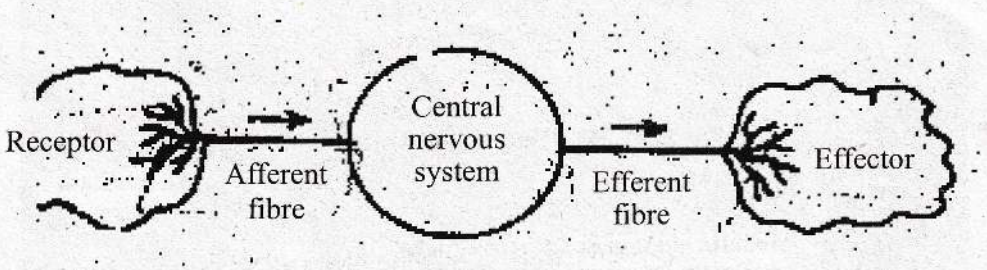


Figure 13.3 (b)

Telephone Exchange

Figure 13.4 - How the action of the central nervous system corresponds to the action of a telephone exchange.

The brain is protected by and situated within the bony cranium and the spinal cord is protected and situated within the bony vertebral column. In addition they are covered by a meninge membrane (See figures 13.5 and 13.6).

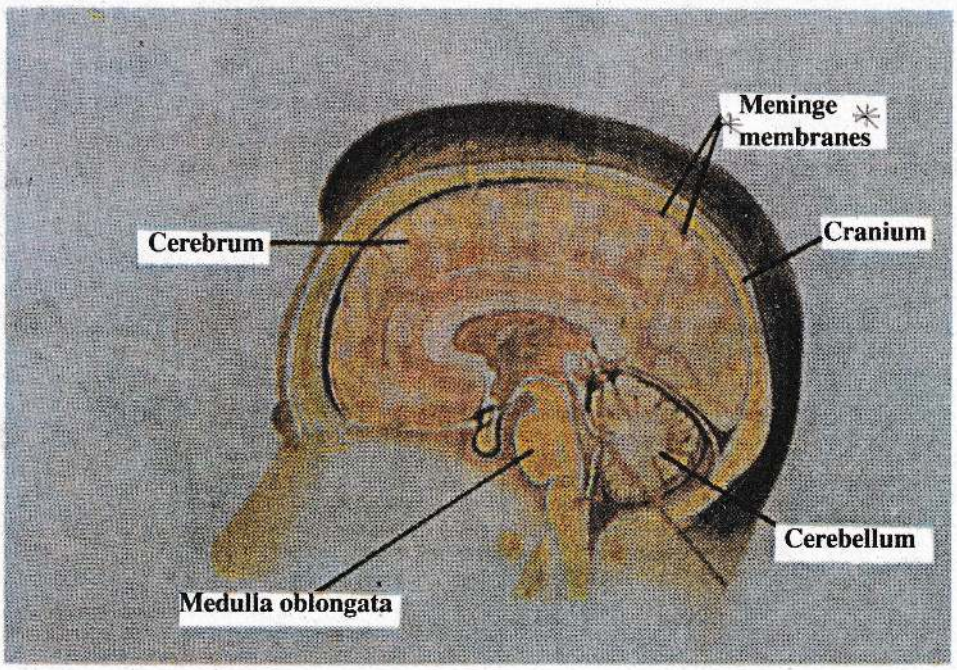


Figure 13.5 - A longitudinal section of the brain

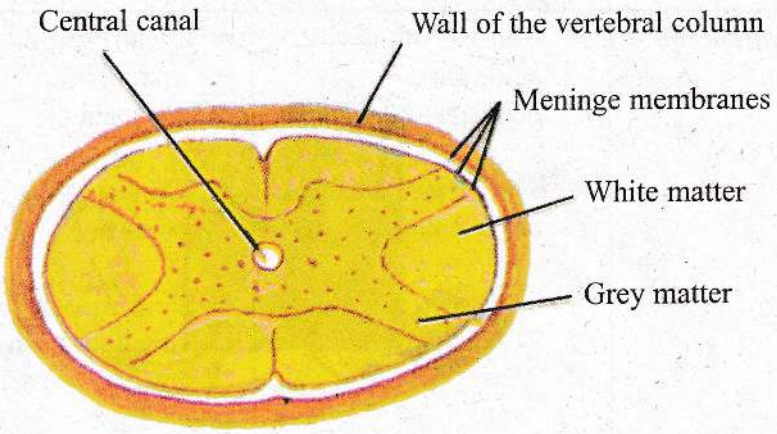


Figure 13.6 - A cross section of the spinal cord within the vertebral column

The fluid between meninge membranes protects the brain and spinal cord from jerks.

Do you know?

The meninge membrane swells, clue to the infection of the cerebro spinal fluid. This disease condition is known as meningitis. Children should be given the immunization vaccine for the prevention from meningitis. Meningitis is a fatal disease. Even through there is a possibility of curing this disease various side effects may arise (Example: hearing and visual defects).

Structure and function of the brain

The cranial cavity is almost filled with the brain. Towards its posterior section the brain becomes narrower gradually forming the elongate spinal cord (Figure 13.7).

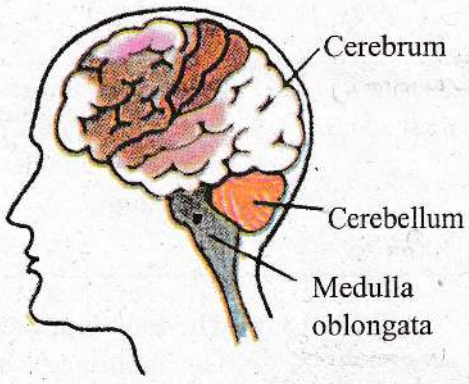


Figure 13.7 - The side view of the human brain.

Structure	Location and nature	Functions performed
Cerebrum	★ Consists of the left and right hemispheres. ★ The surface is folded or convoluted.	★ Identifying the senses such as vision, hearing,smell taste, touch and pain. ★ Controls the conscious or voluntary actions. ★ Performs the higher mental functions such as learning, memory, intelligence and thinking. ★ Controlling the functioning of the right side of the body by the left cerebral hemisphere and those of the left side of the body by the right cerebral hemisphere. ★ Showing division of labour for each function.
Cerebellum	★ A small structure situated behind the cerebellum	★ Coordinating the muscles contributing towards the movement of the various parts of the body. eg. coordinating the movement of the eye muscles and the muscles of the hands when threading a needle.
Medulla oblongata	★ The posteriormost part of the brain situated behind the cerebellum.	★ Controls respiration and swallowing. ★ Controls the heart beat. ★ Controls reflex actions.

Table 13.3 - The location, nature and functions performed by the main parts of the human brain.

nerves leaving the brain are known as the cranial nerves. There are 12 pairs of cranial nerves.

Questions

1. Why is it that when a harm is caused to a cerebral hemisphere the functioning of the opposite side of the body weakens?

2. Explain how a severe blow to the back of the head or the back of the neck becomes fatal.

3. Why is it that a bird whose cerebellum is injured can flap its wings but cannot fly properly?

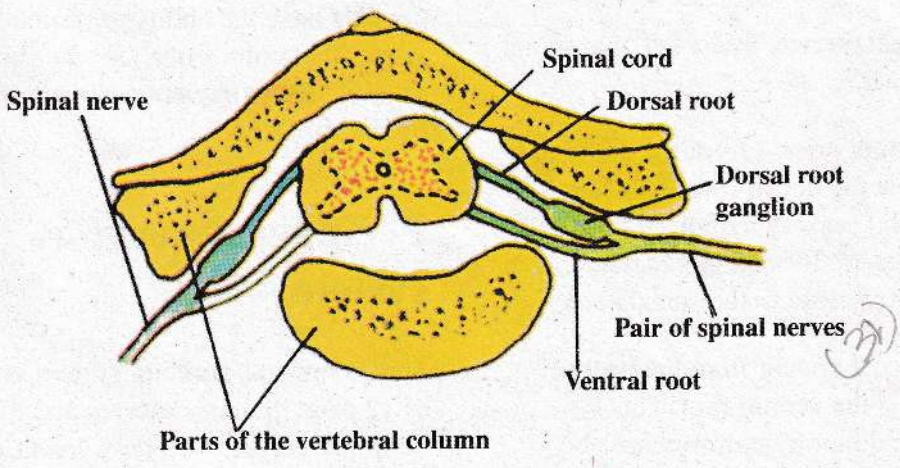
Activity 1

Examine a vertebra obtained from a meat stall. Collect 7-8 vertebrae from the skeleton of an animal. Pass a suitable string through the vertebrae such that the projections in them are in lie.

Questions

1. What is situated in the path of the nerve in the vertebra?

2. To what can you compare the string used to join the vertebrae?



13.8 - The manner in which the spinal cord is placed within a vertibra.

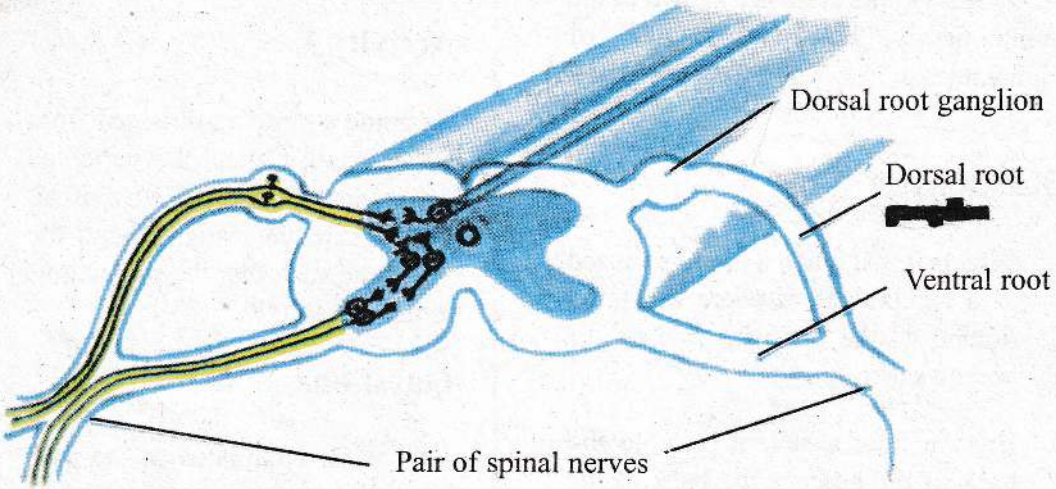


Figure 13.9 - The manner in which the spinal nerves arise. The dorsal root and the ventral root may have a few nerve fibres.

When all the vertebral are articulated together the vertebral canal is formed the cord running through the vertebral canal is known as the spinal cord. The soft substance seen in the centre of vertebra is a part of the spinal cord. The spinal cord extends through the vertebral canal to the posterior end.

The spinal nerves arise fro the spinal cord as two roots.

★ The root arising from the dorsal side is the dorsal root. This has several sensory neurons whose cell bodies are located in ganglia situated close to the spinal cord.

★ The root arising from the ventral side is the ventral root. This has several motor neurons whose cell bodies are located in the grey matter of the spinal cord. The dorsal root and ventral root join to form the spinal cord. There are 31 pairs of spinal nerves.

You may have sometimes seen the trunk region of a snake whose head has been severed or the severed tail portion of a gecko showing a wriggling movement for sometime. This shows that certain animals have the ability to respond, even when the connection to the brain is severed. These movements are controlled by the spinal cord.

Peripheral nervous system

The peripheral nervous system consists of 12 pairs of cranial nerves and 31 pairs of spinal nerves. You have learnt earlier the manner in which these nerves are distributed.

Responses arising without your knowledge

Think as to whether you respond to every stimulus consciously or after giving thought to it. Are there instances where you instantly responded without your knowledge? Sometimes you have seen another person responding in this manner.

Assignment 3

Pay attention to the responses shown during the following instances and tabulate your observations for each of the following instances.

- ★ During an instance, you are in the house.
- ★ During an instance where a pedestrian is walking on the road.
- ★ While a driver is driving a vehicle.
- ★ During any other similar instance.

Questions

"During instances where responses were made instantly without the individual's knowledge, did the individual gain any advantage from it?

Responses shown without ones knowledge are known as reflex actions or reflexes. You may have identified several reflex actions when engaged in assignment 3. The most important feature of a reflex action is the response shown within a very short time of receiving the stimulus. Reflex actions play a part in safeguarding our life or providing protection to a particular organ Reflex actions taking place by the intervention of the spinal cord are known as spinal rafters and reflexes taking place by the intervention of the brain are known as cranial reflexes (Table 13.2). Identify the two types of reflex actions.

Spinal reflexes	Cranial reflexes
1. Taking the hand off at the touch of a thing.	1. Nausea or feeling vomitish.
2. Taking the foot off when prickled by a Horn.	2. Cough

Table 13.4

Reflex arc

The path through which a nerve impulse is carried from the receptor to the effectors during a reflex action is known as the reflex arc.

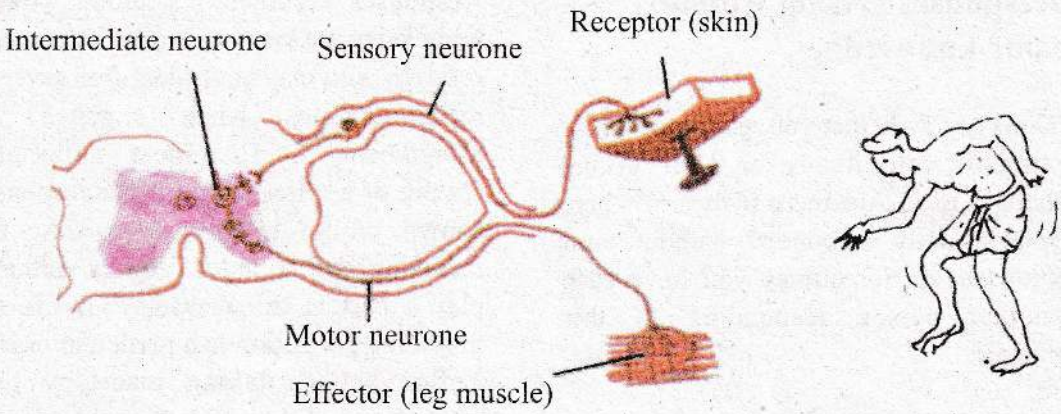


Figure 13.10 - Reflex are

Assignment 4

Keeping in mind that a reflex helps to safeguard life or protect a particular organ, explain the following reflex actions.

1. Cough
2. Sneezing
3. Nausea

Influence of the brain on spinal reflexes.

Although taking away the leg on reviewing a harmful stimulus occur by the intervention of the spinal cord the brain interviews in understanding the stimulus and sending out impulses towards suitable effectors to show responses like rubbing the place where the harmful stimulus was received. Accordingly if the spinal cord breaks at the centre, even though reflex actions occur in the region that is not connected to the brain, that individual may not show any sensitivity to them.

Nervous coordination and non-nervous coordination

The organs or systems in the body do not function singly. Organs function in close relationship with other organs or other systems. Systems too function in close relationship with other organs or systems. The functioning of organs or systems in close relationship such that the various body functions take place in an orderly manner is known as coordination.

The coordination that takes place among the various organs or systems in the body occurs in two ways.

1. With the intervention of the nerves - this is nervous co-ordination.

2. With the intervention of chemical substances known as hormones. This is non-nervous co-ordination.

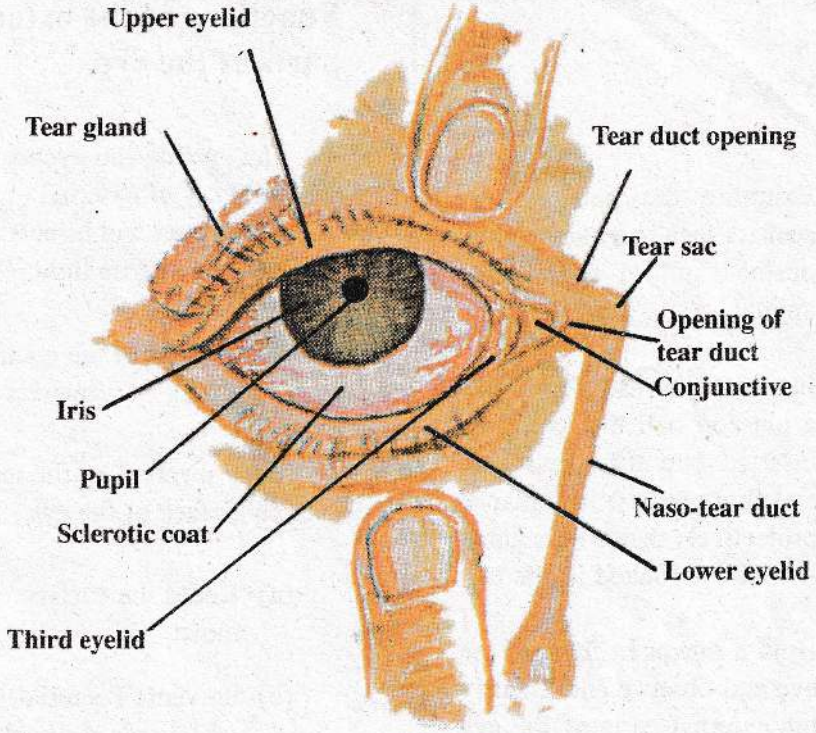


Figure 13.11 - External appearance of the human eye

When you involve in an exercise, the respiratory system and the heart work in co-ordination in order to generate additional energy. This is nervous co-ordination. A number of such activities take place in the body when the partly digested food enter the intestine the secretion of the pancreatic juice takes place without the intervention of the nerves. This is a non-nervous co-ordination.

We will now consider as to how the sense organs involved in the reception of the stimuli are arranged.

1. The eye

This can be described as the most important organ among the sense organs. We see certain object, when the light coming from that object is caught by the eye. In common usage, the eyeball and the remaining parts seen around and outside the eyeball are known as the eye.

Activity 2

1. Examine the pair of eye sockets seen in a human skull or the skull of some other animal.

   Insert a spherical object like a pin-pon ball that could be inserted into the eye socket and find out how it is placed protectively inside it and how it could be rotated inside it.

2. Hold a mirror in front of the eye and observe and identify the external parts of the eye (compare with figure 13.11).

Functions of the external parts of the eye

★ The eyelids and eyebrows prevent the entry of external objects such as dust, sweat and insects and also the entry of intense light.

★ The closing of the eyelids from time to time gives some rest to the eye.

★ Tears secreted by the tear glands to the surface of the eye

   (a) Keeps the surface of the eyeball moist.

   (b) Prevents bacterial infection and safeguards the health of the eye.

★ The excess tears are sent to the nose by means of the naso-tear duct.

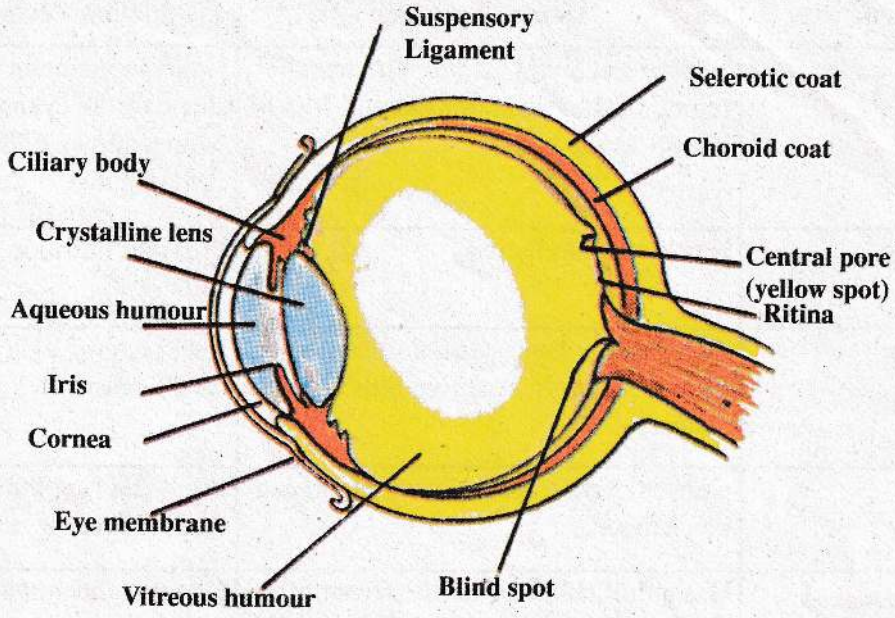


Figure 13.12 - Internal structure of a human eye

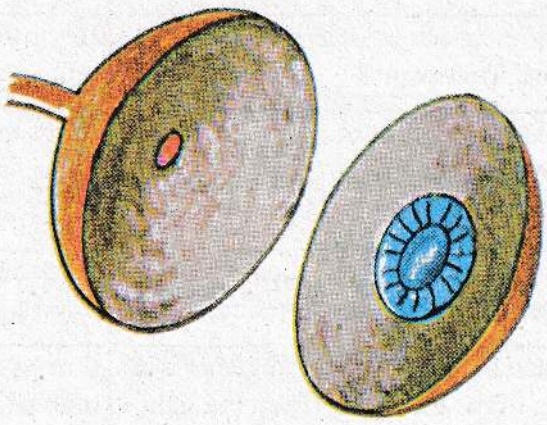


Figure 13.13 - A section showing the internal structure of the eye.

Structure	Special Feature	Function Performed
Selerotic layer	White in colour. Opaque. The front region of the eye is transparent. It is known as the cornea.	Helps to maintain the shape of the eyeball. The cornea allows light to enter the eye.
Choroid	Has blood capillaries	Provides nutrition to the eye.
Retina	The external layer has a dull colour. Consists of light sensitive rods and cones.	Reception of light falling on the retina.
Lens	Convex. Transparent. Focal length can be changed.	Light entering the eye is focussed on the retina.
Iris	Has a dull colour. Placed in front of the lens. Subjected to contraction and relaxation.	Controls the amount of light entering the eye.
Pupil	Circular aperture in the centre of the iris.	Light enter the eye through this.
Ciliary muscle	A circular muscle connected to the ligament around the edge of the lens.	Helps in adjusting the focal length of the eye lens.
Aqueous humour	Liquid between the lens and the cornea. Transparent.	Helps to focus light on the retina.
Vitreous humour	A gelatinous substance placed within the eyeball behind the lens. Transparent.	Helps to focus light on the retina.
Yellow spot (Central pore)	Area with a dense collection of cone shaped cells place on the retina.	Helps in sharp vision.
Optic nerve	Formed by the collection together with nerve fibres that extent from the light receptor cells of the retina.	Carries the impulses revived by the retina tothe brain.

Table 13.4 - The different parts of the eye and their functions.

How does the eye provide vision?

Light coming from an object in front of the eye, travels across the cornea, aqueous humour, lens and vitreous humour and is focused on the retina. A small inverted image is then formed on the retina. The retinal receptor cells on the retina get stimulated by this light and impulses arise. When these impulses travel to the optic sensory region of the brain through the optic nerve it becomes possible to see and identify the object in front of the eye.

Protection of the eye

The value of eyes are felt only when a person with eyes looses her or his eyes. It is therefore important that you protect your eyes. Even though the eyes are by nature, designed to be protected, injury may be caused to the eyes due to various external causes. It is therefore important to be alert about these and also about optical defects.

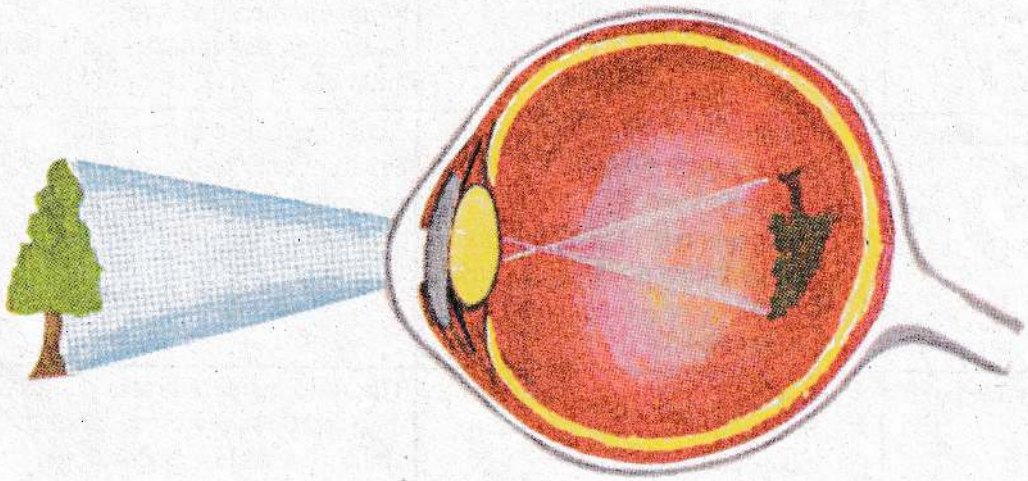


Figure 13.14 - How an image forms on the retina

Assignment 5

With the use of suitable material, make a suitable three dimensional model to demonstrate the formation of an image on the retina of the eye.

Questions

4. The eye could be compared to a camera. Explain this statement.
5. How does the eye differ from a camera?

The Ear

The ear is the receptor of hearing.
The ear is made up three parts, namely the outer ear, middle ear and the inner ear. The middle ear and the inner ear are situated in a cavity made up of the temporal bone. See Figure 13.15

Structure	Location / Nature	Function Performed
Ear lobe	Cannot be turned unlike in animals.	Directing sound waves to the ear.
External auditary meatus	★ A curved tube ★ The internal boundary is the tympanic membrane ★ Hair and wax glands are situated on the wall	The hair and secretions of the wax glands prevent the entry of external substanes like dust insects and girms.
Tympanic membrane	★ A delicate membrane	Vibrates according to the sound waves entering the ear
Auditory ossicles	★ Articulated to one another ★ Acts as a system of levers	Vibrations received from the tympanic membrane are intensified and transmitted to the inner ear
Eustachian tube	★ A narrow tube through which the middle ear opens into the pharynx ★ The end close to the pharynx is often closed (it opens up during yawing or when swallowing something)	Acts to equalise the pressure existing inner to the tympanic membrane to the atmospheric pressure.
Cochlea	★ Takes the shape of a snail shell ★ Inside filled with a fluid and has sound receptors ★ The auditory nerve arises from the cochlea	The fluid inside vibrates due to the vibrations reweived from the auditory ossicles. Accordingly impulses arise in the sound receptors.
Auricular atrial apparatus	★ Consists of three tubes placed at right angles to each other (semi circular tubes) ★ Nerve fibres arising from this join the audotory nerve	Helps in maintaining the equilibrium of the body
Auditory nerve	★ Consists of nere fibres arising from sound receptors	Carries the impulses received from the sound receptors to the brain

Table 13.5 - Parts of the human ear and their functions.

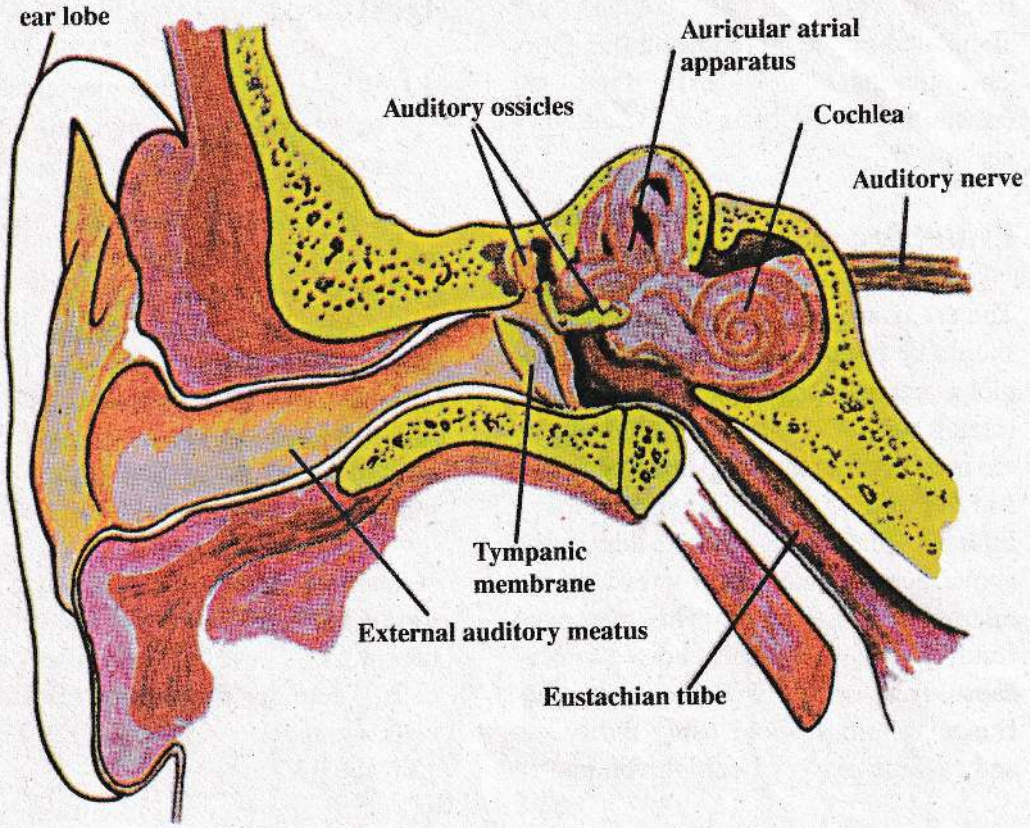


Figure 13.15 - Internal structure of the human ear

Questions

1. Indicate by means of a flow chart the manner in which the sensations regarding a sound wave entering the external auditory meatus are transmitted to the brain.

2. Why do ear of a person, climbing up a mountain or coming down a mountain get 'locked'.

3. State two types of treatment that could be given to a person, whose ears have got locked to escape from it.

4. State a reason that may be a cause of an ear ache in a person who has contacted a cold.

How do we hear?

You have now identified the path traversed by an impulse arising from a sound wave. A sound wave directed by the ear lobe, to the external auditory meatus makes the air inside vibrate.

These vibrations are transmitted across the tympanic membrane and auditory ossicles respectively to the fluid contained in the cochlea. The sound

receptor cells in the cochlea are stimulated by the vibrations in this fluid. The impulses that arise then are transmitted to the brain by the auditory nerve.

Protection of the ear

The ear is an important sense organ that should be protected. The insertion of ear picks, match sticks and hair pins to scratch the ear or remove wax from the ear may damage the tympanic membrane and the wall of the auditory meatus. The infection of wounds formed during the above actions may even spread to the internal parts of the ear. This may even result in deafness. Intense noise too may cause, harm to the tympanic membrane. Hence we must avoid using radio sets and cassette players at a high volume.

Questions

1. Why is it that certain medicines used as a remedy for infections of the middle ear, are made to be inhaled through the nose?

The Nose

The nose helps us to identify smells. It should not be forgotten that many other important functions too are carried out by it. Here we will consider as to how the nose functions as a sensory organ.

Actually the alfactory cells situated in the top of the nasal cavity are the olfactory receptors. These are modified nerve cells. There are two groups of olfactory cells within the two nostrils. (See Figures 13.6 and 13.7).

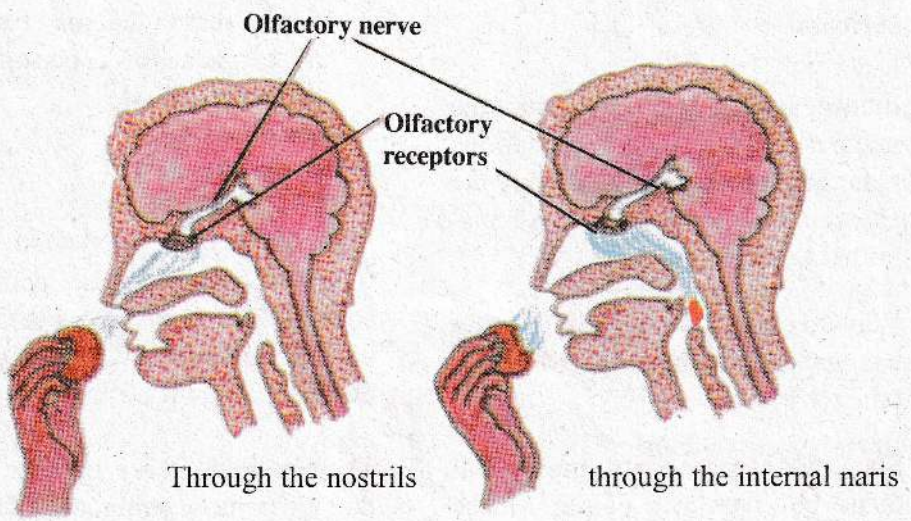


Figure 13.16 - The manner in which the smell of food influences the olfactory situated on the top of the nasal cavity.

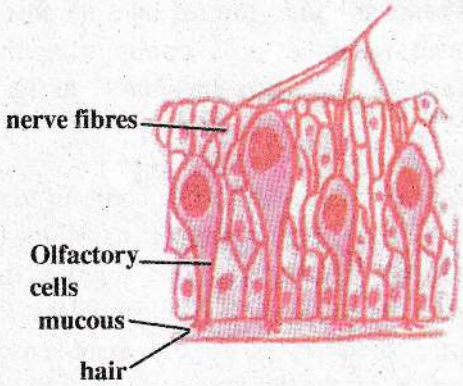


Figure 13.17 - A vertical section of a group of olfactory receptors. The delicate hairs situated at the end of the nasal cavity region and the manner in which they are embedded in he mucous.

How is a smell sensed or felt?

Only certain substances given out volatile substances that is capable of stimulating the olfactory receptors. Only a very minute amount of a scented substance is necessary to stimulate the olfactory receptors. This means, the smell threshold is extremely low. When the hairs in the olfactory cells are stimulated by the volatile substances given out from a scented substance. The resulting is sent through the nerve impulses to the olfactory nerve. These impulses, on been sent to the relevant sensory area of the brain, identifies the smell.

Do you know?

The olfactory senses in most animals are very strongly developed. The sensation of smell in dogs is sharper than that of humans. This is why, dogs are used to catch criminals.

The Tongue

The tongue is the organ that helps to identify taste. There are 4 primary tastes sensed or felt by the tongue.

- ★ Sweet taste
- ★ Salt taste
- ★ Sour taste
- ★ Bitter taste

These tastes mix in various proportions giving various tastes. You have seen your mother tasting with the tip of her tongue a little amount of curry, taken to the palm of her hand. She does this to test whether the salt content in it is sufficient. Can there be a special reason for testing, for salt with the tip of the tongue? Even if you wash your mouth after a bitter medicine. You will feel the bitter taste at the base of your tongue for a long time. What is the reason for this?

Assignment 6

Suggest an activity to investigate how the various regions of the tongue are sensitive to the primary tastes. Experiment it.

Record your observations in a suitable way.

Compare your activity with those of others in the class.

Questions

1. What are the important things you should pay attention to when doing this activity?
2. What are the inferences you arrive at?

How is taste felt?

Using a mirror, examine the surface of the tongue. You will be able to see a number of protrusions on it. Taste receptors known as taste buds are present on these protrusions. With the help of figure 13.18 identify how a taste bud is composed.

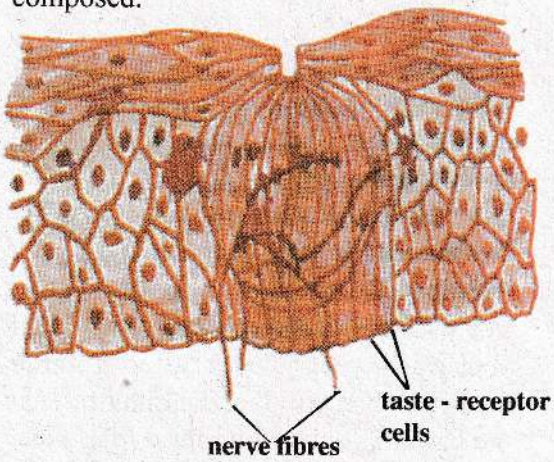


Figure 13.18 - A vertical section of a taste bud.

The taste bud is formed by a number of taste receptor cells coming together. Taste-sensory hairs are situated at the tip of taste-receptor cells.

When certain substances come in touch with the taste sensitive hairs in the various regions of the tongue they become stimulated. The impulses that arise then travel to the taste-sensory region of the brain where the relevant sense is felt.

Questions

1. When you drink tea, immediately after eating sweet meats, the tongue will not feel the sweetness of the tea. What is the reason for this?
2. Why it is that one does not feel one's own body smell?

Do you know?

- ★ The sensitivity to taste is not the same in various individuals. The reason for this being the fact that they have various taste threshold values.
- ★ A grown up person has about 10,000 taste buds and a child has a little more than this. It has been found that as one grows older the taste buds decrease.
- ★ Taste buds may get damaged due to hot food or very acidic or alkaline food.

★ When this taste-receptors and the smell-receptors receive the same stimulus continuously one may not feel the taste or smell. This is known as receptor adaptation. The reason for this been the decrease or complete stoppage of the rate at which the impulses of the taste receptors and smell receptors are sent.

5. The Skin

The skin is the tissue that covers the body. It is also the largest organ in the body. A variety of functions are performed by the skin. We will now consider as to how the skin performs as a sense organ.

Earlier you identified that the skin can receive five sensations namely touch, pain, pressure, warmth and cold. The nerve endings or receptors relevant to these sensations are located in the layer known as the dermis. Figure 13.19 show the various parts of the skin.

Impulses arising in the particular receptors due to a stimulus are carried to the relevant areas in the brain where the sensation is recognized.

Non-nervous coordination

Non-nervous coordination takes place due to the chemical substances known as hormones. Hormones are produced in the endocrine glands. Hormones are released direct to the blood from which they are carried to the relevant places and co-ordination brought about. The hormone

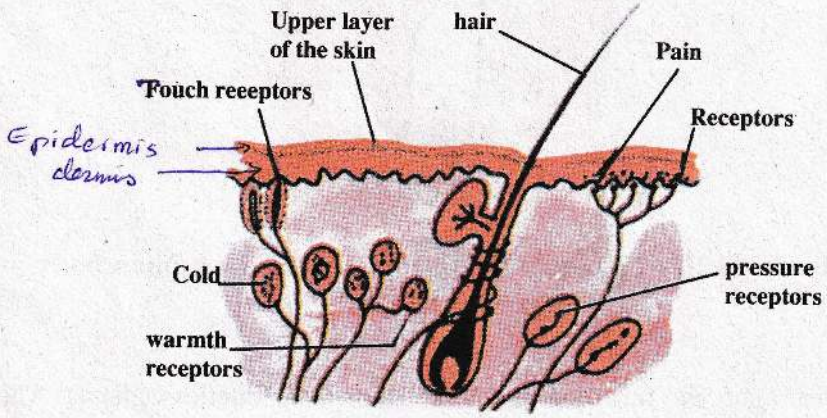


Figure 13.19 - A vertical section of the skin.

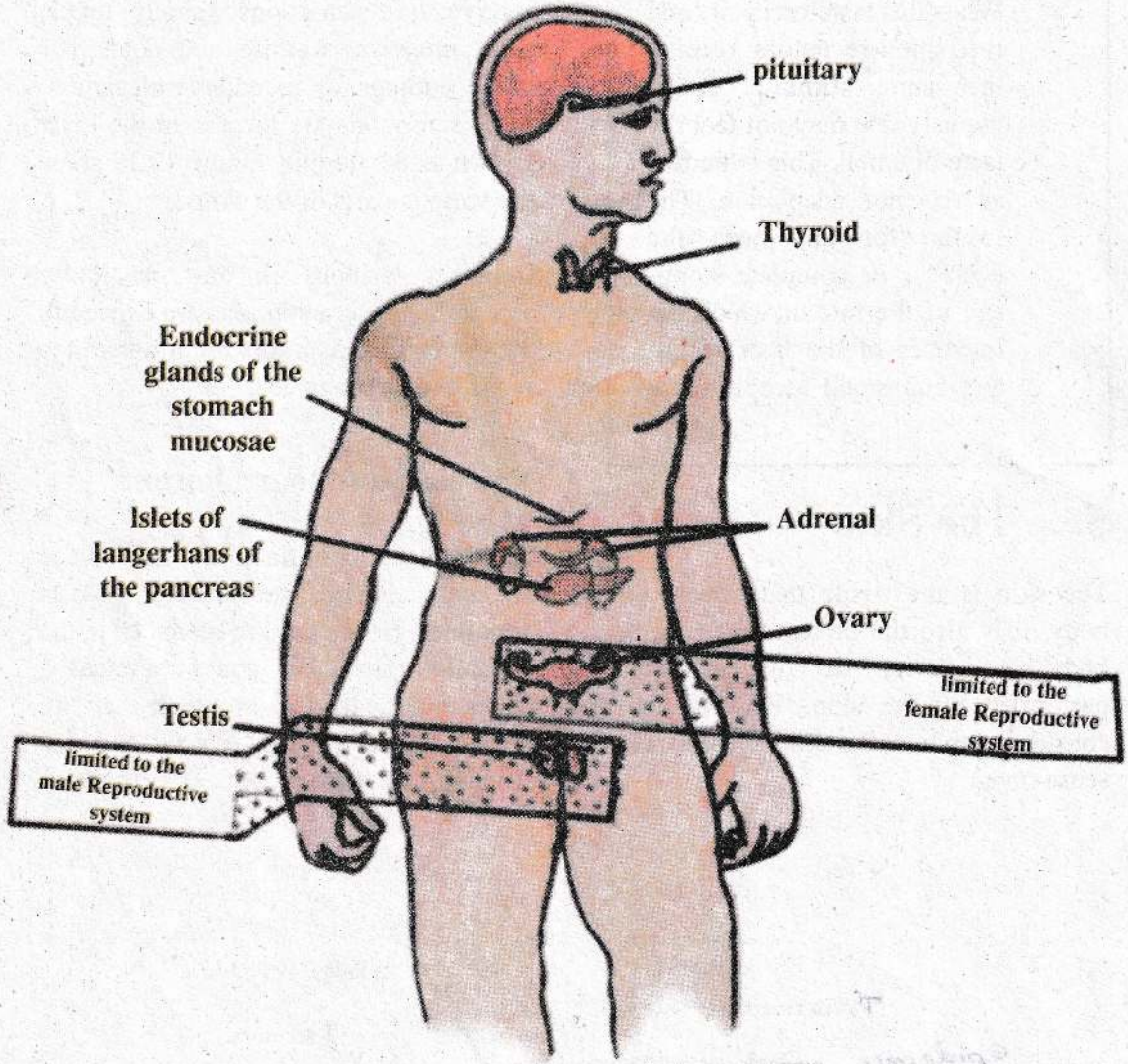


Figure 13.20 - The main ductless glands of the human body.

gets destroyed once its functioning is over. As the secretions of the endocrine glands are released direct to the blood stream they are ductless. Hence they are known as ductless glands. The human body contains a large number of ductless glands. Identify a few of them from figure 13.20.

The ductless gland	Hormone produced	Influence of the hormone
Pituitary	Somato tropin (growth hormone)	Controls the growth of the body. Reduction of this during childhood may produce dwarfs and an excess secretion may produce giants. In adults when secreted in excess may bring about an abnormal growth of parts such as the nose, face, hands, feet and fingers (Figure 13.21)
Thyroid	Thyroxin	* Reduction causes simple goitre (Figure 13.20) * Excess secretion causes goitre thyroid (Figure 13.24)
Adrenal gland	Adrenaline	Prepares the body to act during an emergency (Figure 13.24)
Islets of langerhans	Insulin	* Maintains the glucose level of the blood constant
Certain cells of the testis	Testosterone	* Controls the secondary sex characters of males
Certain cells of the ovary	Oestrogen	* Controls the secondary sex characters of women

Table 13.6 - A few ductless glands, the hormones secreted by them and their functions

(a)

Increase in the secretion of the growth hormone during childhood results in gigantism and decrease in the secretion of this hormone brings about dwarfing.

(b)

An increased secretion of the growth hormone of an adult brings about an unnatural growth of the face and nose.

Figure 13.21

Figure 13.22 - Simple goitre due to deficiency of thyroxine.

Figure 13.23 - Goitre, resulting from excess thyroxine secretion is not conspicuous but the eyes enlarge and protrude forwards.

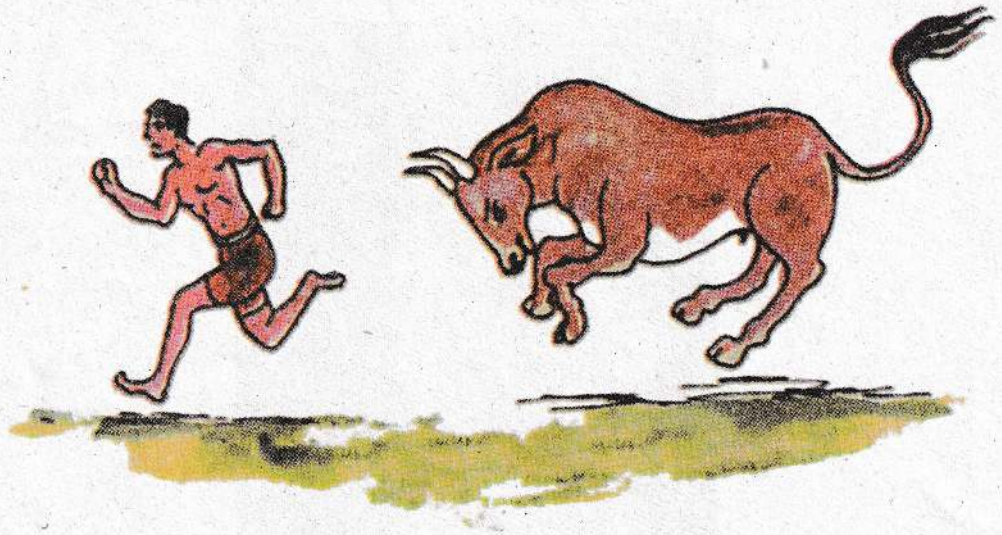


Figure 13.24 - Thanks to adrenaline!
received the strength to save his life due to adrenaline.

Do you know?

An individual requires a very small amount of iodine for a day. The amount required for a life time is less than a teaspoon. However the influence it has on the individual is immense. The daily requirement of iodine is fulfilled by the crops growing in the soil. However when the iodine content in the soil is reduced the amount of iodine in the crops too is lessened.

Simple goiter is common among people living in mountainous regions. This is due to the deficiency in iodine in the crops as a result of the iodine in the soil being removed due to soil erosion. People consuming sea weeds and sea fish get sufficient iodine.

Assignment 7

Collect information about iodine deficiency using the booklet, "what you should know about iodine deficiency diseases," distributed by the Health Education Bureau to schools or any other books.

1. What is the importance of selecting salt as a remedy for iodine deficiency?

2. What are the main things that one should follow when using iodine's and salt?

What is meant by the internal environment of the body?

The environment around the body cells is the internal environment of the body. The tissue fluid around the body cells and the blood plasma around the blood cells make up the internal environment of the body. The tissue fluid is the blood plasma that has diffused out from the blood capillaries. The tissue fluid differs from the plasma being free from proteins.

What is homeostasis?

The composition of the internal environment should be kept constant to a great extent in order to keep the body cells and the blood cells alive and for their proper functioning.

The maintenance of the internal environment in a constant state is known as homeostasis. The maintenance of homeostasis of a particular factor in the internal environment is known as regulation.

How is the temperature of the internal environment regulated?

The normal temperature of the human body is 37°C. This is the optimum temperature at which all the chemical processes responsible for the maintenance of the human body are carried out well. If the body temperature rises up or comes down to a great extent the individual may die. The body temperature too changes according to the temperature of the external environment. However the body adjusts itself to this and maintains the temperature at a constant level. The chart below indicates in brief the actions taken by the body for this purpose.

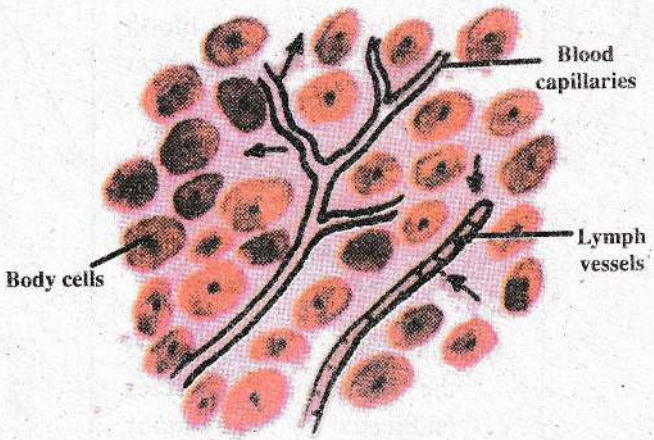
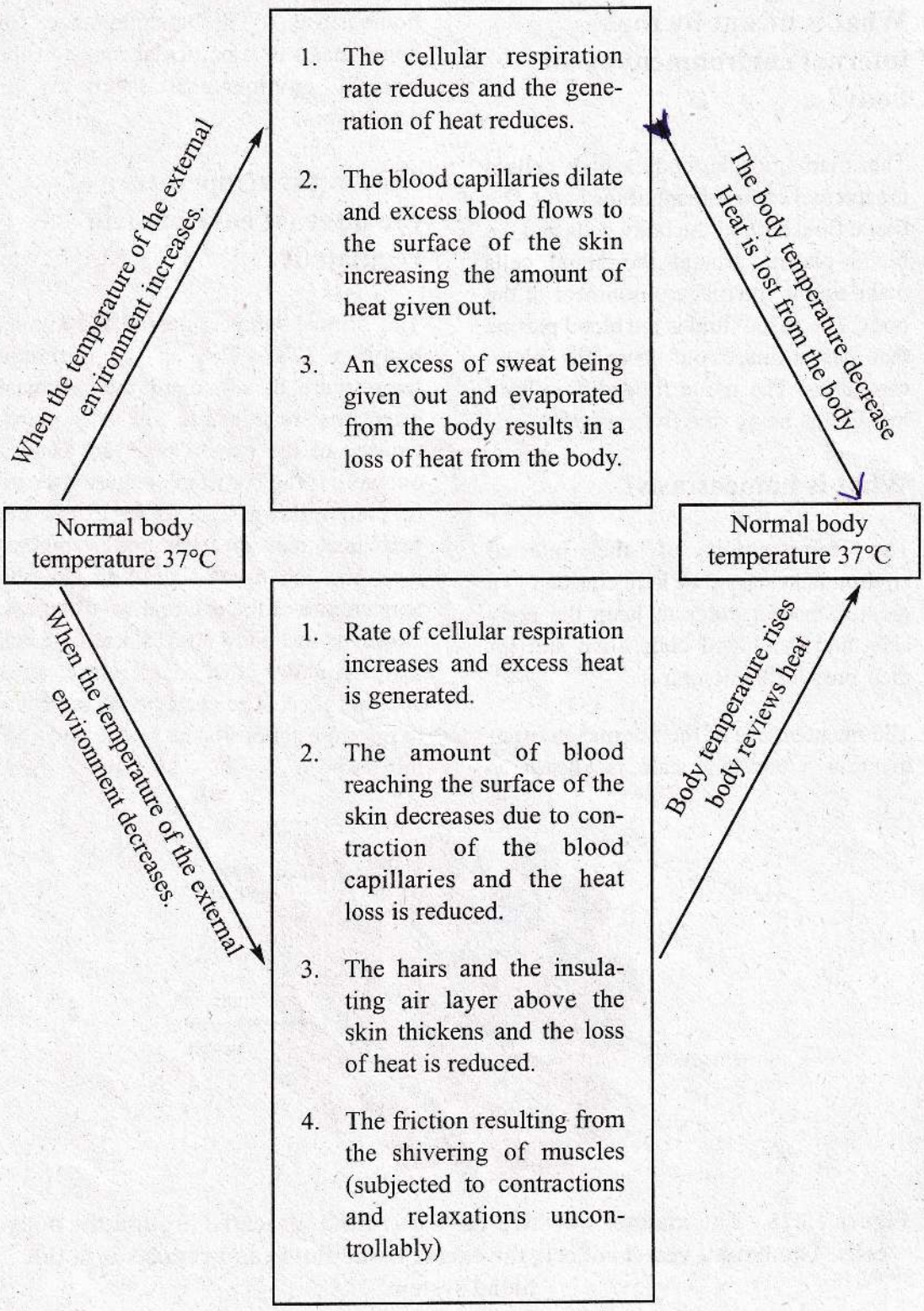


Figure 13.25 - The manner in which the tissue fluid is located around the body cells. The lymph vessel collects the excess tissue fluids and returns it to the blood system.


1. The cellular respiration rate reduces and the generation of heat reduces.
2. The blood capillaries dilate and excess blood flows to the surface of the skin increasing the amount of heat given out.
3. An excess of sweat being given out and evaporated from the body results in a loss of heat from the body.
When the temperature of the external environment increases.
The body temperature decrease Heat is lost from the body
Normal body temperature 37°C
Normal body temperature 37°C
When the temperature of the external environment decreases.
Body temperature rises body reviews heat
1. Rate of cellular respiration increases and excess heat is generated.
2. The amount of blood reaching the surface of the skin decreases due to contraction of the blood capillaries and the heat loss is reduced.
3. The hairs and the insulating air layer above the skin thickens and the loss of heat is reduced.
4. The friction resulting from the shivering of muscles (subjected to contractions and relaxations uncontrollably)

When the external environment cools, the reduction in the loss of heat due to the contraction of blood capillaries and increase in heat generation as a result of the increase of cellular respiratory rate is brought about by the secretion of excess adrenaline from the adrenal gland.

The above mechanism takes place when the environmental temperature rises or goes down slightly. However the body is unable to adjust itself to high fluctuations in the environmental temperature.

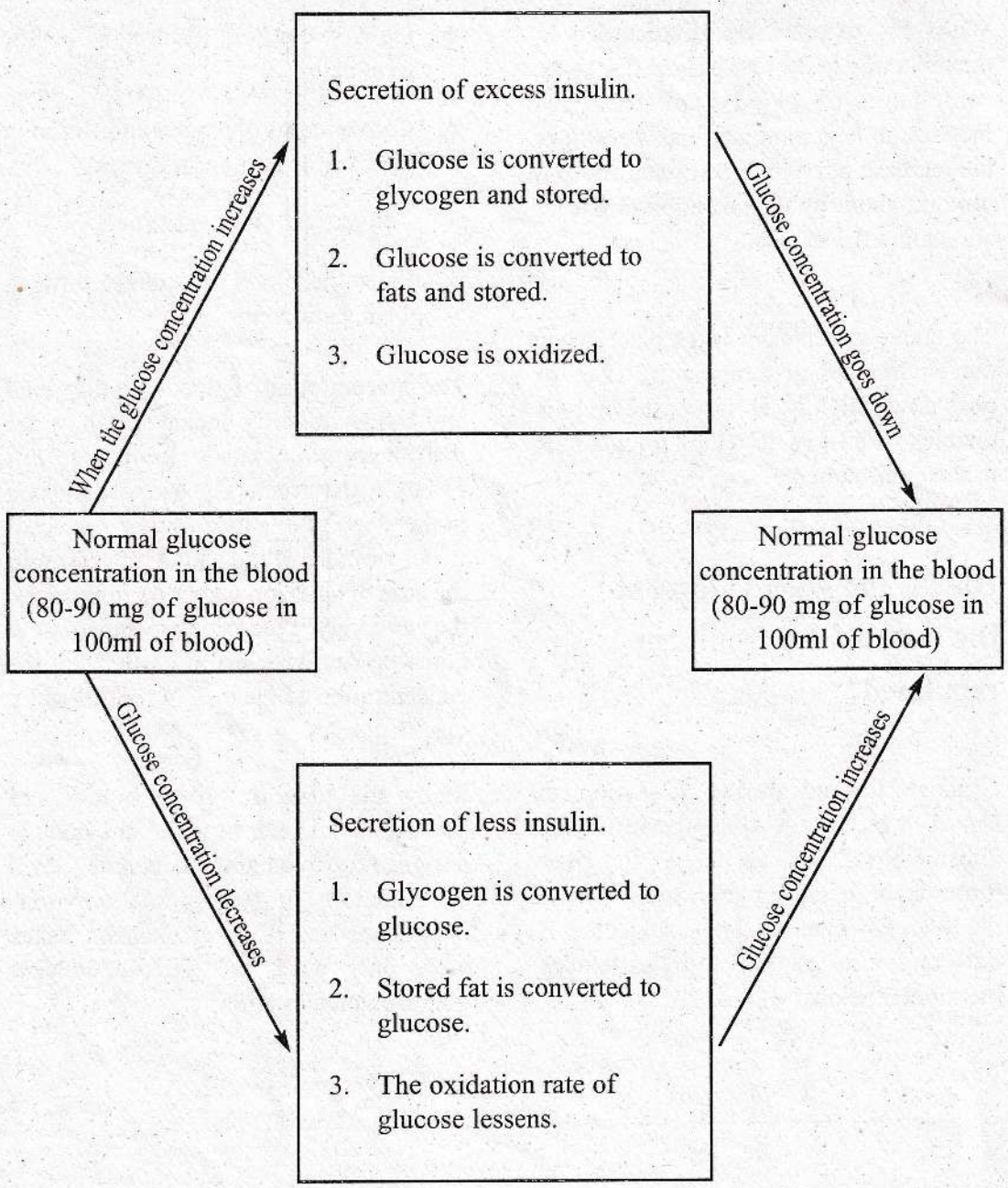
How is the glucose level of the internal environment regulated?

Glucose formed during digestion is absorbed by the blood capillaries in the intestinal wall and carried to the liver through the hepatic portal vein. Within the liver, this glucose can be subjected to one or more of the four processes mentioned below.

- ★ Utilised for the respiration of the liver cells.
- ★ Converted to glycogen and stored in the liver or in other tissues.
- ★ Converted to fat, and stored.
- ★ Enter the blood circulation through the hepatic vein.

The concentration of glucose in the blood and tissue fluids is decided on how far the above processes take place. For example, the excess glucose that adds on to the blood after a meal can be subjected to one or more of the above processes. In the case of a person who remains hungry, the stored glycogen is being converted to glucose. You have learnt earlier that the concentration of glucose is controlled by insulin.

Study the diagram given below and identify the manner in which the body is designed to maintain the glucose level concentration of the internal environment constant. This mechanism takes place only when the glucose concentration fluctuates slightly.



Questions

1. Administering excess insulin to the body can bring about fatal results. Why is this?
2. Why is it that people living in very cold regions should consume on excess amount of food?

How is the concentration of water regulated?

The increase in the concentration of salt in the blood is equal to the decrease in the water concentration. The secretion of excess of the hormone ADH from the pituitary increases the excretion of salts from the kidneys while the amount of water that is given out from the body along with urine becomes less. By this means the water in the body is preserved.

Really speaking, controlling the water - balance in the body means the controlling of the salt concentration of the blood.

How do plants respond towards stimuli?

In assignment 2, on investigations about other organisms that respond towards stimuli, recall again about the plants that responded towards stimuli.

Activity 4

1. Arrange a setup such that light falls only from one side, on some 'mung' seedlings planted in a yoghurt cup. Keep such a setup for about 24 hours and observe the changes that took place in the mung seedlings.

2. Layout a thick layer of cotton wool on the vertical surfaces of a block of wood such that it will not fall off. Keep this on a trough of water such that the cotton wool will be kept moist. With the help of pens fix some 'mung' seedlings such that their young leaves and roots are directed towards various directions and keep for a few days. Find out the directions to which the roots and stem grow.

3. Select a plant like passion fruit which has tendrils. Select a tendril that has not started coiling and while it is fixed to the plant rub slowly on one side below its tip. Observe what happens after doing this for a few minutes.

4. Select 3-4 mimosa plants in which the leaves have not drooped.

   i. Touch the leaves of one plant.

   ii. Bring a candle flame near the leaves of another plant.

   iii. Hold ammonia gas to the leaves of another plant.

   Record your observations.

5. Observe carefully, the behaviour of the leaves of a few plants like Katuru-murunga (Sesbania), Albizzia and Thora and record your results.

6. Select a plant grown in a glass box such that its roots could be observed and keep a small clay vessel containing water on a side of the roots. Keep this for about 7-8 days and observe and record the behaviour of the roots (here the plant should get water only from the clay vessel).

Activity	Plant / plant part	Stimulus reviewed	Plant / plant part response shown
1	'Mung' seedlings	light	stem grows towards light
2	'Mung' seedlings - - stem root	 gravity gravity	
3	Passion fruit tendril	touch	
4	Mimosa leaves	i. touch ii. heat iii. chemicals	
5	Sesbania (Katuru murunga) Thora / Albizzia leaves	darkness	
6	Roots of a mung seedling	water	

Questions

1. What are the stimuli to which plants respond?

Observations made on activity 4 shows that plants respond to stimuli namely light, touch, heat, water gravity and chemical substances. In many of these responses the cause for the movements that took place in the plant parts were mainly the hormones produced in the plants. It has been found that plants too can produce hormones like animals.

The practical use of plant hormones

Indole acitic acid (IAA) and Indole butric acid are two plant hormones belonging to the oxene group. The artificial production of hormones and their productive use in cultivation and horticulture is very common.

They are used as,

1. Weedicides.
2. For the rooting of cuttings.
3. To get flowers and fruits quickly.
4. To get flowers and fruits during off season.
5. To prevent the fall of leaves and fruits off season.
6. To reduce plant growth (when obtaining dwarf plants.

Summary

- ★ Like animals, plants too respond to stimuli.
- ★ The receptors and effectors are connected by the nervous system.
- ★ The neurone is the building unit of the nervous system.
- ★ The brain and spinal cord belong to the central nervous system.
- ★ The peripheral nervous system is made up of 31 pairs of spinal nerves and 12 pairs of cranial nerves.
- ★ The impulses rewieved from the receptors are sorted out and sent to the relevant effectors to bring about responses, by the central nervous system.
- ★ The brain and spinal cord are protected by a skeletal covering and a meninge membrane.
- ★ The brain shows a division of labour.
- ★ Reflex actions are a short term co-ordination type that helps in saving a life or a body organ.
- ★ Some reflex actions are controlled by the brain and some reflex actions are controlled by the spinal cord.
- ★ Receptors for vision are situated in the eye.
- ★ Receptors for hearing as well as a balancing organ of the body are situated in the ear.
- ★ Receptors for smell are situated in the nose and the receptors for taste are located in the tongue.
- ★ Five types of receptors, namely those for touch, pressure, warmth, cold and pain are located in the skin.
- ★ Non-nervous coordination takes places by hormones produced by ductless glands.
- ★ The secretions of the ductless glands control various activities of the body.
- ★ Maintenance of the internal environment of the body in a constant state is known as homeostasis.
- ★ The body has the Ability to adapt itself to regulate the factors that influence the maintenance of homeostasis.
- ★ Many plant-movements take place due to the influence of plant hormones.
- ★ Man has been able to produce plant hormones artificially and use them productively.

Now you should be able to

- ★ Distinguish among stimuli, responses, receptors and effectors.
- ★ Explain the manner in which impulses are transmitted from receptors to effectors.
- ★ Identify the structure and functions of the central nervous system.
- ★ Explain the importance of a reflex action and a reflex arc.
- ★ Explain the structure, functions and safety of the sense organs.
- ★ Explain the manner in which the non-nervous co-ordination of the human body takes place and the influence of a few ductless glands.
- ★ Describe how the body temperature, glucose concentration and water are regulated.
- ★ Identify the responses shown by plants towards stimuli.
- ★ Identify instances where plant hormones are used practically.

Science and Technology - Grade 10

Glossary

Chapter 1 - Force and Motion

Acceleration	- ත්වරණය	- ஆர்முடுகல்
Accelerator	- ත්වරකය	- ஆர்முடுக்கி
Action	- ක්‍රියාව	- தாக்கம்
Axis	- අක්ෂය	- அச்சு
Brake	- තිරිංගය (රෝධකය)	- தடுப்பு
Capillary tube	- කේශික නළය	- மயிர்த்துளைக்குழாய்
Compression balance	- සම්පීඩන තරාදිය	- நெருக்கற் தராசு
Couple of forces	- බල යුග්මය	- விசையிணை
Direction	- දිශාව	- திசை
Displacement	- විස්ථාපනය	- இடப்பெயர்ச்சி
Force	- බලය	- விசை
Friction	- ඝර්ෂණය	- உராய்வு
Fritional force	- ඝර්ෂණ බලය	- உராய்வு விசை
Gradient	- ආක්‍රමණය	- படித்திறன்
Graph	- ප්‍රස්ථාරය	- வரைபு
Inclination	- ආනතිය	- சாய்வு
Inclined plane	- ආනත තලය	- சாய்தளம்
Magnitude	- විශාලත්වය	- பருமன்
Mass	- ස්කන්ධය	- திணிவு
Mechanics	- යාන්ත්‍ර විද්‍යාව	- பொறியியல்
Motion	- චලිතය	- இயக்கம்
Multiflash/ Stroboscopic photograph	- සැණෙලි ඡායාරූපය	- பல்பளிச்சீட்டு ஒளிப்படம்/ சுழனிலைக்காட்டி
Newton's laws	- නිව්ටන් නියමය	- நியூற்றனின் விதிகள்
Push	- තල්ලුව	- தள்ளுகை
Quantity	- ප්‍රමාණය	- கணியம்
Reaction	- ප්‍රතික්‍රියාව	- மறுதாக்கம்
Reading	- පාඨාංකය	- வாசிப்பு
Retardation	- මන්දනය	- அமர்முடுகல்
Scalar quantity	- අදිශ රාශිය	- எண்ணிக்கணியம்
Speed	- වේගය	- கதி
Speedometer	- වේගමානය	- கதிமானி

Spring balance	- දුනු තරාදිය	- விற்றராசு
Standard unit	- සම්මත ඒකකය	- நியம அலகு
Stop cock	- විරාම කරාමය	- குழாயடைப்பு
Thrust	- තෙරපුම	- உதைப்பு
Time interval	- කාල ප්‍රාන්තරය	- நேர ஆயிடை
Trapezium	- ත්‍රිපිසියම	- சரிவகம்
Trolley	- ට්‍රොලිය	- துரொல்லி
Uniform Speed	- ඒකාකාර වේගය	- சீரானகதி, சீர்க்கதி
Uniform velocity	- ඒකාකාර ප්‍රවේගය	- சீரானவேகம், சீர்வேகம்
Vector Quantity	- දෛශික රාශිය	- காவிக்கணியம்
Velocity	- ප්‍රවේගය	- வேகம்
Weight	- බර	- நிறை

Chapter 2 - Work and energy

Acceleration due to gravity	- ගුරුත්වජ ත්වරණය	- ஈர்ப்பினாலான ஆர்முடுகல்
Appliance	- උපාංගය	- சாதனம்
Axle	- අක්ෂ දණ්ඩ	- அச்சாணி
Ball bearing	- බෝල බෙයාරිම	- குண்டுப்போதிகை
Beaker	- බීකරය	- முகவை
Bunsen burner	- බන්සන් දහකය	- பன்சன் சுடரடுப்பு
Burner	- දහකය	- சுடரடுப்பு
Calculator	- ඝනකය/කැල්කියුලේටරය	- கணிப்பான்
Chemical energy	- රසායනික ශක්තිය	- இரசாயனச் சக்தி
Combustion	- දහනය	- தகனம்
Conduction of heat	- තාප සන්නයනය	- வெப்பக்கடத்தல்
Conductivity	- සන්නායකතාව	- கடத்தாறு
Conductor	- සන්නායකය	- கடத்தி
Conservation of energy	- ශක්ති සංස්ථිතිය	- சக்திக் காப்பு
Convection	- සංවහනය	- உடன்காவுகை
Density	- ඝනත්වය	- அடர்த்தி
Efficiency	- කාර්යක්ෂමතාව	- திறன்
Effort	- ආයාසය	- எத்தனம்
Electric cell	- විද්‍යුත් කෝෂය	- மின்கலம்
Electric Current	- විද්‍යුත් ධාරාව	- மின்னோட்டம்
Electricity	- විද්‍යුතය	- மின்

Endless belt	- නොනිමි පටිය	- அந்தமில்வார்
Endless Chain	- නොනිමි දම්වැල්	- அந்தமில்சங்கிலி
Energy	- ශක්තිය	- சக்தி
Fuel	- ඉන්ධන	- எரிபொருள்
Gear system	- ගියර් පද්ධතිය	- கியர்த்தொகுதி
Generator	-ජනකය	- பிறப்பாக்கி
Heat	- තාපය	- வெப்பம்
Heating coil	- තාපන දඟරය	- வெப்பமாக்கும் சுருள்
Immersion heater	- ගිල්වුම් තාපකය	- அமிழ்ப்பு வெப்பமாக்கி
Internal energy	- අභ්‍යන්තර ශක්තිය	- அகச்சக்தி
Isolated system	- ඒකලිත පද්ධතිය	- தனியாக்கிய தொகுதி
Kinetic energy	- චාලක ශක්තිය	- இயக்கப்பாட்டுச்சக்தி
Land breeze	- ගොඩ සුළං	- தரைக்காற்று
Load	- භාරය	- சுமை
Lubricant	- ස්නේහකය	- மசகு
Machine	- යන්ත්‍රය	- பொறி
Matter	- පදාර්ථය	- சடப்பொருள்
Nuclear energy	- න්‍යෂ්ටික ශක්තිය	- கருச்சக்தி
Nuclear fission	- න්‍යෂ්ටික පිපිරීම	- கருப்பிளவு
Particle	- අංශුව	- துணிக்கை
Pedal	- පාදිකය	- மிதிப்படி
Percentage efficiency	- ප්‍රතිශත කාර්යක්ෂමතාව	- சதவீதத்திறன்
Point of application	- උපයෝගී ලක්ෂ්‍යය	- பிரயோகப்புள்ளி
Potential energy	- විභව ශක්තිය	- அழுத்தச்சக்தி
Power	- ජවය,	- வலு
Pulley	- කප්පිය	- கப்பி
Radiation	- විකිරණය	- கதிர்ப்பு
Radiator	- විකිරකය	- கதிர்த்தி
Radioactive element	- විකිරණශීල මූලද්‍රව්‍යය	- கதிர்த்தொழிற்பாட்டு மூலகம்
Rate	- ශීඝ්‍රතාව	- வீதம்
Ratio	- අනුපාතය	- விகிதம்
Roller bearing	- රෝලර් බෙයාරිම	- உருளிப் போதிகை
Roughness	- රළු බව	- கரடுமை
Sea breeeze	- මුහුදු සුළං	- கடற்காற்று
Sensation	- සංවේදනය	- உணர்ச்சி, புலனுணர்வு
Smooth	- සුමට	- ஒப்பமான

Solar energy	- සූර්යශක්තිය	- ஞாயிற்றுச்சக்தி, சூரியசக்தி
Solar panel	- සූර්ය පත්‍රය	- ஞாயிற்றுப் படல்
Sound	- ධ්වනිය, ශබ්දය	- ஒலி
Source of energy	- ශක්ති ප්‍රභවය	- சக்தி முதல்
Source of heat	- තාප ප්‍රභවය	- வெப்பமுதல்
Specific heat capacity	- විශිෂ්ට තාප ධාරිතාව	- தன்வெப்பக் கொள்ளளவு
Spiral spring	- සර්පිල දුන්න	- சுருளிவில்
Steam turbine	- හුමාල ටර්බයිම	- கொதிநீராவிச் சுழலி
Syringe	- සිරින්ජය	- புகுத்தி
Temperature	- උෂ්ණත්වය	- வெப்பநிலை
Toothed wheel	- දැති රෝදය	- பற்சில்லு
Transformation of energy	- ශක්ති පරිවර්තනය	- சக்தி நிலைமாற்றம்
Transformer	- පරිණාමකය	- நிலைமாற்றி
Transmission	- සම්ප්‍රේෂණය	- ஊடுகடத்தல்
Vibration	- කම්පනය	- அதிர்வு
Winding key	- එතුම් යතුර	- சுற்றும் சாவி
Work	- කාර්යය	- வேலை

Chapter 3 - Cells and Tissues

Absorption area	- අවශෝෂණ ප්‍රදේශය	- அகத்துறிஞ்சும் பிரதேசம்
Active absorption	- සක්‍රීය අවශෝෂණය	- உயிர்ப்புள்ள அகத்துறிஞ்சல்
Active transport	- සක්‍රීය පරිවහනය	- உயிர்ப்புள்ள கொண்டுசெல்லல்
Adaptation	- අනුවර්තනය	- இசைவாக்கம்
Aquatic plant	- ජලරුහ ශාක	- நீர்வாழ்தாவரம்
Axon	- අක්සනය	- வெளிக்காவு நரம்புமுளை
Biceps muscle	- ද්විශීර්ෂ පේශිය	- இருதலைத்தசை
Bleeding	- රුධිරය ගැලීම	- குருதிவடிதல்
Blood clot	- රුධිර කැටිය	- குருதிஉறைதல்
Blood plasma	- රුධිර ප්ලාස්මාව	- குருதித்திரவவிழையம்
Brain	- මොළය	- மூளை
Branching	- ශාකනය වීම, අතු බෙදීම	- கிளைகொள்ளல்
Building unit	- කැනුම් ඒකකය	- அமைப்பலகு
Condy's solution	- කොන්ඩිස් ද්‍රාවණය	- கொண்டிசுக்கரைசல்
Cardiac muscle tissue	- හෘත් පේශී පටකය	- இதயத்தசை இழையம்
Cell body	- සෛල දේහය	- கலவுடல்
Cell membrane	- සෛල පටලය	- கலமென்சவ்வு

Cell sap	- සෛල යුෂය	- கலச்சாறு
Cell wall	- සෛල බිත්තිය	- கலச்சுவர்
Cell	- සෛලය	- கலம்
Celluar respiration	- සෛලීය ශ්වසනය	- கலச்சுவாசம்
Cellulose	- සෙලියුලෝස්	- செலுலோசு
Central nervous system	- මධ්‍ය ස්නායු පද්ධතිය	- மையநரம்புத் தொகுதி
Cheek cell	- කොපුල් සෛලය	- கன்னக்கலம்
Cholorophyll	- හරිතප්‍රද	- குளோரோபில், பச்சையம்
Chloroplast	- හරිතලවය	- பச்சையவுருமணி
Chromosome	- වර්ණදේහය	- நிறமூர்த்தம்
Concentration	- සාන්ද්‍රණය	- செறிவு
Conducting tissue	- සන්නායක පටකය	- கடத்துமிழையம்
Constriction	- සංකුචනය	- சுருக்கு
Contraction	- සංකෝචනය	- சுருங்குதல்
Cross section	- හරස්කඩ	- குறுக்குவெட்டு
Cytoplasm	- සෛල ප්ලාස්මය	- குழியவுரு
Dendrite	- අනුශාඛිකාව	- உட்காவு நரம்புமுளைக்கிளை
Dendron (Dendrite)	- අනුශාඛිකාව	- உட்காவு நரம்புமுளை
Diffusion	- විසරණය	- பரவல்
Dilatation	- විස්තාරණය / ඉහිල්වීම	- தளர்தல்
Division of labour	- ශ්‍රම විභජනය	- தொழிற்பகுப்பு
Electron microscope	- ඉලෙක්ට්‍රෝන අණ්වීක්ෂය	- இலத்திரன் நுணுக்குக்காட்டி
Endosmosis	- අන්තරාස්‍රැතිය	- அகப்பிரசாரணம்
Epidermal tissue	- අපිචර්මීය පටකය	- மேற்றோல் இழையம்
Epidermis	- අපිචර්මය	- மேற்றோல்
Exosmosis	- බාහිරාස්‍රැතිය	- புறப்பிரசாரணம்
Feeding	- භක්ෂණය	- உணவூட்டல்
Function	- කෘත්‍යය	- தொழில்
Gene	- ජානය	- பரம்பரையலகு
Germ	- විෂබීජය	- கிருமி
Gland	- ග්‍රන්ථිය	- சுரப்பி
Guard cells	- පාලක සෛල	- காவற்கலம்
Homoiothermic	- අවලතාපී	- ஒருசீர்வெப்பத்துக்குரிய
Impulse	- ආවේගය	- கணத்தாக்கம்
Intermediate neuron	- අතරමැදි නියුරෝනය	- இடைநரம்புக்கலம்
Involuntary muscle	- අනිච්ඡාතුග පේශිය	- இச்சையின்றி இயங்கும் தசை

Mammal	- ක්ෂීරපායියා	- முலையூட்டி
Mechanical tissue	- යන්ත්‍රාරක පටකය	- தாங்கும் இழையம்
Metabolic activity	- පරිවෘත්තීය ක්‍රියාව	- அனுசேபச் செயற்பாடு
Mitochondrium	- මයිටොකොන්ඩ්‍රියම	- இழைமணி
Motor nerve	- චාලක ස්නායුව	- இயக்க நரம்பு
Multicellular	- බහු සෛලීය	- பல்கலமுள்ள
Muscle fibre	- පේශි තන්තුව	- தசைநார்
Myelin sheath	- මයිලින් කොපුව	- மயலின் கவசம்
Nerve endings	- ස්නායු කෙළවර	- நரம்பு முனைகள்
Neuroglia	- නියුරොග්ලියාව	- நரம்புப்பசையிழையம்
Neurone (nerve cell)	- ස්නායු සෛලය	- நரம்புக்கலம் (நியுரோன்)
Nitrogenous waste	- නයිට්‍රජනීය අපද්‍රව්‍ය	- நைதரசன் கழிவு
Nucleus	- නෘෂ්ටිය	- கரு
Onion peel	- ලූණු සිවිය	- வெங்காய உரிப்பு
Organ	- අවයවය	- அங்கம்
Organelle	- ඉන්ද්‍රියිකාව	- புன்னங்கம்
Organism	- ජීවියා	- அங்கி
osmosis	- ආස්‍රැනිය	- பிரசாரணம்
Perepheral nervous system	- පර්යන්ත ස්නායු පද්ධතිය	- சுற்றயல் நரம்புத்தொகுதி
Permeable	- පාරගම්‍ය	- ஊடுபுகவிடக்கூடிய
Phenomenon	- සංසිද්ධිය	- தோற்றப்பாடு
Plastid	- ලවය	- உருமணி
Platelet	- පට්ටිකාව	- சிறுதட்டுகள்
Salivary gland	- බේට ග්‍රන්ථිය	- உமிழ்நீர்ச்சுரப்பி
Secretion	- ස්‍රාවය	- சுரப்பு
Selectively permeable	- වරණ පාරගම්‍ය	- தேர்ந்துபுகவிடும்
Semipermeable	- අර්ධ පාරගම්‍ය	- ஒருபங்கூடுபுகவிடும்
Sensory nerve	- සංවේදක ස්නායුව	- புலன்நரம்பு
Sense organ	- සංවේදී අවයවය	- புலனங்கம்
Shape	- හැඩය	- வடிவம்
Skeletal muscle tissue	- කංකාල පේශි පටකය	- வன்கூட்டுத்தசை இழையம்
Skeletal muscle	- කංකාල පේශිය	- வன்கூட்டுத்தசை
Smooth muscle tissue	- සිනිදු පේශීය පටකය	- மழமழப்பான தசையிழையம்
Soil water	- පාංශු ජලය	- மண்ணீர்
Spatula	- පත්ත	- துடுப்பு
Species	- විශේෂය	- இனம்

Spinal cord	- සුෂුම්නාව	- முண்ணான்
Stoma	- පුටිකාව	- இலைவாய்
Striated muscle	- විලිඛිත පේශිය	- வரித்தசை
Structure	- ව්‍යුහය	- கட்டமைப்பு
Synapse	–උපාගමය	- நரம்பிணைப்பு
Thistle funnel	- තිසල් පුනිලය	- முள்ளிப்புனல்
Tissue	- පටකය	- இழையம்
Triceps muscle	- ත්‍රිශීර්ෂ පේශිය	- முத்தலைத்தசை
Unicellular	- ඒක සෛලික	- தனிக்கலமுள்ள
Unstriated muscle	- නිර්විලිඛිත පේශිය	- வரிகொள்ளாத் தசை
Vacuole	- රික්තකය	- புன்வெற்றிடம்
Visceral muscle	- අන්තරංග පේශිය	- உடலகத்தசை
Voluntary muscle	- ඉච්ඡාකෘත පේශිය	- இச்சையுள்தசை
Wood	- කාෂ්ඨය	- வைரம்
Zerophytes	- ශුෂ්ක ශාක	- வறணிலத்தாவரம்

Chapter 4

Anhydrous	- නිර්ජලීය	- நீரற்ற
Adhesive force	- ආසක්ත බලය	- ஒட்டற்பண்புவிசை
Air space	- වාත අවකාශය	- வளியிடைவெளி
Apex	- අග්‍රස්ථය	- உச்சி
Ascent of sap	- රසෝද්ගමනය	- சாற்றேற்றம்
Bark ring	- පොතු වලය	- மரவுரி வளையம்
Capillary attraction force	- කේශා කර්ෂන බලය	- மயிர்த்துளைக்கவர்ச்சி விசை
Cladode	- ස්කන්ධාභය	- இலைத்தொழிற்றண்டு
Cohesive Force	- සංසක්ත බලය	- பிணைவு விசை
Companion cell	- සහචර සෛලය	- துணைக்கலம்
Control experiment	- පාලක පරීක්ෂණය	- கட்டுப்பாட்டுப் பரிசோதனை, - ஆளுகைப் பரிசோதனை
Cortex	- බාහිකය	- மேற்பட்டை
Cuticle	- උච්චර්මය	- புறத்தோல்
Epidermis	- අපිචර්මය	- மேற்றோல்
Guttation	- බින්දූදය	- கசிவு
Humidity	- ආර්ද්‍රතාව	- ஈரப்பதன்
Inter cellular space	- අන්තර් සෛලීය අවකාශය	- கலத்திடைவெளி
Medulla	- මජ්ජාව	- மையவிழையம்
Palisade cell	- ඉති සෛලය	- வேலிக்காற்கலம்

Parenchyma cell	- මෘදුස්තර සෛලය	- புடைக்கலவிழையக்கலம்
Pericycle	- පරිචක්‍රය	- பரிவட்டவுறை
Petal	- දල පත්‍රය (මල් පෙත්ත)	- அல்லி
Potometer	- පානමානය	- உறிஞ்சன்மானி
Root hair cell	- මූල කේශ සෛලය	- வேர்மயிர்க்கலம்
Root pressure	- මූල පීඩනය	- வேரமுக்கம்
Scleren chyma	- දෘඩස්තරය	- வல்லருக்கலவிழையம்
Spongy tissue	- සච්චර පටකය	- கடற்பஞ்சு இழையம்
Stele	- ස්ථූනය	- கம்பம்
Transpiration	- උත්ස්වේදනය	- ஆவியுயிர்ப்பு
Transpiration pull	- උත්ස්වේදන ඵුෂණය	- ஆவியுயிர்ப்பு ஈர்ப்பு
Visceral muscle	- අන්තරංග පේශිය	- உடலகத்தசை
Xylem vessel	- ශෛලම වාහිනිය	- காழ்க்கலன்

Chapter 5

Atom	- පරමාණුව	- அணு
Atomic model	- පරමාණුක ආකෘතිය	- அணுமாதிரியுரு
Atomic number	- පරමාණුක ක්‍රමාංකය	- அணுவெண்
Atomic structure	- පරමාණුක වූහය	- அணுக்கட்டமைப்பு
Atomic weight	- පරමාණුක භාරය	- அணுநிறை
Boiling point	- තාපාංකය	- கொதிநிலை
Boiling tube	- කැකැරුම් නලය	- கொதிகுழாய்
Charged particle	- ආරෝපිත අංශුව	- மின்னேற்றப்பட்ட துணிக்கை
Combustion tube	- දහන නලය	- தகனக்குழாய்
Compound	- සංයෝගය	- சேர்வை
Crystal	- ස්ඵටිකය	- பளிங்கு
Decomposition	- වියෝජනය	- பிரிகையடைதல்
Dissolve	- ද්‍රවණය කරනවා	- கரை
Electron	- ඉලෙක්ට්‍රෝනය	- இலத்திரன்
Electronic configeration	- ඉලෙක්ට්‍රෝන වින්‍යාසය	- இலத்திரன் நிலையமைப்பு
Element	- මූලද්‍රව්‍ය	- மூலகம்
Energy level	- ශක්ති මට්ටම	- சக்திப்படி
Filter paper	- පෙරහන් කඩදාසිය	- வடிகட்டித்தாள்
Filtrate	- පෙරෙනය	- வடிதிரவம்
Flame	- දැල්ල	- சுவாலை
Freeging point	- හිමාංකය	- உறைநிலை
Heterogeneous	- විෂමජාතිය	- பல்லினமான

Homogeneous	- සමජාතීය	- ஏகவினமான
Ignition tube	- ඒවලන නලය	- எரிகுழாய்
Isotope	- සමස්ථානික	- சமதானி
Mass number	- ස්කන්ධ ක්‍රමාංකය	- திணிவெண்
Melting point	- ද්‍රවාංකය	- உருகுநிலை
Mixture	- මිශ්‍රණය	- கலவை
Negative charge	- සෘණ ආරෝපණය	- மறையேற்றம்
Neutral	- උදාසීන	- நடுநிலையான, நொதுமலான
Neutron	- නියුට්‍රෝනය	- நியூத்திரன்
Nucleus	- නාෂ්ටිය	- கரு
Positive charge	- ධන ආරෝපණය	- நேரேற்றம்
Proton	- ප්‍රෝට්‍රෝනය	- புரோத்தன்
Quick lime	- පිළිස්සූ හුණු	- நீறாத சுண்ணாம்பு
Residue	- අවශේෂය	- மீதி
Slaked lime	- දියගැසූ හුණු	- நீறிய சுண்ணாம்பு
Stirrer	- මත්ථය	- கலக்கி
Sub-atomic particle	- උප පරමාණුක අංශුව	- உப அணுத்துணிக்கை
Vapourisation	- වාෂ්පීකරණය	- ஆவியாக்கல்
Volatile	- වාෂ්පශීල	- ஆவிப்பறப்புள்ள

Chapter 6 - Compounds from Elements

Aqueous	- ජලීය	- நீர்சார்
Assumption	- උපකල්පනය	- எடுகோள்
Balanced chemical equation	- තුලිත රසායනික සමීකරණය	- சமன்படுத்திய இரசாயனச் சமன்பாடு
Bond	- බන්ධනය	- பிணைப்பு
Carbon rod	- කාබන් කූර	- காபன்கோல்
Chemical formula	- රසායනික සූත්‍රය	- இரசாயனச் சூத்திரம்
Chemical reaction	- රසායනික ප්‍රතික්‍රියාව	- இரசாயனத்தாக்கம்
Circuits	- පරිපථය	- சுற்று
Component	- සංඝටකය	- கூறு
Co-valent bond	- සහ සංයුජ බන්ධනය	- பங்கீட்டுவலுப்பிணைப்பு
Diamond	- දියමන්තිය	- வைரம்
Double bond	- ද්විත්ව බන්ධනය	- இரட்டைப் பிணைப்பு
Dry cell	- වියළි කෝෂය	- உலர்கலம்
Electron pair	- ඉලෙක්ට්‍රෝන යුගලය	- இலத்திரன் சோடி
Electrovalent bond	- විද්‍යුත් සංයුජ බන්ධනය	- மின்வலுப்பிணைப்பு
Experiment	- පරීක්ෂණය	- பரிசோதனை

Filament	- සූත්‍රිකාව	- இழை
Fused	- විලීන	- உருக்கிய
Graphite	- මිනිරන්	- காரீயம்
In parallel	- සමාන්තරගත	- சமாந்தரமாக
In series	- ශ්‍රේණිගත	- தொடராக
Inert gas	- නිෂ්ක්‍රිය වායුව	- சடத்துவ வாயு
Ion	- අයනය	- அயன்
Ionic bond	- අයනික බන්ධනය	- அயன்பிணைப்பு
Noble gas	- උච්ච වායුව	- விழுமிய வாயு
Observation	- නිරීක්ෂණය	- அவதானிப்பு, நோக்கல்
Organic solvent	- කාබනික ද්‍රව්‍ය	- சேதனக் கரைப்பான்
Product	- ඵලය	- விளைவு, விளைபொருள்
Radical	- මූල්වකය	- மூலிகம்
Reactant	- ප්‍රතික්‍රියකය	- தாக்கி
Reactivity	- ප්‍රතික්‍රියාකාරීත්වය	- தாக்குதிறன்
Room temperature	- කාමර උෂ්ණත්වය	- அறைவெப்பநிலை
Spark of fire	- ගිනි පුපුර, ගිනි පුළිඟුව	- தீப்பொறி
Stable	- ස්ථායී	- உறுதியான
Triple bond	- ත්‍රිත්ව බන්ධන	- மும்மைப்பிணைப்பு
Uni co-valent bond	- ඒක සහසංයුජ බන්ධන	- ஒரு பங்கீட்டு வலுப்பிணைப்பு
Unstable	- අස්ථායී	- உறுதியற்ற
Valency	- සංයුජතාව	- வலுவளவு
Volume	- පරිමාව	- கனவளவு

Chapter 7 - Transporation of materials in Human

Alimentary canal	- ආහාර මාර්ගය	- உணவுக்கால்வாய்
Amino acid	- ඇමිනෝ අම්ලය	- அமினோவமிலம்
Anaemia	- නිරක්තිය	- குருதிச்சோகை
Antibody	- ප්‍රතිදේහය	- பிறபொருளெதிரி
Aorta	- මහා ධමනිය	- பெருநாடி
Arm pit	- තිහිල්ල	- கக்கம்
Arteriole	- ධමනිකාව	- புன்னாடி
Atrial systole	- කර්ණිකා ආකුංචය	- இதயக்கூடச் சுருக்கம்
Atrium	- හෘත් අලින්දය	- கூடம்
Auricle	- හෘත් කර්ණිකාව	- இதயச் சோணை
Auriculo ventricular septam	- හෘත් කර්ණික/කෝෂික ආවාරය	- இதயச்சோணைஅறைப் பிரிசுவர்
Basophill	- බේසොපිල	- மூலநாடி

Biconcave	-ද්වි අවතල	- இருகுழிவான
Bicuspid valve	- ද්විතුණ්ඩ කපාටය	- இருகூர்வால்வு
Byproduct	- අතුරුඵලය	- பக்கவிளைபொருள்
Bleeding	- රුධිර වහනය	- குருதிப்பெருக்கு
Blood clotting	- රුධිර කැටි ගැසීම	- குருதி உறைதல்
Blood glucose	- රුධිරගත ග්ලූකෝස් ප්‍රමාණය	- குருதிக் குளுக்கோசு
Blood group	- රුධිර ගණය	- குருதி இனம்
Blood plasma	- රුධිර ප්ලාස්මාව	- குருதித்திரவவிழையம்
Blood pressure	- රුධිර පීඩනය	- குருதியமுக்கம்
Blood smear	- රුධිර අඳුන	- குருதிப்பூச்சு
Blood transfusion	- රුධිර පාරවිලයනය	- குருதி குறுக்குப் பாய்ச்சல்
Bone marrow	- ඇට මිදුලුව	- என்புமச்சை
Bone	- අස්ථිය	- என்பு
Cancer	- පිළිකාව	- புற்றுநோய்
Capillary	- කේශ නාලිකාව	- மயிர்த்துளை
Cardiac diastole	- හෘත් විස්තාරය	- இதயவிரிவு
Centrifuge	- කේන්ද්‍රාපසරණය	- மையநீக்கி, மையநீக்கு
Corpuscle	- දේහාණුව	- சிறுதுணிக்கை
Diastole	- විස්තාරය	- விரிவு
Diastolic pressure	- විස්තාර පීඩනය	- விரிவமுக்கம்
Disc shaped	- මණ්ඩලාකාර	- வட்டத்தட்டு வடிவமுள்ள
Double blood circulation	- ද්විත්ව රුධිර සංසරණය	- இரட்டைக் குருதிச்சுற்றோட்டம்
Elastic	- ප්‍රත්‍යාස්ථ	- மீள்தன்மையுள்ள
Electrocardiogram	- විද්‍යුත් හෘතුක රේඛය	- மின்னிதயவரையம்
Endocrine gland	- අන්තරාසර්ග ග්‍රන්ථිය	- அகஞ்சுரப்பி
Eosinophil	- ඉයොසිනොපීල	- இயோசீனாடி
Expiration	- ප්‍රශ්වාසය	- வெளிச்சுவாசம்
Fatty acid	- මේද අම්ලය	- கொழுப்பமிலம்
Fluid tissue	- තරලමය පටකය	- பாய்ம இழையம்
Folic acid	- පෝලික් අම්ලය	- போலிக்கமிலம்
Glandular swelling	- (කුද්දටිය) ග්‍රන්ථි ප්‍රදහය	- சுரப்பிவீக்கம்
Groin	- ඉකිලිය	- கவடு
Heart beat	- හෘත් ස්පන්දනය	- இதயஅடிப்பு
Heart	- හෘදය	- இதயம்
Infection	- ආසාදනය	- தொற்று
Inferior vena cava	- අපරමහා ශිරාව	- கீழ்ப்பெருநாளம்

Inspiration	- ආශ්වාසය	- உட்சுவாசம்
Jaundice	- කාමලාව, සෙංගමාලය	- செங்கண்மாரி
Kidney	- වකුගඩුව, වෘක්කය	- சிறுநீரகம்
Lactcal	- පයෝලස නාලිකාව	- பாற்சிறுகுழாய்
Limb	- ගාත්‍රය	- அவயவம்
Liver	- අක්මාව	- ஈரல்
Lung	- පෙනහැල්ල, පුප්ඵුසය, ක්ලෝමය	- நுரையீரல்
Lymph	- වසා	- நிணநீர்
Lymphatic duct	- වසා ප්‍රණාලය	- நிணநீர்க்கான்
Lymphatic gland	- වසා ග්‍රන්ථිය	- நிணநீர்ச்சுரப்பி
Lymphatic system	- වසා පද්ධතිය	- நிணநீர்த்தொகுதி
Lymphatic vessel	- වසාවාහිනිය	- நிணநீர்க்கலன்
Lymphocyte	- වසා සෛලය	- நிணநீர்க்குழியம்
Mechanism	- යන්ත්‍රණය	- பொறிமுறை
Mineral salt	- ඛණිජ ලවණය	- கனியுப்பு
Mitral valve	- මයිට කපාටය	- மைற்ரல் வால்வு
Monocyte	- මොනොසයිටය	- ஒற்றைக்குழியம்
Neutrophil	- නියුට්‍රොෆිල	- நடுநிலைநாடி
Oxygenated blood	- ඔක්සිජනීකෘත රුධිරය	- ஒட்சிசனேற்றப்பட்ட குருதி
Pace maker	- කන්තුක ගතිකරය	- இதயமுடுக்கி
Pigment	- වර්ණකය	- நிறப்பொருள்
Pituitary gland	- පිටියුටරි ග්‍රන්ථිය	- கபச்சுரப்பி
Pulmonary vein	- පුප්ඵුශීය ශිරාව	- சுவாசப்பை நாளம்
Pulse	- නාඩි වැටීම	- துடிப்பு
Erythrocyte Sedimentation Rate	- රතු රුධිරාණු අවසාදන වේගය	- செங்குழிய அடையல் வீதம்
R.A.T.E. (E.S.R)		
Rhesus (Rh) factor	- රීසස් සාධකය	- Rh காரணி
Sedimentation	- අවසාදනය	- அடையல்
Semilunar valve	- අඩසඳ කපාටය	- அரைமதி வால்வு
Skin	- සම	- தோல்
Slide	- කදාව	- வழுக்கி
Small intestine	- කුඩා අන්ත්‍රය	- சிறுகுடல்
Sterilization	- ජීවාණුහරණය	- கிருமியழித்தல்
Stethoscope	- වෙද නලාව	- உடலொலிபெருக்கிக் காட்டி
Stimulus	- උත්තේජය	- தூண்டல்
Sub clavian vein	- අධෝක්ෂ ශිරාව	- காறையென்புக் கீழ்நாளம்

Suction	- චූෂණය	- உறிஞ்சல்
Superior vena cava	- උත්තර මහා ශිරාව	- மேற்பெருநாளம்
Systolic pressure	- ආකුංචිය පීඩනය	- சுருங்கலமுக்கம்
Sweat	- ශ්වේදය, ඩහදිය	- வியர்வை
Systole	- ආකුංචය	- சுருக்கம்
Thoracic caval vein	-උරස් මහා ශිරාව	- நெஞ்சறைப் பெருநாளம்
Thoracic cavity	- උරස් කුහරය	- நெஞ்சறைக்குழி
Thoracic duct	- උරස් ප්‍රණාලය	- நெஞ்சறைக்கான்
Thyroid gland	- තයිරොයිඩ ග්‍රන්ථිය	- கேடயப்போலிச் சுரப்பி, தைரொயிட்டுச் சுரப்பி
Tissue fluid	- පටක තරලය	- இழையப் பாய்மம்
Tricuspid valve	- ත්‍රිකුණ්ඩ කපාටය	- முக்கூர்வால்வு
Tuberculosis	- ක්ෂයරෝගය	- கயரோகம்
Universal donor	- සාර්වදායකයා	- பொதுவழங்கி
Universal recipient	- සාර්ව ප්‍රතිග්‍රාහකයා	- பொதுவாங்கி
Valve	- කපාටය	- வால்வு
Ventricle	- කෝෂිකාව	- இதயவறை
Ventricular systole	- හෘත් කෝෂික ආකුංචය	- இதயவறைச் சுருக்கம்
Venule	- අනු ශිරාව	- புன்னாளம்
Viscosity	- දුස්ස්‍රාවිතාව	- பிசுக்குமை
White blood corpuscle (Leucocyte)	- (ශ්වේතාණුව) සුදු රුධිරාණු	- வெண்குருதிச் சிறுதுணிக்கை (வெண்குழியம்)

Chapter 8 - Classification of Elements

Change	- විපර්යාසය	- மாற்றம்
Classification	- වර්ගීකරණය	- பாகுபாடு
Extraction	- නිස්සාරණය	- பிரித்தெடுப்பு
Group number	- කාණ්ඩ අංකය	- கூட்டஎண்
Group	- කාණ්ඩය	- கூட்டம்
Metal	- ලෝහය	- உலோகம்
Non metal	- අලෝහය	- அல்லுலோகம்
Orbit	- කාක්ෂිකය	- மண்டிலம்
Outermost energy level	- අවසාන ශක්ති මට්ටම බාහිර ශක්ති මට්ටම	- புறச்சக்திப்படி
Period number	- ආවර්ත අංකය	- ஆவர்த்தன எண்
Period	- ආවර්තය	- ஆவர்த்தனம்
Periodic table	- ආවර්තිතා වගුව	- ஆவர்த்தன அட்டவணை
Shell	- කවචය	- ஓடு

Chapter 9 - Photosynthesis

Alcohol	- මද්‍යසාර	- அற்கஹோல்
Asparagus	- හාතාවාරිය	- சாத்தாவாரி
Autotroph	- ස්වයංපෝෂිතය	- தற்போசணி
Benedict solution	- බෙනඩික්ට් ද්‍රාවණය	- பெனடிற்றின் கரைசல்
Cactus	- පතොක් වර්ග	- கள்ளி
Cover slip	- වැසුම් පෙත්ත	- மூடித்துண்டு
Extract	- නිස්සාරිකය	- பிரித்தெடு
Forceps	- ඩැහි අඩුව	- சாவணம்
Funnel stem	- පුනීල දණ්ඩ	- புனல்தண்டு
Green plant	- හරිත ශාකය	- பச்சைநிறத்தாவரங்கள்
Heterotroph	- විෂම කෝෂිකයා	- பிறபோசணி
Hypothesis	- උපකල්පනය	- கருதுகோள்
Leaf vein	- පත්‍ර නාරටිය	- இலைநரம்பு
Monosaccaride	- මොනොසැකරයිඩ, සරලසීනි	- ஒருசக்கரைட்டு
Mortar and pestle	- වංගෙඩිය සහ සහ මොහොල	- உரலும் உலக்கையும்
Nutrient	- පෝෂකය	- போசணைக் கூறு
Optimum	- ප්‍රශස්ත	- உத்தமம்
Organic compound	- කාබනික සංයෝගය	- சேதனச்சேர்வை
Photosynthesis	- ප්‍රභා සංශ්ලේෂණය	- ஒளித்தொகுப்பு
Phyllotaxis	- පත්‍ර වින්‍යාසය	- இலையொழுங்கு
Pith	- බඩය, මජ්ජාව	- மையவிழையம்
Prism	- ප්‍රිස්මය	- அரியம்
Raw material	- අමු ද්‍රව්‍ය	- மூலப்பொருள்
Sacculent	- මාංශල	- சதைப்பிடிப்பான
Scale	- පරිමාණය	- அளவிடை
Set up	- ඇටවුම	- ஒழுங்கமைப்பு
Solar energy	- සූර්ය ශක්තිය	- சூரியசக்தி, ஞாயிற்றுச்சக்தி
Spirit lamp	- ස්ප්‍රීතු ලාම්පුව	- மதுசார விளக்கு
Starch	- පිෂ්ටය	- மாப்பொருள்
Store	- සංචිත කරනවා	- சேமி
Synonym	- පර්යාය පදය, සමාන පදය	- ஒத்தசொல், ஒத்தகருத்துள்ள சொல்
Tripod	- තෙපාව	- முக்காலி
Wire gauze	- කම්බි දැල	- கம்பிவலை

Chapter 10 - Electric current

Absolute zero	- නිරපේක්ෂ ශූන්‍යය	- தனிப்பூச்சியம்
Adjusment	- සිරුමාරු කිරීම	- செப்பஞ்செய்கை
Aerial	- ඇහැසිය / ගුවන් කම්බිය	- வானி, மின்னலைக்கம்பி
Alternating current	- ප්‍රත්‍යාවර්ථ ධාරාව	- ஆடலோட்டம்
Ammeter	- ඇම්මීටරය	- அம்பியர்மானி
Armature	- ආමේචරය	- ஆமேச்சர்
Attraction	- ආකර්ශණය	- கவர்ச்சி
Accessory	- උපාංගය	- துணைக்கருவி
Axis of rotation	- භ්‍රමණ අක්ෂය	- சுழற்சி அச்சு
Beam	- කදම්බය	- கற்றை
Brush	- ඇතිල්ල	- தூரிகை
Capacitor	- ධාරිත්‍රකය	- கொள்ளளவி
Cathode ray oscilloscope	- කැතෝඩ කිරණ දේලනේක්ෂය	- கதோட்டுக்கதிர் அலைவுகாட்டி
Cathode ray tube	- කැතෝඩ කිරණ නලය	- கதோட்டுக்கதிர்க்குழாய்
Centre zero galvanometer	- මැද බින්දු ගැල්වනොමීටරය	- மையப்பூச்சிய கல்வனோமானி
Circuit diagram	- පරිපථ රූප සටහන	- சுற்றுவரிப்படம்
Closed circuit	- සංවෘත පරිපථය	- மூடிய சுற்று
Coil	- දඟරය	- சுருள்
Condenser	- කොන්ඩෙන්සරය/ සංසනීකාරකය	- ஒடுக்கி
Conductor	- සන්නායකය	- கடத்தி
Connecting wire	- සම්බන්ධක කම්බිය	- தொடுக்கும் கம்பி
Core	- මධ්‍යය, හරය, මදය	- அகணி
Crookes tube	- ක්‍රෑක්ස් නලය	- குறுக்ஸ் குழாய்
Cross sectional area	- හරස්කඩ වර්ගඵලය	- குறுக்கு வெட்டுப்பரப்பளவு
Diameter	- විෂ්කම්භය	- விட்டம்
Diode	- ඩියෝඩ/ඩයෝඩය	- இருவாயி
Direct current	- සරල ධාරාව	- நேரோட்டம்
Directly proportional	- අනුලෝමව සමානුපාතික	- நேர்விகித சமனான
Dissection	- විච්ඡේදනය	- வெட்டிச் சோதிப்பு
Drawing pin	- සිත්තම් කටුව	- வரைதல் ஊசி
Earphone	- ඉයර්ෆෝනය	- செவிப்பன்னி
Earth	- බිම්ගැන්වුම	- புவித்தொடுப்பு
Electric current	- විද්‍යුත් ධාරාව	- மின்னோட்டம்
Electric discharge	- විද්‍යුත් විසර්ජනය	- மின்னிறக்கம்

Electric potential	- විද්‍යුත් විභවය	- மின்அழுத்தம்
Electric pulse	- විද්‍යුත් ස්පන්දනය	- மின்துடிப்பு
Electricity	- විද්‍යුතය	- மின்
Element	- මූලද්‍රව්‍යය	- மூலகம்
Equivalent resistance	- සමක ප්‍රතිරෝධකය	- சமவலுத்தடை
Fluorescent tube	- ප්‍රතිදීප්ත නලය	- புளோரொளிர்வுக் குழாய்
Free electron	- නිදහස් ඉලෙක්ට්‍රෝනය	- சுயாதீன இலத்திரன்
Fuse	- විලායකය	- உருகி
Galvanometer	- ගැල්වනොමීටරය	- கல்வனோமானி
Glass rod	- වීදුරු කුර	- கண்ணாடிக்கோல்
Gold leaf electroscope	- ස්වර්ණ පත්‍ර විද්‍යුත් දර්ශකය	- பொன்னிலை மின்காட்டி
Headphone	- හෙඩ්ෆෝනය	- தலைப்பன்னி
Holder	- හෝල්ඩරය	- பிடி
Indirectly proportinal	- ප්‍රතිලෝමව සමානුපාතික	- நேர்மாறு விகித சமனான
Infinity	- අනන්තය	- முடிவிலி
Input	- ප්‍රදානය	- பெய்ப்பு
Instantaneous current	- ක්ෂණික ධාරාව	- கணநிலை மின்னோட்டம்
Insulator	- පරිවාරකය	- காவலி
Light emitting diode	- ආලෝකය විමෝචක ඩයොඩය	- ஒளிகாலும் இருவாயி
Light sensitive diode	- ආලෝක සංවේදී ඩයෝඩය	- ஒளிஉணர் இருவாயி
Load	- භාරය	- சுமை
Loudspeaker	- ශබ්ද විකාශකය/ලවුඩ්ස්පීකරය	- ஒலிபெருக்கி
Magnet	- චුම්බකය	- காந்தம்
magnetic field	- චුම්බක ක්ෂේත්‍රය	- காந்தப்புலம்
Magnetic pole	- චුම්බක ධ්‍රැවය	- காந்த முனைவு
Metal rod	- ලෝහ කුර	- உலோகக்கோல்
Meter	- මීටරය	- மானி
Monitor	- මොනිටරය	- சட்டம்பி
Multimeter	- මල්ටි මීටරය	- பல்மானி
National electricity grid	- ජාතික විදුලි ජාලය	- தேசிய மின்நெய்யரி
Negative terminal	- සෘණ අග්‍රය	- மறைமுடிவிடம்
Neon tester	- නියොන් ටෙස්ටරය	- நியோன் சோதிப்பான்
Ohm's law	- ඕම් නියමය	- ஓமின் விதி
Ohmmeter	- ඕම් මානය	- ஓம்மானி
Output	- ප්‍රතිදානය	- பயப்பு
Permanent resistor	- ස්ථිර ප්‍රතිරෝධකය	- நிலையான தடையி

Pointer	- දර්ශකය/සූචකය	- காட்டி
Positive terminal	- ධන අග්‍රය	- நேர்முடிவிடம்
Potential difference	- විභව අන්තරය	- அழுத்த வித்தியாசம்
Propagation	- ප්‍රචාරණය	- செலுத்துகை
proportion	- සමානුපාතය	- விகிதசமன்
Receiver	- ග්‍රාහකය	- வாங்கி
Repulsion	- විකර්ෂණය	- தள்ளுகை
Resistance	- ප්‍රතිරෝධය	- தடை
Resistivity	- ප්‍රතිරෝධකතාව	- தடைத்திறன்
Resistor wire	- ප්‍රතිරෝධක කම්බිය	- தடையிக்கம்பி
Resistor	- ප්‍රතිරෝධකය	- தடையி
Rheostat	- ධාරා නියාමකය	- இரிய நிறுத்தி, இறையோதற்று
Rotating wheel	- භ්‍රමණ රෝදය	- சுழலும் சில்லு
Screen	- තිරය	- திரை
simple cell	- සරල කෝෂය	- எளிய மின்கலம்
Slip ring	- ඇනිල්ලුම් වළල්ල, ඇනිල්ලුම් මුදුව	- நழுவல் வளையம்
Standard current	- සම්මත ධාරාව	- நியம ஓட்டம்
Standard international unit	- සම්මත අන්තර්ජාතික ඒකකය	- நியம சர்வதேச அலகு
Static electric charge	- ස්ථිති විද්‍යුත් ආරෝපණය	- நிலைமின்னேற்றம்
Super conductor	- සුපිරි සන්නායකය	- மீக்கடத்தி
Supply	- සැපයුම	- வழங்கல்
Switch	- ස්විචිය	- ஆளி
Tester	- ටෙස්ටරය	- சோதிப்பான்
Thunderstorm	- අකුණු කුණාටුව	- இடிமின்னற்புயல்
Transformer	- පරිනාමකය	- நிலைமாற்றி
Transistor	- ට්‍රාන්සිස්ටරය	- திரான்சிற்றர்
Turn of wire	- කම්බි පොට	- கம்பிமுறுக்கு
Vacuum pump	- රික්ත පොම්පය	- வெற்றிடப்பம்பி
Variable resistor	- විචල්‍ය ප්‍රතිරෝධකය	- மாறும் தடையி
Vinegar	- විනාකිරි	- வினாகிரி
Voltage	- වෝල්ටීයතාවය	- வோல்ற்றளவு
Volta pile	- වෝල්ටා පුංජය	- வோல்ற்றா அடுக்கு
Welding	- පැස්සීම	- காய்ச்சியிணைத்தல்
Zero adjusment	- මූලාංකය සිරුමාරු කිරීම	- பூச்சியச் செப்பஞ் செய்கை
Zero point	- මූලාංකය	- பூச்சியப்புள்ளி

Chapter 11 - Effect of Electric Current

Anode	- ඇනෝඩය	- அனோட்டு
Cathode	- කැතෝඩය	- கதோட்டு
Compass	- මාලිමාව	- திசைகாட்டி
Conversion	- පරිවර්තනය	- மாற்றல்
Domestic electric circuit	- ගෘහ විද්‍යුත් පරිපථය	- வீட்டு மின்சுற்று
Effect	- ආචරණය/ඵලය	- விளைவு
Electric cord	- විදුලි රැහැන	- மின்நாண்
Electric heating apparatus	- විද්‍යුත් තාපන උපකරණය	- வெப்பமாக்கல் மின் உபகரணங்கள்
Electro magnet	- විද්‍යුත් චුම්බකය	- மின்காந்தம்
Electro magnetic field	- විද්‍යුත් චුම්බක ක්ෂේත්‍රය	- மின்காந்தப்புலம்
Electrode	- ඉලෙක්ට්‍රෝඩය	- மின்வாய்
Electrolysis	- විද්‍යුත් විච්ඡේදනය	- மின்பகுப்பு
Electrolyte	- විද්‍යුත් විච්ඡේද්‍යය	- மின்பகுபொருள்
Electroplating	- විද්‍යුත් ලේහාලේපනය	- மின்முலாமிடல்
Flemings' s left hand rule	- ප්ලෙමින්ගේ වමත් නීතිය	- பிளெமிங்கின் இடக்கை விதி
Heating effect	- තාපන ඵලය	- வெப்பமாக்கல் விளைவு
Heating element	- තාපන මූලාවයව	- வெப்பமாக்கல் மூலகம்
Insulated	- පරිවෘත්	- காவலிடப்பட்ட
Lines of magnetic force	- චුම්බක බල රේඛා	- காந்தவிசைக்கோடுகள்
Magnetic effect	- චුම්බක ඵලය/චුම්බක ආවාරණය	- காந்த விளைவு
Magnetic strength	- චුම්බක ප්‍රබලතාව	- காந்த வலிமை
Magnetised	- චුම්බකිත	- காந்தமாக்கப்பட்ட
Optimum temperature	- ප්‍රශස්ත උෂ්ණත්වය	- உத்தம வெப்பநிலை
Oscillation	- දෝලනය	- அலைவு
Red hot	- රක්ත තප්ත	- செஞ்சூடான
Soft iron	- මෘදු යකඩ	- மெல்லிரும்பு
Right hand rule	- සුරත් නීතිය	- வலக்கை விதி
Transformation	- පරිනාමණය	- நிலைமாற்றம்
White hot	- ශ්වේත තප්ත	- வெண்சூடான

Amptitude	- විස්තාරය	- வீச்சம்
Bell jar	- සෙෆ්ටා සරාව	- மணிச்சாடி
Block of glass	- වීදුරු කුට්ටිය	- கண்ணாடிக்குற்றி
Clamp	- කලම්ප	- பிடிகருவி
Compression	- සම්පීඩනය	- நெருக்கல்
Convergence	- අභිසරණය	- ஒருங்கல்
Converging beam	- අභිසාරී කදම්බය	- ஒருங்கும்கற்றை
Converging lens	- අභිසාරී කාචය	- ஒருக்கும் வில்லை
Crest	- ශීර්ෂය	- மூடி
Defects of vision	- දෘෂ්ටි දෝෂ	- பார்வைக் குறைபாடுகள்
Deviation	- අපගමනය	- விலகல்
Diminished image	- ඌනිත ප්‍රතිබිම්බය	- உருச்சிறுத்த விம்பம்
Divergence	- අපසරණය	- விரிகை
Diverging beam	- අපසාරී කදම්බය	- விரிகற்றை, விரியும் கற்றை
Diverging lens	- අපසාරී කාචය	- விரிவில்லை
Dust	- දූලි/දුවිලි	- தூசி
Electric bell	- විදුලි සීනුව	- மின்மணி
Emergent ray	- නිර්ගත කිරණය	- வெளிப்படுகதிர்
Enlarged image	- විශාලිත ප්‍රතිබිම්බය	- உருப்பெருத்த விம்பம்
Erect image	- උඩුකුරු ප්‍රතිබිම්බය	- நிமிர்ந்த விம்பம்
Fixed focus camera	- අචල නාභී කැමරාව	- நிலைத்த குவியக் கமரா
Flat surface	- සමතල පෘෂ්ටය	- தட்டையான மேற்பரப்பு
Flute	- බට නලාව	- புல்லாங்குழல்
Focal lenght	- නාභීය දුර	- குவியத்தூரம்
Fog	- ධූමිකා/සහ මීදුම්	- மூடுபனி
Frequency	- සංඛ්‍යාතය	- மீடிறன்
gravitational potential energy	- ගුරුත්වාකර්ෂණ විභව ශක්තිය	- ஈர்ப்பு அழுத்தசக்தி
Hack saw blade	- කියත් තලය	- வெட்டுவாள்
Inciedent ray	- පතන කිරණය	- படுகதிர்
Interface	- අතුරු මුහුණත	- இடைமுகம்
Inverted image	- යටිකුරු ප්‍රතිබිම්බය	- தலைகீழ் விம்பம்
Light	- ආලෝකය	- ஒளி
Longitudinal wave	- අත්වායාම තරංගය	- நெட்டாங்கு அலை
Luminous object	- දීප්ත වස්තුව	- ஒளிர்பொருள்
Mechanical wave	- යාන්ත්‍රික තරංගය	- பொறிமுறை அலை

Mist	- මීදුම	- மென்மூடுபனி
Musical instrument	- සංගීත භාණ්ඩය	- இசைக்கருவி
Musieal scale	- සංගීත ග්‍රාමය	- இசைச் சுரவரி
Natural vibration frequency	- ස්වාභාවික කම්පන සංඛ්‍යාතය	- இயற்கை அதிர்வு மீடிறன்
Note	- ස්වරය	- சுரம்
Optical bench	- ප්‍රකාශ බංකුව	- ஒளியியல் வாங்கு
Paper cone	- කඩදාසි කේතුව	- கடதாசிக் கூம்பு
Parallel beam	- සමාන්තර කදම්බය	- சமாந்தரக்கற்றை
Path	- පථය/මාර්ගය	- பாதை
Pendulum	- අවලම්බය	- ஊசல்
Periodically	- ආවර්තක ලෙස	- ஆவர்த்தனமாக
Pich	- තාරතාව	- சுருதி
Principal focus	- ප්‍රධාන නාභිය	- தலைமைக்குவியம்
Progressive wave	- ප්‍රගමන තරංගය	- விருத்திஅலை
Projector	- ප්‍රක්ෂේපකය	- எறிவை
Rainbow	- දේදුන්න	- வானவில்
Rarefaction	- විරලනය	- ஐமையாக்கம்
Real image	- තාත්වික ප්‍රතිබිම්බය	- மெய்விம்பம்
Reflected ray	- පරාවර්තික කිරණය	- தெறித்தகதிர்
Reflection	- පරාවර්තනය	- தெறிப்பு
Refracted ray	- වර්තන කිරණය	- முறிந்த கதிர்
Refraction	- වර්තනය	- முறிவு
Regular reflection	- සවිධි පරාවර්තනය	- ஒழுங்கான தெறிப்பு
Resonance	- අනුනාදය	- பரிவு
Ripple tank	- රැලිලි වැංකිය	- குற்றலைத் தாங்கி
Ripple	- රැළිත්ත	- குற்றலை
Slinky	- ස්ලින්කිය	- சிலிங்கி
Smoke	- දුම	- புகை
Sound wave	- ධ්වනි තරංගය	- ஒலிஅலை
Sound	- ධ්වනිය, ශබ්දය	- ஒலி
Spectrum	- වර්ණාවලිය	- திருசியம்
Spiral spring	- සර්පිලාකාර දුන්න	- சுருளிவில்
Spring belt	- දුනු පටිය	- வில்வார்
Stroboscope	- භ්‍රමේක්ෂය	- சுழனிலைகாட்டி
Trough	- නිම්නය	- தாழி
Ticker tape	- ටික් පටිය	- திக்கர்நாடா

Ticker timer	- ටික් මුහුර්තකය	- திக்கர் நேரங்காட்டி
Transparent medium	- පාරදෘශ්‍ය මාධ්‍යය	- ஊடுகாட்டும் ஊடகம்
Transverse wave	- තීර්යක් තරංගය	- குறுக்கலை
Tuning fork	- සරශුලය	- இசைக்கவை
Vibration	- කම්පනය	- அதிர்வு
Vibrator	- කම්පකය	- அதிரி
Virtual image	- අතාත්වික ප්‍රතිබිම්බය	- மாயவிம்பம்
Visible light	- දෘශ්‍ය ආලෝකය	- கட்புல ஒளி
Visible spectrum	- දෘශ්‍ය වර්ණාවලිය	- கட்புலத்திருசியம்
Wave length	- තරංග ආයාමය	- அலைநீளம்
Wave motion	- තරංග චලිතය	- அலை இயக்கம்
Wave theory of light	- ආලෝකයේ තරංග වාදය	- ஒளியின் அலைக்கொள்கை
Wave	- තරංගය	- அலை

Chapter 13 - Co - ordination and Homeostasis

Adrenaline	- ඇඩ්‍රිනලින් හෝර්මෝනය	- அதிரீனலீன்
Afferent fibre	- අභිවාහී තන්තු	- உட்காவு நார்
Alfactory nerve	- ආඝ්‍රාණ ස්නායුව	- மணநுகர்ச்சி நரம்பு
Aqueous humour	- අම්මය රසය	- நீர்மயவுடனீர்
Auditory assicles	- ශ්‍රවණ අස්ථිකා	- செவிச்சிற்றென்பு
Auditory nerve	- ශ්‍රවණ ස්නායුව	- செவிநரம்பு
Cell body	- සෛල දේහය	- கலவுடல்
Central canal	- මධ්‍ය නාලය	- மையக்கால்வாய்
Cerebellum	- අනුමස්තිෂ්කය	- மூளி
Cerebral hemisphere	- මස්තිෂ්ක අර්ධගෝලය	- மூளையவரைக்கோளம்
Cerebrum	- මස්තිෂ්කය	- மூளையம்
Cerumen	- කලාදුරු	- குறும்பி
Choroid	- රුධිරග්‍රාහිය	- தோலுரு
Ciliary muscle	- ප්‍රතියෝජක පේශිය	- பிசிர்த்தசை
Cochlea	- කර්ණ ශංඛය	- நத்தைச் சுருள்
Cone cells	- කේතු සෛල	- கூம்புக் கலங்கள்
Connective tissue	- සම්බන්ධක පටකය	- தொடுப்பிழையம்
Co-ordination	- සමායෝජනය	- இயைபாக்கம்
Cornea	- ස්වච්ඡය	- விழிவெண்படலம்
Cranial nerve	- කපාල ස්නායුව	- மண்டையோட்டு நரம்பு
Cranial reflex	- කපාල ප්‍රතීකය	- மண்டையோட்டுத் தெறிவினை

Cranium	- කපාලය	- மண்டையோடு
Dermis	- චර්මය	- உட்டோல்
Dorsal root	- පෘෂ්ඨීය මූලය	- முதுகுப்புறவேர்
Dorsal root ganglion	- පෘෂ්ඨීය මූල ගැංග්ලියම	- முதுகுப்புறவேர்த்திரட்டு
Ductless gland	- නිර්නාල ග්‍රන්ථිය	- கானில் சுரப்பி
Ear lobe	- කන්පෙත්ත	- செவிச்சோணை
Effector	- කාරකය	- விளைவுகாட்டி
Effercent fibre	- අපවාහි තන්තු	- வெளிக்காவு நார்
Endocrine gland of gastro mucosa	- ආමාශයික ශ්ලේෂ්මලයේ අන්තරාසර්ග ග්‍රන්ථිය	- உதரச்சீத அகஞ் சுரப்பி
Erection	- උද්ගාමක වීම	- நிமிர்தல்
Eustachian tube	- යුස්ටේකිය නාලය	- ஊத்தேக்கியாவின் குழாய்
Exophthalmic goitre	- උදක්ෂි ගලගණ්ඩය	- கண்டமாலை
External auditary meatus	- බාහිර ශ්‍රවණ නාලය	- புறக்காதுக்கால்வாய்
Eye ball	- අක්ෂි ගෝලය	- கட்கோளம்
Fluid	- තරලය	- பாய்மம்
Ganglion	- ගැංග්ලියම	- திரட்டு
Gland	- ග්‍රන්ථිය	- சுரப்பி
Grey mater	- ධූසර ද්‍රව්‍යය	- நரைநிறப்பொருள்
Growth hormone	- වර්ධක හෝර්මෝනය	- வளர்ச்சி ஓமோன்
Hepatic portal vein	- යාකෘතික ප්‍රතිහාර ශිරාව	- ஈரல்வாயில்நாளம்
Homeostasis	- සමස්ථිතිය	- ஒரு சீர்த்திடனிலை
Immunization	- ප්‍රතිශක්තිකරණය	- நிர்ப்பீடனமாக்கல்
Impulse	- ආවේගය	- கணத்தாக்கு
Involuntary action	- අනිච්ඡානුග ක්‍රියාව	- இச்சையின்றிய செயல்
Iris	- තාරා මණ්ඩලය	- கதிராளி
Islets of langerhans	- ලැන්ගහැන් දිපිකා	- இலங்ககான் சிறுதீவுகள்
Lachrymal duct opening	- අශ්‍රුප්‍රණාල විවරය	- கண்ணீர்க்கான் துவாரம்
Lachrymal gland	- අස්‍රග්‍රන්ථිය	- கண்ணீர்ச்சுரப்பி
Medulla oblongata	- සුෂුම්නා ශීර්ෂකය	- நீள்வளைய மையவிழையம்
Meningeal membrane	- මෙනින්ජී පටලය	- மூளைச்சரும மென்சவ்வு
Meningitis	- මෙනින්ජයිටිස්	- மூளைச்சரும அழற்சி
Middle ear	- මැද කණ	- நடுச்செவி
Motor nueron	- චාලක ස්නායුරෝනය	- இயக்கு நரம்புக்கலம்
Mucous	- ශ්ලේෂ්මල	- சீதம்
Naris	- නාස් පුවුව	- மூக்குத்துவாரம்
Nasal Cavity	- නාස් කුහරය	- மூக்குக்குழி

Nasal lachrymal duct	-නාසා අශ්‍රුප්‍රණාලය	- மூக்குக் கண்ணீர்க்கான்
Nervous co-ordination	- ස්නායුකසමායෝජනය	- நரம்பு இயைபாக்கம்
Non-nervous co-ordination	- අස්නායුක සමායෝජනය	- நரம்பின்றிய இயைபாக்கம்
Odoriferous	- සඟන්ධ	- மணங்கொண்ட
Olfactory cell	- ඝ්‍රාණ සෛලය	- மணநுகர்ச்சிக் கலம்
Olfactory receptor	- ඝ්‍රාණ ප්‍රතිග්‍රාහකය	- மணநுகர்ச்சி வாங்கி
Optic nerve	- මධ්‍ය ස්නායුව	- பார்வை நரம்பு
Orbit (of eye)	- අක්ෂිකූපය	- கட்குழி
Ovary	- බීම්බකෝෂය	- சூலகம்
Pain receptor	- වේදනා ප්‍රතිග්‍රාහකය	- நோ வாங்கி
Pancreas	- අග්න්‍යාෂය	- சதையி
Peripheral nervous system	- පර්යන්ත ස්නායු පද්ධතිය	- சுற்றயல் நரம்புத் தொகுதி
Pharynx	- ග්‍රසනිකාව	- தொண்டை
Pinna of ear	- කන් පෙත්ත	- காதுச்சோணை
Pituitary gland	- පිටියුටරි ග්‍රන්ථිය	- கபச்சுரப்பி
Pressure receptor	- පීඩන ප්‍රතිග්‍රාහකය	- அமுக்க வாங்கி
Process (Projection)	- ප්‍රසරය	- முளை
Pupil	- කණීනිකාව	- கண்மணி
Receptor	- ප්‍රතිග්‍රාහකය	- வாங்கி
Reflex action	- ප්‍රතීක ක්‍රියාව	- தெறிவினை
Reflex arc	- ප්‍රතීක චාපය	- தெறிப்புவில்
Regulation	- යාමනය	- சீராக்கல்
Reproductive system	- ප්‍රජනක පද්ධතිය	- இனப்பெருக்கத்தொகுதி
Response	- ප්‍රතිචාරය	- தூண்டற்பேறு
Retina	- දෘෂ්ටිවිතානය	- விழித்திரை
rod (cells)	- යෂ්ටි (සෛල)	- கோல் (கலங்கள்)
Saliva	- ඛේටය	- உமிழ்நீர்
Salivary gland	- ඛේට ග්‍රන්ථිය	- உமிழ்நீர்ச்சுரப்பி
Sclerotic layer	- ශ්වේත ඝන ස්තරය	- வன்கோதுப்படை
Semi circular canal	- අර්ධ චක්‍රාකාර නාල	- அரைவட்டக் கால்வாய்
Sensation	- සංවේදනය	- புலனுணர்ச்சி
Sense organ	- සංවේද ඉන්ද්‍රිය	- புலனங்கம்
Sensory neuron	- සංවේදක නියුරෝනය	- புலன்நரம்புக்கலம்
Simple goitre	- සරල ගලගණ්ඩය	- கண்டமாலை
Skull	- හිස්කබල	- தலையோடு
Spinal canal	- කශේරු නාලය	- முள்ளந்தண்டுக்கால்வாய்

Spinal column	- කශේරුව	- முள்ளந்தண்டு
Spinal cord	- සුෂුම්නාව	- முண்ணான்
Spinal nerve	- සුෂුම්නා ස්නායුව	- முண்ணான் நரம்பு
Spinal reflex	- සුෂුම්නා ප්‍රතිකය	- முண்ணான் தெறிவினை
Spinal wall	- කශේරු බිත්තිය	- முள்ளந்தண்டுச் சுவர்
Stimulus	- උත්තේජය	- தூண்டல்
Suspensory ligament	- අවලම්බක බන්ධනිය	- தாங்கி இணையம்
Tactile receptor	- ස්පර්ශ ප්‍රතිග්‍රාහකය	- தொட்டுணர்வாங்கி
Taste bud	- රසාංකුරය	- சுவையரும்பு
Taste receptor	- රස ප්‍රතිග්‍රාහකය	- சுவைவாங்கி
Temporal bone	- ශංඛක අස්ථිය	- கடைநுதல் என்பு
Testis	- වෘෂණ	- விதை
Threshold value	- දේහලීය අගය	- தொடக்கப் பெறுமானம்
Thyroid	- තයිරොයිඩය	- தைரொயிட்டு
Tympanic membrane	- කර්ණ පටහ පටලය	- செவிப்பறை மென்சவ்வு
Upper eye lid	- උඩු ඇසිපිය	- மேற்கண்மடல்
Ventral root	- උදරීය මූලය	- வயிற்றுப்புறவேர்
Vertibral column	- කශේරුව	- முள்ளந்தண்டு
Vestibule of the ear	- කර්ණාලින්ද උපකරණය	- தலைவாயில்
Vitreous humour	- කාච රසය	- கண்ணாடியுடனீர்
Voluntary action	- ඉච්ඡානුග ක්‍රියාව	- இச்சையுள் செயல்
Warm receptor	- උණුසුම ප්‍රතිග්‍රාහකය	- வெப்பவாங்கி
Water balance	- ජල තුල්‍යතාව	- நீர்ச்சமநிலை
White matter	- ශ්වේත ද්‍රව්‍යය	- வெண் சடப்பொருள்
Yellow spot	- කහලපය/මධ්‍ය කුපය	- மஞ்சட்பொட்டு

J.S.M

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