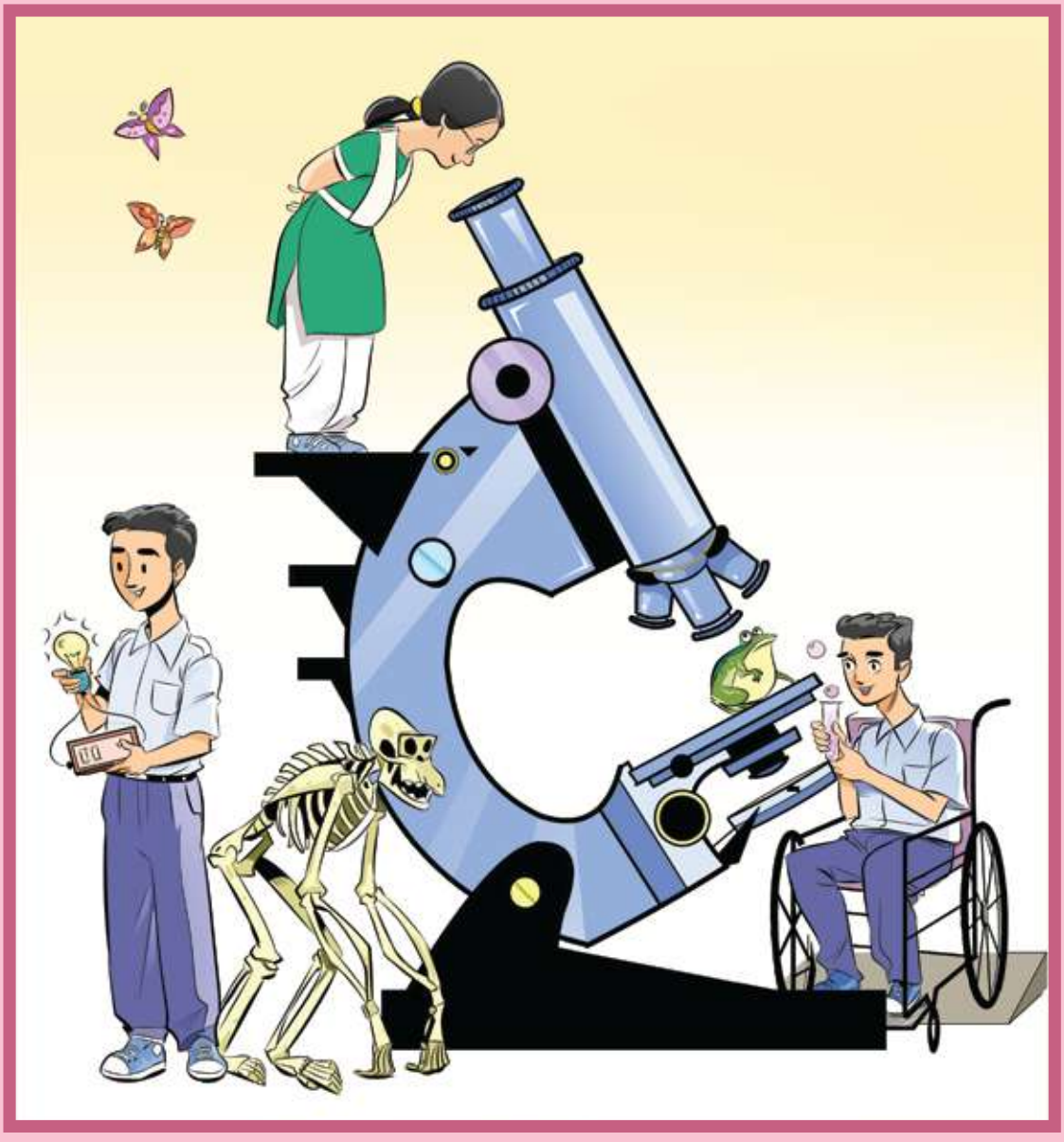
Science

Classes Nine and Ten



National Curriculum and Textbook Board, Bangladesh

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Science

Classes Nine and Ten

Revised for the year 2025

National Curriculum and Textbook Board, Bangladesh

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Preface

The importance of formal education is diversified. The prime goal of modern education is not to impart knowledge only but to build a prosperous nation by developing skilled human resources. At the same time, education is the best means of developing a society free from superstitions and adheres to science and facts. To stand as a developed nation in the science and technology-driven world of the 21st century, we need to ensure quality education. A well-planned education is essential for enabling our new generation to face the challenges of the age and to motivate them with the strength of patriotism, values, and ethics. In this context, the government is determined to ensure education as per the demand of the age.

Education is the backbone of a nation and a curriculum provides the essence of formal education. Again, the most important tool for implementing a curriculum is the textbook. The National Curriculum 2012 has been adopted to achieve the goals of the National Education Policy 2010. In light of this, the National Curriculum and Textbook Board (NCTB) has been persistently working on developing, printing, and distributing quality textbooks. This organization also reviews and revises the curriculum, textbook, and assessment methods according to needs and realities.

Secondary education is a vital stage in our education system. This textbook is catered to the age, aptitude, and endless inquisitiveness of the students at this level, as well as to achieve the aims and objectives of the curriculum. It is believed that the book written and meticulously edited by experienced and skilled teachers and experts will be conducive to a joyful experience for the students. It is hoped that the book will play a significant role in promoting creative and aesthetic spirits among students along with subject knowledge and skills.

The purpose of science education is to develop observational skills, problem-solving skills, and interest of the students about natural phenomena and various elements of the environment through creating curiosity. In addition to the theoretical aspects of science, this textbook for class IX and X also provides different hands-on activities to increase their creativity and imagination, as well as investigative work to develop the student's curiosity and adherence to science. Students will be able to acquire the necessary skills and positive attitudes to secure personal and social safety and overcome various adverse situations through science practice.

It may be mentioned here that due to the changing situation in 2024 and as per the needs the textbook has been reviewed and revised for the academic year 2025. It is mentionable here that the last version of the textbook developed according to the curriculum 2012 has been taken as the basis. Meticulous attention has been paid to the textbook to make it more learner-friendly and error-free. However, any suggestions for further improvement of this book will be appreciated.

Finally, I would like to thank all of those who have contributed to the book as writers, editors, reviewers, illustrators and graphic designers.

October, 2024

Prof. Dr. A K M Reazul Hassan
Chairman
National Curriculum and Textbook Board, Bangladesh

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Chapter One

Healthy Life, Better Living

We cannot live without food. Regularly several types of food are necessary for the growth and development of the body, repair and replacement of worn out tissue, and for producing energy etc. Our health depends largely on the quality of the food we take. Food can make differences in our appearance, work, behaviour and standard of life. During the process of respiration the chemical energy of food is converted into different forms of energy including energy. Every living being takes food from the environment according to its need. Each type of food is a complex chemical compound. This complex food turns into simple food by different types of enzymes in different parts of our digestive system. This process is called digestion. After digestion, foods are absorbed by the protoplasm of the cells. This is called assimilation. After digestion the indigested part of the food comes out of the body through a special process.

At the end of this chapter we will be able to-

- explain the components of food and the ideal food pyramid;
- describe the needs of the preservation of food;
- analyse the impact of natural food and fast food on the preservation of health;
- explain the sources of vitamins and their deficiency symptoms;
- explain the sources of minerals and their deficiency symptoms;
- explain the necessity of body mass index;
- explain the usefullness of water and fibrous food;
- describe the use of chemicals in food and its effects;
- explain the harmful reactions of tobacco and drugs in human body;
- explain what AIDS is;
- explain the technique of maintaining physical fitness.

1.1 Food and Nutrition

According to the nutrition science, all that we eat are not food. The edible items which can produce energy and immunity and help to grow and develop a living body by its nutrition are called food. Nutrition is– getting necessary food items from the environment and digesting and absorbing them, then fulfillment of energy need, developing the immunity of diseases, and growth of the body. The organic and inorganic elements in food which provide the energy required for living body are collectively called the nutrients e.g. glucose, minerals and vitamins etc. Nutrients do not need to be digested. Living beings get nutrients from food. The three main functions of food are–

1. growth and development, repair and protection of the body.
2. production of heat and energy.
3. protecting the body from diseases and making the body healthy, energetic and active.

Elements of Food

There are seven components of food (Fig: 1.01) e.g.-carbohydrates, proteins, fats, vitamins, minerals, fiber and water. Fats and carbohydrates are called the energy producing foods and proteins are called the body building foods. Although these components have other important functions.Vitamins, minerals, water and fiber help preserve the living processes of the body in many different ways.

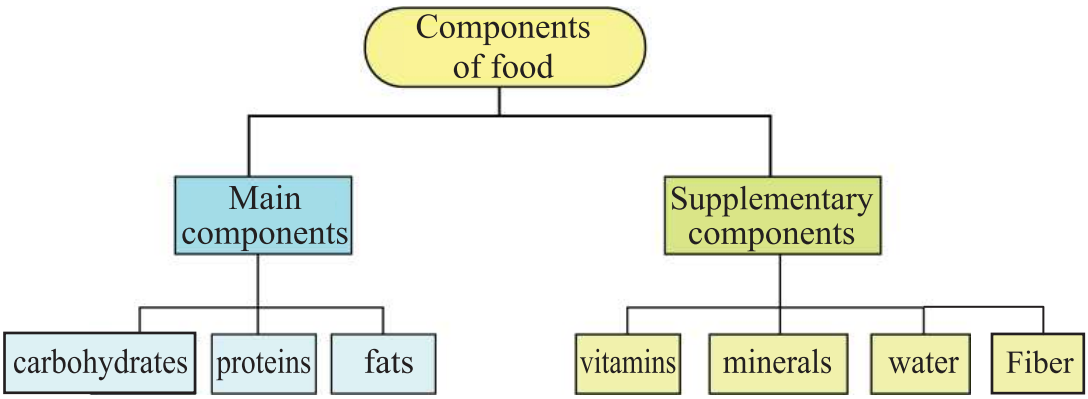


Fig. 1.01 : Seven components of food

1.1.1 Carbohydrates

Carbohydrates are the main food for human beings. It is formed by carbon, hydrogen and oxygen. It produces energy and heat. Sugar has no colour and smell but is sweet in taste. There are several types and sources of carbohydrates.

Plant Sources

Starch: Rice, wheat, maize and many other cereals are the main sources of starch. Besides these, potato, sweet potato and arum are vital sources of starch.

Glucose: It is less sweet than sugar. This carbohydrate is available in grapes, apples, carrots, dates etc.

Fructose: In mango, papaya, banana and orange, or other sweet fruits and in flower extracted honey, fructose is available. This is called fruit sugar.

Sucrose: Sugarcane, sugar, molasses and sugar candy are the sources of sucrose.

Cellulose: Wood apple, mango, banana, watermelon, groundnut, dry fruit and all kinds of vegetables are the potential sources of cellulose.

Animal Source

Lactose or Milk Sugar: The milk of cows, goats and other animals are the sources of lactose.

Glycogen: Glycogen is available in the meat and liver of birds like chicken, pigeon etc.

Nutritional Value

Carbohydrate has an important role in nutrition. Carbohydrate produces energy and heat in body. During respiration carbohydrate is oxidized and produces energy for metabolism. Glycogen provides energy in deficiency of food or in hard labour. Cellulose is a non digestive type carbohydrate. This is a fibrous food. It protects the body from constipation. Besides, proteins and fats are synthesized from carbohydrates.

To get rid of the deficiency diseases of sugar, we have to take an optimum amount of sugar every day. On the other hand if the amount of sugar is more than the need, extra fat is accumulated as fat cell in the body. It may cause obesity and diabetes. Through the breathing or respiration process, we inhale oxygen which gets mixed with blood in our lungs. Red blood cells of blood carry this oxygen to the cells of our body and there it reacts with glucose to produce different forms of energy including heat. This energy is the source of all our energies.

The energy in food is measured as food calories or kilo calorie. The amount of heat energy produced by the oxidation of one gram of food is called the food calorie. The amount of energy which is needed to increase 1° Celsius temperature of 1 gram water is called one calorie. One thousand calorie is equal to one kilo calorie or one food calorie. Food calorie is expressed in kilo calorie. The calorie of carbohydrates and protein is almost equal 4 kcal/gm, while fat has the highest- amount of calorie, that is, 9 kcal/ gm. An adult male person needs to eat food approximately equivalent of 2500 kcal per day and for a woman this figure is approximately equivalent of 2000 kcal a day.

1.1.2 Proteins

A protein is composed of carbon, hydrogen, oxygen, nitrogen and sometimes sulphur. A protein is converted into an amino acid after digestion. A protein is identified by its amino acid. 20 types of amino acids have been found so far in the human body. Amino acids are the units of protein formation.

According to their sources, there are two types of proteins-- animal proteins and plant proteins. The proteins which are obtained from animals are called animal proteins e.g. fish, meat, egg, milk, cheese etc. The proteins which are obtained from plants are called plant proteins. e.g. pulse, bean, seeds, pea, nuts, etc.

Eight out of a total of 20 amino acids are essential. These are lysine, tryptophan, methionine, valine, leocine, isoleucine, phenyle alanine and threonine. Body can synthesize the other amino acids except these eight types. These eight types of proteins are more available in animal protein. That is why the nutrient value of animal protein is much more than plant proteins. Plant foods like pulse,

soybean, pea and maize are rich in higher nutrient value. The other plant foods have no essential amino acid. So these plant foods have less nutrient value.

Proteins are essential for the building of animal body. Most of the parts of the body are formed by proteins. Bone, muscle, hair, bird feather, nail, animal horns etc. are made by protein. 50% of dry weight of an animal cell is protein, because the structure and function of a cell is regulated by proteins.

1.1.3 Fats and Lipid

Fats are composed of fatty acids and glycerol. There are 20 types of fatty acids in food. The quality of fats depends on fatty acids. Solid lipids are called fats. Lipids are saturated fatty acids. They are solid at normal temperature and pressure e.g. the fats of fish and meat. The lipids which are liquids at and pressure are called oils. Oils are unsaturated fatty acids. They are liquid at normal temperature and pressure e.g. soybean oil, mustard oil etc. Lipids are of two types according to their sources.

1. Animal lipids: Meat with fat, butter, ghee, cheese, yolk of eggs are the sources of animal fat.

2. Plant lipids: Different types of vegetable oils are the sources of plant lipids. Mustard, soybean, sesame, linseed, maize, coconut, sunflower and palm oil are the sources of plant lipids. Cashew, pistachio and peanut are also the sources of lipids.

Role of Lipid

1. Lipid is the highest source of heat and other types of energy in the body.
2. Lipid is essential for the growth and nutrition of the body.
3. It prevents the misuse of heat and works as a source of food storage for the future.
4. It keeps the skin smooth, soft and healthy and thus protects the skin from skin disease.
5. Lipid helps to absorb the soluble vitamins e.g.- A, D, E and K.

Diseases Resulting from Lipid Deficiency and Remedies

The deficiency of lipids causes skin diseases and eczema. Skin becomes dry and rough and loses its beauty. The long time deficiency of lipid causes break down of the stored protein and body loses its weight. On the other hand too much of lipid disturbs the blood circulation of the body. Fatty body is more prone to suffer from different diseases.

1.1.4 Vitamins

Even if the food contains sufficient amounts of carbohydrates and proteins, a special type of food is necessary for the normal growth and nutrition of the body. This food component is called vitamin.

Vitamin is essential for normal growth and a healthy body. Vitamin is an organic compound. If we eat a healthy diet with adequate vegetables everyday, we can get the required vitamins from our daily food. Some vitamins are soluble in fats and some are soluble in water.

Fat soluble vitamins : Vitamin A, D, E and K.

Water soluble vitamins : Vitamin B complex and Vitamin C.

Fat Soluble Vitamins

Vitamin A

Animal sources of vitamin A are eggs, cow's milk, butter, posset, yogurt, liver and different types of oil rich fish, specially the cod fish. Plant sources of vitamin A are carotene rich vegetables e.g. red amaranthus, kachu shak, data shak, basil, jute leaf, kalmi shak, mint, pea, carrot, lady finger, cabbage, peanut and different types of fruits e.g. mango, ripe

papaya, jackfruit are the great sources of vitamin A. Large amounts of vitamin A is present in carrots. The functions of vitamin A are:

1. It ensures smooth activities for the growth and development of the body.
2. It maintains normal activities of different types of epithelial tissue e.g. skin and cornea of the eyes.
3. It keeps teeth, gum and bones healthy.
4. It keeps the eye sight normal and protects the eyes from night blindness.
5. It protects the body from contagious diseases.

Deficiency Symptoms of Vitamin A and Remedies

Vitamin A deficiency causes xerophthalmia. Although thist condition initially presents as night blindness, prolonged deficiency can lead to ulceration or erosion of the cornea of the eye. The affected person can become completely blind if this disease occurs. In the absence of vitamin A, symptoms such as sores, colds, coughs, sore throats, urinary problems etc. are also seen. A lack of vitamin A can cause small bumps at the base of the skin follicles. Taking too much vitamin A can also be harmful.

Vitamin D

Animals are the only source of vitamin D. Vitamin D is synthesized in human skin with the help of ultraviolet rays, from the cholesterol present in the human skin that is transformed into vitamin D step by step through the liver and kidneys.Yolk of eggs, milk and butter are the main sources of vitamin D. Cabbage, liver and oil rich fish are also the sources of vitamin D. Vitamin D helps the body absorb calcium which is useful to build bones. Because of the deficiency of vitamin D, children may be attacked with rickets disease. Taking more vitamins than the need is harmful to the body. So, a huge amount of calcium and phosphorus are absorbed. As a result, a large amount of calcium is stored in the kidney, heart and veins.

Vitamin E

All types of vegetable oil, especially palm oil, are the best sources of vitamin E. More or less all the foods have vitamin E. Large amount of is available in com oil, cotton seed oil, sunflower oil and lettuce leaf. In human bodies vitamin E is the anti oxidant. This anti oxidant inhibits the accumulation of fat in veins and keeps the skin healthy. Eating a balanced diet everyday can fulfill the demand of vitamin E.

Water Soluble Vitamins

Vitamin B complex

Vitamin B complex or vitamin B are 12 in number. This group of vitamins is called the vitamin B complex. Vitamin B complex is very important for normal health. The presence of vitamin B is essential for the growth of the body especially for the work of the brain and the nervous system, metabolic activity of the cell and for reproduction.

The sources, deficiency symptoms and the amount of different types of vitamins in the B complex group are shown below:

Vitamin	Source	Symptoms
Thiamin (B_1)	Plant source: husked rice, flour, pulse, oil seed, nut, fresh fruits and vegetables. Animal source: Liver, egg, milk, fish etc.	Severe deficiency of vitamin B1 causes the symptom of beriberi disease. Weak nerve, depression, tiredness, loss of appetite, weight loss are also caused by its deficiency.

Riboflavin (B_2)	Liver, egg, milk, green vegetables, young shoot of plant and germinated seed.	Wounds in the angle of lips, mouth and tongue wrinkled skin.
Niacin or Nicotinic acid (B_5)	Meat, liver, ata, pulse, nut, oil seed, chick-pea and vegetables.	Its deficiency causes pellagra disease. The main features of pellagra are dermatitis (inflammation of skin), diarrhea and dementia (memory problem), collectively known as 3D.
Pyridoxine (B_6)	Rice, ata, fish, meat, vegetables, chick-pea, fungi, kidney and yolk of eggs.	Loss of appetite, vomiting tendency and anaemia occur due to its deficiency.
Cobalamin or Cyanocobalmin (B_{12})	Liver, milk, fish, meat, egg, cheese kidney etc.	Anaemia and nervous system disorder occur due to its deficiency.

Vitamin C (Ascorbic acid)

Fresh vegetables and fruits contain vitamin C. The fruits like amloki, lemon, orange, tomato, pineapple and guava are the sources of vitamin C. The vegetables like radish, lettuce, coriander leaf, mint, green chili, cauliflower and bitter gourd contain large amounts of vitamin C. Dry fruit, seed and canned food usually do not contain this vitamin.

The role of vitamin C are-

1. The cells of skin, bone, teeth become compact and strong.
2. The damaged cells get repaired.
3. Teeth and gum become strong.
4. Vitamin C has an important role in the metabolism of fat, protein and amino acids.
5. It keeps the skin bright and smooth.
6. It protects the body from diseases.

Due to its severe deficiency scurvy disease (bleeding from the gum of teeth) occurs. For its deficiency (i) Bones cannot become strong. (ii) Skin diseases are caused by its deficiency and it takes time to repair the damaged cell (iii) The gum of the teeth swells and teeth become weak. (iv) The immunity of the body decreases and frequently catches cold.

Individual Work

Task : Make a chart of the diseases caused by the deficiency of vitamins that we have discussed.

1.1.5 Minerals and Water

For the normal growth and nutrition of the body, minerals are as essential as vitamins. Minerals mainly help in the formation of cells. Animals get minerals from the plant source. We fulfill the demand of minerals by eating vegetables, fruits, milk, egg, fish and drinking water. The source, nutritional value and the deficiency symptoms of some important minerals are described below:

Iron (Fe)

Iron is the main element of blood. 100 mL blood contains 50 mg iron. It is stored in liver, pancreas, bone and red blood cells. The plant sources of iron are

cauliflower, spine amaranths, neem leaf, fig, green banana, maize, wheat, nut and millet. The animal sources are fish, meat, egg and liver. The main function of iron is hemoglobin formation. Hemoglobin deficiency causes anaemia. The symptoms of anaemia are pale eyes, swelling of hands and legs, weakness, headache and palpitation.

Calcium (Ca)

The main element of bone and teeth is calcium. About 2% of human body weight is calcium. The amount of calcium is the highest among the minerals. Of them, 90% is accumulated in the bone and teeth accompanied with phosphorus and magnesium. The amount of calcium is significant in blood and lymph. The plant sources of calcium are: pulse, sesame, soybean, cauliflowers, carrots, spinach, kochu leaf, red amaranthus and kalmi leaf. The animal sources of calcium are milk, eggs, small fish and dry fish.

Calcium is essential for strong bone and teeth. Besides this, calcium helps in blood circulation, normal construction of the muscle of the heart and the movement of heart and muscle. Rickets and osteomalacia of aged women occur due to deficiency of calcium. Calcium deficiency delays in the formation of teeth of babies and disturbs in blood circulation.

Phosphorus (P)

The importance of phosphorus regarding its amount in the body is next to calcium. Like calcium, phosphorus is also an element of the bone. Phosphorus is accumulated in the bone, liver and plasma. Phosphorus plays a vital role in the formation of nucleic acid and nucleo protein and in carbohydrate metabolism. Plant source- cereal, beans, peanuts and nuts are the sources of phosphorus. Animal source- Eggs, milk, fish, meat are the sources of phosphorus.

The main function of phosphorus is the formation of bone and teeth. Osteoporosis, rickets and dental caries result from phosphorus deficiency.

If there is sufficient amount of protein and calcium in food, phosphorus deficiency does not occur.

Water

Water is one of the main components of food. Water is essential for the human body. The structure and function of the body cannot be maintained without water. Water constitutes 60-75% of our total body weight. Water is essential for the formation of our blood, muscle, nerve, teeth, bones etc.

It is not possible to form the body cell and maintain physiological function of the body without water. It works as a solution for the human body. Water helps in digestion and absorption of food. Metabolism produces urea, ammonia etc in our body. Water helps to dispose these toxic elements from the body as urine and sweat. Besides this, water keeps our body cool by sweating and evaporation.

The sources of water in body-

1. Drinking water, other drinks e.g. tea, milk, coffee and juice.
2. By taking food e.g. vegetables and fruit.

If the intake of water and release of water are equal, the balance of water is maintained in the body. An adult person should drink 2-3 liters of water per day.

Hot weather and hard labour are the causes of deficiency of water in the body. So, the amount of drinking water should be increased in this situation. If diabetes is not in control, it causes repeated urinating. So, the deficiency of water occurs in the body.

Severe thirst, inhibition of blood circulation and shrunk skin result from the deficiency of water. The nerve and muscle also become weak due to lack of water. The balance of acid and alkali is lost and it causes acidosis. 10% of water loss of the body causes fainting and even death of a person. Vomiting and diarrhoea are also caused by water deficiency in the body. The patient should take salt water or saline water for the rapid cure of water deficiency. The water

and salt which come out of the body, is recovered by saline water. If oral saline is not available in the house, it can be made by mixing a pinch of salt, a handful of molasses or sugar and a glass of boiled safe water at room tempreture.

1.1.6 Fibre

Besides the components of food, discussed so far, another very important component of food is roughages or fiber-rich foods. Fibre or roughage is mainly obtained from plants. Entire seeds, pulse, potato, fruits with peel and vegetables are the sources of roughage. Besides this, dry fruit, cumin, coriander and pea contain a large amount of roughage. Roughage is mainly cellulose contained in the plant cell wall. Roughage does not supply any nutrient to our body. It can protect the body from constipation, heart disease and diabetes. How roughage protects these diseases are yet to be known clearly. Roughage can go right through the intestine. It is not digested.

The importance of roughage food is as follows:

1. It helps to digest food. It absorbs water and increases the amount of stool.
2. It helps to dispose the indigested food from the body.
3. It helps to decrease the extra fat of the body.
4. It also decreases the tendency of frequent hunger.
5. It is thought that roughage food can decrease gallbladder diseases, cancer of the intestine and colon, piles, appendices, heart diseases and obesity.

So we should take 20-30 grams of fiber food everyday. This fiber is obtained from vegetables and fruits.

1.2 Body Mass Index (BMI)

A baby continues to grow after birth. Then it becomes a child, reaches teenage, youth and adulthood. The growth of human body continues up to the age of 20-24 years. The height does not increase after that time. Then the role of food

is to repair and keep the body healthy. In adult age, for good health, it needs to maintain a balance between height and weight of the body. The index which shows the balance in height and weight is called the BMI or Body Mass Index. If the body weight is balanced with the height, then it can be considered a nutritionally healthy body.

The law of BMI

body weight (kg) / height (meter)^2

That is, the body weight of a person is divided by the square meter of his height and that is the BMI of that person.

For example:

The body weight of a person is 80 kg and height is 1.8 meter.

$$\text{BMI} = \frac{80}{1.8 \times 1.8} = 24.7 \text{ (approximate)}$$

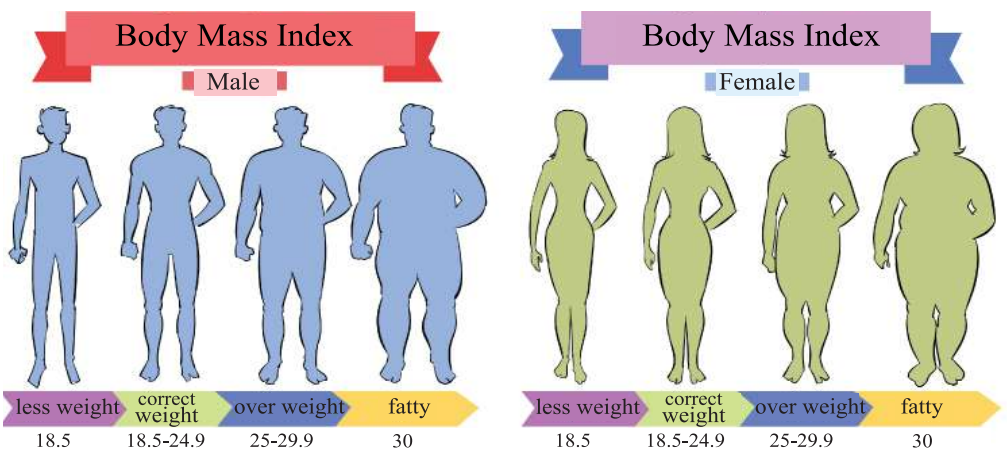


Fig. 1.02 : Body Mass Index

BMI is the indicator of fat in our body. Fig. 1.02 shows that 25 is healthy and normal BMI. If a person has less or more BMI than this, he/she is considered under-weight and obese respectively. Note that BMI is not the only or most accurate indicator of health, but it is widely used.

Group Work

Calculate the BMI of all the students of your class and show it in a graph chart (Fig : 1.03). What is the average BMI of your class?

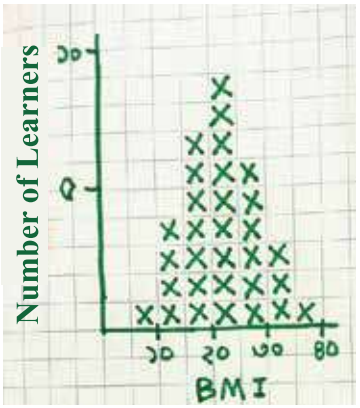


Fig. 1.03 : BMI and group of learners

1.3 What will be the daily diet

We have learnt about the calorie and kilocalorie of food while discussing the nutritional value of food in this chapter.

An adult, who does physical work, should take food of 2000-2500 kilocalories per day. It is necessary to eat vitamins, minerals and fibrous food along with vegetables and fruits. (The fibre element of food is not shown separately in this figure.)

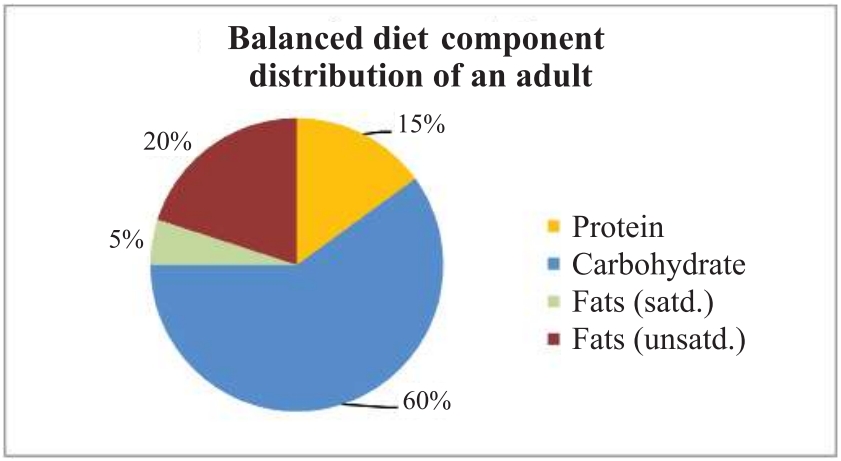


Fig. 1.04 : Balanced diet component distribution of an adult

Individual Work

Task : Hilsa fish, chicken egg, meat with fat, bean seed, yogurt, rice, potato, sugar, oil, sweet pumpkin, cauliflower, tomato, small fish, chick-pea, ice cream, bread, honey, ghee, basil, jackfruit, mango.

Make a chart of food elements with the 21 food items mentioned above. Same food can be part of more than one list.

Carbohydrate	Protein	Fat	Vitamins and minerals	
			Vegetables	Fruit

Now, sort out the foods as low cost and high cost. According to the table below make a list of low cost and high cost foods.

List of the foods (low cost food)

Name of the food components	Low cost food	Costly food
1. Carbohydrate 2. Protein 3. Fats 4. Vitamin enriched vegetables/fruits 5. Mineral enriched vegetables/fruits		

From the above table you can surely assume that to eat healthy food it is necessary to eat costly food'– is not true. By proper planning we can eat healthy food with minimum cost.

1.3.1 Balanced Diet

We have already come to know what food is and what the elements of food are. Over-eating is harmful to health and at the same time eating less food is also harmful to health. So, we have to take balanced food for good health. To become obese by eating more is a big problem in the first world.

Balanced diet does not mean a specific food. Balanced diet is a diet which contains all the seven elements of food in a specific amount and eating this food we get the necessary calories and fibres for our normal activities. For example, an adult active healthy an average male needs about 2500 and an average female needs about 2000 kilo calorie energy daily. We get this calorie from food. So, in our daily food list we need to select such food items in which all the seven elements of food are present in a proper amount.

For preparing a list of balanced food we have to consider the age, sex and physical work done by the person . For the preparation of the list of food for a baby and an aged person, easily digestible and fat free food should be considered. Growing babies need protein, calcium and phosphorus enriched food for the growth of bones and teeth. Extra proteins, calcium, and iodine are very important for producing blood and for the development of the embryo in a pregnant person. No definite balanced food is available in nature. We have to prepare the balanced food.

The preparation of balanced food

Carbohydrate	Protein	Fat	Vitamin	Mineral
Rice	Fish	Butter	Milk, Eggs	Milk
Wheat	Meat	Oil	Fruit	Eggs
Sugar/ Molasses	Eggs	Ghee	Fish/Meat	Vegetables

The Pyramid of Balanced Diet

It is important to include carbohydrates, vegetables, fruits, proteins and fats in a balanced diet menu. It is seen that the amount of carbohydrate is highest in the menu of a teenager or an adult. In food pyramids of a balanced diet, carbohydrates are placed at the bottom of the pyramid because the amount of carbohydrates is higher than the other elements of food. Then the vegetables, protein and fats are placed one after another in a pyramid (Fig : 1.05). So the fats are placed on the top of this pyramid.

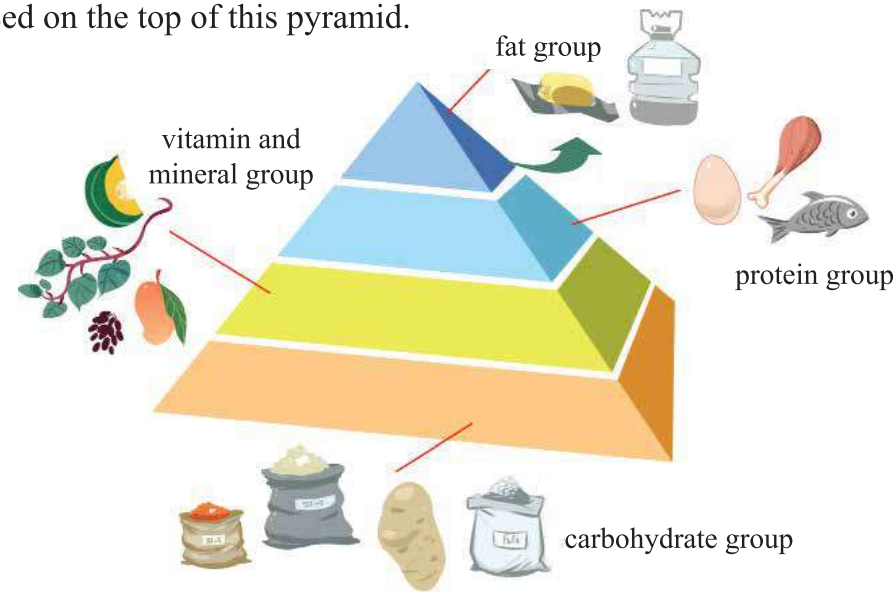


Fig. 1.05 : Pyramid of balanced diet

1.3.2 Selecting Food for High Standard Living

The food habits of all men are not the same. The availability of food is not same in all countries due to geographical and natural causes. The need of foods is different in winter and in summer to adjust with life. Selection of food depends on growth and development and physiological activities of the body. So, food should be selected by considering the amount and its calorie value for high standard of living.

In the food pyramid, we have shown how much of which type of food component should be eaten. Now, we will say what foods can be made using these elements of food. For example, oil or butter shown in the pyramid are not eaten by themselves, they are used to make other foods.

Nutritionists have divided the sources of nutrition into four classes. These are :

1. Meat or fish, eggs, pulses (peanuts, chick pea and nuts).
2. Fat or lipids
3. All kinds of edible vegetables and fruits.
4. Cereals and their products e.g. in bread and rice.

To get balanced food we should take all these four types of food every day. Nutritionists think that the selection of food should have a variety from these four classes.

The amount of proteins, carbohydrates, fats, vitamins and minerals should be considered for the preparation of the menu from breakfast to dinner. In our country, breakfast completed is with light food. Taking tea is a habit among the aged people of towns and villages. Many of the city dwellers complete their breakfast just with a cup of tea. This habit is very harmful to the health. It is necessary to eat at least some snacks with tea. All the nutrients will be easy to get if the breakfast is completed with bread, butter or egg and a banana. In summer, body remains healthy if the breakfast is done with molasses of sugarcane and flakes rice (chira and goor). Lunch is considered the main meal in our country. Lunch should be a balanced meal.

In the tropical regions (tropical countries) fish rather than meat is the source of protein. But in winter eating more meat is not harmful. Yogurt and fruit after every meal are good for the health.

In our country, many students and service holders have no specific time for lunch. So, they take a light food in the evening. The evening snack should be prepared according to the economic condition of the family as well as the nutrient value of the food.

The food for dinner should be easy to digest. So less amount of protein should be taken in this meal. A high standard of living can be maintained by this type of food selection.

Fast Food or Junk Food

Fast food or junk food is such a food which is tasty rather than nutritious. These foods are very tasty to eat but not good for the health. Most of these foods have the chemicals which make the food tasty but not healthy. There are lots of animal fats and sugar in these foods. Burger, fried chicken, pizza, chips, chrispy foods, cake and biscuit have lots of animal fat. There is a high amount of sugar in soft drinks and in carbonated drinks like cola or lemon. When we take these fat foods, it turns into fat cells in our body. Taking much sugar can damage our teeth and skin. Fast food can never be a balanced food. They lack vitamins and minerals which are essential for our body. Fast food is the cause of obesity for growing boys and girls. In fact, fresh natural food is better than canned and packet foods.

Individual Work

Task : Make a list of the food components present and absent in fast food

1.4. Preservation of Food

All types of food get spoilt or become unsuitable for eating due to natural causes. The causes of food spoilage are- getting attacked by germs and fungi, their quick multiplication, incresase of enzymes in the food, humidity of the environment and increase of acidity due to rise of temperature. None of these causes alone spoils food. Several reasons together spoil food. For example, the increase of humidity in the environment helps multiply germs and spoil food. Similarly, the rise of temperature increases the amount of enzymes in food and spoils it.

Germs or bacteria produce toxic elements in the food. These toxic elements are called toxin. This toxin is of different types.To be attached with some of these toxins is called food poisoning. Some toxins attack the nervous system and may cause death.

Yeast, a kind of fungus, quickly destroys the fruit juice, tomato sauce, jelly, sweet pickle and sarbot. So the food gets a bad sour smell. If bread is kept in an open place for few days, an ash colour layer grows on it. These are the mold fungus like mucor and aspergillus. Oranges, pickles, tomatoes and cheese rot due to this type of fungus.

By storing food, we can have the taste of some seasonal fruits, crops, vegetables, fish and other foods in other seasons. If the production of any fruit or crops is very much at a particular time or place, we can consume, shift and export them to other places at different times through preservation. So, we should preserve various kinds of food by different processes maintaining the proper food value. Thus, we can meet up our food deficiency.

1.4.1 Various Processes of Storing Food

Actually foods are spoilt by the multiplications of germs and the enzyme secreted by the germs. Humidity and heat help germs grow and ıncrease the activities of the enzyme. As a result, this condition helps spoil the foods. If the factors which help ruin the foods can be controlled, then foods can be preserved for a long time.

Commercially foods are preserved and marketed adopting special methods. At home foods are preserved by using preservatives and machineries. Some of such methods are described below.

1. Drying: Drying is an ancient method for preserving food. Fungus and bacteria can not attack the dry food. So, the activities of enzyme are inhibited. Foods are preserved for a long time by this method.

2. Refrigeration: Mainly vegetables, fruit, cooked food and sweetmeats can be preserved by the refrigeration method for several days. In this process the multiplication of germs and the activities of germs cannot be prevented for a long time.

3. Freezing: In this method foods are kept at a temperature of 0° Fahrenheit or minus 18° Celsius or below so that the foods remain in good condition for a long time. Not only the fresh vegetables, fruits, juice, fish and meat but also ready made food and ice cream are preserved by applying this method.

4. Preservatives: The chemicals which are used to preserve food are called preservatives. Chemical preservatives are used to prevent food spoiling and to hinder the growth of fungus and bacteria. These preservatives have no nutritional value. The preservatives should be used in a specific amount. There are various types of preservatives and their uses are also different. Fungi and bacteria cannot grow in food due to use of preservatives.

Some important preserva tives are mentioned below:

i) Vinegar is a common preservative. It is used in pickles and sauces. 5% solution of acetic acid is called vinegar.

ii) Sulfate salt e.g. sodium bisulfate or potassium meta-bisulfate are used to prevent the multiplication of fungus, bacteria and other micro organisms.

iii) Sodium Benzoate: This is a salt of benzoic acid. It specially prevents the fungal multiplication and is used for preservation of fruit juice and fruit pulp.

Besides these, salts of Propionic Acid and Sorbic Acids are used for the preservation of yogurt, sweets, cheese, butter and bakery food items.

The amount of preservatives mentioned above is different for different foods. Preservatives should be used in the proper quantity. Otherwise it becomes harmful to health.

5. Preservation in Sugar or Salt Solution: Salt and sugar solutions have been used for preservation for a long time. The salt solution is called the brine. Sugar and salt eases the exosmosis of microbes so that foods are not rotten- jam, jelly and marmalade are preserved in sugar. The pieces of guava, apple, and pineapple are preserved for a time in the air tight concentrated solution of sugar.

Before using the preserved food, we should be careful. If the food colour changes, food swells up, if any white or black layer is noticed and the surface of the food becomes slippery, then it should be understood that the foods have started rotting. One should avoid taking this kind of food because it may cause food poisoning.

1.4.2 Use of Chemicals for Preservation of Foods, and its Physiological Effects

A toxic chemical called formalin is often used to preserve milk, fruit, fish and even meat from rotting, although there is considerable doubt as to whether it has any role in food preservation at all. Use of formalin is prohibited for preservation of food. Some dishonest businessmen use formalin for food preservation. Long- Term use of formalin causes indigestion, diarrhoea, asthma, damage of the liver and kidney or cancer. Due to long-term use of formalin, child-bearing mothers may give birth to malformed babies.

The chemicals named Ripen and Ethylene are used for the quick ripening of mangoes, tomatoes, bananas or papayas. If ethylene is used on fruit, these should be sold in the market after 7-8 days of its use. But this is not done and fruit is supplied to the market within 2-3 days. So, the effect of chemicals remains and causes diseases in the human body. Besides this, calcium carbide is used for ripening fruits. This calcium carbide forms acetylene gas in the presence of air vapour. Then this acetylene gas is transformed into acetylene ethanol which is very harmful to health.

A hormone called culter is used for the delayed ripening to mangoes. Culter is used as spray on the mango trees. Consequently, mango cannot ripen quickly and can stay on the tree for a long time. Culter is also very harmful to health.

For the prevention of the use of these toxic chemicals, the consumers' right law should be applied strictly. So the printing media and electronic media can circulate this information to raise consciousness in the society so that the common people do not buy this fruit. The people, who are involved in this dishonest activity, should be punished by the government. The mobile court and the consciousness of the people can be very effective in this regard.

1.5 Tobacco and Other Addictive Substances

The leaf and branch of tobacco plants are dried to make tobacco. Dried tobacco leaves are cut into small pieces and wrapped with paper to make cigarettes, biri and churut. Taking the smoke and vapour of its burning is called smoking. The nicotine of tobacco temporarily stimulates the nerve as well as endangers the body. Besides nicotine, other toxic chemicals also enter into the body by smoking. Cigarette smoke contains some toxic gases, chemicals and narcotics. These substances decrease the oxygen carrying capacity of hemoglobin in the blood. Besides, there are some sticky substances and hydrocarbons which cause various lung diseases (Fig : 1.06) and even cancer.

1.5.1 Bad Effects of Smoking

Smoking is the most familiar drug to us. The harmful situations and diseases resulting from smoking are shown below:

i) Smokers are attacked with diseases more frequently than others.

ii) Smokers suffer from one or the other diseases like. lung cancer, lip, mouth, laryngs, throat and urinary bladder cancer, bronchitis, ulcer in stomach, heart and blood-related diseases. Most of the patients of lung cancer die within about five years.

iii) Studies show that the life expectancy of the smokers shortens.

iv) The people, who do not smoke but stay near the smokers and take smoke indirectly, are also affected.

Fig. 1.06 : Lungs of a non smoker (left) and smoker (right)

1.5.2 Attempts to Control Smoking and Use of Tobacco Products

i) Smoking is prohibited in buses, trains, open fields, restaurants, offices, hospitals and rail stations. Smoking in public places is a punishable offence. There is a law in our country against this. But it is a matter of regret that there is no enforcement of this law and people smoke anywhere they like and pollute the surroundings. This law should be strictly enforced. The Government should take bold steps for anti-smoking campaign.

ii) It is mandatory to print horrific images of smoking-related diseases along with the sentence "Smoking is like taking poison" or "Smoking is harmful to health" on the packets of the tobacco products.

iii) Advertising of tobacco or tobacco products has been banned.

iv) It is imperative to strictly prohibit selling and advertising of cigarettes and tobacco products near schools, colleges or other educational institutions.

1.6 Drug Addiction of Substance Abuse

According to Word Health Organization (WHO), drugs are such substances which,when,taken change the normal behaviour of a living being.

A drug is not synonymous with narcotic substance. But we address narcotics as drugs in common day-to-day use of language. When a person develops a kind of physical and mental relationship with the drug due to continuous drug consumption and suffers from physical and mental problems if the drug is not taken regularly, it is called drug addiction or drug dependence. In other words, substance abuse. (Fig : 1.07).

The important drugs which create addiction are opium and opium products, heroin, wine, pathidrin, barbiturate, cocaine, vung, choros, marijuana and LSD etc. Among them heroin is the most harmful. A man can be drug addicted for different causes e.g. curiosity, bad company, trying to remove depression, to get relief from mental stress, to make oneself more active, family feud and family habit and so on. If any of the parents is addicted to drugs, there is a possibility of drug addiction for the children.

Fig. 1.07 : Drug addiction destroys the life of a man completely.

1.6.1 Symptoms of Drug Addiction

There are some symptoms of an addicted person. These symptoms are not generally seen in a normal person. Important symptoms are-

(i) Less attraction for food (ii) untidiness (iii) hazy vision and red eyes (iv) indifference to everything and disturbances in sleep (v) laziness and depression (vi) too much sweating (vii) staying away from others (viii) anxiety and tension (ix) less attentiveness, stealing money and other things from home.

Personal willingness or unwillingness certainly plays the most vital role in making an individual addicted to drugs. However, social and environmental influences are also instrumental in creating attraction for drugs among people.

The causes of drug addiction are mentioned in the table below:

Environmental causes	Family causes
i) Availability of drugs ii) Unemployment iii) Unsocial environment iv) Drop out from school early v) Drug business in the surrounding areas vi) Professional cause vii) Living in the place where antisocial activities or crimes take place frequently viii) Living in a place where opportunity to take drugs is rampant or where a group of addicts stay	i) Lack of control of parents ii) Depression iii) Loneliness iv) Indulgence in desperate behaviour of children v) Detachment from family vi) Carelessness to children (vii) Rough and violent livelihood or mentality viii) Bad company

1.6.2 Control of Drug Addiction

It is very difficult to stop drug addiction. Because a drug addict knows the destructive effects of drugs but cannot abstain from taking it. Drug addiction can be decreased by medical treatment, but in this case the role of the addicted person is very important. The person should be admitted to a drug cure centre or hospital and treatment should be done very systematically. At first the addicted person should be kept away from his addicted friends. He should be marked so that drugs cannot come to his reach. Then he needs mental treatment so that he can forget the drug. For this he needs to get involved in a particular work. Drug addiction cannot be stopped suddenly. At first less amount of drug should be given to the addict for some days and then gradually giving drugs can be stopped. In this way, the bad effect of sudden stop of giving drugs can be decreased. Nerve relaxing medicines and sleeping pills can decrease the disturbance in sleep, anxiety and repulsive nature.

Drug addiction is not only a personal problem but also a great family problem and disturbance. This problem is a barrier to the development of society and country. Some dishonest people become rich by doing drug business, but on the other hand, life of some people is enveloped in darkness. Talented students are ruined and even die due to drug addiction. Social crimes also increase due to this. So, drug taking and its business should be strictly controlled. For controlling drugs the role of law enforcing agencies e.g. the role of government can be more effective than the effort from personal or social institutes.

Social Attempts

1. Finding out the addicted persons and providing medical treatment to them with compassion and without hatred.
2. Counselling for the addicts.
3. Proper rehabilitation of the addicted persons and appropriate counseling of their families by trained personnel and getting them back to the normal stream of life in the society.

Government Attempts

1. Banning of taking and selling drugs by taking strict legal measures. This law should be enforced strictly.
2. The bad effects of drug addiction should be circulated by the government and non-government media.
3. It is worth mentioning that there is The Narcotics Control Act in our country. If the law is strictly applied, the people and the country can be saved from the harmful effects of drugs.

1.7 AIDS

AIDS is the most deadly disease in the world. It is a contagious disease. At first it was found in America in 1981. Since then it has been recognized as a deadly disease in the world. AIDS is mostly found in Africa.

Human beings have a natural system of immunity. There is a system in our blood which can protect us from diseases. In this case the lymphocytes of blood Produce antibodies for the prevention of diseases. The persons who get this disease lose their immunity which causes death. So this disease is called AIDS (Acquired Immune Deficiency Syndrome). It is found that a virus called Human Immuno Deficiency Virus or HIV (Fig : 1.08) is the cause of this disease.

1.7.1 : Causes of AIDS

HIV destroys the natural immunity of the body. After entering into the blood stream of the body, HIV attacks the T-lymphocytes of White Blood Cells. For this reason, natural immune system of the body is destroyed. So the body is attacked with some rare diseases. Among them respiratory diseases, brain diseases, gastro intestinal diseases and tumours are worts mentioning. It has been observed that no disease symptoms are usually manifested in the human body for the first 5-10 years after HIV infection. These persons thus, act as a carrier of this disease, and then they can infect others.

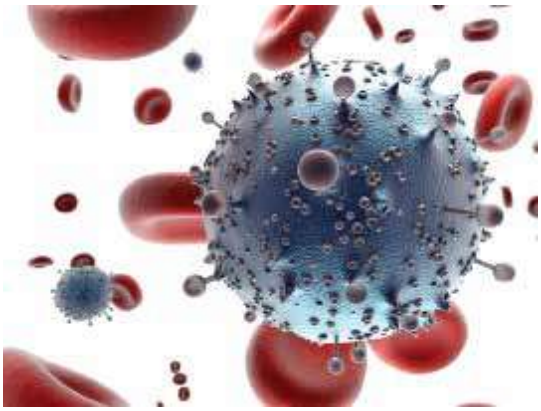


Fig. 1.08 : HIV virus of blood

A lot of information regarding AIDS has already been known to us. We now know who are most vulnerable to this disease. HIV is mainly transferred to healthy body by sexual intercourse. Unprotected sexual relationship either between men and women or homosexual relationships poses high risk for the transmission of this disease. If a pregnant woman is attacked with this disease, her child may also be attacked with the same. Newborn babies can get this disease by breast-feeding. Besides, the disease can be transmitted by blood transfusion from the diseased person. The use of same syringe by multiple drug addicts may also transmit the disease. This disease cannot be transmitted by food, water, insects or external touch of the body of the AIDS patients. This disease is most probably transmitted via blood, sperm etc body fluids.

The most important thing about the prevention of the disease is to inform people about how AIDS is transmitted. The spreading of this disease can be decreased by not infecting others and protecting oneself from contagion. The knowledge about the unprotected sexual relations, being conscious of the dangers of using the syringe of drug users, being careful about donating and receiving blood can reduce the risk of this disease. The government and social organizations can create public awareness for the prevention of this disease. Recently, bone marrow transplants have experimentally cured some AIDS patients completely. Apart from this, the disease can be kept under control by using oral medication, although it is not completely cured.

1.8 Physical Exercise and Rest for Health

Body is the first impression of man. So, body is called the most important tool for the struggle of life. It is our responsibility to keep this tool in proper condition. Regular physical exercise is essential for a healthy body. Physical fitness also develops from physical exercise. Sleep, food and rest are essential for human life because these help the different parts of the human body to work properly. But it should be kept in mind that it does not develop the hidden treasure of the body. This development is possible only by taking regular exercise.

We know that the nervous system controls the muscles of our body. So, if we regularly exercise the muscles; it can make the nervous system fresh and active. Physical exercise activates the physiological and metabolic system of the body. So, our capacity for daily work increases. Taking exercise just for a few minuites can provide us with proper digestive capacity, blood circulation, good respiratory system and proper heat control of the body. That means we will get a healthy body. It should be remembered that the functions of the muscle have a great role in this matter. We have to take regular exercise so that the main muscles of the body become active and stimulated. The habit of physical exercise should be chosen depending on age, general health and body structure.

The habit of physical exercise should be developed considering age, physical structure, general health and so on. Exercise is not a matter of mere dismal labour. All kinds of sports are sources of recreation in one handand they are types of physical exercise on the other. Nowadays, boys and girls equally take part in

games ranging from running, swimming, walking, cycling and karate to football, tennis, hokey and cricket. To keep our body fit, we should not only take exercise regularly but also lead our daily life accordingly. If a man walks 8000 to 10000 steps daily, he can hope to live a healthy, disease-free and longer life.

When a man becomes very tired of hard labour, then the muscles of the body become inactive, and so, we should keep our body in rest without work. This is called rest. Sleeping is the best rest. Daily six hours sleep is essential for keeping the body and mind fresh and healthy. Boys and girls need 8/9 hours and children need 10/12 hours sleep. The people who work at night need to get rest at day time.

Rest of Mind

Not only the body but also the mind needs rest. To remove all the stress and anxiety from the body and mind, both body and mind should have sound sleep. In this way the body and the mind gets proper rest.

It has been found that body and mind gets rest even by giving attention from one work to another. This is called rest by change of work. Recreation after hard labour is a rest, on the other hand, after hard mental labour doing a different work is the way to get rest.

It is seen that many famous writers are cleaning their fountain pen for hours together. He is getting rest doing this work. Some people take rest by gardening, rearing pets, doing amateur vegetable gardening or by recreation. All these are called rest by change of work.

Exercise

Multiple Choice Questions

1. What is mainly available in carrots?

a. Glucose b. Fructose
c. Sucrose d. B-carotene

2. Fat soluble vitamins in the body are

i. A, D, E
ii. A, B, C
iii. A, D, K

Which is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

Read the paragraph below and answer the questions 3 and 4.

Rahima's weight is 50 kg and her height is 1.5 metre. She has got vomiting and diarrhoea from yesterday. Her weight has become 47 kg due to water loss.

3. Due to the deficiency of essentials element Rahima's

i. Blood circulation is disturbed
ii. Muscles become weak,
iii. Salts remain balanced

Which is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

4. What is the BMI of Rahima after becoming sick?

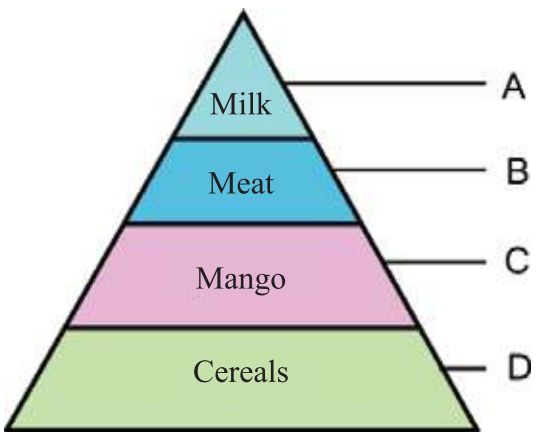
a. 22.3 (approx) b. 20.9 (approx)
c. 49.25 (approx) d. 44.75 (approx)

Creative Question

1. Tonu is 14 years old, she has 35 kg body weight and her height is 1.5 meter. Now-a-days her skin has become reddish and she has no appetite for food but her temperature is normal.

a. What is her BMI?
b. What is meant by zeropthalmia?
c. How much energy is consumed for Tonu in two day's metabolism?
d. Analyze the way to solving the problems of Tonu?

2. Look at the picture below and answer the questions:



a. What are fibres?
b. What are vitamins?
c. Find out the substitute foods for the food mentioned in this pyramid and prepare a list of a balanced diet for one day.
d. Why the food element marked as D is important? Explain.

Chapter Two
Water for Life

The other name for water is life. Water is needed not only for life but also for the development of the country. We obtain water from various sources. The sources of this essential resource are being polluted in many ways. In this chapter, we shall know about these threats and discuss how we shall face them.

At the end of this chapter, we will be able to-

- describe the properties of water;
- explain the structure of water;
- describe the different sources of water;
- explain the necessity of water for aquatic flora and fauna and also the standard of water;
- analyze the role of water in recycling steps for water conservation;
- describe the necessity of good quality water;
- explain the process of purification of water;
- explain the reasons for water pollution at sources in Bangladesh
- explain the effects of water pollution;
- explain the effects of global warming on fresh water in Bangladesh;
- describe the strategy to prevent water pollution and the responsibility of civil society;
- analyze the role of water in the development works;
- analyze the effects of threats on sources of water;
- describe the necessity for conservation of water sources and the strategies involved;
- explain that getting water is a fundamental right of all citizens;
- describe the universality of water and international rules;
- make investigations on the use of pure water and its effects on healthy living;
- investigate the reasons for the crisis of water (in domestic /agricultural /industrial use);
- draw posters to make people aware of the use and conservation of water;
- make people aware of normal water flow and prevention of water pollution;
- raise public awareness on the issue "water is a fundamental human right";
- be aware of preventing misuse of water and doing proper use of water;

2.1 Water

Water is one of the naturally abundant liquids on earth. In the human body, around 60-75% is water. Similarly meat, fish, vegetables etc. contain 60-90% water. Seventy five percent of the earth's surface is covered with water which is also essential for human survival. So it is said " the other name for water is life." Now, let us know some important properties of water.

2.1.1 Properties of Water

Melting Point and Boiling Point

What is the melting point and boiling point of water? When water is in solid state, we call it ice. The temperature at which ice melts is called its melting point and it is 0° Celsius. On the other hand, at atmospheric pressure, the temperature at which a liquid boils is called its boiling point. Boiling point of water is 99.98° Celsius which is very close to 100° Celsius. That is why we generally say that boiling point of water is 100° Celsius.

Pure water is colourless, odourless and tasteless. Do you know what the density of water is? The density of water depends on temperature. The density of water is highest at 4° Celsius and it is 1 gram/cc or 1000 kg/m^3 ' which means at 4° Celsius, the mass of 1cc water is 1 gram or the mass of 1 m^3 of water is 1000 kg.

Electrical Conductivity

Pure water does not conduct electricity; however, the presence of electrolytes like salts or acids in water makes it electrically conductive.

One of the very important properties of water is that it can dissolve a wide range of substances including both organic and inorganic. That is why water is termed as "a universal solvent". Another important property of water is its amphoteric behaviour. In the presence of an acid, water behaves like a base whereas, in the presence of a base, it behaves like an acid. However, pure water is completely neutral i.e. its pH is 7 which we shall learn in detail in chapter seven.

Structure of Water

Do you know what water consists of? Water consists of two hydrogen atoms and one oxygen atom (Fig : 2.01). So, in Chemistry, water is written as H_2O which is the chemical formula of water.

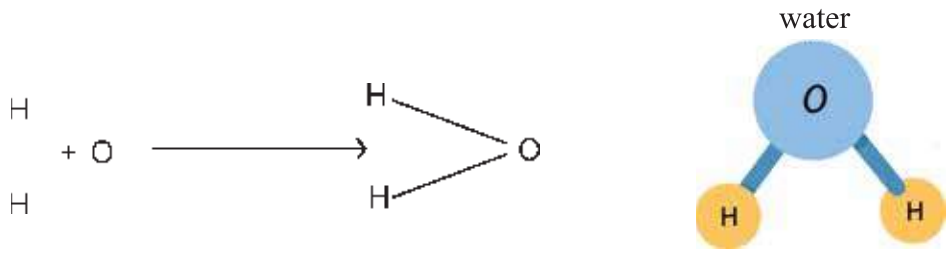


Fig. 2.01 : One molecule of water is composed of one oxygen atom and two hydrogen atoms

With the help of modern technology, it is seen that the molecules in water are present in the form of clusters.

2.1.2 Sources of Water

What are the sources providing water to us? The largest sources of water are seas or oceans which contain approximately 90% of the total water in the world. However, such a huge reserve of water is saline, as a result, we can not drink it, and even we cannot utilize it directly for many other purposes. Sea water is also called saline water or marine water.

The other sources of water are glaciers and snow where water is present in the form of ice. Approximately 2% of the total water reserve is available in this source. As it is present in the form of ice, this water also is not usable. The sources of usable water are rivers, canals, beels, lakes, ponds and ground water. We get groundwater through tube wells. Of course, ice or snow accumulated on mountains may melt and create water falls. It is to be noted that only 1 % of water is usable.

Sources of Fresh Water in Bangladesh

What are the sources of water that we are utilizing everyday for different purposes like cooking, washing, drinking, irrigation etc.? Sometimes we also need huge amounts of water for cultivation (for example, to grow IRRI rice). Where do we get this water from? Waterfalls are is not that available in our

country, therefore, main sources of fresh water in our country are rivers, canals, beels, ponds, lakes and earth's crust. However, due to the presence of hazardous chemicals (especially arsenic), the groundwater of large areas in Bangladesh has become unsuitable for drinking and in those areas rain water is collected, treated and then drunk.

2.1.3 Importance of Water for Aquatic Flora

Different types of aquatic plants like water hyacinth, water lily, algae, bindweed, duckweed (lemna), ori pana, water nut, water lettuce, lotus, hydrilla, water cress, Jussiacea repens etc. are known to all of you. Where do they grow? Most of them grow in water (Fig : 2.02). Some of them, like bindweed, grow both in water and land. Most of the aquatic flora could not grow without water or even if a few could grow, they would neither survive nor grow. What would happen in that case? In that case, the aquatic ecosystem could be hampered because the aquatic flora produce oxygen by photosynthesis and maintain the level of dissolved oxygen in water in one hand, on the other hand, they also work as food reserves for aquatic animals like fish. So if there were no aquatic flora, aquatic fauna could not survive which would be disastrous for the environment.

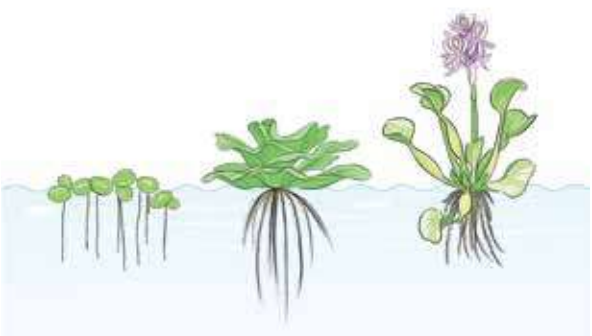


Fig. 2.02: Some aquatic plants

You know that plants usually take water and other necessary elements through their roots. However, aquatic flora collect water and necessary elements especially minerals through the whole parts of their body. So, if all the parts of the aquatic plants do not come in contact with water, their growth might be hampered.

It is also to be noted that, stems and other parts of the aquatic plants are so soft that they are suitable for adapting with water current and movement of aquatic fauna. If they grew on land instead of water, they would breakdown and would not grow and would not even survive. In fact, these plants have acquired these characteristics through millions of years of natural selection to survive in the struggle with the environment.

Do you know how the aquatic plants reproduce? Aquatic plants usually reproduce asexually and reproduction would have been hampered in the absence of water. So we can say that water is essential for reproduction and growth of aquatic plants which are very important for the ecological balance. If there were no water, aquatic plants would not grow or survive and as a result environmental disaster could occur.

2.1.4 Importance of Water for Aquatic Fauna

Among thousands of aquatic animals, fish is the most well-known to us. What happens when we catch a fish and put it out of water? It dies. Why? Because as we can not survive without air or oxygen, we die due to breathing problems, in the case of fish, it happens in the same way. Fishes take oxygen through the gills which are suitable for taking up oxygen only from water and not from air. If there were no water, no fish could survive. Not only fish but also other animals that take in oxygen by respiration through gills would not survive. As a result, environment would degrade and it would be very difficult for us to survive. You know that protein is an essential element for our growth. Approximately 80% of proteins needed for us comes from fish. Therefore, if there were no water, we might not have the necessary proteins. Therefore, all physiological activities including physical growth could be disturbed.

2.2 Water Quality Parameter

Water is a very valuable natural resource. It is a habitat for aquatic flora and fauna which are very important components of our environment. In addition, water is also used for irrigation. Moreover, mariners, boatmen and people who are in a similar profession depend on water for drinking and other purposes.

So, if the quality of water is not maintained, it will not only be threatening for the environment or bio-diversity but the use of water for other purpuses will also be limited. Now, let us give an idea about the water quality parameters.

The quality of water depends on the purposes for which water is to be used. First of all, we will find out the required quality of water of river, canal, heel, and seas.

Colour and Taste: You all know that pure water is colourless and odourless. Natural surface water in rivers, canals and lakes should be colourless and tasteless to sustain aquatic lives.

Turbidity

Turbid water could be harmful to aquatic flora and fauna because turbid water hinders the penetration of sunlight resulting in reduced photosynthesis of aquatic plants. As a result, growth of the aquatic plants is hampered and oxygen production by photosynthesis decreases as well. Moreover, in turbid water fish and other aquatic animals suffer from problems related to food collection.

Water becomes turbid for natural reasons like river erosion siltation etc. Again manmade reasons also cause turbidity e.g. water becomes turbid due to the presence of oil, grease and other insoluble substances. If these types of substances, especially soil and sand, increase significantly, at a stage, they settle down as sediment at the bottom of the river. As a result, navigability decreases resulting in a huge problem for the water vehicles like ships, launches, boats etc. In Bangladesh, it is a common problem that launches or steamers get stranded during their movement from one place to another. Why does it happen? It happens due to reduced navigibility.

Presence of Radioactive Substance

The presence of radioactive substances in the water of rivers and canals can cause dangerous diseases like cancer in aquatic biota. Therefore, river water, should be free from radioactive substances.

Presence of Waste

Surface water must be free from waste materials because waste materials may produce infectious microorganisms and that may cause disaster for aquatic biota.

Dissolved Oxygen

As we need oxygen for respiration, aquatic fauna also need oxygen for their respiration. How do they get oxygen? They get oxygen from water where oxygen is present as a dissolved gas. If the level of dissolved oxygen in water is reduced, it results in respiratory problem. In fact, aquatic fauna can't survive without dissolved oxygen. It is to be noted that the minimum level of dissolved oxygen required for sustaining life in water bodies is 5 mg/litre.

Temperature

Temperature is an important water quality parameter. The increase of temperature in water results in reduced amount of dissolved oxygen in one hand, on the other hand, starting from hatching, many physiological processes of aquatic animals fall into trouble.

pH

pH is a parameter with which we can easily evaluate whether a water sample is neutral, acidic or alkaline. For neutral water, pH is 7. If water is acidic pH becomes lower than 7 and if it is alkaline, pH becomes more than 7. The higher the amount of acid in water, the lower the pH is, while the higher the amount of alkali, the higher the pH. pH is a very important water quality parameter. Usually surface water is alkaline. It is found from research that a pH range of 6-8 is suitable for sustaining aquatic biota. If pH value alters significantly, it results in huge damage to aquatic lives. Fish eggs and newly hatched fishes are very sensitive to pH. Highly acidic condition of water i.e., very low pH of water extracts important elements like calcium leading to deformation of aquatic biota.

Salinity

Do you know why our national fish hilsha moves to fresh water during spawning? Although hilsha is a sea fish, it moves to fresh water for spawning because sea water is saline i.e., it contains huge amount of salt which sterilizes fish eggs. As a result, those fish eggs cannot produce young fish. So, it is a natural process that hilsha fish migrates to rivers at the time of spawing. But it is not applicable to all specees of fish. There are some aquatic fauna including certain species of fish which can spawn in water of high salinity.

2.3 Recycling of Water and Role of Water in Conservation of Environment

It is known to us that approximately 75% of the earth surface is covered with water, most of the water (about 97%) is saline and that is why they can not be utilized directly for different purposes. Only 1 % of water resources we have is fresh and the major portion of it is available in rivers, lakes etc. and it is being polluted (the pollution of fresh water will be discussed later in detail in this chapter). Even ground water being used for various purposes including drinking, is getting contaminated by toxic chemical substances like arsenic, and becoming unsuitable for drinking and cooking. Therefore, it clearly indicates that although we have a lot of water resources, the amount of potable and usable water is very limited. Hence, we need to be very careful in using water and we have to think about the reuse of water indeed.

Do you think that water is being recycled naturally? Yes, it is. You have learnt previously from water cycle in class VII that water from surfaces evaporates at day time with the help of sunlight and enters into the atmosphere as vapour which goes upwards and at a stage condense into cloud and finally comes back as rain water. A major part of the rain water flows as surface runoff and falls into waterbodies from where it is converted into vapour, condensed to cloud and precipitated as rain water. This recycling of water is very important because disruption of this recycling of water could lead to droughts or floods which in tum decrease the food production, and eventually long term droughts might turn the whole earth into a desert. Precipitation is a kind of natural recycling of water. If we collect wastewater after use and reuse it after treatment, the whole process will be a kind of recycle of water as well.

Role of Water in Conservation of Nature

As all the components and process of the environment depend on water directly or indirectly, so water is essential for a sustainable environment. If there is no water, plant will not grow, there will be no food production. In short, our existence along with the whole environment will be destroyed with out water.

Necessity of Quality Water: What do we do at first after getting up from the bed in the morning? We wash our hands and face. Can we do these works without water? No, it is impossible. Whatever we do in our daily life, we need to use water. Starting from taking bath to cooking food, we need water. If this water is not of good quality, we have to face a lot of troubles. For example, if the water is saline or has bad odour, we cannot drink it. Surface water in several districts in south western part of Bangladesh has become saline and that is why residents in those areas have been suffering from severe lack of fresh water. They can't utilize surface water for drinking and other purposes. So, they have to collect rainwater, and use it after purification. Moreover, if the drinking water is not of good quality, particularly if it contains disease causing germs, it may lead to severe public health problem. Do you think that we can use sea water in industry or agriculture? No, we can't because high salinity of sea water corrodes the equipments such as boiler used in industry. Similarly, most of our crops cannot grow in saline water i.e., saline water is not suitable for irrigation in agriculture. After all, we can say that starting from industrial use to agriculture and in our daily works, supply of good quality water is very essential. Otherwise it may cause health problem in one hand, and it may hamper us economically on the other.

2.4 Purification of Water

Surface water may contain harmful substances including toxic chemicals and pathogenic microorganisms. So whatever the sources, water must be purified before use. Ground water is normally germ free but we all know about the presence of harmful chemicals like arsenic in this water.

Methods of purification of water depend on the purpose of using water. As usual, although very pure water is required for drinking, such pure water is not required for irrigation. The methods that are involved in water purification usually are filtration, chlorination, boiling, distillation etc.They are discussed below:

Filtration

You have learnt about filtration in class VI. What is filtration? Filtration is a process to separate solid substances from a mixture of solid and liquid substances. Usually water contains insoluble dust or soil particles or waste materials which are removed by filtration. For that, water is passed through a layer of sand which traps the solid particles present in water. In addition to sand, finely woven cloths can be used for this purpose. The modern filters used in residences are made of quality materials.

Chlorination

Disease causing microorganisms in water are killed by disinfectants. Different types of disinfectants are used for purification of water. One of them is chlorine gas (Cl_2). Bleaching powder [Ca(OCl)Cl] and other chlorine containing compounds are also used for this.

Do you know what makes the tablets or kits used for water purification during flood in our country? It is basically sodium hypochlorite (NaOCl). Chlorine present in it kills the germs present in water. Other than chlorine, germs can also be destroyed by ozone gas (O_3) or ultraviolet radiation. In the bottled water factories, water is disinfected by these methods.

Boiling

Boiling of water is known to all of us. Is it possible to kill germs in water by boiling? Yes, it is possible. Boiling of water can kill germs present in water. Do you know how long the water should be boiled to kill germs in water completely? After starting the boiling, heating for additional 15-20 minutes can disinfect water completely. It is a simple and economical process for purifying drinking water at home.

Distillation

You have learnt about distillation in class VI. When very pure water is needed, water is purified by distillation method. For example, to manufacture medicine or to carry out chemical reactions, 100% pure water is needed. In this method, basically water taken in a container is heated to vapour which is condensed and collected in another container. The possibility of having other substances in water purified by this method is very low.

2.5 Reasons for Pollution of Water Sources in Bangladesh

Water of all sources is being polluted all over the world including Bangladesh. Let us see the reasons behind this.

Do you know what happens to waste water including that obtained after taking bath or obtained from toilet? A major part of domestic waste water falls into the rivers or lakes through sewerage pipes or drainage and pollute water severely. Starting from pathogens, different types of chemicals are present in the waste water. As a result, water is polluted.

What do we do with the solid waste generated in our homes? We usually discharge them either in dust bin or in open places . After discharging, waste materials undergo biodegradation in 1-2 days. Upon rainfall, biodegraded waste which is full of pathogenic microorganisms and different types of harmful chemicals gets mixed with rainwater and pollutes water in rivers, canals, beels or lakes.

You all know that, chemical fertilizers, organic fertilizers and pesticides are used in cultivation to increase soil fertility. Does it cause any water pollution? Yes, it does. Either by surface runoff from precipitation or flood water, the above mentioned harmful substances are carried to the waterbodies and contaminate water.

Do the industries pollute water? Yes, one of the main reasons for pollution of water sources is discharge of industrial waste into water. If you visit the river Buriganga, you will see that its water is black and has intolerable odour. The reason behind this is industrial development on the bank of the river particularly

the development of leather industries. Industrial wastes are directly discharged into the Buriganga without any treatment polluting the river water severely. Reports are published on pollution of water in Buriganga River both m newspapers and television. Like the Buriganga, most of the river water is being polluted by thousands of industries including textile industries, dyeing industries, dye manufacturing industries, fertilizer industries, paper industries etc. Moreover, water of rivers and seas is also being polluted due to discharging human excreta and petroleum oil like materials from boats, launches, steamer or ships. Dust, soil particles or other substances mix with water and pollute it by river bank erosion, storm etc. Waste water discharged from chemical laboratories containing toxic chemicals like acids, alkalies etc. are also polluting water at different sources. Contamination of groundwater by chemicals like arsenic is known to all of us.

2.5.1 Effects of Water Pollution on Plants, Animals and Human Beings

Pollution of water from different sources like rivers, lakes and underground may pose harmful effects and sometimes that may cause disasters. The harmful effects are discussed below:

Do you know that typhoid, cholera, dysentery, infectious hepatitis B- all these are water-borne diseases? Yes, all these deadly diseases and many others spread through water and even may become epidemic. The pathogens of these diseases enter into water in many ways (excreta and degraded waste are the potential sources in this regard). Upon taking bath in that water, drinking that water, cooking or washing food are coming contact with that water, those pathogens are transmitted to human beings or other animals.

There are some chemical substances like cow dung, plant residue, food items such as sugar, glucose etc. react with dissolved oxygen in water.

What will be the effects of this reaction? As a result of this reaction, the dissolved oxygen level in water decreases and even it could be decreased to zero if the amount of aforementioned substances is very high. In that case, aquatic fauna including fish will die due to lack of oxygen. If this condition prevails for

a long time, at a stage living beings in the water bodies will not be able to survive there.

Lake Erie in Ohio State in the USA was declared dead in 1960's. The reason behind this was discharge of waste water enriched with phosphate from detergent industries developed on the bank of Lake Erie. Increase of phosphate and nitrogen in water results in algae bloom. When the algae die, they undergo biodegradation and consume dissolved oxygen resulting in oxygen starvation in water. In this situation, waterbodies cannot sustain life and becomes dead like Lake Erie. After that incident, the US government formulated law to stop waste water discharge into waterbodies without treatment. The detergent industries then started discharging waste water after removal of phosphorus by treatment and Lake Erie sprung back to life after 10 years.

Now, the pollution level in the River Buriganga is similar to Lake Erie and fish is rarely found there. Not only the Buriganga, many of our rivers have been polluted by industrial wastes severely and if proper steps are not taken immediately, the rivers will be dead like Lake Erie. This may result in significant environmental degradation.Waste materials, algae etc. not only result in oxygen depletion but also cause bad odour in water and therefore lead to disruption of recreational usage of waterbodies like swimming, fishing, river cruise etc. It is known to you that inorganic substances (such as acids, alkalies, salt) are also harmful to aquatic biota. Drinking water containing toxic metallic substances like mercury, lead, arsenic, can cause many diseases in human body. The effects of mercury, lead and arsenic in human body is mentioned below:

Fig. 2.03: Man becomes sick after drinking contaminated water.

Mercury (Hg): Brain damage, skin cancer and deformation.
Lead (Pb): Dizziness, eye irritation, anaemia, kidney damage and at a high dose, brain damage.
Arsenic: Arsenicosis, Cancer in skin and lungs, gastrointestinal disease.
The use of inorganic fertilizer (Nitrate and phosphate) in agricultural field causes serious water pollution. Contamination of water by radioactive substances like uranium, thorium, cesium, radon etc. is threatening to aquatic biota as well as human beings because radioactive substances cause different types of cancer and respiratory diseases in humans, plants, and animals.

Can you tell how the radioactive substances enter into water? The best example of this is the nuclear accident happened recently in Fukushima city (11 March, 2011) from nuclear power plant. In that accident, due to Tsunami, huge amount of radioactive substances were released to the surroundings. As a result huge radioactivity was found in many things starting from water to food items.

In addition, presence of insoluble matters in water makes water turbid and the corresponding effects have already been discussed.

2.6 Global Warming

2.6.1 Effects of Global Warming on Fresh Water

Global warming means the increase in atmospheric temperature. If the atmospheric temperature increases, temperature of surface water will increase too. About 100 years ago, the atmospheric temperature was approximately 1°C less compared to present atmospheric temperature. You may think that 1°C increase in 100 years is not that significant, but it is a very crucial issue and very significant because a slight increase in temperature results in melting of ice reserves in the world including that in the polar region. The water produced thereof ultimately falls into the seas or oceans resulting in rise of sea or ocean level. Therefore, the low lying countries will be submerged in water. Bangladesh is such a low-lying country.

Salinity

If the sea level rises, marine saline water will mix with the water of rivers, canals, ponds and ground water. Hence all the sources of fresh water will be saline. What will be the difficulties if fresh water sources become saline? At first, fresh water aquatic biota will be in trouble and at a stage they will be extinct. It is due to the fact that with the increase in temperature, dissolved oxygen decreases. Moreover, increase in salinity in water also results in decrease of dissolved oxygen i.e. due to increase in both temperature and salinity of water, the amount of dissolved oxygen will decrease significantly. As a result, aquatic fauna will not survive. A major part of aquatic plants can not grow and survive in saline water and that will lead to loss of aquat¬ic biodiversity.

Precipitation

Due to global warming precipitation and its pattern may change. Computer modeling shows that in some regions there will be excessive precipitation whereas in some other regions, particularly in temperate region, there will be reduced precipitation that may create droughts, even a huge area may Turn into desert. Change in precipitation will alter the flow and amount of water in waterbodies which may cause disasters. Computer modeling also shows that in some region the precipitation in winter will increase significantly which may cause devastating untimely flood.

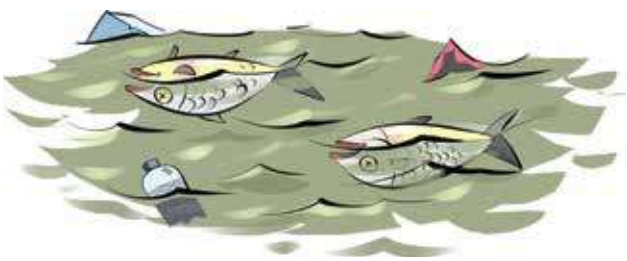


Fig. 2.04: Fishes die due to the rise in temperature.

2.6.2 The Effect of Global Warming in Bangladesh

The effect of global warming in Bangladesh is visible because in recent years summer is becoming hotter gradually even sometimes the temperature reaches as high as 47°C which did not happen before. Data on temperature record show that relatively higher temperature is observed both in summer and winter indicating that the effect of global warming in Bangladesh is obvious.

What would be the effects of global warming on fresh water of Bangladesh? You know that due to global warming ice reserves will melt and sea level will rise. This effect will be intensified in Bangladesh because it is estimated that due to rise in water level in the Bay of Bengal, one-third of our country will be submerged in water. The saline water will intrude into fresh water and basically there will be a scarcity of fresh water. In southwestern part of Bangladesh including Satkhira District, saline water needed for shrimp cultivation is carried by drainage system into the main land. As a result underground water along with other fresh water sources has become saline. Hence, there is scarcity of water to be used for drinking and other purposes. In those areas right now only source of fresh water is rain water. Fresh water scarcity is so severe that residents of 10-15 villages are sharing the rain water collected in a single pond. From a study, it is seen that housewives had to travel 7-8 kilometers for bringing the collected rain water. Due to sea level rise for increasing global warming, the whole Bangladesh may suffer from this kind of water scarcity. A significant part of Maldives and India have already been submerged in water due to global warming and a substantial part of the total population of those countries has already become climate refugees. Bangladesh is a land of rivers and due to global warming change in precipitation pattern may affect the water flow both in terms of amount and flow direction and cause severe problems.

Fig. 2.05: Impact of global warming.

2.7 Strategy for Preventing Water Pollution and Responsibility of the Citizens

We have already known how water is being polluted. The most important aspect of strategy to prevent water pollution is to find out the reasons for water pollution and to take necessary measures accordingly. Now let us see what strategies can be adapted to prevent water pollution:

Protection of Wetlands

Recently in our country, wetlands are being filled to build homes, residential apartments, shopping malls etc. Do you know that wetlands play very important roles in addition to holding water? Wetlands hold water and control flood in one hand, on the other hand, they absorb harmful substances from water and infiltrate pure water both to earth's crust and rivers. Moreover, wetlands help wild animals by providing water. Forests also help in infiltrating groundwater and work as a habitat for wildlife. Destruction of wetlands and forests results in increased water pollution. If steps are taken to protect wetlands and forests, it will be helpful in reducing water pollution. In this regard, civil society can play very important roles. Students of schools, colleges and universities in our country are working for creating public awareness by planting trees, cleaning wetlands, lakes and sea beach to prevent water pollution.

Utilization of Rain Water

In municipal areas, one of the major reasons for water pollution is surface runoff from rainwater. In these areas, most of the places including roads are made of concrete. So rain water cannot infiltrate to earth's crust and converted into surface runoff which carries all wastes and toxic substances through sewerage system and finally discharges into rivers, lakes or wetlands and pollutes water there. How can this pollution be stopped?

Is it possible to collect rain water on the roof top? Yes, it is possible and can be done easily. In fact, we can use that collected rain water for gardening or for watering flower tubs, even we can wash cloths or use toilets or washrooms with that water. These kinds of practices reduce water pollution as well as lessen the pressure on water supply. Many of you know that in Dhaka city, severe scarcity

of water prevails in many areas in summer. Even in some residential areas, it is seen that there is no supply of water for 3-4 days. In that case, utilization of rain-water will play a positive role in the management of water supply. Government, municipal authority and civil society may play potential roles in this regard.

What can be done to reduce pollution by surface runoff in other places except residences? Instead of using concrete we can use porous materials through which water can infiltrate to and accumulate in earth's crust. Gravel is such a material that can be used instead of concrete. Moreover, if possible, rain water can be captured by digging large pond or canal. This kind of rain water management is practised in many cities in the world.

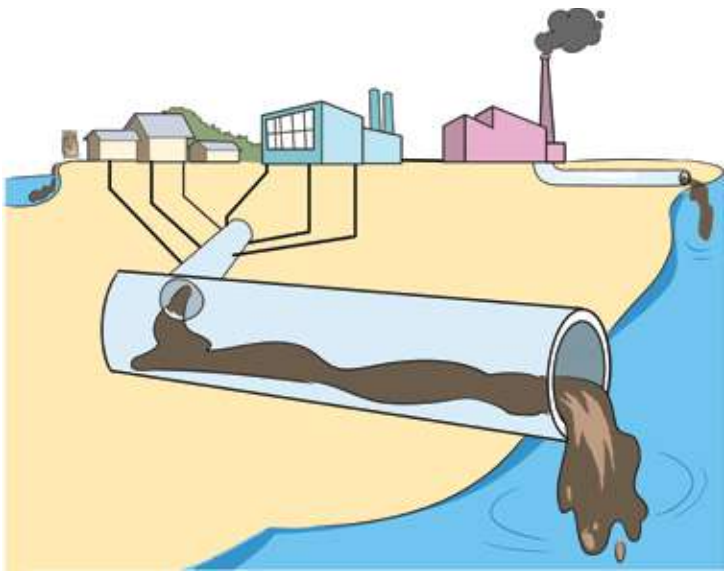


Fig. 2.06 Water pollution

Increasing Public Awareness

Do you understand that a major part of harmful wastes polluting water comes from domestic sources particularly in municipal areas? We use lots of harmful consumer products like aerosol, paints, cleaning agents, insecticides etc in our daily life, and after using we discharge them here and there and they pollute water at a stage. If we dispose those waste items properly in a particular place instead of throwing them here and there, then water pollution will be reduced.

To reduce water pollution in this way, there is no alternative to increasing public awareness. For that, appropriate educational programmes and warnings can be broadcasted by radio or television. Even you, school students, can make posters on necessity and scarcity of water and also on prevention of water pollution to make people aware. In fact, in developed countries like the USA and Europe, steps are taken by the government to increase public awareness.

Prevention of Water Pollution by Industries

Discharge of waste water from industries is one of the main reasons for water pollution particularly river water pollution. The best way to prevent this type of pollution is to treat waste water before discharging. For this, Effluent Treatment Plant (ETP) is needed. The design and steps of ETP depends on nature of harmful substances present in waste water. As the composition of waste water varies from indurtry to industry, a common ETP cannot be used to treat waste water from all industries. But an industrial zone of similar type of industries can be developed and waste water from all industries can be collected and treated by a single ETP for each type of industries.

Prevention of Water Pollution Due to Soil Erosion from Agricultural Land

Cultivation of same crops repeatedly in the same land can damage the fertility resulting in increased soil erosion. Use of organic fertilizers to increase soil fertility helps to reduce soil erosion. Can you tell how it happens? Higher amount of organic substances present in organic fertilizers can retain more water. As a result, upon rainfall, surface runoff is not created easily or soil particles can't move easily by wind and do not pollute water. Therefore, water pollution due to soil particles as well as other toxic chemicals such as insecticides, nitrogen and phosphorus fertilizers etc. is reduced in this way. Pollution can also be prevented by digging ponds surrounding the agricultural land.

Do you know that the remaining part in the field after cutting the crops can prevent water pollution? How is it possible? Changing in crop types also can prevent water pollution. Water pollution can also be prevented by avoiding use of fertilizers immediately before precipitation.

Role of Water in the Development Work

Our country is an agricultural country. Development of our country is impossible without the development of agriculture, and water is required for irrigation in agriculture i.e. development of our country is not possible without water. Can we build house without water? No, it is impossible. All the developed countries in the world are industrially developed. Is there any industry that runs without water? No, there is none. In all industries, use of water is mandatory at some stages. Therefore, we can say that water and development of a nation are complementary.

2.8 Threats at Water Sources in Bangladesh

Do you think that water sources at Bangladesh (rivers, canals, heal, haors, and lakes) are in threats? Yes, certainly water sources in our country are in several threats. Firstly, the threats due to global warming and climate change may be mentioned. You have known before that one third of Bangladesh may be sub-merged in water due to this kind of change. As a result, our water sources will be destroyed. We will discuss here other causes.

Threats Due to Flood and Soil Erosion

Geologically Bangladesh is a flood prone country. Majority of the rivers in Bangladesh have strong water current which causes river erosion. Can you tell what happens to soil eroded by river erosion? Soil mixes with water current and at a stage settles down as sediment and fills up the river bed. This may lead to change in direction of rivers on one hand, on the other hand, a river can be water depleted, and even they (rivers) may die.

Do you know that many rivers in our country have died already? Karotoa, Bibiana, Shakha Barak– all of them are now dead. Even the state of our mighty river, the Padma is now in danger. You might see the movement of cart below the Pakshi Bridge on the river Padma. The reason is sedimentation in the river bed. The drying up of rivers means depletion of water resources.

River Encroachment

Now-a-days, different types of infrastructure even residential areas are developed by encroaching rivers. What are the after-effects of that? The water flow in rivers is becoming narrower and water holding capacity of rivers is going down. As a result, when there is a heavy rainfall, it causes flood. Several rivers including The Buriganga and Shitalakhya are almost dead due to encroachment. If it is not stopped, all these rivers will die in near future.

Flood Control Embankments

Do you think that embankments for flood control are also threats to water resources? Yes, they are. Due to embankments in the Padma, the Jamuna and some other rivers, water flow has been disturbed severely in their tributaries. Monoj, Baral and Kumar rivers had died in this connection. In the southwestern part of Bangladesh, Morichhap, Hamkura and Horihor River also died due to embankments. So it is very clear that embanksments are severe threats to water sources.

Unplanned Waste Management

Do you know how much solid waste is generated in Dhaka city everyday? It is approximately 500 metric tons/day. Half of it is collected and managed by Dhaka City Corporation and the rest are thrown into waterbodies either through sewerage or other means. In addition, almost all industrial wastes are also discharged into rivers without treatment. What are the effects of this kind of activities? Rivers are being filled up gradually and water is becoming poisonous. If it continues, the rivers like the Buriganga, the Shitalakkha and the Balu will die soon. The condition of the rivers surrounding Chittagong city is also similar.

Diversion of Water Flow

In 1975, the Indian Government diverted water flow in the Ganges. In 1977, Bangladesh and India signed an agreement on proper distribution of water of the Ganges. Later on in 1996, another agreement was signed for equitable water distribution. Due to diversion in water flow in the Ganges, many rivers in northern part of Bangladesh have been water depleted converting those areas

into almost a desert. Besides this, India has planned to divert the water of Brahmaputra to western India through Shiliguri corridor. If the project is implemented, the water resources of entire southern part of Bangladesh including 300 km^2 haor area will be in trouble. Recently, India planned to build a dam in Tipaimukh which may convert the eastern part of Bangladesh into a desert. In a nutshell, we can say that diversion of water flow is a potential threat to water sources of Bangladesh.

Water is a Fundamental Right

Water is such a gift of nature which is essential for most organisms. From the ancient time, human beings have been using water for drinking, cooking and other purposes. Five fundamental human rights are food, cloths, shelter, education and medicine. All of them are dependent on water. Therefore, water is also a fundamental human right. As water is a natural resource, no nation or country did produce it, so all human beings have the equal right on every single drop of water. So whenever we use water, we have to keep in mind that it is a resource of others also and we should not misuse it because misuse of water may deprive others and it is not reasonable.

Conservation and Development of Water Sources

We all know that we have huge water resources. But the amount of usable water is limited in true sense. In this situation, if we are not aware, we may suffer severely. All the development works starting from industrialization to road construction and urbanization, the role of water is infinite. However, if water sources fall into risks due to these kinds of developments, then in fact every development will be stopped. Hence, we should have well planned development programmes for industrialization and urbanization so that the water resources are not hampered.

2.9 Universality of Water Flow and International Conventions

Do you know that all oceans and seas in the earth are connected to each other? Yes, they are connected. Again, rivers created from waterfall ultimately fall into

seas or oceans. That means wherever the geological position, origin/source or direction is all the rivers are global natural resources i.e., water resource is a universal matter. It does not belong to a particular nation, country or continent. Due to enmity among different countries, development competition or belligerence, the universality of water resource is being violated in many cases. In 1997, United Nations adopted an International Convention for Utilization of International Rivers for non-navigational purpose which is yet to be fruitful. In addition to that, steps taken by the international community in this regard are discussed below:

Ramsar Convention

UNESCO organized an international meeting on 02 February, 1971 in Ramsar, Iran and the decisions taken there regarding wetlands are known as Ramsar Convention. Bangladesh signed the convention in 1973. Later on the Ramsar Convention was amended in 1982 and 1987.

International Water Course Convention

The International Law Association in 1966, in their 52nd meeting in Helsinki accepted a committee report on the use of water of international rivers. It is known as Helsinki Rule. Later on, International Law Commission of the United Nations worked to formulate a law for utilization of water of international water course which was adopted as a convention in the general assembly of United Nations on 21st May, 1997. According to this convention, no country can withdraw water of a river flowing through more than one country without the consent of other countries. But as per this convention, member countries can utilize water in their part justifiably and reasonably. However, it is to be ensured that by using water, a country should not disturb the water flow in other countries.

Do different countries of the world obey these rules?

Exercise

Multiple Choice Questions

1. Which of the following plant grows both in water and land?

a. Algae
b. Bindweed
c. Water nut
d. Duckweed

2. Extreme decrease in pH of water results in aquatic fauna-

i. improper growth of different organs
ii. lacking of minerals in bodies
iii. attacked with various diseases

Which one is correct?

a. i and ii
b. i and iii
c. ii and iii
d. i, ii and iii

Read the following paragraph and answer questions 3 and 4:

Onik and Tushar culture fish in two separate ponds. The fish growth in Onik's pond is satisfactory whereas in Tushar's pond, the fishes are weak and their organs are not grown properly.

3. What is the type of water of Onik's pond?

a. acidic
b. alkaline
c. neutral
d. enriched with calcium

4. Which of the followings should be used in Tushar's pond?

a. acid
b. alkali
c. calcium
d. phosphorus

Creative Questions

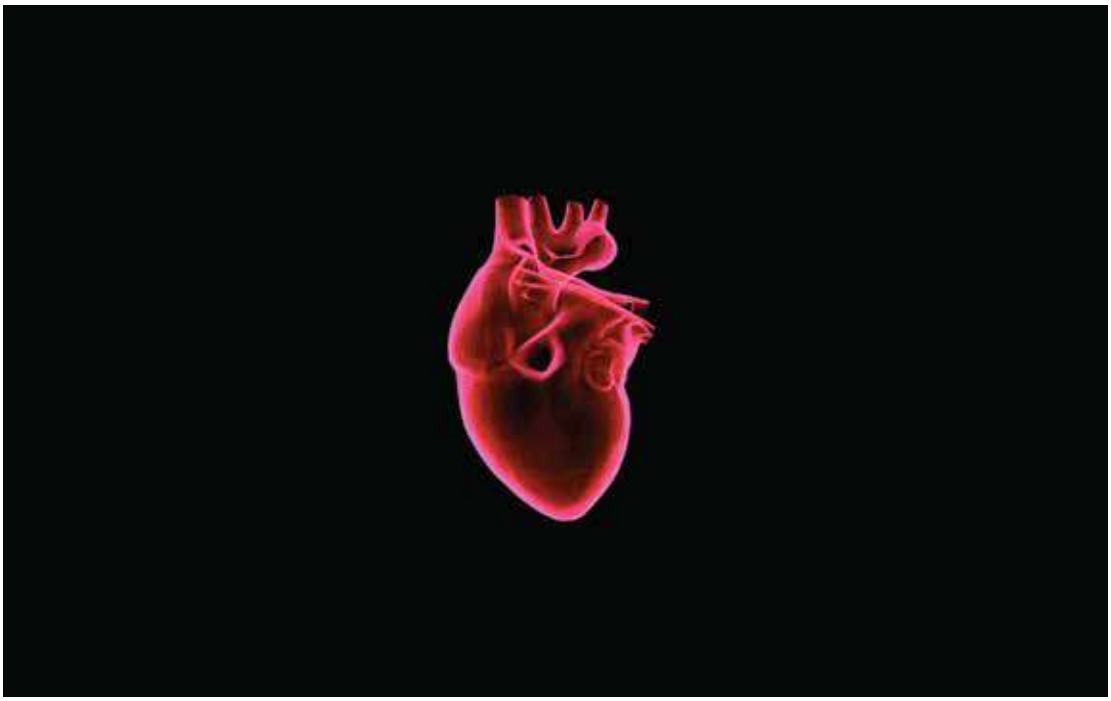
1. See the following picture and answer the questions:

a. Which dissolved gas undergoes chemical reaction with glucose?
b. What do you mean by recycling of water?
c. To what kind the river will be converted? Explain.
d. Do you think that it is possible to spring back the river to sustain aquatic animals? Justify your answer.

2. Mrs. Jamila makes turbid water of a nearby pond suitable for cooking by a special process. On the other hand, Mr. Ratan uses his water both in bottled water manufacturing plant and pharmaceutical industry after disinfecting.
a. What is meant by the term "boiling point of water"?
b. Why do the aquatic plants not break down by water current?
c. How does Mrs. Jamila make pond water suitable for cooking? Explain.
d. Does Mr. Ratan disinfect water for both plants in the same method? Justify your answer.

Chapter Three

All about Heart and others



The blood circulatory system is one of the most vital systems in human beings and other complex animals because this system supplies nutrition all over the body for metabolic activities. Blood circulatory system consists of blood, heart and blood vessels. Heart is formed by cardiac muscles. It is a triangular vacuum chambered and pump like organ. Blood is circulated by its expansion and contraction. Blood vessels are of three kinds according to shape, structure and function i,e, - artery, vein and capillary. The heart works like a pump in humans and other animals for circulating blood through vessels. Oxygenated blood is circulated in the whole body through artery. Normally carbon dioxide rich blood returns to heart from different parts of the body through veins. The connecting site of artery and vein is the capillary system. We will discuss blood in detail in this chapter.

At the end of this chapter, we will be able to-

- explain the components and functions of blood;
- explain the characteristics of blood groups;
- explain the principles of blood transmission;
- explain the necessary precautions for blood transfusion;
- explain the causes of obstacles in blood circulation and its effects;
- explain the blood circulation process in human body;
- analyze the relation among normal blood pressure, heart beat, heart rate and pulse rate;
- explain the physical problems related to blood pressure, and its prevention technique;
- analyze the role of cholesterol in blood circulation in the body;
- explain the necessity and ways of keeping cholesterol at the expected level;
- explain the causes, preventive measures and cures for imbalanced blood sugar;
- describe the ways of keeping a healthy heart.

3.1 Blood

Animal blood is red, opaque inter cellular, salty and alkaline liquid connective tissue. A healthy adult person has 5-6 liters of blood (8% of total body weight). The blood of human beings and other vertebrates is red in colour. Blood is red in colour for hemoglobin. Hemoglobin is a proteinous substance with iron. Hemoglobin chemically joins with oxygen and form oxyhemoglobin. Little amount of carbon dioxide is transferred to lungs with hemoglobin. But most of the carbon dioxide is transferred to lungs through blood as bicarbonate ion.

The Components of Blood and Their Function

The main components of blood are plasma and blood cell (Fig: 3.01). Plasma is 55% and cell is 45% in blood. Blood cell and plasma can be separated by centrifuge. Plasma is pale yellow in colour and blood cells are deep red in colour. Actually blood cells float on plasma.

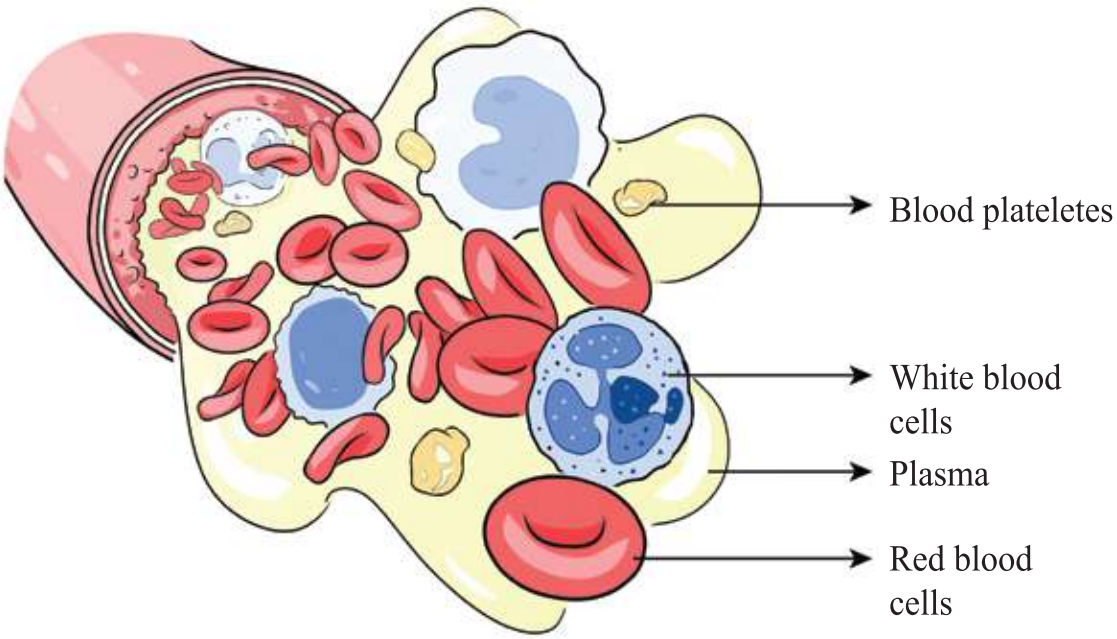


Fig. 3.01 : Different components of human blood

3.1.1 Plasma

The liquid portion of blood is called plasma. Plasma has 90% water and 10% other different types of soluble organic and inorganic substances. The inorganic substances are different types of minerals e.g. sodium, potassium, calcium, chlorine, magnesium, phosphorus, iron, iodine and the gaseous substances like O_2, CO_2, N_2, etc.

The organic substances are-

1. Nutrient- glucose, amino acid, fats and vitamins.
2. Excretory products- urea, uric acid, ammonia and creatinine etc.
3. Protein- Fibrinogen, globulin, albumin, prothrombin etc.
4. Preventive substances are- antitoxin and agglutinin.
5. Various hormones of endocrine glands.
6. Cholesterol, lecithin and bilirubin.

Functions of Plasma

1. Nutrients are transferred to different parts of the body with blood corpuscles by plasma.
2. It extracts the residue from the tissue and transfers to kidney for excretion.
3. The byproduct of respiration that is CO_2 is transferred to lungs as bicarbonate.
4. It transfers the necessary elements for coagulating blood.
5. It transfers hormone, enzyme, and lipid to different parts of the body.
6. It keeps balance of acid and alkali in the blood.

What is Serum?

Serum is a liquid which is separated from the coagulated part of blood after blood clotting. There is a difference between plasma and serum. There are blood corpuscles in plasma but no blood corpuscles are in serum.

3.1.2 Blood Cells

Different types of blood cells spread in plasma are called the blood cellls. Blood cells are of three kinds (i) red blood cell or erythrocyte (ii) white blood cells or leukocyte and (iii) thrombocytes.or platelets.

Red Blood Cell

The red blood cell of human body is biconcave and disc shaped (Fig : 3.02). It has a pigment called hemoglobin which makes blood red. So they are called red blood cells or RBC. RBC is mainly floating flat bags full of hemoglobin. So, RBC can carry lots of oxygen. Mature RBC can not multiply. This RBC is produced continuously from bone marrow and they come to the plasma. The life expectancy of RBC is about four months or 120 days.

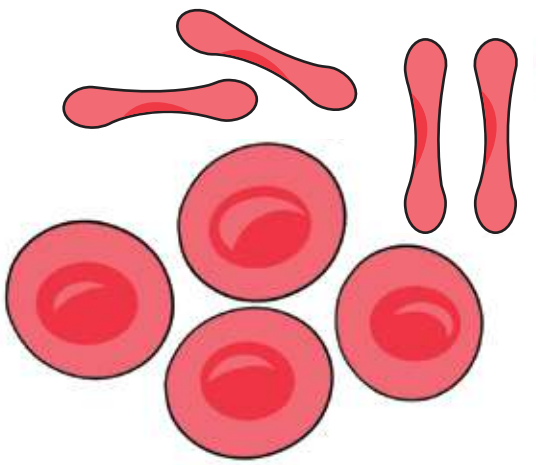


Fig. 3.02 : Red blood cells

In mammals RBC become nucleus-free before coming to plasma. This does not happen in RBC of other vertebrates. Their RBC is stored in the spleen and supplied to plasma for any urgent need.

The number of RBC for human beings at different ages are: in embryo 80-90 lac, in an infant 60-70 lac, adult male 4.5-5.5 lac, and adult female 4-5 lac.

The functions of RBC: The main functions of RBC are-

i. to supply oxygen to each and every cell of the body.

ii. to carry some amounts of carbon dioxide from tissue to lungs.

iii. with the help of hemoglobin RBC works as buffer stock to keep balance between acid and alkali.

White Blood Cell or Leukocytes

There is no specific structure of WBC. They have no hemoglobin but have a big nucleus. The life expectancy of WBC is 1-15 days. They are called the white blood cell for the absence of hemoglobin. Their number is smaller than that of the RBC. They can change their body shape like amoeba. They kill germs by phagocytosis (Fig : 3.03). They can come to tissue by crossing the wall of blood vessels. The WBC can move itself through plasma. If the body is attacked by external germs, the WBC can multiply quickly. In human body the number of WBC is 4-10 thousand per cubic millimeter. The number is usually higher in the bodies of children and patients. White blood cells contain DNA.

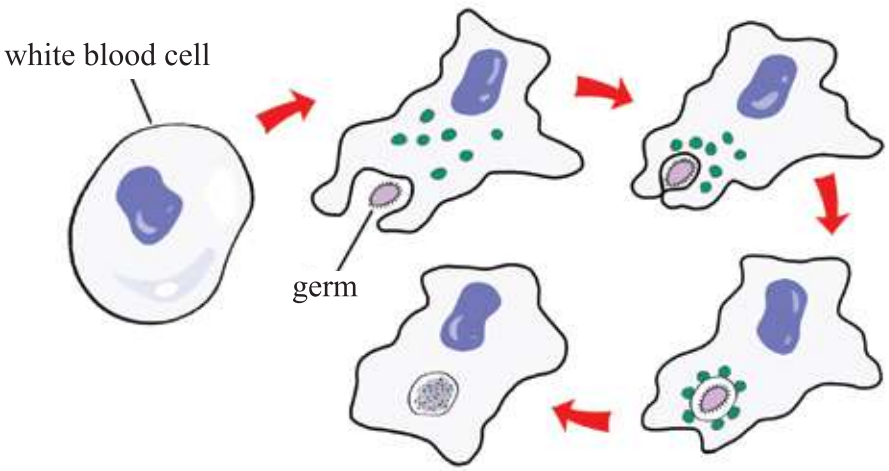


Fig. 3.03 : White blood cell is destroying germs by phagocytosis

Types

WBC is of two types according to structure or the presence or absence of cytoplasm. They are (a) Agranulocytes and (b) Granulocytes (Fig : 3.04).

(a) Agranulocytes

This type of WBC is non-granular and transparent. Agranulocytes are of two types e.g. - lymphocytes and monocytes. They are produced in lymphnode, tonsil, spleen etc. Lymphocytes are small in size with a big nucleus; Monocytes are big in size with a small, oval and kidney shaped nucleus. Lymphocytes

form antibody and this antibody kills the germs. Thus the immunity of the body increases. Monocyte kills the germs by phagocytosis.

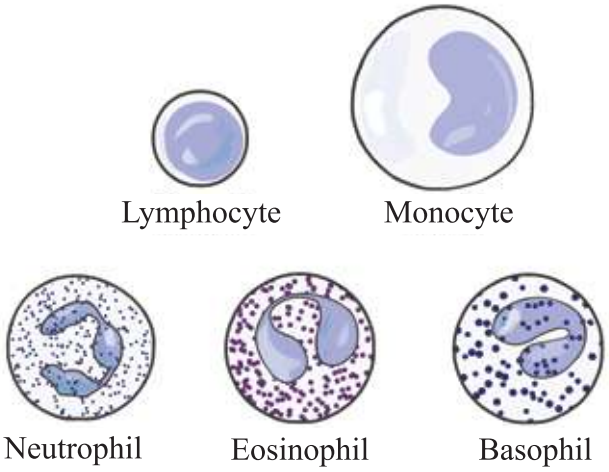


Fig. 3.04 : Different types of white blood cell

(b) Granulocytes

The cytoplasm is small and granular. Granulocytes are of three kinds according to the shape of the nucleus. (i) Neutrophil (ii) Eosinophil and (iii) Basophil.

Neutrophil kills germs by phagocytosis. Eosinophil and basophil secrete a chemical called histamin and prevents allergy. Basophil secretes heparins and prevents blood from coagulation.

Thrombocytes

They are called platelets. They can be round, oval or rod shaped. Their cytoplasm is granular. This cytoplasm has the mitochondria or Golgi substances; but no nucleus. Many people think these are not cells but fragments of bigger cells of bone marrow. The average life expectancy of thrombocytes is 5-10 days. In an adult person the number of thrombocytes is 1.5 – 4.5 lac per cubic milliliter. This number may be higher or lower in a sick body.

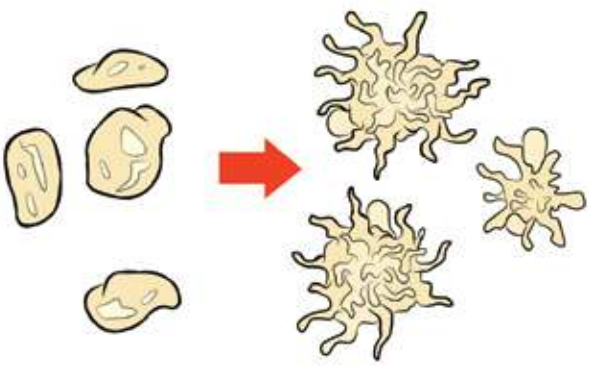


Fig. 3.05 : Thrombocytes and its change of shape

The main function of thrombocyte is to help in blood clotting. When a vessel or any tissue is cut by injury then the thrombocytes of that place break down (Fig : 3.05) and secrete thromboplastin. This thromboplastin transforms the prothrombin into thrombin. This thrombin then transforms the fibrinogen into fibrin net. This fibrin net helps blood to clot. Fibrin is a kind of non soluble protein which makes thread like nets. It coagulates in the damaged part and stops bleeding. This process is more complicated. Different types of chemicals and vitamin K and calcium ion are involved in this process.

Individual Work

Make a table to differentiate between RBC, WBC and Platelets

3.1.3 The Functions of Blood

1. **Respiration:** Blood transfers CO_2 from tissue to lungs and transfers the 0_2 from lungs to tissue. Mainly RBC and plasma do this work.
2. **Hormone Transfer:** Blood transports hormone secreted from the endocrine glands to the different parts of the body.
3. **Transportation of Nutrients:** Blood carries nutrients to the cells of tissue of the body.
4. **Transfer of Residue:** Blood sends the nitrogenous residue to the kidney.
5. **Heat Control:** Blood has role in body temperature regulation by providing equal heat to all parts and organs of the body.
6. **Prevention of Diseases:** The monocytes and neutrophils kill the germs by phagocytosis process. Lymphocytes produce antibody and kill the germs inside the body and protect the body from external germs.

The List of Different Elements of Blood of an Adult Person

1. RBC in male: 4.5-5.5 lac per cubic mL
   Female: 4-5 lac per cubic mL
2. (a) WBC: 4000 : 10000 per cubic mL
   i. Neutrophil: 75%
   ii. Eosinophil : 1-6%
   iii. Monocytes : 2-10%
   iv. Lymphocyte : 20-45%
   v. Basophil: 0-1 %

   } the percentage of total WBC.

3. Hemoglobin } Male: 14-16 gm/dL
   Female: 12-14 gm/dL
4. Platelets: 150000 - 450000 per cubic mL

Other Organic Substances:

i) Serum Urea: 5 - 20 mg/dL
ii) Serum Creatinine: 0.5 - 15 mg/dL
iii) Cholesterol : 0 - 200 mg/dL
iv) Bilirubin : 0.1 - 1.2 mg/dL
v) Blood sugar (before meal) normally 3.9 - 5.6 mmol/L

3.1.4 Abnormal Condition of Blood Elements

The differences in the standard amount of various elements in blood are called abnormal condition of blood e.g.-

(i) Polycythemia: Excessive increase in hemoglobin level and blood cell count.
(ii) Anemia: A decrease in the amount of hemoglobin compared to normal conditions.
(iii) Leukemia: In diseases like pneumonia, plague, cholera etc. the number of white cells increases. But if the number of white cells increases at a much higher level than those, then it is called leukemia or blood cancer. There are several types of leukemia that are largely curable.

(iv) **Leukocytosis:** If the number of white cells increases above the normal level, it is called leukocytosis. This condition occurs in diseases such as pneumonia, whooping cough etc.

(v) **Thrombocytosis:** The number of platelets becomes higher than the normal. Clotting of blood in the blood vessels is called thrombosis. If the blood is clotted in the coronary vessels of the heart, that is called coronary thrombosis. If the blood is clotted in cerebrum, that is called cerebral thrombosis.

(vi) **Parpura:** Purpura is caused by dengue fever due to bleeding under the skin. The number of platelets decreases than the normal.

(vii) **Thalassemia:** Thalassemia is a hereditary disease of blood that affects a person's ability to produce hemoglobin, resulting in anaemia. This disease is passed to children by parents who carry the mutated thalassemia gene. Normally this disease is identified in childhood. The treatment of thalassemia involves regular blood transfusions. In this disease, having iron supplement or iron-rich food does not help much, instead the complications of the disease may worsen due to iron accumulation. Despite regular blood transfusions and other treatments, many patients die young.

3.2 Blood Group

3.2.1 Antigen and Antibody

If the blood of two individuals is mixed, sometimes the blood gets mixed normally but sometimes this mixing can lead to blood clumping. To know this, we have to understand two factors—one is antigen and the other is antibody. Antigen is a foreign substance or protein. When this protein enters into our blood, the immune system of our body considers it harmful to the body and tries to prevent it. To prevent antigen, our blood creates a substance which is called antibody. A special type of reaction occurs when antigen and antibody exist in the same solution. This antigen attacking reaction is called antibody-antigen reaction and, because of this reaction, the blood corpuscles coagulate.

In 1900, Dr. Karl Landsteiner invented through experiments that human red blood cells contain two types of antigen. So, naturally two antibodies are found in the serum (the fluid on which RBCs float) to prevent two antigens. These two

types of antigens in the red blood cells are named A and B. You have certainly understood that if a person's blood contains antigen A, his blood can never contain antibody A. If so happens, the antibody will attack red blood cells of its own blood resulting in death of the individual. The blood that contains antigen A, also contains antibody B. Similarly, the RBC of the blood that contains antigen B, also contains antibody A.

If we have understood antigen and antibody, we will understand how blood is divided into different groups.

If red blood cells have two antigens—antigen A and antigen B, then blood can be divided into four types as follows:

Group A	Antigen A	In serum there is no antibody of antigen A but there is antibody of antigen B.
Group B	Antigen B	In serum there is no antibody of antigen B, only the antibody of antigen A stays
Group AB	Both antigen A and B	In serum, antibody of neither antigen A nor antigen B can stay.
Group O	No antigen	In serum antibody of antigen A and antigen B is present.

Now, you yourself can say which person should be donated blood from which group.

Since red blood cells of blood group O have no antigen, this blood can be donated to any blood group individuals. Whatever antibody this group O blood can have, no harm can be done to the recipient. For this reason, blood group O is called universal donor.

On the contrary, blood group AB cannot be donated to any group except its own group, because all other groups have either antigen A or antigen B. As blood group AB has two antigens, any one or both antibodies can attack red blood cells leading to blood agglutination.

Blood group A and B can be donated to group AB other than their own group because AB group has no antibody, and so, neither of antigens A and B will be attacked.

Again, if we see from the acceptor's point of view, we will find just the opposite. Blood group O cannot accept blood from any other group because serum of all other groups contains both types of antibody. On the other hand, blood group AB can receive blood from all because its serum contains no antibody. For this reason, AB is called universal acceptor.

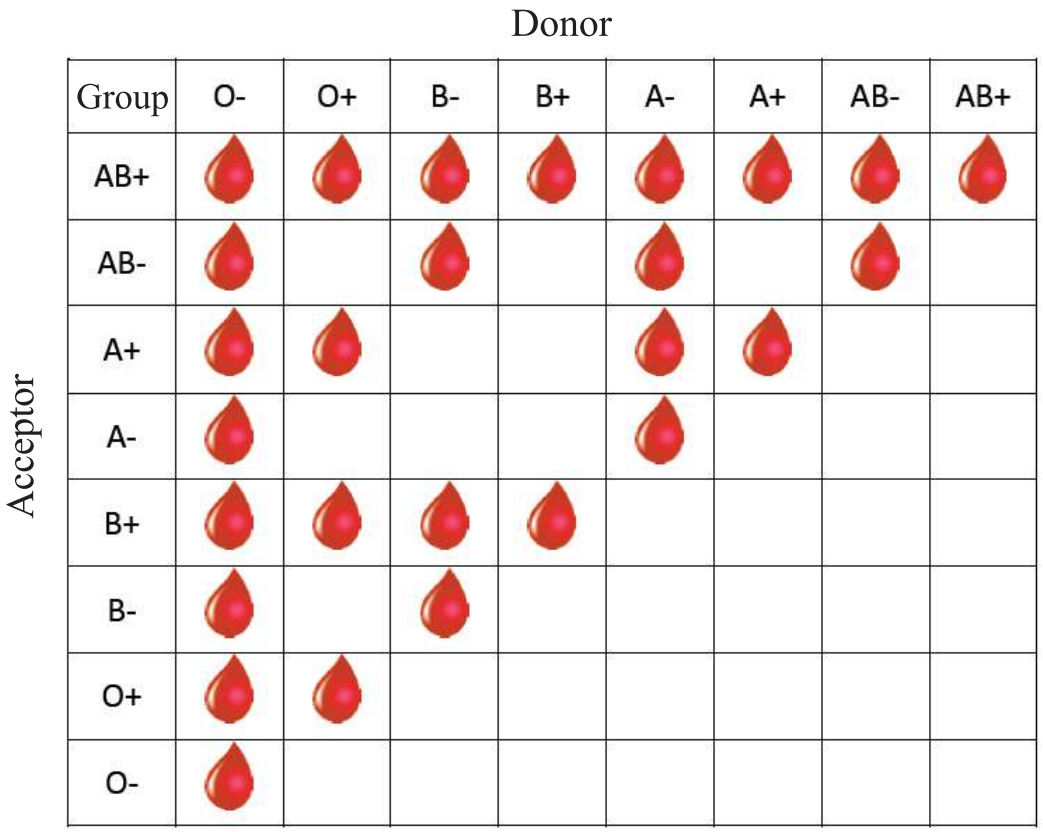


Fig. 3.06 : Which blood group is suitable for whom

3.2.2 Rh Factor

The topic discussed so far has not come to a conclusion because an important division of blood has not been talked about. Those who among you are familiar with blood group, have certainly noticed that only A, B, AB or O does not mean blood group. Always they are followed by plus or minus sign (such as: A+. O-). Where does this plus or minus sign come from?

The red blood cells of a monkey named Rhesus contain a type of antigen which is also found in the RBC of many human beings. According to the name of this monkey, it is called Rhesus factor or Rh factor in brief. The presence of Rh antigen in human body is called Rh+ and the absence of Rh factor in the blood is called Rh-. The plus or minus sign after the blood group is nothing but this Rh factor.

You must have understood that Rh blood can always be donated to the individuals with Rh+ blood. But the opposite of this creates a sort of complexity. If Rh- blood is donated to the individual with Rh+ blood, there will be no reaction for the first time. But the plasma of the recipient will continuously produce the opposite antibody of Rh+ antigen. Therefore, if the recipient receives Rh+ blood for the second time, this antibody Rh+ will react with RBC and blood will be clotted. However, if the recipient does not receive Rh+ blood for the second time, then the Rh+ antibody will be damaged gradually and the recipient may get back normal blood but there is no guarantee.

Rh factor is very important for pregnant women. If the mother's blood is Rh- and the father's blood Rh+, their first child will be Rh+ because Rh+ is a dominant character. In the womb, embryo is joined with the mother's ovary with placenta. Rh+ blood of the child reaches the mother's blood through placenta and mother's plasma will create opposite of Rh+ antibody. Since this antibody is produced slowly, in the case of the first child, Rh+ antibody of the mother's blood cannot do any harm to the first child. As a result, a healthy child is born (Fig : 3.07).

However, in the case of the second issue, Rh+ antibody of the mother's blood enters into the blood of the embryo and destroys the RBC of the embryo. It results in the damage of the embryo and, sometimes, in miscarriage. Even if the baby is born alive, it suffers from anemia and after birth the baby may be attacked with jaundice. For this reason, the would-be husband and wife should test their blood and, if needed, necessary precautions should be taken.

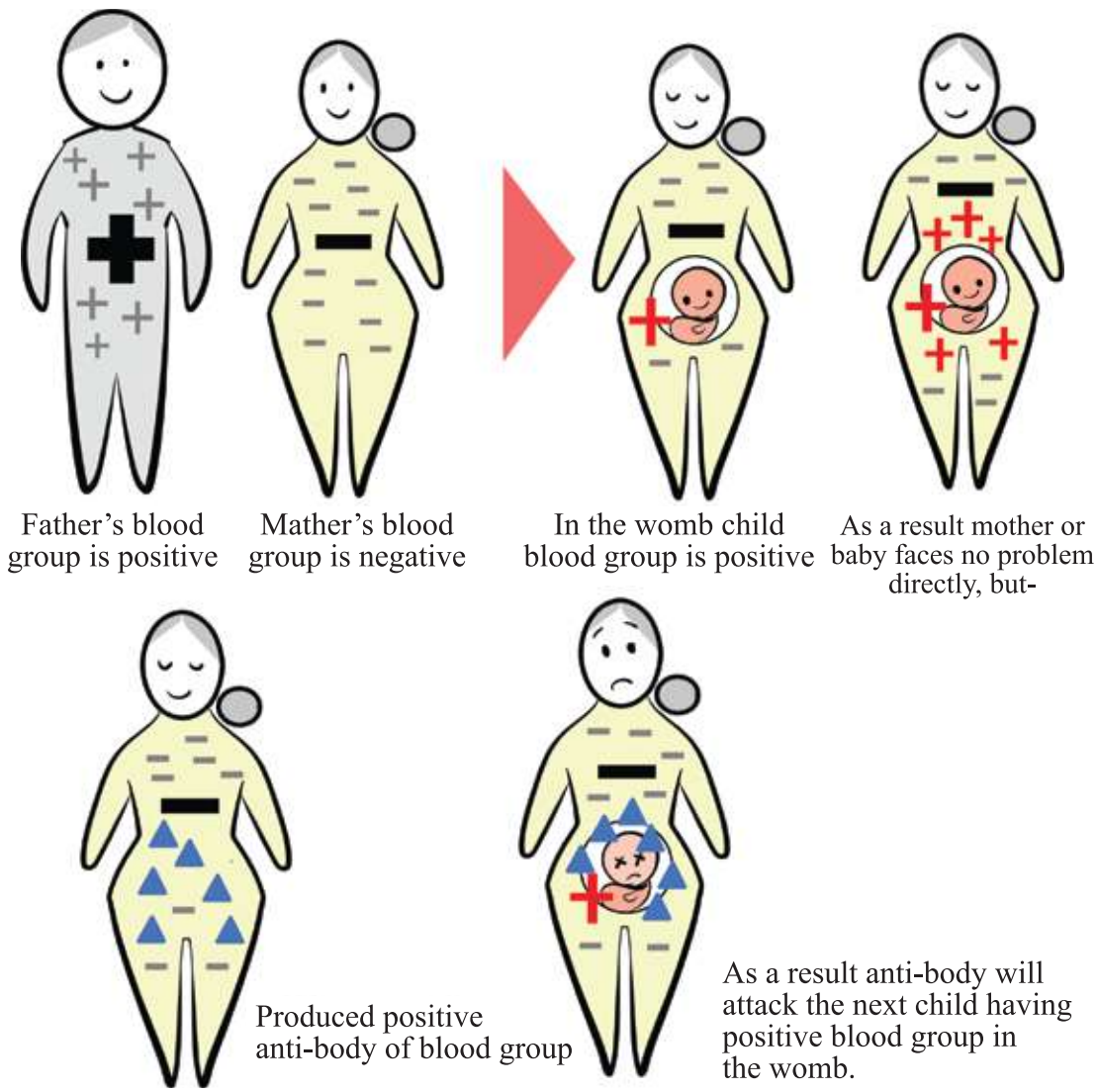


Fig. 3.07 : Rh- of mother and Rh+ father may cause complications of children

Individual Work

Task : Which blood group is suitable for which group, use this information to make a table and findout acceptor group.

	Donor							
Acceptor	Type	A+	A-	B+	B-	AB+	AB-	O+	O-
		√	√					√	√
				√	√				√
									√
			√		√		√		√
		√	√	√	√	√	√	√	√
								√	√
			√						√
									√

3.2.3 The Importance of Classification of Blood

i. Blood test should be done for both the donor and recipient before donating blood because the blood of different groups may cause clotting of blood and result in death. If it is not possible to know the blood group in danger time, then only the group having 0 and Rh negative blood should be donated.

ii. If there is a problem about the fatherhood of a child, blood test can solve the problem.

iii. Criminals can be identified by testing blood group.

Blood Transfusion Policy

Because of illness or an accident, there may be lack of sufficient amount of blood in human body. In that case, blood transfusion is a must. Here, it must be ensured that the donor's blood is germ-free and appropriate. Before blood

transfusion, the donor's blood should be tested whether it is contaminated by the germs of AIDS, hepatitis, or any other fatal diseases. Of caurse, doctors test A,B,O and Rh of the blood of the patient and the donor to match their blood group. Apart from ABO and Rh, there are many other antigen-based minor blood groups in the blood. So, before blood transfusion, ABO grouping and Rh typing as well as a test called cross matching are mandatory so that complications do not arise due to those minor groups.

3.3 Blood Circulation

We have come to know from the beginning of this chapter that the blood is circulated by the blood circulatory system of vertebrates. In human body the important parts of blood circulatory system are: heart, veins, arteries, and capillaries. Before knowing the function of these parts their structure should be known. So they are described below:

3.3.1 Heart

Heart is a pump machine of blood circulatory system. It circulates blood by expansion and contraction. The heart of human beings lies in the middle of the two lungs and above the diaphragm. The broader part of heart is in the upper part and the pointed part is in the lower part of the body (Fig : 3.08).

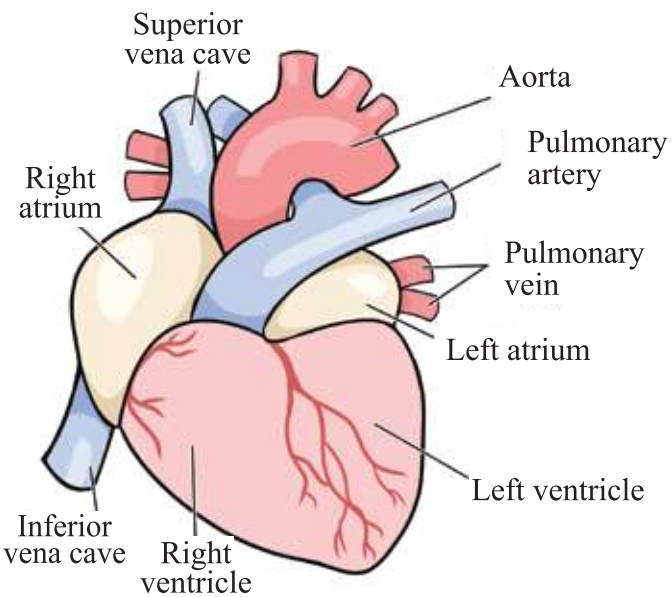


Fig: 3.08 : Heart

Heart is covered with two – layered pericardium. There is pericardial fluid between the two layers. This helps the heart to contract. There are four chambers in a human heart. The upper two chambers are called the left and right atrium and the lower two chambers are called the left and right ventricle. The atriums are divided by inter atricular septum and ventricles are divided by inter ventricular septum. The wall of atrium is thin, while the wall of ventricle is thick and muscular. There is a superior vena cava and an inferior vena cava with right atrium. There are four pulmonary veins with the left ventricle. The pulmonary arteris originate from the right ventricle and the aorta originates from the left ventricle.

Artery

The blood vessels which carry blood from the heart to different parts of the body are called arteries. The wall of artery is thick and three layered and their lumen is narrow (Fig : 3.09). There are no valves in the artery. So blood circulates quickly through artery.

There is pulse in artery. Artery is divided into branches in different parts of the body. They are called the arterioles. They continuously divide and make fine capillary. Thus, artery starts from heart and ends in capillary. High level of oxygenated blood is transferred from heart to different parts of the body through artery. But pulmonary artery carries blood with high level of carbon dioxide from heart to lungs.

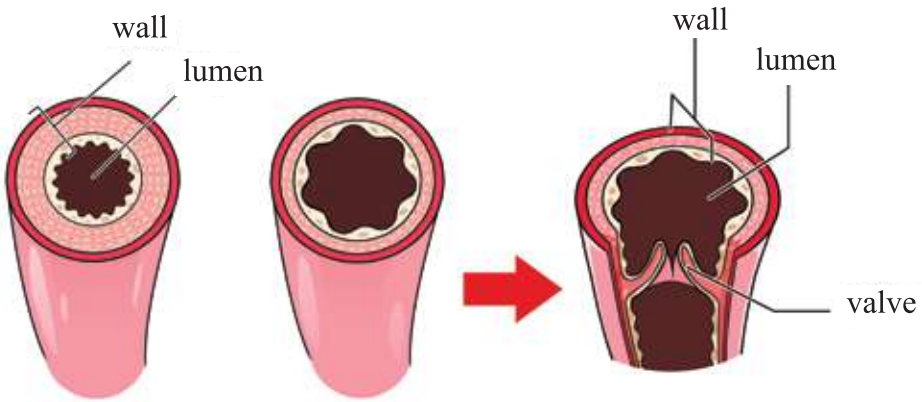


Fig. 3.09 : Artery and Vein cross section

Vein

The blood vessels which carry blood with high level of carbon dioxide from different parts of body to heart are called veins. But pulmonary vein carries high level of oxygenated blood from lungs to the heart. The wall of this vein is also three layered but its wall is very thin and the lumen is larger (Fig: 3.09). There are valves in the vein. So blood circulates slowly

The capillary net at the end of artery creates fine veins. These subveins then create veins. Some veins then create vena cava. Thus, vein starts from capillaries and end in the heart.

Note that both arterial and venous blood contain oxygen and carbon dioxide together. The difference is only in their level or quantity.

Capillary

The minute blood vessels which are formed with one-layered endothe- lium and which form networks throughout the body tissues are called capillaries (Fig: 3.10). Capil- laries connect artery and vein. It is the capillary where nutrients, high level of oxygen, high level of carbon dioxide and wastes are exchanged between blood and the body tissues by diffusion.

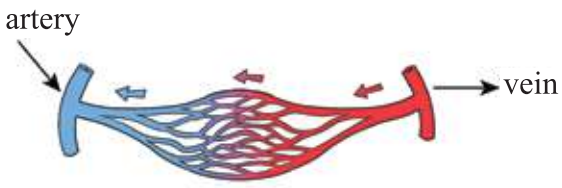


Fig. 3.10 : Capillary Net

3.3.2 Functions of Heart

We know that the blood circulatory system of human body is formed by heart, vein, artery and capillary. The human heart continuously expands, contracts and circulates blood through veins and arteries (Fig : 3.11). The spontaneous contraction of blood is called the systole and spontaneous expansion is called the diastole. It is mentionable that when the atrium goes to systole then the ventricle is in diastole most of that duration (Fig : 3.12).

Heart Beat

Heart is like a pump machine. It is an automatic pump that beats in our body for all the time in a rhythmic way. This beating is called the heart beat. Blood is circulated to our body by heart beat.

Heart beat is a complex system. Human heart is myogenic. That is, it contracts and expands without any external force. But this rate of contraction-relaxation rate can be increased or decreased by external stimuli. The whole process of continuous beating of the heart is called cardiac cycle. The atrium and ventricle are related to the expansion and contraction of heart.

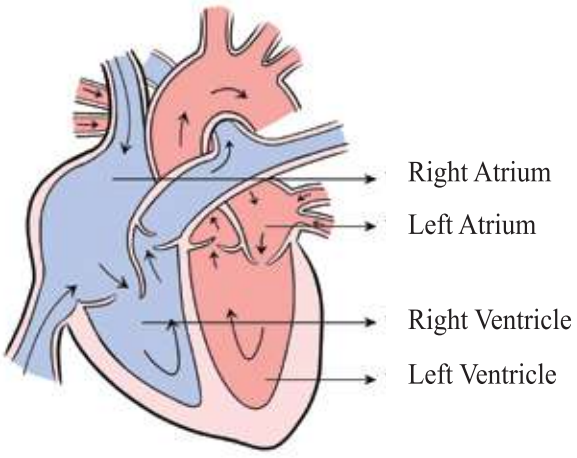


Fig. 3.11 : Different parts of Heart

This cardiac cycle is related to expansion and contraction of the heart. Cardiac cycle consists of four steps (Fig: 3.13)-

a. Diastole of Atrium: During this time, two atriums remain in expanded form. As a result, high level of CO_2 rich blood from the whole body comes to the right atrium through superior and inferior vena cava and high level of O_2 rich blood from lungs enters into the left atrium through the pulmonary vein.

b. Systole in Atrium: When the atriums are filled with blood, they contract. So, blood is sent to the ventricle. high level of CO_2 rich blood from the right atrium comes to the left ventricle and high level of O_2 filled blood from the left atrium comes to the left ventricle.

c. Systole of Ventricle: Ventricles contract when they are filled with blood. At this stage the tricuspid and bicuspid valves remain close and semi lunar valve remains open. At the time of systole of ventricle and the closing time of valve the first sound of heart beat is called 'Lub'.

At this time, high level of oxygenated blood from the left ventricle enters into aorta and high level of CO_2 filled blood from the right ventricle enters into lung artery. From aorta, blood is circulated by different arteries and sub arteries to different capillary of the body

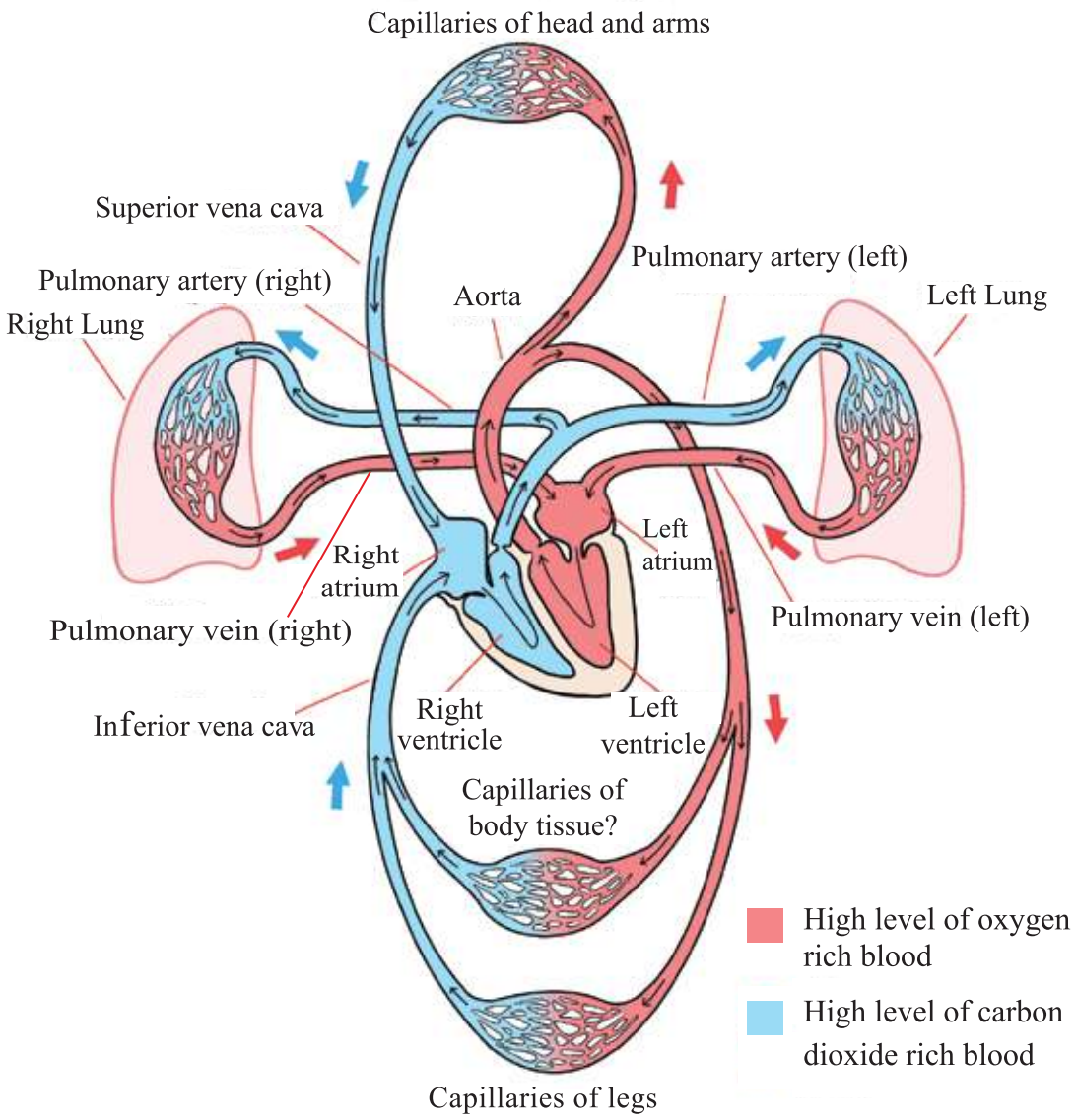


Fig. 3.12 Human blood circulation

and they supply nutrients and high level of O_2 to the body's tissue. On the contrary, high level of CO_2 rich 2 blood is transferred to pulmonary net from pulmonary aorta. Blood receives oxygen from lungs and forces it to the left atrium through pulmonary vein. High level of CO_2 rich blood (deoxygenated blood) again reaches the atrium from capillary through different veins and vena cava.

d. Diastole of Ventricle: The diastole of ventricle starts just after the systole of the ventricle. At this stage, blood from atrium again begins to normally fill the ventricle. At the time of diastole and the closing time of valve the second sound is called 'Dub'.

So the sounds of the heart are-

The systole of ventricle- Lub

The diastole of ventricle- Dub

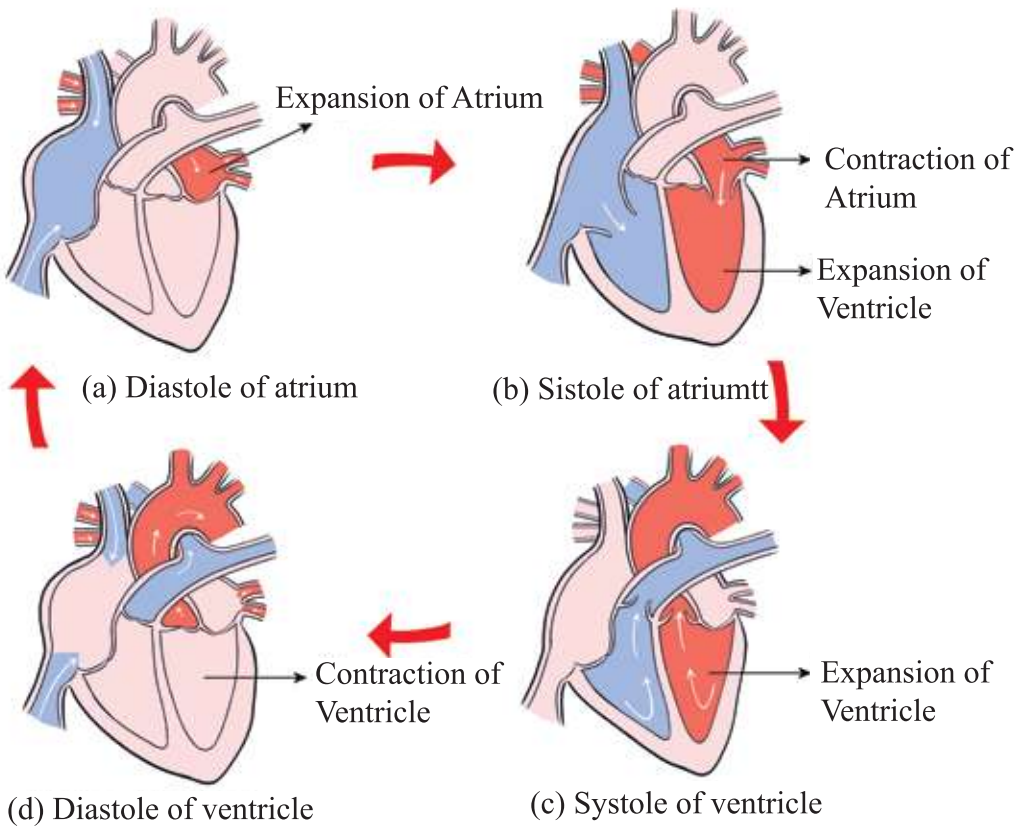


Fig. 3.13 : Cardiac Cycle

A heart beat is composed of a systole and a diastole. It takes 0.8 second. The heartbeat of a healthy person is 70-100 per minute. This beat can be counted by the radial artery of the wrist of our hand. This sound also can be felt by the stethoscope. The diaphragm of the stethoscope should be placed in a particular site of the chest and the end of the two tubes should be placed in the ear. Feeling heart beat in the wrist of the hand is called the pulse. The sound heard by stethoscope is called the heart sound. When the beat per minute is counted at the wrist and some other sites of the body, it is called pulse rate.

3.3.3 The Method of Counting Pulse Rate or Heart Beat

The wrist of the patient should be pressed by the pointer, middle and ring finger. Then the heart beat per minute can be felt. The three fingers should be placed in such a way that the pointer finger is placed towards the heart and middle finger is in the middle and the ring finger is placed towards the fingers of the patient (Fig: 3.14). Now, heart beat per minute can be felt by the middle finger. This is pulse If the pulse is not found in wrist, it can be found near the throat or it can be heard directly by placing ear on the chest. Pulse rate can be counted by the method described above. Pulse rate should be counted by watch. Pulse rate is normally high during hard work, when one becomes nervous, during severe pain or in fever. Pulse rate is normally 60 - 100. In fever, shock or hyper activity of thyroid gland is the cause of high pulse rate which is higher than 100. Pulse rate increases 10 per minute for increasing 1 degree Fahrenheit temperature. If the pulse rate is very high, or very low or irregular, there may be a problem in the heart. The pulse rate may be lower than 60 resulting from jaundice or heart block.

Fig. 3.14 : Counting pulse rate or heart beat

Normally, pulse rate increases due to mental excitement, exercise and in the evening. At this stage, pulse rate may be high but that should be thought normal. In sleep and in the morning after sound sleep, pulse rate may be less than 60. This condition should also be taken normal.

3.4 Blood Pressure

During the expansion and contraction of heart, blood creates pressure to the wall of the artery that is called blood pressure. So, blood pressure means the pressure of blood in the artery. Blood pressure depends on activity of the heart, elasticity of arterial wall, and density and amount of blood. The pressure in the systole stage is called systolic blood pressure and the pressure in the diastolic stage is called diastolic blood pressure. A normal healthy adult person has 110-140 mm Hg systolic blood pressure and 60-90 mm Hg diastolic blood pressure. Normal blood pressure is usually expressed as 120/80 mm Hg. However, the normal blood pressure value may be more or less than this value depending on the age and situation. Sphygmomanometer is the machine for determining blood pressure.

3.4.1 High Blood Pressure

High blood pressure is called hypertension. If the blood pressure continues to be higher than the standard rate of age in the normal state of body and mind, that is called high blood pressure or hypertension. If the blood pressure is low, that is called low blood pressure. If the systolic blood pressure is higher than 140 mm Hg and the diastolic blood pressure is higher than 90 mm Hg that is called high blood pressure. If the blood pressure is high for tension, depression, sleeplessness or any other cause, that cannot be said high blood pressure. No medicine is needed in this case. The cause of hypertension is still unknown in 90% cases. But obesity, fatty body, taking too much salt, less physical work, diabetes, restlessness, mental pressure, high blood cholesterol are the probable causes of high blood pressure. Hypertension may cause stroke, paralysis, heart enlargement, heart attack, heart failure, kidney damage or disturb in eye vision. Low blood pressure is not as harmful as high blood pressure. But if blood pressure becomes very low, it may cause many problems.

Following precautions can be taken for the prevention of high blood pressure.

1. Diabetes should be controlled.
2. Be careful about body weight.
3. Avoid fatty food e.g.– ghee, butter, beef, mutton or the meat of other four-legged animals and prawn.
4. Take a balanced diet.
5. Don't take more food than you need.
6. Keep away from smoking
7. Take regular exercise.
8. Sleep 7 - 8 hours daily.
9. Live a stress free and anxiety free life.
10. Don't take extra salt with meal.

3.4.2 Cholesterol

Cholesterol is a kind of lipid or steroid. Each and every tissue of human body has cholesterol. Its amount is high in brain and liver. Cholesterol combined with other substance works as a carrier of lipid in blood. The compound of lipid and protein is called the lipoprotein. According to the amount of fat, there are two kinds of Lipoprotein-High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL). If the LDL level of blood increases, bad cholesterol of blood also increases.The presence of more LDL in blood is harmful to health. On the other hand the presence of more HDL is good for health. The normal amount of cholesterol in blood is less than 200 mg/dL. The presence of more cholesterol causes the risk of heart disease. If the amount of cholesterol is more than the normal amount, this cholesterol and calcium are accumulated in the inner wall of the blood vessels and the lumen shrinks. So, the elasticity of artery decreases and the artery becomes rigid. This is called arteriosclerosis. Arteriosclerosis causes split in the artery. Bleeding from this injury causes blood coagulation and disturbs the flow of blood. If the blood is clotted in the coronary vessels, that is called coronary thrombosis. And if blood is clotted in brain, that is called cerebral thrombosis. These may cause death. If the amount of cholesterol increases, the amount of LDL also increases and HDL decreases. If the amount of LDL is more than 150 mg/dl, a doctor should be consulted.

3.5 Ways to Keep the Heart Healthy

We knew from the first chapter that we need a balanced diet for healthy body. Rest and exercise are needed to keep the body active. Eating a balanced diet is important. Devoloping some some good habits of livelihood is also important. There are many causes of diseases. But proper food management and livelihood can keep our heart healthy. These are-

1. Body weight should be controlled according to height. Over weight weakens the heart.
2. Food should have a combination of both animal and plant proteins.
3. There should be control in carbohydrates, sugar and fat food. Veg etables and fibrous food should be eaten more. Vegetable oil should be taken. The oil of some sea fish reduces the amount of cholesterol in blood and decreases the tendency of blood clotting. So, the people who eat fish have less risk of heart disease. Those who do not eat animal meat should follow the advice of nutritionists to avoid protein deficiency.
4. The amount of minerals and vitamins in a balanced diet should be kept fixed. Regular taking of garlic, tamarind, fruits rich in vitamin C, and other fruits reduces the risk of heart diseases.

Besides this, right amount of food should be taken and food should not be taken more than the needs. Situation of mental stress should be avoided. Light exercise, walking, disciplined life, that is, sleeping on time, avoiding smoking can save us from heart disease and high blood pressure.

3.6 Diabetes

Diabetes is a kind of metabolic disease. When we eat anything, that food turns into glucose and gets into blood. A hormone named insulin which is secreted from pancreas converts this glucose into energy. When someone is attacked with diabetes, the pancreas cannot produce sufficient insulin or the body cannot use insulin. For this reason, glucose in the blood increases. Normal level of glucose in human blood is 3.9 - 5.6 mMole/l or 70-110 mg/deci.l. Diabetes is not a contagious disease. Diabetes has indirect effect on heart disease. The amount of

glucose becomes high in the blood. This affects normal activities of different parts of the body e.g. - heart, kidney and eyes. It is seen that the diabetes patients have more risk of coronary heart disease. It makes the heart inactive and causes stroke resulting in death. On the other hand, long-term diabetes causes high blood pressure or hypertension. High blood pressure is the symptom of coronary heart disease. If blood sugar is uncontrolled for a long time, the risk of coronary heart disease becomes very high. There is also types of diabetes that has nothing to do with sugar levels, but that will not be discussed in this chapter.

High Risk People of Diabetes

Anyone can be attacked with diabetes at anytime. The following four classes of people have high risk-

1. Hereditary- Father, mother or blood kins have diabetes
2. There who are over weight and have fatty body
3. Those who do not take exercise or do not take part in physical labour
4. Those who taking steroid medicine for a long time

Symptoms of Diabetes

1. Frequent urinating, especially at night;
2. Feeling of excessive thirst frequently;
3. Excessive feeling of hunger and too much physical weakness;
4. Weight loss though eating much, lean and thin body;
5. Feeling of tiredness after doing little labour;
6. Skin becomes dry;
7. Haziness;
8. Slow recovery from any injury;

Food for Diabetic Patient

The role of food is very important for diabetic control. Diabetic patients should control food with regular taking of medicine. Only medicine cannot control the disease without proper food management. The patient should take such a diet as it fulfills the minimum calorie needed and checks the amount of sugar in blood and urine.

Diabetes Control

Diabetes can be controlled in three ways - food control, taking medicine and disciplined life.

(a) Diet: If a fat person gets diabetes he/she has to take food according to doctor's recommendation until the weight becomes normal. Diabetes patients should not take sugar or sweet. However, if there is a possibility of life-threatening sudden drop in blood glucose level, only then the diabetic person can eat small amount of sweets. They should eat protein rich food (green vegetables, mushroom, nut, egg, fish, meat without fat) and low carbohydrate food.

(b) Taking Medicine: All the diabetes patients have to control food and lead a disciplined life. In most of the cases the disease gets under control for maintaining these two rules. But insulin dependent patients should take insulin.

(c) Disciplined Life: The patient should maintain discipline stoically.

1) Regular taking of balanced diet.
2) Regular exercise.
3) Regular urine test and keeping record.
4) Avoiding sweets.

Exercise

Multiple Choice Questions

1. Which of the followings coagulate blood?

a. RBC
b. Platelets
c. WBC
d. Lymphocyte

2. Which supply oxygenated blood?

a. Artery and Pulmonary artery b. Vein and Pulmonary vein
c. Artery and pulmonary vein d. Vein and artery

Read the passage below and answer the question no 3 and 4.

Avishek got an accident on the way to Manikgonj. His friend had severe bleeding for that, so blood was needed. Avishek said that he could donate blood without any blood test.

3. What is the blood group of Avishek?

a. A b. B
c. AB d. O

4. Which of the gas does not occur in serum?

a. O_2 b. CO_2
c. Cl_2 d. N_2

Creative Questions

1. Rafin is a student of class X. His father is a healthy man. He has noticed that it takes time to cure the injury of the body, his skin has become dry and he gets tired after little labour. So, his father called in a doctor. The doctor advised some rules and regulations to keep the body healthy.

a. What is blood pressure?
b. What is meant by systolic blood pressure?
c. What diseases Rafin' s father got?
d. What advice did the doctor give to Rafin's father to keep healthy? Explain.

2. See the figure below and answer the question:

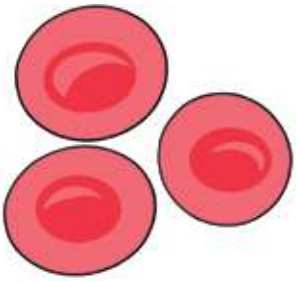


Fig. A

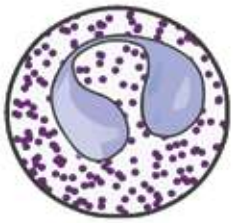


Fig. B

Fig. C

a. What is blood?
b. What is capillary?
c. Explain the role of the cell shown in Figure B in human body.
d. Both Figure A and Figure C are located in the same connective tissue but their functions are different. Explain.

Chapter Four

Starting a New Life

It is thought that life was originated on the earth about three hundred and fifty crore years ago. The climate of the world then was not stable. After crores of years now the world is in a stable state and has a more or less specific climate. Many species live on this earth. That means the earliest life forms evolved to give rise to all those species.

Human life begins with a cell in the mother's womb. The cell being formed by the interaction of an egg of mother and sperm of father. In the early part of life it takes the shape of a baby. Later the baby reaches teen age, youth and gradually develops to the stage of old age. One of the evolving stages of the life cycle of a man is adolescence. During adolescence physical and mental changes take place in human body. In this chapter, we shall discuss the origin and evolution of life on earth and the course of physical and mental changes during adolescence.

At the end of this chapter, we will be able to-

- explain adolescence;
- explain the causes of physical changes in adolescence;
- describe the ways of adjustment to the physical and mental changes in adolescence;
- explain the strategies of keeping good physical and mental health during adolescence;
- explain health risk of marriage in adolescence and its effects;
- explain the concept of test tube baby;
- explain the way of determining sex;
- explain the origin of life and the concept of biological evolution;
- explain the concept of origin of new species on earth.

4.1 Adolescence

The birth of a baby is an event of great pleasure in a house. Everyone wants to fondle it and take it in their lap. The baby gradually grows up. Childhood ranges up to the age of five. Normally a male baby after six years of age is called a boy and a female baby is called a girl. Generally we count boyhood from the age of six to ten. After ten years a girl is called a teenage girl and a boy is called a teenage boy. This period of human life is called adolescence. The period of adolescence ranges from ten to nineteen years. From this period the course of changing starts from boy to man and from girl to woman. Normally the change of a girl starts earlier than a boy. Adolescence among girls starts from the age of eight to thirteen years and among boys from ten to fifteen. Sometimes this change happens earlier or later.

4.1.1 Changes at Puberty

Among the changes of adolescence the physical changes are noticed first. These changes give clear ideas about one's adolescence. It takes time to grow in early childhood. But growth in adolescence is sudden. Suddenly the boys and girls become taller and their weight also increases rapidly (Fig : 4.01). Many more changes occur in boys and girls from the age of ten and it continues for three to four years.

Fig. 4.01 : Rapid growth during puberty

For various reasons, people of our country hesitate to discuss these very natural changes. But as you are now passing the adolescence period, you had better know what changes may take place in you. Then, you will be able to be prepared for the future life without being scared or shy.

There are three kinds of changes in adolescence.

1. Physical
2. Mental
3. Behavioural

1. Physical Changes

(a) Growing taller and gaining weight rapidly.
(b) Boys (at the age of 16/17) grow beard and moustache, and breasts of girls get enlarged.
(c) Growing hair in different parts of the body.
(d) Coarseness of voice.
(e) Ejaculation in boys, Beginning of menstruation in girls
(f) The chest and shoulder of boys becoming broader, Expansion of the hip bone in girls.

2. Mental Changes

(a) Great desire to get attention, care and love of others, specially the nearest ones
(b) Tendency to act with emotion
(c) Growing curiosity about the relation of boys and girls
(d) Getting attracted to opposite sex
(e) Starting the stage of mental maturity
(f) Starting to become self dependent instead of depending on others

3. Behavioural Changes

(a) Behaving like an adult
(b) Trying to show the individual personality
(c) Trying to establish own opinion in every situation
(d) Tendency to get involved in risky and dangerous work

Note that the changes mentioned in the case of the third gender may not fall into specific categories. In that case, do not panic and consult a doctor. A third gender doesn't always mean it's abnormal, but some may require treatment.

Individual Work

Exercise: Fill up the table below (individual work)

Adolescence		
Physical Change (girls)	Physical Change (boys)	Mental Change (Both)

4.1.2 Cause of Changes in Adolescence

Normally adolescence period ranges from 11 to 19 years for boys and girls. Many physical and mental changes take place in this period. But the time of adolescence may be different for the variation of weather, place and amount and quality of food. The changes of adolescence period are caused by a class of chemical substances called hormone secreted from endocrine gland. Hormone is produced in the body in a natural way. Levels of some of the hormones in boys and girls are also different So the changes are also different. Main two hormones are responsible for the chang- es of girls. These are estrogen and progesterone.

Fig. 4.02 : Growth of beard and moustache during adolescence of boys

Fig. 4.03 : Conscious of the changes of the body during adolescence of girls

Many changes occur for these hormones. The changes are change in voice, rapid physical growth, enlargement of different parts of the body. The menstruation of girls starts for this hormone and it starts from the age of 10-17 years. Starting menstruation is a symbol of healthy body. In Bangladesh, menstruation stops at the age of 45-55. On average, this menstrual cycle occurs every 28 days or once a month and usually lasts for 3-7 days. However, this period can vary greatly from person to person.

Testosterone hormone is responsible for the different changes in the body of a boy in adolescence period. Many physical and mental changes occur in the body for this hormone. Male-like heaviness in the tone of voice, growth of beard and moustache and rapid physical development occur in this time (Fig: 4.02).

For the boys ejaculation or involuntary loss of semen begins. Sperms begin to generate from the age of 13 to 15. Both boys and girls have mental changes along with the physical changes. They become imaginative and act with emotion. At this stage, both boys and girls usually feel attraction for opposite sex. They want to keep themselves smart and tidy (Fig: 4.03). Thus, the teenagers step in adult- hood.

Individual Work

Task: Write T for the true and F or for the false statement below:

Statement	√ or ×
The changes happen in adolescence period are due to hormones.	
The cause of changes in adolescence period is eating much food.	
Both estrogen and progesterone hormone work in the girl's body.	
Estrogen hormone is produced in a boy's body .	
The changes in the boy's body during adolescence are due to progesterone hormone.	
Estrogen helps to digest food .	

You have come to know that the age 11-19 years is called the adolescence period. You also know that physical and mental changes happen in this period. Keeping healthy body is related to these changes.

4.1.3 Keeping Proper Physical Health

In adolescence period, ejaculation happens occasionally to boys in sleep. This is called night pollution. It is not a matter of fear or shyness. It is a common condition at this age. Young males normally start to produce sperms at the age of 13 to 19. Sometimes, semen comes out of the body in sleep. Ejaculation takes place as a spontaneous physiological process and it continues. Hence there is no need to worry except taking bath to be clean. As the body grows very fast in this time, nutritious diet (Fig: 4.04 and 4.05) especially vegetables and water should be taken properly so that they can live a normal life. In puberty, other than physical changes, some mental changes take place. If it is needed, boys may share it with their parents and intimate relatives. In the adolescence period, everyone becomes emotional. All should understand that it is the action of hormone and, after puberty, everything will be normal. Like boys, girls also undergo many changes in adolescence. Among the changes, menstruation is an important change. Generally at the of 9 to 13, menstruation starts. For girls, menstruation is a common physical condition. Menstruation may continue for 3 to 5 days. In some cases, this duration may be longer or shorter. Anticipation the start of me struation, it is better to take preparation earlier. At this time, girls should keep clean, take bath regularly, have nutritious food and should drink sufficient water. Girls should take much rest in this period.

Fig. 4.04 : Eating nutritious food is needed during adolescence of boys

Fig. 4.05 : Eating nutritious food is needed during adolescence of girls

As blood is lost during menstruation, girls should take lots of fish, meat, vegetables and fruit recover the loss. Abdominal pain my occur during menstruation. In that case, fomentation with hot water can be comfortable. Headache and lumbago may also happen. Seeing all these symptoms, girls should not be afraid. If the pain is severe, a doctor may be consulted.

Nowadays, absorbent pads are available to absorb blood during menstruation. If absorbent pads are not available, clean and germ-free cotton or a piece of dry cloth can be used. If the cloth is needed to be reused, then it should be washed with soap and hot water and dried in the sun. This cloth should not be kept in a dark and damp place, then the cloth may be attacked with germs.

4.1.4 Keeping Proper Mental Health

During adolescence many a girl wants to remain alone. Many can behave abnormally. Emotional changes also happen with mental or physical change. The other family members should behave in a friendly and sympathetic manner keeping in their mind that mental changes happen in adolescence. At this stage, both girls and boys should be provided with psychological support and encouragement. It will help them grow as a healthy man or woman and build up a better future.

The boys and girls themselves should be careful to keep their proper mental health. Their first duty is to adjust themselves with mental and physical changes. They have to understand clearly that these changes are very normal. So, their uneasy feelings and fear should be discarded. Secondly, they have to discuss the matter openly with their parents and elders brothers and sister so that they can be free from fear and shyness. In this way, their tendency to stay alone and the feeling of shyness will decrease. Mental cheerfulness can be maintained by reading story books or by playing with the friends.

Parents, brothers and sisters, teachers and all the family members should give necessary mental and emotional support to boys and girls during puberty. In this way, they will grow up as healthy and strong adults and will be able to build a beautiful future.

Individual Work

Activity Sheet: Prepare a list of the measures to be taken for keeping physical and mental health of girls and boys in adolescence period.

Health Option	Measures to be Taken
Physical health	
Mental health	

4.1.5 Marriage in Adolescence and Pregnancy

Marriage age for girls is 18 years and for boys it is 21 according to Bangladeshi law. But some parents marry off their sons and daughters before this age and do not care about the law. Have you ever thought what problems they have to face for marriage before proper age? They face various complex situations. One of them is early pregnancy.

What is pregnancy?

When a sperm and an ovum unite, a woman becomes pregnant. The woman faces some uneasy symptoms in the early few months of pregnancy. For girls, it is a special physical process and it happens when a child develops in the womb.

These symptoms are-

- Nausea and vomiting (Fig : 4.06)
- Giddiness and headache
- Frequent urination

Fig. 4.06 : Vomiting may take place during pregnancy

Health Risk

To give birth is a normal process. The physical and mental problems for pregnancy in proper age are not many. Physical problems can be removed by consultation with a doctor and a healthy baby is born. A girl does not have the mental maturity and physical development for pregnancy. So, those who become mother in the early age suffer from many mental and physical problems. Many physical problems may occur for the pregnancy before 20 years because physical growth and development is not completed at this stage. On the other hand the girls do not have the proper conception of pregnancy and child birth. Pregnancy at early age causes not only physical and mental problems of the mother but also the life of the baby may be at risk. This is harmful for society and family.

Fig. 4.07 : A girl can't go to school due to pregnancy

Fig. 4.08 : Normal household work becomes difficult due to pregnancy

Health Problem

Pregnancy at immature age causes bleeding in pregnancy, severe pain, hazy vision and miscarriage. Besides this, there is a risk of death for the mother and baby.

In early pregnancy, the foetus does not have sufficient room to grow up in the mother's womb. So, low weight baby is born. This baby has low immunity. This baby cannot grow as a healthy and successful person.

Educational Problem

If a school going girl becomes pregnant, she cannot go to school for shyness. She gets mental stress and suffers from anxiety. She also faces problems in normal movement (Fig : 4.08). So, she drops out of school.

Family Problem

Girls cannot do the household work for immature pregnancy. Frequent physical sickness leads to unhappiness in the family. In Indonesia early marriage rate is very high and it has been found that separation takes place among more than half of the early-married couples.

Financial Problem

Doctors have to be consulted regularly for the whole nine months of pregnancy. Besides this, a pregnant woman needs to call in a doctor frequently in case of any complex physical problem. Much money is needed for doctor and medicine. Extra nutritious food is also needed for the mother and that also costs much money (Fig : 4.09). After all, the family faces economic hardship.

Fig. 4.09 : Very often doctor's consultation is necessary which causes financial problem

Miscarriage and Its Complexities

When a foetus grows in its mother's womb, in the first stage, it develops in the uterus. In the developing stage of embryo, if the embryo comes out spontaneously from the uterus, then miscarriage happens. Willful miscarriage is called abortion. Sometimes the girls have unwanted pregnancy. So, they go to untrained midwife for partner's pressure or being influenced by others or for frustration. This causes risky abortion. Such an abortion has mental and emotional effects. Everyone should be made aware of these physical and mental problems. Getting the right information about birth control from the local family planning worker is recommended to avoid the risk of premature pregnancy.

Individual Work

Work: Note down the problems of immature pregnancy and its remedies:

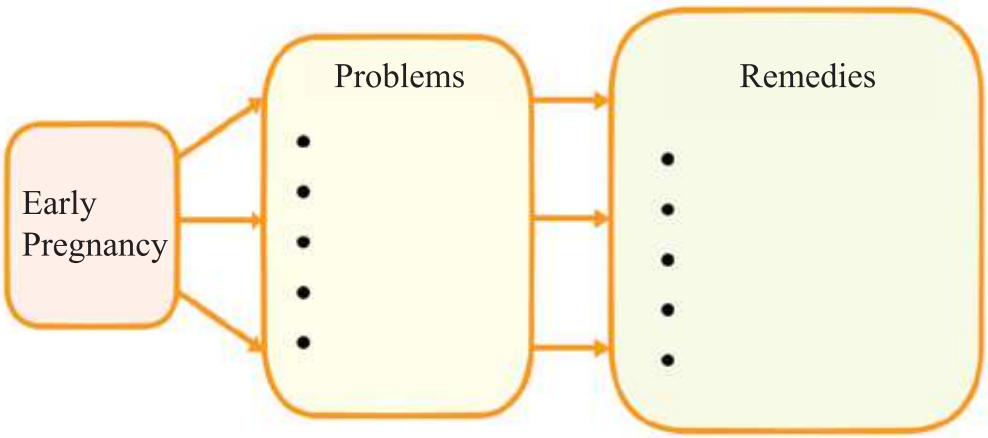


Fig : 4.10

Individual Work

Work: Describe the risks of miscarriage.

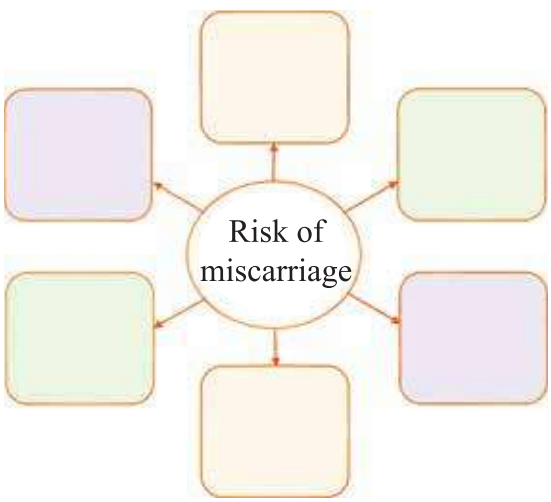


Fig : 4.11

4.1.6 Test Tube Baby

If the ovum and sperm are fertilized outside the body, then this early embryo is placed in the uterus of a woman; thus giving birth to a baby is called test tube baby. Fertilization outside the body is called in-vitro fertilization. Italian scientist Dr. Petrucci, in 1959, made the first ever test tube baby. But he was not very successful. The baby was alive only for 29 days. After 19 years, in 1978, Dr. Patrick Stepto and Dr. Robert Edward made the test tube baby called Louise Joy Brown. A test tube baby is born after in-vitro fertilization.

This is a systematic process. (1) It includes collection of ovum and sperm from a sexually capable couple, (2) fertilizing them in a culture medium to produce early embryo, (3) placing the embryo in the uterus of a woman, (4) taking care of the pregnant woman and finally child birth. Nowadays, this process has started in our country fairly well for the childless couples to get offspring.

4.2 Sex Determination of Child

We know that the nucleus of the cell of any living being has a specific number of chromosomes. There are 23 pairs of chromosomes in a human cell. Among these 23 pairs, a specific pair of chromosome is called sex determiner or sex chromosome. In the case of men, these two chromosomes are different. One is named X and the other is Y. Look at the picture, the X chromosome is long and the Y chromosome is short. In the case of women, both of the sex chromosomes are X. All other chromosomes except sex chromosomes are called autosomes.

Though there are 23 pairs (46) of chromosomes in a human cell, female ovum cell and male sperm cell for reproduction are exception to this. These cells have half the number of total 46 chromosomes. Ovum is created by taking one chromosome from each pair. So, the ovum has 22 autosomes and an X chromosome. As male sex chromosome has both X and Y chromosomes, two types of sperm cells can be created by taking one chromosome from each pair. One will consist of 22 autosomes and an X chromosome and the other will have 22 autosomes and a Y chromosome (Fig : 4.12).

Mother	Father	Child
22 autosomes of ovum+X	22 autosomes of sperm+X	22 pairs of autosomes +XX (daughter)
22 autosomes of ovum+X	22 autosomes of sperm+Y	22 pairs of autosomes +XY (son)

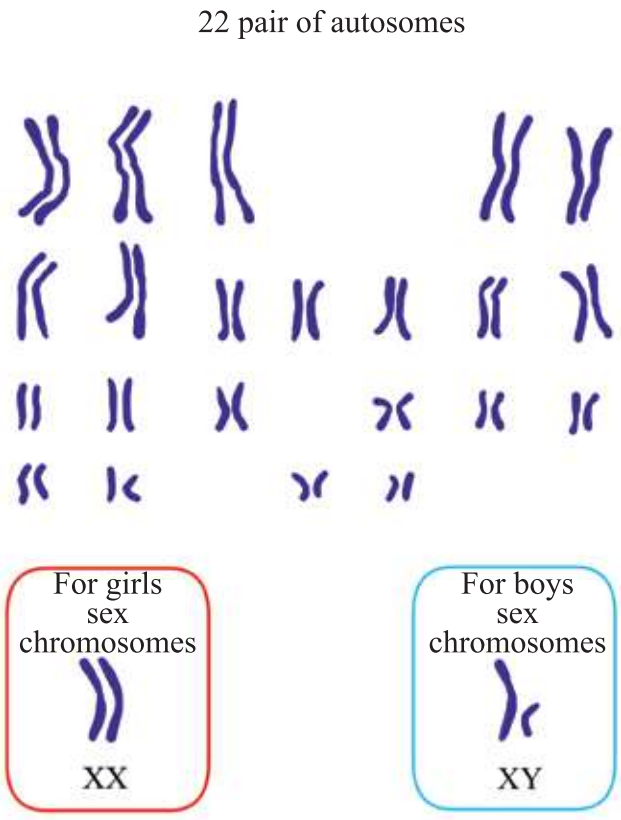


Fig. 4.12 : 23 pair of chromosomes of human beings

Pregnancy takes place when an ovum gets fertilized by a sperm. That means a fertilized human cell contains 23 pairs of chromosome. If it grows up with 22 pairs of autosomes and XX sex chromosome, the child will be a girl. If the fertilized cell contains 22 autosomes and XY sex chromosome, the child will be a boy (Fig : 4.13).

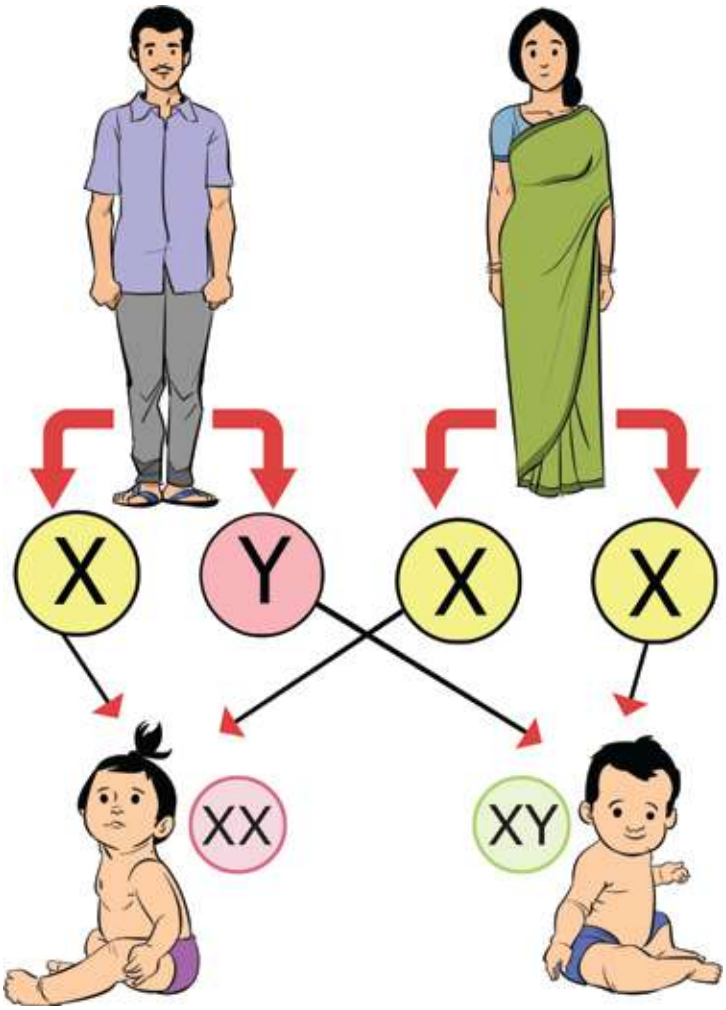


Fig. 4.13 : Determination of boy or girl

A healthy child, either boy or girl, is a huge blessing for parents, but unfortunately, due to illiteracy and bigotry, many people prefer male children. Not only that, the mother is held responsible for giving birth to girl. You must have now understood that the mother is in no way responsible for whether the child will be a boy or a girl. The real cause is whether X chromosome carrying sperm or Y chromosome carrying sperm—from numerous sperms—fertilizes the ovum.

Note that mammals, including humans, generally have the XY system for sex determination, but there are exceptions. This is not the only method for determining sex in the living beings.

4.3 Origin of Life on Earth

According to the latest scientific data, the Earth was a hot gas-mass formed from the Sun about four and a half billion years ago. This heated gas-body continuously radiated heat and as its temperature decreased, it gradually condensed to a liquid state. The mass then solidified from the outside to the inside, and the resulting water vapor formed a cloud. As rain from such clouds formed watersheds, or oceans, in the solid outer layer of the Earth. At one point, life appeared in sea water and the continuous change of organisms that formed in sea water resulted in the present day diverse biota.

After deep rational thought and experimentation, modern man has come to the conclusion that organic expression is at the root of the emergence of the living beings. The word Evolution comes from the Latin word 'Evolveri'. English philosopher and educator Herbert Spencer (Herbert Spencer) first used the term evolution. At one time, it was said that the slow, continuous and ongoing changes that lead to the emergence of complex and advanced new species or organisms from simpler organisms is called evolution. However, biological evolution does not always occur slowly, but has been shown to occur rapidly due to environmental factors. Not only that, there are also examples of complex organisms taking simpler forms due to evolution. Mexican cavefish have lost their sight as they move from the upper layer of the water and start living in dark caves in deep water. So now the biological evolution is defined by the alleles of the gene (a particular gene can exist in more than one form, then different forms of that gene are called its alleles). According to the modern definition given by Curtis-Barnes (1989), evolution is the change in the allele frequency of one or closely related species in a given area from generation to generation.

Let's say, all the genes of all the tigers of Sundarbans are determined and a list is made, where the number of alleles of any gene is also calculated. After several years, all the genes of all the tigers of the next generation were determined and the number of alleles was also calculated. Then comparing the genes of two generations, if there is a significant change in the number of alleles of a gene from one generation to another, then it can be said that biological evolution is occurring in this population of tigers.

4.3.1 How, When and Where Life Originated

There are many theories about the origin of life. But all of them have the same opinion about the origin of life from sea water. The logic about this theory is:

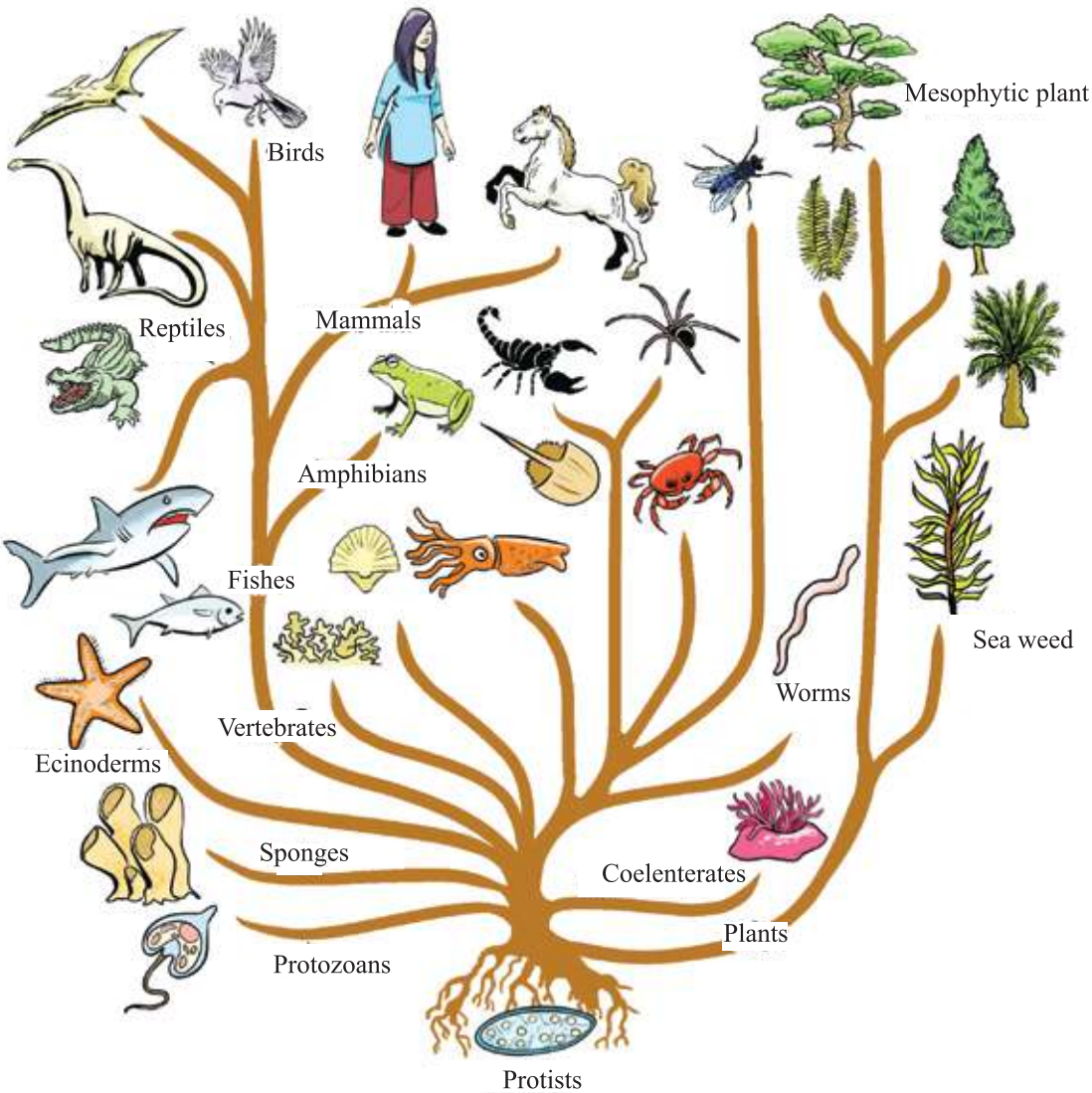


Fig. 4.14: Biological evolution is a complex network of numerous changes occurring simultaneously in various branches.

the presence of different salt in cell, blood and other fluid of the body which have similarities with minerals of sea water. Secondly, sea water has many unicellular simple organisms. About how life was originated on this earth, the scientists have estimated that about 260 crore years ago, the atmosphere had lots of methane, ammonia, hydrogen sulphide, water vapour, nitrogen and carbon dioxide gas, but no oxygen. Continuous volcanic eruption happened. It increased the temperature of the atmosphere. As a result of thunderbolt and ultraviolet ray, these chemical compounds produced amino acid and nucleic acid. Then this amino acid and nucleic acid collectively produced nucleoprotein. This nucleoprotein then got the capability to replicate and initiate living organisms. The events of origin of earth and origin of life are called the chemical evolution or evolution.

It is thought that nucleoprotein is produced by nucleic acid and protein. Protovirus was formed from this nucleoprotein and then virus evolved. Virus is an intermediate stage of living and non-living stage.

Nucleoprotein → Proto-virus → Virus

Probably bacteria were created after that and then evolved protozoa. Bacterial nucleus is proto type. So, it is called the proto-cell. Then these protozoa formed a structured nucleus. Some unicellular life began to produce chlorophyll; so, food synthesis started with production of oxygen as by-product. Then, photosynthetic life began to increase. After that, multi-cellular organisms evolved from unicellular organisms. Thus, evolution of plants and animals began in two lines.

1. Evidences for Evolution

Two concepts are tried to establish in evolution; one is the evidences that evolution really occurred; the other is the process of evolution or how evolution happens in life. There are many evidences that the evolution is happening for millions of years in life. These are described below:

Morphological Evidences: The external structure of living beings is called morphology. Their similarities and dissimilarities are called comparative anatomy.

Homologous organs, analogous organs, vestigial organs, and comparative anatomy are described here.

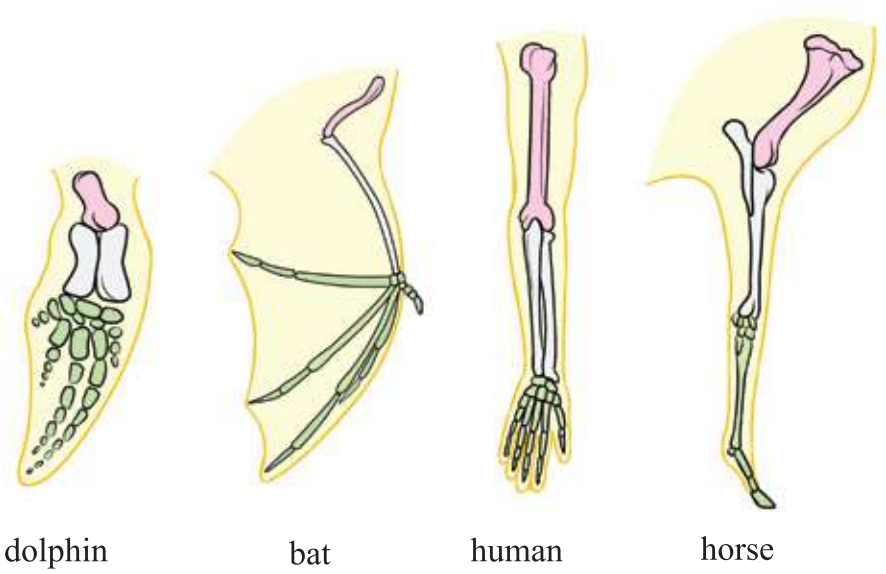


Fig. 4.15 : Homologous organs

(a) Homologous Organs: Bird's wings, bat's wings, whale flipper, seal's front legs, human hands are homologous organs. They are different in appearance but similar in internal structure. Their basic nature of bone system is similar (Fig : 4.15). That is, their humerus radio-ulna, carpal, metacarpal, and phalanges are arranged from top to bottom. The external structure becomes different due to the adaptation to different environments. Front legs of birds and bats are for flying. Whale flipper is for swimming, front legs of a horse is for running, human hand is for holding. Thus, it is understood that the origin of homologous organs are the same. That is, these animals are originally same, but they are changed for adaptation to different environments. The scientists think that all the animals with homologous organs have the same origin; that is, they have originated from the same ancestor. This theory supports the biological evolution.

(b) Analogous Organs: The body parts which have same function but their origin, development and structure are different are called analogous organs. The

wings of insects, bats, and titmouse are analogous organs. Their origin and structure are different but they have got the same function for adapting in the same environment. These analogous organs also support the theory of evolution.

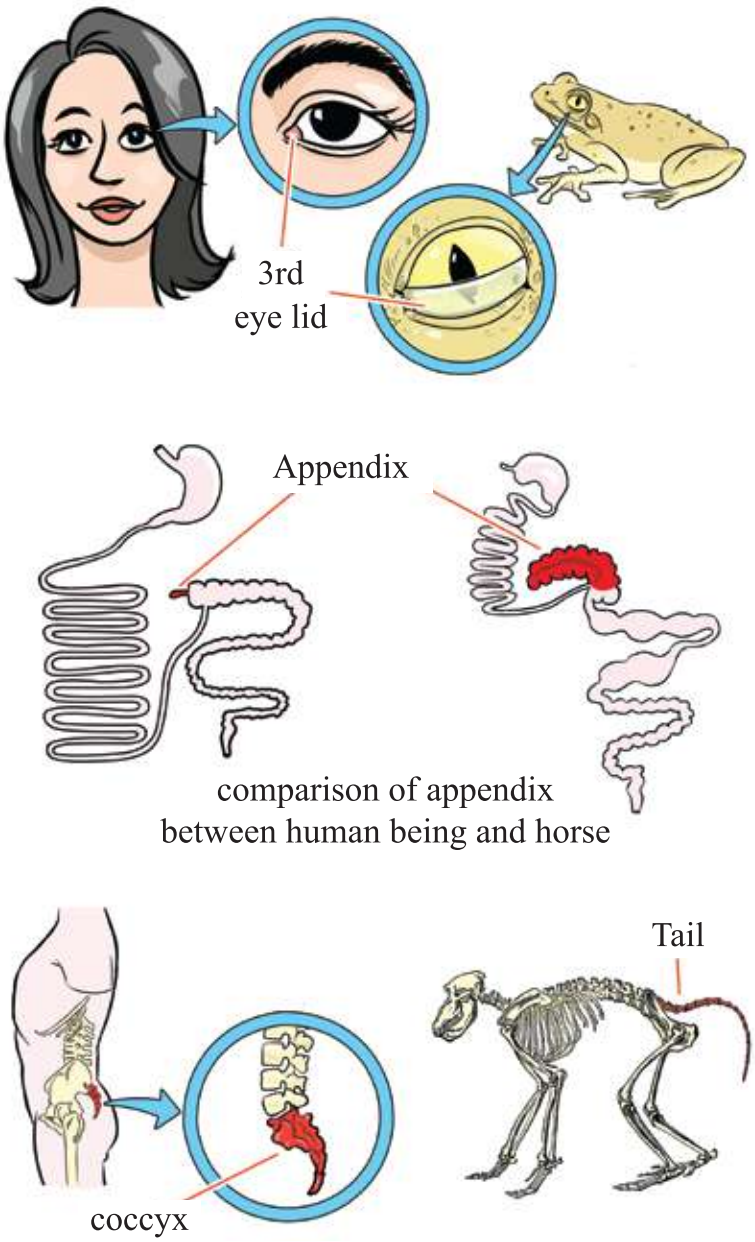


Fig. 4.16 : Vestigial organ

(c) Vestigial Organs: There are some body parts which are functional in some animals and non-functional in other animals, these are called the vestigial organs. There are many vestigial organs in animals. Human caecum and the appendix attached to it are non¬functional but in guinea pigs they are functional. Human body has no tail but at the end of the spinal cord, a vestigial bone called coccyx is present. Coccyx bone was well-formed in human ancestors. The structure of external ears in cows, horse, goat, elephant and humans are similar. So, we can conclude that animals having vestigial organs have originated from the ancestors in which that part was functional (Fig : 4.16).

2. Comparative Anatomy

The similarities and dissimilarities of the anatomy of different animals are called the comparative anatomy. Comparative study of some organs of vertebrates shows that there are similarities in their basic structure. This information supports the biological evolution. For example, the heart of vertebrates can be mentioned. The fish has two chambered heart, the amphibians have three chambered heart. The reptile has two auricles and two partially divided ventricles. The birds and mammals have four chambered hearts. The basic structure of heart of the vertebrates mentioned above has gradually become complex. That is, these complex lives originated from a common ancestor through the process of evolution.

3. Evidence About Connecting Animals

There are some living beings which have the characteristics of two groups of living beings. These are called the connecting living beings. For example,

Fig. 4.17 : Platypus

platypus (Fig : 4.17) can be mentioned. They have the characteristics of both reptiles and mammals. Platypus lays egg like reptiles. On the other hand, they have body hair; lactating gland and their broods suck the mother's breast. Most of the connecting animals became extinct because they could not effectively adapt to this world.

There are some plants which have the characteristics of two groups of plants. The gymnosperm Gnetum has the qualities of both angiosperm and gymnosperm.

According to biological evolution, if a group of life originates from the other group of life there must be a connecting animal between the two groups. So the presence of the connecting animal supports biological evolution. It means if mammals originate from reptiles, in between there should be such organism which is connecting reptiles and mammals. Therefore, the existence of these connecting animals in nature supports biological evolution.

4. Embryological Evidences

The young animal in the egg or in the ovary (in case of mammals) or the young plant in the seed is called the embryo. The origin and development of different embryo supports the theory of biological evolution.

There are many similarities in the embryo of fish, amphibians, reptiles, birds and mammals. In the early stage of embryo it is impossible to differentiate. Every embryo has a gill and a tail.

After observing the similarities of embryo scientists have come to a decision that "Every life makes a repetition of the evolutionary history of its ancestors at least for a short time" Haeckel termed this natural process as 'Ontogeny repeats phylogeny'. That is, the development of embryo of any organism shows the history of its ancestors. This is a direct evidence of evolution.

5. Fossil Evidence

The branch of science which discusses the exploration of extinct organisms is called the paleontology. In this branch different types of fossils are examined to know of various extinct animals. Fossil related evidences are the strongest

among the evidence of evolution. Fossils are the impression of fossilized whole body or its part remained for a long time in the stone layer bowels of earth. These are stored in different layers of rock. Fossil proves undoubtedly that one living being originated from the other living beings through systematic evolution. Before the discovery of fossils, there were some gaps in the history of evolution for the lack of proper evidence. It was predicted that there were some animals in between the two generations which was not found. This undiscovered living organism is called the missing link. After the discovery of fossils that missing link was found. So, the problem of chronological history of evolution has been solved. Fossils are considered to be the live evidence of the past or ancient times.

Fig. 4.18 : Archaeopteryx

For instance, after the experiment of extinct archaeopteryx (Fig : 4.18) it is seen that they had teeth and legs like reptile, two wings with feather like a bird, a long tail, a bunch of hair at the end of the tail. This proves that birds originated from the reptiles.

In case of flora, there is a plant called pteridosperm which has the characteristics of both fern and gymnosperm. So, it is thought that gymnosperms originated from fern.

6. Living Fossils

There are some living organisms which have originated in ancient times and still exist without change, but the contemporary living organisms of the same classes have been extinct. This is called living fossil. The arthropod Limulus (Fig: 4.19), reptile Sphenodon, mammal platypus are the examples of living animal fossils. Equisetum, Gonium, Ginkgo Biloba are the examples of living plant fossils.

Fig. 4.19 : Limulus– a living fossil

Limulus originated 400 million years ago. The other arthropod of that time has been extinct. But they are still alive. So they are called the living fossils.

7. Molecular Biology

At present, it has been possible to unravel the genetic code or mystery of life of many organisms. Therefore, matching the nucleotide sequences of DNA or RNA or amino acid sequences of proteins of one organism's DNA or RNA or proteins with the similar sequence of another organism has become easy. This can be done using appropriate software if you have a computer connected to the internet. This method determines how closely or distantly an organism is genetically related to another organism. This shows how consistent the picture of biological evolution is with other methods, including fossils. As it turns out, it proves evolution so strongly that it has been said that if no fossils were found, it would be no problem to determine the history of evolution using only genetic information of life.

4.4 Theories of Evolution

A new species or one species from another originates through evolution. Different theories of evolution of different scientists are described below:

Fig. 4.20 : Scientist Lamarck

4.4.1 Lamarck's Theory

Lamarck (Fig : 4.20) coined the word 'Biology'. At first he established the analytical theory of evolution. He mentioned this subject in his book Philosoplic Zoologique in 1809. Lamarck's theory is called Lamarckism. Lamarckism is based on some hypotheses.

These are described below:

1. Theory of Use and Disuse

According to Lamarck, new organ can develop or become extinct according to its need. According to him if an organ is continuously used that organ becomes stronger and healthy according to environmental needs. On the other hand, if the organ has no need for the environment, that organ is not used and becomes inactive for remaining unused continuously and finally becomes extinct. According to Lamarck, use and disuse of organ initiate the changes in living beings. These are the characteristics acquired generation after generation.

2. Environmental Effect

Living beings always try to adapt with changing environment. This is their inborn characteristic. The living beings get many changes to adapt with the naturally changing environment. According to Lamarck the nature and physical structure of living beings change with the change of environment. This is also an acquired characteristic of living beings.

3. Transmission of Acquired Characteristics and Origin of New Species

According to Lamarck, the characteristics which are earned by the living beings in their life are transferred from one generation to other. That is, acquired characteristics are inherited. According to Lamarck's theory, for the inheritance of acquired characteristics in every generation, some new characteristics are formed and gradually one species develops from another species.

Lamarck established his theory after some observation. Some examples can explain his theory.

- For continuous swimming on water the aquatic birds get thin skin in between their toes and the feet turned into webbed feet.
- The ancestors of snake had four legs like salamanders. As they lived in the cave of mountains, their legs remained unused and finally those legs became completely lost.
- According to Lamarck, giraffe has a long neck for collection of leafs from tall trees. Inheritance of acquired character helped evolve such long neck in giraffe.

The modem scientists cannot believe the biological theory of Lamarck. They do not believe that the species have changed with the passage of time. After expansion of genetics, the geneticists experimented about the inheritance of acquired characters. But in reality the geneticist did not find any evidence of inheritance of acquired characters. It means the geneticists have found no evidence in favour of the idea that acquired characteristics are transferred from one generation to another. It can be simply said that if a man makes his hand stronger by taking exercise or by using it continuously, it is not necessarily true that his offspring will be born with strong hands.

4.4.2 Darwin's Theory or Darwinism

After 50 years of the theory given by Lamarck, a British natural scientist Charles Darwin made a revolution in the thinking of biologists. Charles Darwin (1809-1882) (Fig: 4.21) was born in Shrusberi in England. He visited the Galapagos Island in the Pacific Ocean. The surprising characteristics of plant and animal attracted him. He collected information and returned to England in1837. After 20 years of his return to England in 1859, he established his theory and explained it in his book, "Origin of Species by Means of Natural Selection". It should be noted that another naturalist, Alfred Russell Wallace (1823-1913), conducted independent research around the same time and reached the same conclusion as Charles Darwin.

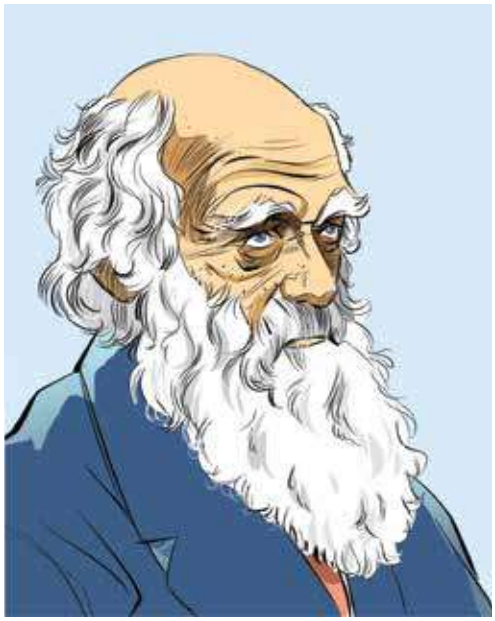


Fig. 4.21 : Scientist Charles Darwin

According to Darwin, the universal truths taking place in nature are–

1. High rate of Population Growth

According to Darwin growing population in high rate is the natural characteristics of living beings. Population grows in geometric rate. For example: A mastered plant grows 730000 seeds per year. A female salmon lays three crore eggs in breeding season. If all the elephants in every generation

survive, a pair of elephants will produce one crore 19 lac elephants in 750 years.

2. Limited Food and Shelter

As the earth surface is limited, the shelter and food for living beings are also limited.

3. Struggle for Existence

The living beings multiply in geometric rate. As the food and shelter is limited, so they have to face a hard competition. Darwin calls this struggle for existence. Darwin noticed that living beings have to struggle in three stages e.g.-

(a) Inter-specific Struggle: For example, frogs eat insects, snakes eat frogs, and peacock eats both snake and frogs. So there is a relation of food and consumers among the species and they have a cruel struggle for life.

(b) Intra-specific Struggle: The food and shelter of the same species are similar. When their numbers increase there is a competition among them. For example, if the number of herbivores increases in an island they start struggling among themselves as their food and shelter is limited. Thus, the strong animals take food by preventing the weak ones. Then the weak animals die without food within a few days.

(c) Struggle with Environment: Flood, drought, cyclone, sand wind, earthquake, volcanic eruption and other unfavourable natural conditions disrupt the natural living system of animals. So, the living beings have a continuous struggle with nature. For example, the cuckoo, a bird of north and Central America,was extinct due to cold and snowfall.

4. Variation or Change in Body

According to Charles Darwin, in this earth two living beings are not the same, there are some differences among them. The differences among the two living beings are called variation. The favourable variation helps living beings in the struggle for existence.

5. Survival of the Fittest

According to Darwin, only the variation which is suitable for struggling and adaptive to the environment will survive. The rest will become extinct gradually. The bear, tiger or plants of the polar region will not survive in the tropical region.

6. Natural Selection

This topic is most important in Darwinism. The natural process, in which the favourable variety or adaptive variety gets more facilities, is called the natural selection. If the favorable variety which is selected by nature survives for more time, its population grows rapidly. On the other hand, unfavourable variety cannot adapt with the nature and gradually becomes extinct (Fig : 4.22).

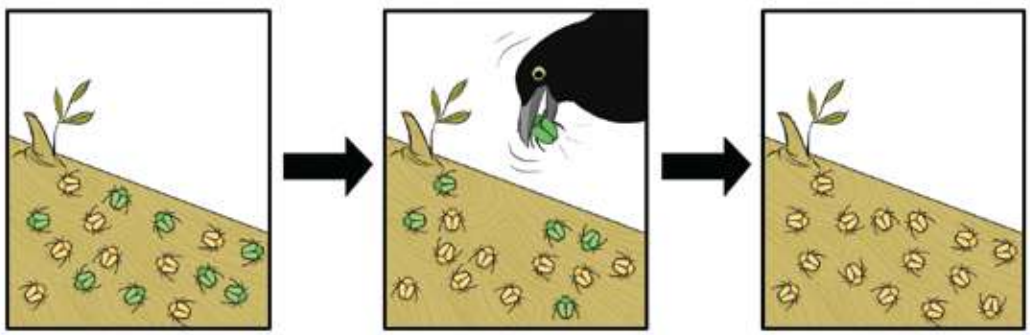


Fig. 4.22 : Favourable variety which is selected by nature survives for more time, its population grows rapidly.

According to Darwinism, the living beings which can adapt with the nature will be the fittest, that fittest living beings will win in the competition to survive and multiply and become dominant.

7. Origin of New Species

The plants and animals which have the favourable variation, nature selects them and rears them. Favourable varieties of plants and animals can adjust with the environment and can multiply more compared with unfavourable varieties. Favourable variation is inherited to their progeny. Nature selects the generation that have more favourable variations. Thus, the new species of animals and plants are created by natural selection for a long time. According to Mendelism and Darwinism, geneticists, cytologists, and taxonomists now think about the origin of new species that species can originate slowly by- (1) Isolation from the main population of ancestral species (2) Hybridization and (3) Polyploidy of chromosomes during cell division. So, the new living beings will be adapted and origin of new species will occur by natural selection.

It is not that evolution occurs only in nature. Evolution can also be done by experiment in the laboratory. This is also evidence of the reality of evolution. There is no scientific evidence found against evolution till today. The more knowledge we gain about the biological kingdoms, the more difficult it becomes to deny evolution.

Exercise

Multiple Choice Questions

1. In which water did life first originate?

a. River water b. Fountain water
c. Sea water d. Pond water

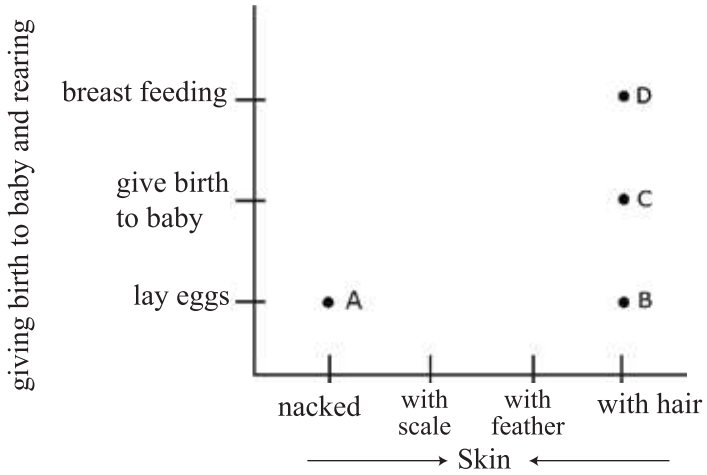
2. Before the creation of proto-virus the atmosphere had the gas

i. Oxygen
ii. Hydrogen
iii. Nitrogen

Which one is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

Answer the question 3 and 4 from the graph bellow:



3. Which animal will occur in the position A of the graph?

a. Fish b. Toad
c. Snake d. Tortoise

4. What is the position of platypus?

a. A and B b. B and C
c. B and D d. C and D

Creative Questions

1. Mrs. Santa is not capable of carrying child in her womb and she sees a specialist doctor. To solve this problem, the doctor helped her to ovulate an ovum in a special method. On the other hand Mrs. Santa's cousin Mita has got five daughters for expecting a son.

a. What is nucleoprotein?
b. What is living fossil?
c. Explain what special method was followed by the doctor for Mrs. Santa.
d. Give a scientific explanation of giving birth to five daughters by Mita.

2. Jaman could not understand the theory of evolution and goes to his father. His father explained him the evidence of homologous organ. Then Jaman wanted to understand the theory of evolution from his father. His father explained both Lamarckism and Darwinism.

a. What is sex chromosome?
b. What is evolution?
c. How did the father explain the evidence of evolution?
d. Which of the two theories explained by the father is more acceptable? Give your opinion with comparative study.

Chapter Five

Light for Sight

Light is immensely important in our daily life. If we close our eyes, we cannot see anything. Again, in a completely dark place, we cannot see anything despite keeping our eyes open. Light is the means by which we can see anything. You have known about different phenomena of light in the previous classes. In this chapter besides knowing about the uses of mirrors, you will also learn about refraction of light. Moreover, you will know about the functions of the eyes, the least distance of distinct vision, the power of lenses, defects of vision, and the use of lenses for maintaining normal vision.

At the end of this chapter we will be able to-

- explain the uses of mirrors;
- explain the refraction of light;
- explain the function of the eyes in viewing anything;
- explain the least distance of distinct vision;
- explain the power of a lens;
- explain what causes defects of vision;
- describe the way of rectifying defects of the eyes by using lenses;
- explain the way of keeping vision normal;
- take good care of the eyes and make others aware of eye care.

5.1 Uses of Mirrors

There are manifold uses of mirrors in our day-to-day life. In this lesson, we will discuss two special uses of mirrors. These are safe driving and the use of mirrors near dangerous blind turns on hilly roads.

Safe Driving

One of the conditions of safe driving is keeping a close eye all the time on what is happening around the car. Usually, two side view mirrors are used facing the two sides of the front doors of a car (Fig: 5.01). Besides, inside the car at the middle of the front side, there is one rear-view mirror. These mirrors help to view the both sides and the back side of the car. As a result, the driver does not need to twist or move his body to observe different sides.

Fig. 5.01 : Unsafe driving

Using these mirrors, the driver can look in front and on the back side of the car keeping his hands on the steering wheel all the time. Before starting the car, all the mirrors (Fig: 5.02) need to be adjusted properly, so that the driver can clearly see both sides and the back side of the car while sitting in the driving seat.

Fig. 5.02 : Three mirrors of a car

The mirrors should also be cleaned properly to remove any dirt or dust particles on them. Otherwise, the position of the image of another car may not be seen properly. If the car needs to be moved backward, the driver should look at all three mirrors and continue looking through the mirrors until the car halts. Furthermore, if the driver wants to change the lane while moving on the road, he should look at the three mirrors so that the position of any car behind can be assessed.

The Blind Turn on Hilly Roads

The hilly roads are usually built in a zigzag manner. There are often blind turns at which the next part of the road makes a turn at 90°. As a result, any incoming vehicle cannot be directly seen and driving becomes very dangerous on these hilly roads. To solve this problem and make driving safe on such hilly roads, big spherical mirrors are placed on stands at the blind turns. (Fig. : 5.03). In effect, an incoming car from the other side of the turn can be seen if a moving car comes near these mirrors and consequently the driver can control the speed of the car and drive the car safely.

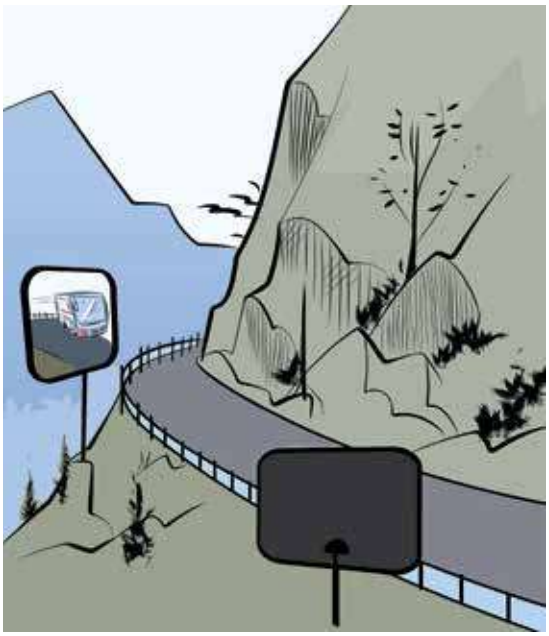


Fig. 5.03 : Blind turn of hilly roads

Individual Work

Task : Examine the three viewing mirrors of a car. You will see that these are not plain mirrors that you are familiar with. Their surfaces are curved and these are convex mirrors. For this reason, everything looks smaller than usual in these mirrors and they can cover a large area.

5.2 Refraction of Light

You have learned about the refraction of light and its practical applications in class eight. We know that light always travels in a straight line in a transparent homogneous medium. When a light ray is incident obliquely (i.e. not perpendicularly), on the interface between two transparent media, the direction of the ray changes at the surface of separation of the two media. The phenomenon of changing the direction of a light ray upon oblique incidence is called the refraction of light. Observe Figure 5.04, where the medium in the upper part is air and that in the lower part is water.

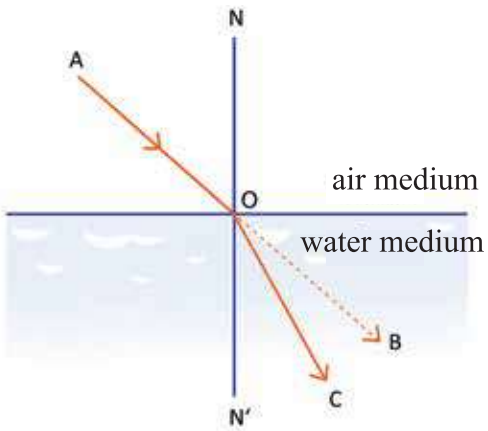


Fig. 5.04 : Refraction of light

A light ray propagates from point A and is incident on point O. Then AO is the incident ray and O is the point of incidence. A normal NN' is drawn through the point O on the surface of the water. The first medium is air and the second medium is water. Water is optically denser than air, so, the light ray AO is refracted towards *ON'* and passes along the line OC instead of going along OB. Here, OC is the refracted ray.

$\angle AON$ is the angle of incidence and $\angle$CON' is the angle of refraction. Note that had the light ray been incident along NO instead of along AO, it would have gone straight along ON'.

Individual Work

Keep a coin in a cup and withdraw your head away from the cup such that the coin is no longer visible. Now pour some water into the cup. After some time, you will be able to see the coin. In the empty cup, light could not reach your eyes as it traveled straight, while with water in the cup, light rays had bent at the interface between water and air and reached your eyes.

Laws of Refraction

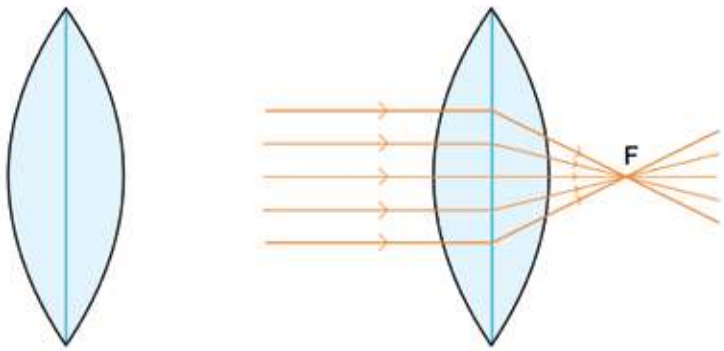
The refraction of light rays can be described by two laws:

1. The incident ray, the refracted ray, and the normal drawn on the interface at the point of incidence lie in the same plane.
2. For a definite pair of media and for a particular colour of light, the ratio between the sine of the angle of incidence (i.e. sinθ) and the sine of the angle of refraction (i.e. sinθ') is a constant. That is sinθ/sinθ'=n.

The constant n appearing in the second law is called the refractive index of the second medium relative to the first medium for a particular colour of light. If the first medium is taken as the vacuum, the refractive index of the second medium is called the absolute refractive index of the second medium or substance. The refractive index of water is 1.33. The refractive index of air is so close to 1 that it is essentially taken as 1. However, keep in mind that refractive index of a material medium varies with the wavelength of light.

5.3 Lens

A transparent refracting medium bounded by two spherical surfaces is known as a lens. Most of the lenses are made of glass. But nowadays lenses are also made of quartz and plastic and the uses of their uses are increasing day by day. Lenses are mainly of two types; namely, a) Convex or converging lens, and b) Concave or diverging lens. As the name suggests, light rays converge toward a point going through a convex lens and light rays diverge away from each other while going through a concave lens.



(a) (b)

Fig. 5.05 : Convex lens and its focus point

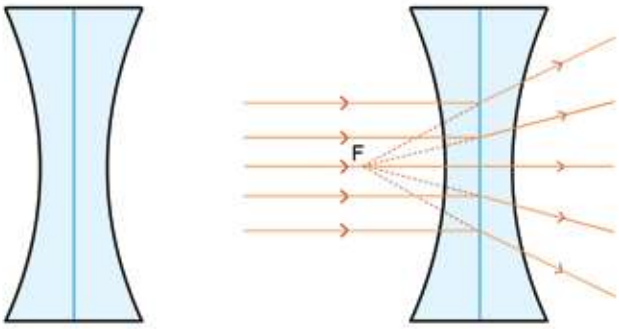


Fig. 5.06 : Concave lens and its focus point

Figure 5.05 shows a convex lens. The middle part of a convex lens is thicker than the edges and hence it is sometimes called a "thick-in-the-middle" lens. Light rays are incident on the convex surface of a convex lens. This lens converges a parallel beam of light to a point (Fig. : 5.05). This point is called the focal point of the lens and the distance from the center of the lens to the focal point along the axis of the lens is called the focal length. Light rays coming out of a convex lens converge to a single point and again diverges away. On the other hand, the middle part of a concave lens is thin and both the edges are thick (Fig: 5.06). A parallel beam of light incident on the concave surface of this lens diverges away. If the diverging rays are extended backward, they meet at a point and the diverging rays seem to be coming from that point. This point is the focus point of the concave lens and the distance between the center of the lens and the focus point is the focal length.

The surfaces of a lens are most commonly parts of a spherical surface. The center of the sphere of which a spherical surface is a part is called the center of curvature of the surface of a lens. There are two centers of curvature of a lens for the two surfaces. The straight line going through both the centers of curvature of a lens is the principal axis of the lens. A beam of rays parallel to the principal axis of a lens converges to a point (for a convex lens) or seems to diverge from a point (for a concave lens). This is called the principal focus point of a lens. In figures 5.05 and 5.06, the point F is the principal focus. The distance from the optical centre to the principal focus is the focal length of the lens.

5.3.1 Power of Lens

We know that the incident rays parallel to the principal axis of a lens converge at a point on the principal axis after refraction by a convex lens. On the other hand, incident rays parallel to the principal axis of a concave lens diverge after refraction by it and appear to diverge from a point on the principal axis. To measure the capacity of converging and diverging parallel rays of light by a lens we define a quantity called the power of a lens. Taking the inverse of the focal length (converted into meters) gives the power of a lens. Its unit is a diopter (D). That means if the focal length of a convex lens is 2 meters, its power is ½ diopter = 0.5 diopter. The power of a lens may be positive (convex lens) or negative (concave lens). The power of any lens + 1 D means it is a convex lens and it will converge a parallel beam of light at a distance of 1 meter on the principal axis from the optical center of the lens.

Similarly, if the power of a lens is -2 D means the lens is concave and it diverges a beam of light parallel to its principal axis in such a way that it appears (seems) that the rays are diverging from a point ½ meter away from the optical centre of the lens on the principal axis.

5.4 Functions of Eye

5.4.1 How We See

You learned about the construction of the eyes in class eight. In this lesson, we shall discuss how we see using our eyes (Fig: 5.07).

The components of an eye are the retina, eye lens, aqueous humor, vitreous humor, and cornea. In this chapter, you learned how light rays are refracted through a lens. It should be clear to you that the eye acts as a converging lens. We have seen that a convex or converging lens always creates an inverted image. The image inside a camera is formed in the same way. Whenever we have an object in front of us, light rays reflected from the object are refracted by the lens in our eyes and create an inverted image of the object on the retina. When light is incident on the retina, the small rod cells connected with the nerves and cone cells, convert the incident light into electrical signals. The signal is readily transmitted to the brain through the optic nerves. Note that the cone cells respond to intense light and help perceive the colors and distinguish between the colors.

On the other hand, rod cells are sensitive to faint light. This is why we can see in faint moonlight using rod cells but cannot distinguish colors. The inverted image created on the retina is again been inverted back to the straight image of the object by the brain.

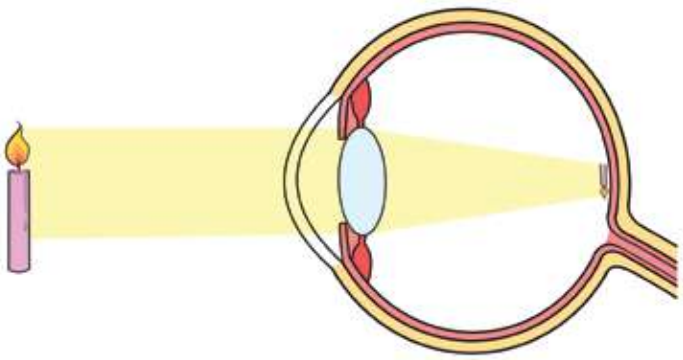


Fig. 5.07 : How we see

5.4.2 Least Distance of Distinct Vision

The normal eye does not have an unlimited capacity to cope with any illumination. Human beings try to see an object clearly by adjusting the focal length of the lens in the eyes. But if an object is very close to the eye it cannot be seen distinctly or clearly if its distance from the eye is smaller than a minimum distance. The minimum distance from the eye, up to which an object can be seen distinctly, if placed there is called the least distance of distinct vision and the point is called the near point of distinct vision. This distance varies with age. For a child, this distance is approximately 5 centimeters and for an adult person, this distance can be up to 25 centimeters. The far point exists at an infinite distance from the eye. That is why, we can see the distant stars in the sky with the naked eye.

5.4.3 Defects of Eye and Its Remedy

Do you have any idea about the eye problems? In this lesson, we shall discuss different defects of the eye and their remedy.

We know that a normal and healthy eye can distinctly see any object between the near point and the far point at an infinite distance from the eye. This is the range of normal vision of the eye. If this range of normal vision of the eye is disrupted the condition is called a defect of the eye.

Though there are several defects of the eye, we shall only discuss two main defects. These are:

(a) Myopia or shortsightedness
(b) Hypermetropia or farsightedness

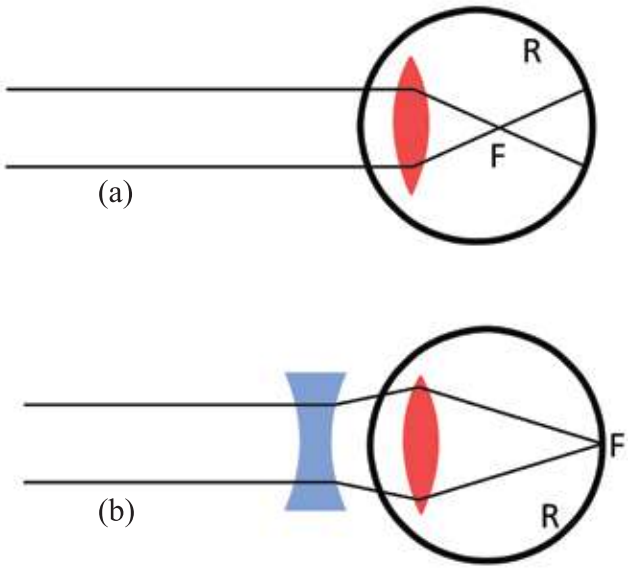


Fig. 5.08 : Short sight and its remedy

Myopia or Short Sight

When an eye can see an object close to it but cannot see a distant object, then it is called shortsightedness or myopia. The far point of such an eye is at a finite distance not at the infinity. An object can be seen more distinctly if placed nearer to the least distance of distinct vision.

The following two are the causes of this defect:

1. If the converging power of an eye lens increases or the focal length of the eye lens decreases.

2. If for any reason the radius of the eyeball increases.

As a result, light rays coming from a distant object create an image not on the retina but rather at a nearer point (F) in front of the retina (Fig: 5.08). consequently, we cannot distinctly see the object using our eyes.

Remedy

To rectify this defect, one has to use a pair of spectacles or eyeglasses with concave lenses whose focal length is equal to the distance of the far point of shortsightedness. The diverging action of this lens is opposite to the converging action of the convex lens. As a result, the effective focal length of the lens of the eye will increase and the image will be formed at a farther point. Hence parallel light rays coming from an infinite distance will diverge exactly by the amount required. These diverged rays will be refracted in the lens of the eye and form a sharp image right on the retina (R).

Hypermetropia or Farsightedness

When the eye can see distant objects clearly but cannot see a nearby clearly the defect is called farsightedness. Normally elderly persons suffer from it. This defect arises for two reasons as mentioned below:

1. If the converging power of an eye lens decreases or the focal length of the eye lens increases.

2. If for any reason the radius of the eyeball decreases.

As a result, although the light coming from a far distance can create an image on the retina properly, light rays coming from a nearer point, after getting refracted through the eye lens, converges at a point F behind the retina (Fig: 5.09). Hence, we cannot distinctly see an object close to the eye.

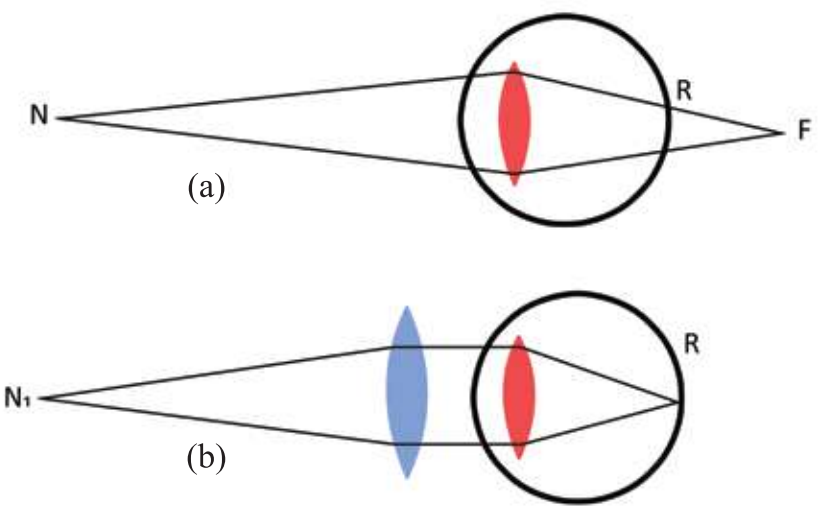


Fig. 5.09 : Long sight and its remedy

Remedy

To rectify this defect, one has to use a pair of spectacles or eyeglasses with convex lenses. Hence light coming from a near point gets refracted two times, once in the lens of the spectacle and again in the lens of the eye and the effective focal length of the lens of the eye reduces. The rays will get sufficiently converged and an image will be created right on the retina (R).

5.4.4 Ways to Protect Normal Eye Vision

Our eyes are very important organs. It is necessary to take proper care of the eyes so that they remain free of any defects. There are many ways to maintain normal and healthy eyes. Some important instructions may be given in this regard.

(a) Proper intake of nutritious food is very important for the eyes. One has to eat foods enriched with vitamins A, C and E. Food containing fatty acids, zinc, deep green vegetables, and different types of fruits, are very good for the eyes. These types of food prevent eye diseases. Carrots, fish, broccoli, wheat, sweet pumpkin, and yellow fruits (such as mango, ripe papaya, etc.) should be eaten in a moderate amount.

(b) For the proper care of eyes, it is important to obey the right method of leading life. The eyes become tired like the body after the labour rendered throughout the day. It is necessary to sleep whole night (7-8 hours) to make the eyes energetic again. So, particular time for sleeping must be ensured. Besides through research it is found that smoking is harmful to the eyes. So smoking must be stopped. It is essential to use sunglasses to take precaution when you are out in an intensified sun-light. In this case, sunglasses which can prevent the ultra- violet ray should be used. One should be cautious during cooking with oil and wielding works. It is wise to wear safety glasses while working with chemicals. (c) In insufficient light, everything is to be seen from a very close distance and it is harmful to the eye. The light of the room should be sufficient so that it does not create any difficulty to read. If it seems that the eyes are fatigued it is better to take rest rather than reading. If we read book or anything keeping them at a distance less or more than the least distance of distinct vision of the eye, it creates pressure on the eyes. Perhaps you have observed that if you operate com- puter for a long time, your eyes become tired. Studies have shown that watching television for a long time or using mobile phones or computers can damage the eyes. Look away for 20 seconds every 20 minutes, especially when looking at a monitor. The screen of the device itself is not harmful but keeping the eyes focused for a long time at a short distance is mainly responsible for the damage. Therefore, to protect the eyes from this damage, television, computer or mobile should be used from a certain distance and at proper intervals.

Exercise

Multiple Choice Questions

1. What is the least distance of distinct vision of a normal eye?

a. 5 cm b. 10 cm
c. 25 cm d. 50 cm

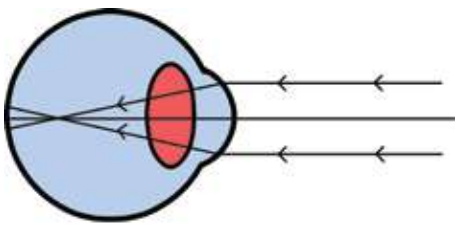
2. Which of the following is applicable for a convex lens?

i. Its power is positive.
ii. The middle part of the lens is thin and both the edges are thick.
iii. It converges parallel rays at a point.

Which one of the following is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

Observe the figure below and answer questions no. 3 and 4



3. What is the name of the defect of the eye mentioned in the figure?

a. Shortsightedness b. Farsightedness
c. Presbyopia d. Astigmatism

4. What type of lens should be used to rectify the aforementioned defect?

a. A convex lens b. A concave lens
c. A convexo-concave lens d. A plano-concave lens

Creative Questions

1. Sejuti cannot clearly see the writings by the teacher on the blackboard from a distance. On the other hand, Sejuti's father faces difficulty in seeing nearby things. Subsequently, Sejuti and her father consulted with the doctor who advised her to use one kind of lens and a different kind of lens for her father.

   a. What is refraction of light?
   b. What is meant by the least distance of distinct vision?
   c. What type of defect of the eye is Sejuti suffering from? Explain.
   d. Analyze the logic behind the doctor's advice for using a different kind of lens by Sejuti's father.

2. See the figures below and answer the questions.

Fig : 1

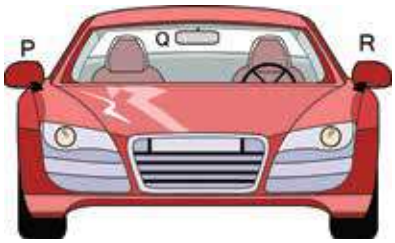


Fig : 2

a. What is a lens?
b. What is meant by the power of a lens?
c. What is the reason for using the mirror X in Figure 1? Explain.
d. Explain the role of the mirrors P, Q, and R in the car in Figure 2.

Chapter Six

Polymer

In our daily life different types of polymeric substances are closely related. Some of them are natural while others are synthetic. In our day-to-day life, we cannot think of a single moment, when we are not using any polymer. Some of the polymeric substances are environment friendly and some of them are harmful to the environment. In this chapter, we shall learn how to recognize polymer and also learn which polymer we shall use and which ones we shall keep aloof from.

At the end of this chapter, we will be able to-

- explain natural and synthetic polymer;
- explain the polymerization process;
- describe the sources, characteristics and usage of natural and synthetic polymers;
- explain the process of yarn manufacturing from fiber;
- explain the characteristics of different types of yarn;
- explain the physical and chemical properties of rubber and plastic;
- explain the role of rubber and plastic for environmental imbalance;
- identify the characteristics of different types of yarn by applying heat;
- be aware of using rubber and plastic.

6.1 Polymer

Household items of melamine, electric switch board, carpets, PVC pipes, polythene bags, jute bags, silk, wool, cotton, nylon, rubber, all these items are very useful and well known to us. All of them are polymers. The word "polymer" came from two Greek words "poly" which means many and "meros" which means part. That means, in the language of chemistry, the large molecule which is formed by joining together many small molecules is called polymer. The small molecules that make polymer are called Monomer. So, the chain here can be considered as a polymer. In chemistry, polymer is formed by chemical combination of monomer molecules.

Polythene bag that we use is a polymer made from ethylene monomer. Similarly PVC pipe is the polymer of vinyl chloride monomer. These are the polymers formed from only one type of monomer. They can also be formed from more than one type of monomers. For example, synthetic electric switch board is a polymer named Bakelite which is made of phenol and formaldehyde monomers. Household melamine items are basically melamine resin polymers which are made from melamine and formaldehyde monomers. At the beginning, we mentioned several examples of polymer, some of which are available in nature and they are called natural polymers.

Can you identify which are the natural polymers? Jute, silk, cotton and rubber, are natural polymers. On the other hand, melamine, resin, Bakelite, PVC, and polythene are not available in nature. They are manufactured in industry synthetically and they are synthetic polymers.

6.1.1 Polymerization

Polymers are made from Monomers through a specific process. The process in which many Monomers join together to form Polymer is called a polymerization. Usually polymerization requires high pressure and temperature.If two monomers join together, the resulting substance is called Dimer. We can write the Dimer production process in this way: it can be written as-

1 monomer + 1 monomer → monomer-monomer or
We also can write in another way such as (Monomer)2
Similarly, when three Monomers join together, the resulting substance will be Trimer. That is , we can write:

1 monomer + 1 monomer + 1 monomer → monomer- monomer-monomer or $(monomer)_3$

Thus, if more than three, suppose n numbers of Monomers are joined together and produced a compound, the compound will be called Polymer. Then the polymerization process will be:

monomer + monomer +... monomer → $(monomer)_n$
n monomer → $(monomer)_n$

Do you know how polythene is made? Polythene is made by heating ethylene gas at 200°C and 1000-1200 atmospheric pressure. To accelerate the polymerization process, oxygen gas is used as a catalyst.

$$n\ (\text{ethylene})\ \underset{(O_2\ \text{catalyst})}{\xrightarrow{\text{(high temperature and pressure)}}}\ \text{polythene}$$
Monomer Polymer

or,
$$n\ (CH_2 = CH_2) \underset{(O_2\ \text{catalyst})}{\xrightarrow{\text{(high temperature and pressure)}}} (-\ CH_2 - CH_2-)_n$$
Ethene (monomer) Polythene (n polymer)
n = 600 – 1000

However, this process is not popular now-a-days as it requires high pressure. Alternatively, by using titanium trichloride ($TiCl_3$) catalyst, polythene is made at atmospheric pressure.

6.2 Fiber and Yarn

You know that cloth is one of our five fundamental rights. Cloth saves us from heat and cold, and helps us to maintain our privacy and we make beautiful dress with cloths. In ancient time, when there was no cloth, there was no way to screen us and that is why that is called uncivilized era of human civilization. Therefore cloth is a very important thing for the modem civilized society.

Do you know how cloths are produced? Cloths are produced from yarn and yarn is produced from fiber which consists of smaller filaments. Basically fibers and filaments are the same things. In textile industries fibers mean the filaments used for weaving. In addition to yarn and textile, fibers are also used to make carpet, filter, electronic insulator etc.

According to the source our essential fibers are of two types: (a) natural fibers and (b) artificial fibers. Cotton, jute, linen, silk, wool, hair, asbestos, metal fibers etc. which are naturally abundant are called natural fiber. On the other hand, polyester, rayon, dacron, nylon etc. which are made synthetically by the chemical reactions are called man made fiber.

Among the natural fibers, cotton, jute and some others obtained from plants are called plant fibers. On the other hand, silk, wool, hair etc. obtained from animals are called animal fiber, whereas metallic fibers are obtained as minerals in nature and they are called mineral fibers.

Among the man-made fibers, rayons are obtained from cellulose and, that is why they are called cellulosic fibers. Cellulose is a fibrous material which makes plant and animal cells. Some artificial fibers such as nylon, polyester poly propylene, dacron etc. prepared from chemicals other than cellulose are called non-cellulosic fibers.

6.2.1 Characteristics and Use of Fibers

Whether a textile or garment is comfortable or not depends on what type of yarn has been used, which in turn is related with the type of fibers. So, characteristics of fibers are very important. Now, let us discuss that.

Cotton

We feel comfortable wearing cotton clothes on hot days. Because cotton has low heat transferring and transportation capacity. So cotton fabrics prevent external heat from entering inside during the hot weather and consequently, the body remains cool and during winter heat of the body can not go out and so the body remains warm. The higher thermal conductivity of cotton fiber results in quicker dissemination of heat produced in. human body. Moreover, the spaces or pores between the yarns in cotton are wider compared with other fibers allowing easier air passing which gives us comfort.

Fig. 6.01 : Cotton fiber under microscope

Cotton is the main plant fiber. From microscopic observation (Fig : 6.01), it is seen that, cotton fiber looks like a tube, inside the tube there is a relatively thinner and narrower space named lumen initially. Fibers after separating from the fruit are dried in sun light and resulting tubular fiber which shrinks gradually to a twisted thread like-material. There are 100- 250 natural twists/inch in each fine, long cotton fiber.

During yarn manufacturing, the twisted parts are linked with each other finely which gives better texture in cotton cloths. Garments made of cotton do not look very bright. However, the brightness and glaze can be increased by moisturization. Cotton fibers have strong affinity for most of the dyes and therefore, upon washing or heating, dye adsorbed in cotton fiber is retained. Strong inorganic acids damage the cotton fibers but weak acids cannot do it. Cotton fibers do not require special arrangement and that is why, it is being widely used. One of the defects of cotton fiber is that it shrinks when washed.

Silk

At the beginning of discovery of silk, use of it was the symbol of aristocracy and was limited to royal family. Silk was reserved for the kings, queens, emperors and empresses. Therefore, silk is used for making gorgeous and luxurious textiles. The main attraction of silk is its beauty. There are more than 300 different types of silk with different colour. Silk fiber is collected from cocoon which is produced by silk worms. Silk is basically made of protein called fibroin.

Among the animal fibers, silk is the strongest and longest fiber. Because of its unique quality, silk is termed as the 'Queen of Fibers'. Long time exposure to sunlight damages it quickly. Silk is very thin but warm and much of it can be stored in a small space.

Wool

To save us from cold, our first choice is the cloths made of wool. Wool is thermally non-conductive and, that is why, widely used in winter season. Improved softness, better dimensional stability, stronger dye ability are the notable characteristics of wool. In wool there is huge vacant space among fibers and that can trap air. As wool is thermally non-conductive, heat cannot be conducted from body in winter. Wool is inert to dilute acid and alkali but concentrated acid and alkali damage wool. Wool can be attacked by fungi and some times by moth.

Wool is a very old fiber and produced from different species of sheep. About 200 types of different wools are produced by 40 different species of sheep. Based on collection methods, wool is divided into two types which are Fleece wool and Pulled wool. Fleece wool is collected from sheep which are alive while pulled wool is collected from dead or killed sheep. Wool consists of a protein named Keratin which is also found in human hair and nails. Among different types of wool, Alpaca, Vicuna, Mohair (from goat) Kashmiri are very famous.

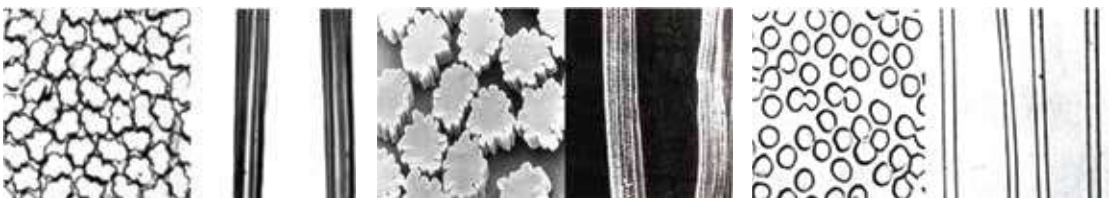
Nylon

Nylon is the principal non-cellulosic synthetic fiber. It is produced by the polymerization of adipic acid and hexamethylene diamine. Nylon is basically two types: nylon 6,6 and nylon 6.

Nylon is very thin but strong. Its elasticity doubles when it is wet. It does not bum but melt and after melting, it forms transparent bead like borax bead. Nylon is used for parachute cloths, rope, tyre, carpet etc.

Rayon

Rayon (Fig : 6.02) is the main and first among the synthetic fibers. It is made from cellulose obtained from plants and animals. There are three types of rayon which are (1) viscose rayon, (2) cuprammonium rayon and (3) acetate rayon. Rayons are well known for their brightness, intense lusture, luxury, aristocracy and attractive beauty they are fairly long-lasting as well.



Acetate Viscose Cuprammonium (Vertical)

Fig. 6.02 : Shapes of rayon fibers under microscope

They are almost inert to dilute acids but reactive to salts. Rayon melts on heating and therefore, a calender of high temperature should not be used for ironing rayon cloths.

6.2.2 Manufacturing Yarn from Fiber

Is it possible to make cloth directly from fiber? No, it is not possible. For that, it requires yarn manufacturing first. The process of yarn manufacturing depends on properties of fiber. Manufacturing process is specific for a particular fiber. Now, let us discuss different steps involved in yarn production.

Collection of Fiber

Collection of fiber is the main step for manufacturing yarn which differ from fiber to fiber. For example, in case of cotton, corpus fruit is collected from plants and seed is separated from the cotton. This process is known as ginning. The fiber obtained from ginning is called cotton lint. Cotton lints are bundled together to make bale. In spinning mill, yarn is produced from the bale.

Do you think that we can follow the same collection method for jute? No, certainly not, because in case of jute or jute like plants, fiber is not collected from seeds. It is collected from plants directly. For that, after cutting plants they are piled together to remove leaves and it takes usually 5-8 days. The piled plants are called Pil or Chella in some parts of Bangladesh. If the plants are piled together, decomposition of leaves starts and the leaves are separated easily from the plants by shaking. But it is to be noted that plant leaves should not decompose completely because in that case it would be difficult to separate the decomposed leaves. The plants are then bundled together and kept it submerged in water for 10-l5 days for rotting. Why rotting is required? From rotten plants, fiber can easily be separated. After separating from the stick, fiber is washed with water and then dried in sunlight. The dried fibers are bundled together to make bale like cotton fiber. Then, jute bale is taken to a spinning mill for making yarn.

Now, let us see how to collect animal fibers. You know that silk is prepared from silk fiber. In this case, yarn is produced directly. In case of man made fiber, yarn is produced directly like silk. However, for wool, animal fiber (wool, hair) is collected by cutting them from the body of the animal. Do you think that the animals suffer severely for cutting their wool or hair? No, they do not suffer much because it can be recovered within a short time and that can be cut again and again for fiber. So, it is clear that fibers can be collected many times from an animal. We have already said that hair or fur collected in this method is called fleece wool. Collected wool is then taken to a spinning mill for making yarn.

Spinning

Spinning is carried out in spinning mills (Fig : 6.03). Usually in a mill, a particular type of fiber is used because the steps involved in spinning process vary based on the nature of the fiber. Therefore, mills for different yarns made of different fibers are also different. However, based on the fibers, although the spinning processes are different, there are some similarities among the processes. Now, let us know about the processes of spinning from fiber .

Blending and Mixing

The bale of fibers carried to the spinning mill is opened in blending room. Fiber is then cut down into smaller fragments with a specially designed device. At this time, trash and dirt are also removed. Then cotton of various grades are mixed together. Is the mixing important? Yes, mixing is important because Bangladesh is a small country where commercial production of cotton is negligible and major part of cotton is imported from different countries; therefore, practically it is impossible to have constant supply of cottons of uniform quality all the time. If mixing is not performed, yarn of uniform quality will not be produced all the time. Sometimes the quality will be too good and sometimes it may be too poor. Moreover, mixing lowers the production cost. The process of preparing the cotton mixture is known as blending and mixing. In case of jute fibers, it is called batching.

Carding and Combing

Carding and combing are the second step of spinning. This step is applicable to cotton, linen and wool. Based on the characteristics and length of fibers, the machineries used in this process vary. Very small fibers are not suitable for yarn manufacturing and they are discarded; soil particles or other dirt are also removed this time. In some cases only carding works well, however, for very fine, smooth and narrow yarn, combing is essential. For linen fiber, a special combing technique known as Heckling is used. Heckling makes yarn fine and delicate.

Fig. 6.03 : Yarn manufacturing in spinning mill

The fiber obtained after carding and blending is like a thin layer and it is known as sliver. When the sliver is twisted, yarn is produced. Spinning is basically nothing but twisting. At this stage, sliver is gradually stretched to make it

thinner. Finally at the end of the sliver, a few bunch of fiber is retained. In this way, the next sliver is twisted. Stretching of sliver is called Rodding. Twisting helps the fibers to stick together and turn into yarn.

The strength of the yarn depends on the number of twist. Usually more twisting makes yarn stronger. However, too much twisting may tear off yarn. The extent of twisting is determined by the characteristics of original fiber. Usually for long fiber (such as jute, linen) relatively more twisting is required. Twisting is performed by a device known as Twist Counter.

Preparing Silk from Silk Fiber

The first step of silk manufacturing is the production of cocoon from silk worms. Matured cocoon is boiled in soap water in an iron pan; as a result, cocoon softens and the skin is separated easily. When the skin is separated, one end of the fiber becomes visible. If that end is stretched slowly, the long yarn comes out (Fig : 6.04). For fine and thin yarn, 5- 7 cocoon filaments are taken together and then stretched. A spinning jenny is used for this purpose. Spinning with the help of spinning jenny is shown in Figure 6.4.

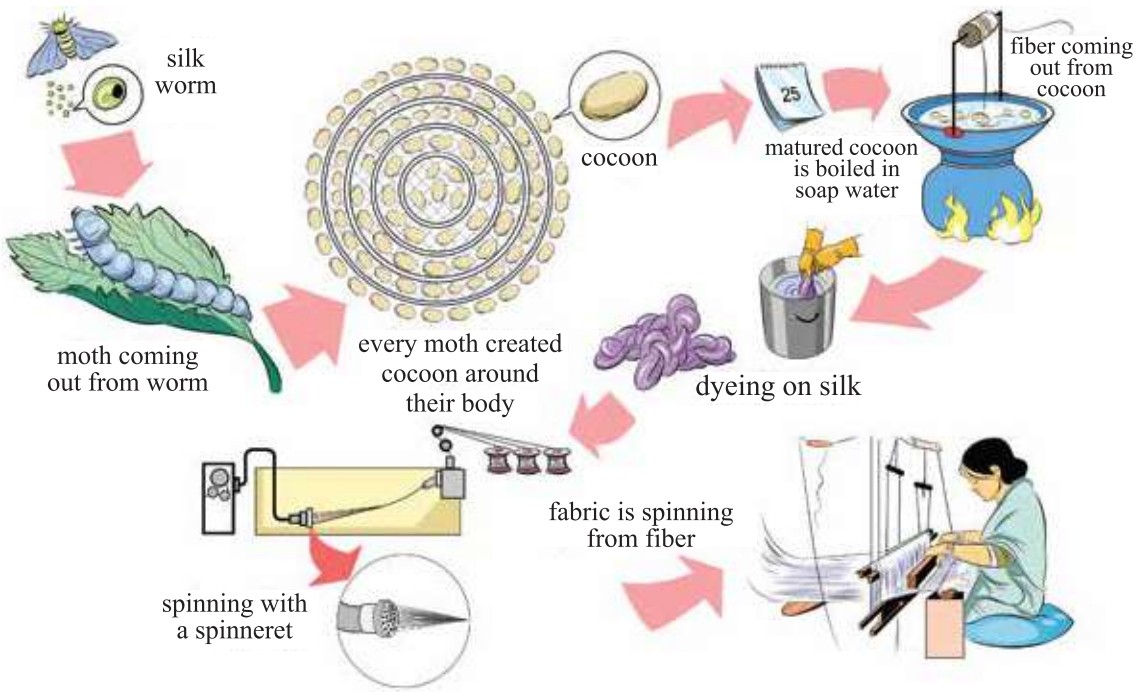


Fig. 6.04 : Making of yarn from silk fiber

When the filaments are grouped together, they stick to each other due to presence of gummy materials in the filaments and a bunch of yarn is produced.

Production of Yarn from Artificial Fibers

Methods of manufacturing yarn from artificial fibers are almost similar. With a suitable solvent and usually with more than one type of smaller fibers, a concentrated and viscous solution is prepared. This solution is called spinning solution. Spinning solution is passed through a small hole in spinneret (Fig : 6.4) with high pressure. A suitable chemical is used to congeal the solution during passing through the spinneret, as a result, a long filament comes out from the spinneret and that can be used as yarn to weave cloths.

Characteristics of Yarn

Characteristics of yarn depend on fibers. In all the cases, it is seen that characteristics of yarn are identical to the corresponding fibers. You have already studied the characteristics of fibers, and therefore, you understand what the characteristics of yarns can be.

Investigation

Activity: to identify the characteristics of different types of yarn by heating
Materials required: silk, wool, cotton, polyester cloths/yarn, nylon, a candle and fire box.
Procedure: Lit the candle with the help of the fire box. Now bum all the yarn one by one and observe carefully.
What happened to cotton yarn? It burned quickly with a smell like burnt paper. Cotton contains cellulose and they produce identical smell on burning like paper. What did you observe when nylon was burnt? Nylon did not burn as quickly as cotton, it burned slowly. At the end, it formed a bead like material unlike cotton. Moreover, there was no characteristic smell like cotton because nylon does not contain cellulose. Now, you note down the characteristics obtained for all other yarn/cloths.

6.3 Rubber and Plastic

6.3.1 Rubber

We use eraser everyday. Do you know what kind of material is this? It is rubber. Tyre of bicycle, rickshaw, or other transports, tubes, balloon in birthday parties, all are rubber products. In addition, water pipe, surgical gloves, conveyer belt, rubber band, nipple for feeding kids etc. are also rubber products. So, it is clear that, rubber and rubber products are inextricably related with our daily life. Now, let us discuss the properties of rubber.

Physical Properties of Rubber

Natural rubber is an amorphous solid substance which is insoluble in water. Although it is insoluble in many organic solvents such as acetone, methanol, it is soluble in turpentine, petrol, ether, benzene etc. Rubbers are usually white or pale brown coloured. Rubbers are elastic and sensitive to heat and upon heating, they melt. Pure rubber does not conduct heat and electricity. Recently, scientists have developed special rubbers that conduct electricity.

Chemical Properties of Rubber

We know that almost all substances expand on heating, however, it is not true for rubber, i.e. rubber shrinks on heating resulting in reduced volume. One of the most important properties of rubber is that it is inert to many chemicals and solvents such as weak acids and alkalis, water etc. Therefore, it is widely used for surface coating.

Have you ever noticed what happens if rubber is kept for a long time? Gradually it is corroded because rubber undergoes a chemical reaction with oxygen present in air. Natural rubber reacts with ozone (O_3). As a result, it is degraded gradually and finally damaged.

6.3.2 Plastic

Plastic means substance that can easily be molded. In molten condition, plastic can be given any particular shape. We are using a number of plastic products such as bucket, jug, melamine dishes, PVC pipe, toys, seat belt and, now-a-days,

even furniture are made from plastic. It is also known to you that all these plastic products are polymer. Let us see the properties of plastic.

Physical Properties of Plastic

Can you tell whether plastic dissolves in water or not? No, it does not. Plastic is insoluble in water and an important aspect of plastic is that it does not conduct heat and electricity, and that is why, they are widely used as insulator. You know that plastics can be given any shape as expected and this is the unique property of plastic.

What happens to plastic on heating? Polythene, PVC pipe, polyester, toys etc. soften on heating and when they are cooled in molten state, they harden. These plastics are called thermoplastics, On the other hand, melamine, bakelite (used in electric socket and coating on handle of fry pan) etc. burn and harden on heating, and they do not soften. They can be molded only once. These plastics are called thermosetting plastics.

Chemical Properties of Plastic

Most of the plastics are chemically inert to moisture and oxygen. That is why, they do not corrode even if they are exposed to air for a long time. Plastic does not react with dilute acids and alkalis, however, concentrated mineral acids dissolve some plastics. Plastics are combustible and produce huge amount of heat energy when burnt.

Are plastics biodegradable? No, they are not biodegradable. They do not degrade ever if they are exposed to air, water or soil for a long time. Recently scientists have discovered biodegradable plastics which are used for special purposes like dental implantation. Medical sutures used to repair wear or used after surgical operation are also a kind of biodegradable plastic.

When plastic is burnt, it produces many toxic substances. For example, PVC on burning produces hydrogen chloride gas. On the other hand, polyurethane (used or making furniture) on burning releases toxic carbon monoxide (CO) and hydrogen cyanide (HCN) gas.

6.3.3 Role of Rubber and Plastic in Environmental Imbalance

Majority of the plastics and synthetic rubbers are not biodegradable. So, if they are discharged as waste without recycling, they accumulate in nature and cause lots of problems. Have you noticed that sewerage lines in municipal areas are occupied by plastics and rubbers? Accumulation of these materials at a stage, block the sewerage lines stopping the flow of waste water that results in water logging on roads upon rainfall. Clearly, it hampers the environmental balance. Similarly, a significant part of waste is not managed properly and discharged into river or lakes directly. If they are deposited long time in this way, water depth will be reduced and will cause navigability problem.

Moreover, if they are discharged on soil, soil fertility will decrease. Waste plastic or rubber sometimes enters into animal body such as cattle, sheep or goat when those animals take grass in field, and they can accumulate in animal flesh and fat. In fact, the discharged plastic in water bodies may contaminate fish flesh. Finally when we take meat or fish, those accumulated plastic and rubber enter into human body and may cause diseases like cancer. So, it is clear that, if plastics and rubbers are not managed properly, they can pollute the environment severely and may lead to environmental imbalance. Therefore, we have to reuse and recycle plastic and rubber again and again and also we have to make people aware in this regard. If they become unsuitable for use, we have to collect them and collected plastics and rubbers can be sold as well. If we do so, our environment will be conserved as well. In case if we do not have opportunity to sell it, we have to send it to the proper authority. Balance of environment can be protected by converting plastic materials into other materials and fuels through recycling.

Exercise

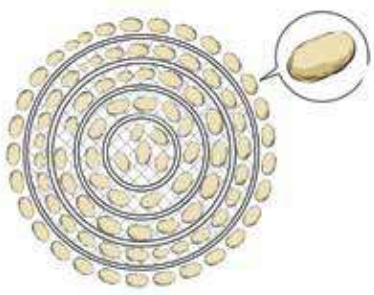
Multiple Choice Questions

1. What type of fiber requires heckling?

a. Jute b. Wool
c. Silk d. Linen

2. The characteristic of the fiber shown on the right is-

i. It is very fine
ii. It is very cheap
iii. It warms quickly



Which of the following is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

From the diagram given below, answer question 3 and 4:

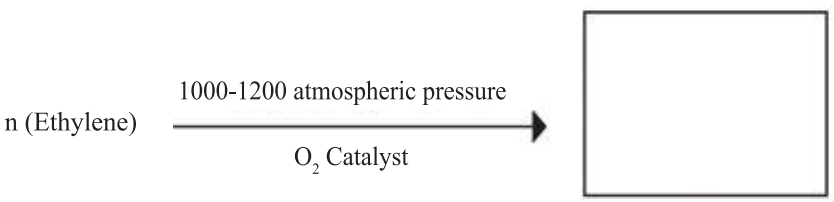


Fig : A Fig : B

3. What will be produced in Fig. B?

a. Resin b. Polythene
c. Melamine d. Asbestos

4. Which of the following fibers is similar to the product in Fig. B?

a. Silk b. Wool
c. Hair d. Polyester

Creative Questions

1. Arju was going to school in an early morning in January. He wore two shirts both made of cotton. He felt quite cold. He remembered that 3 months ago when he wore even one shirt, he did not suffer from this type of problem.

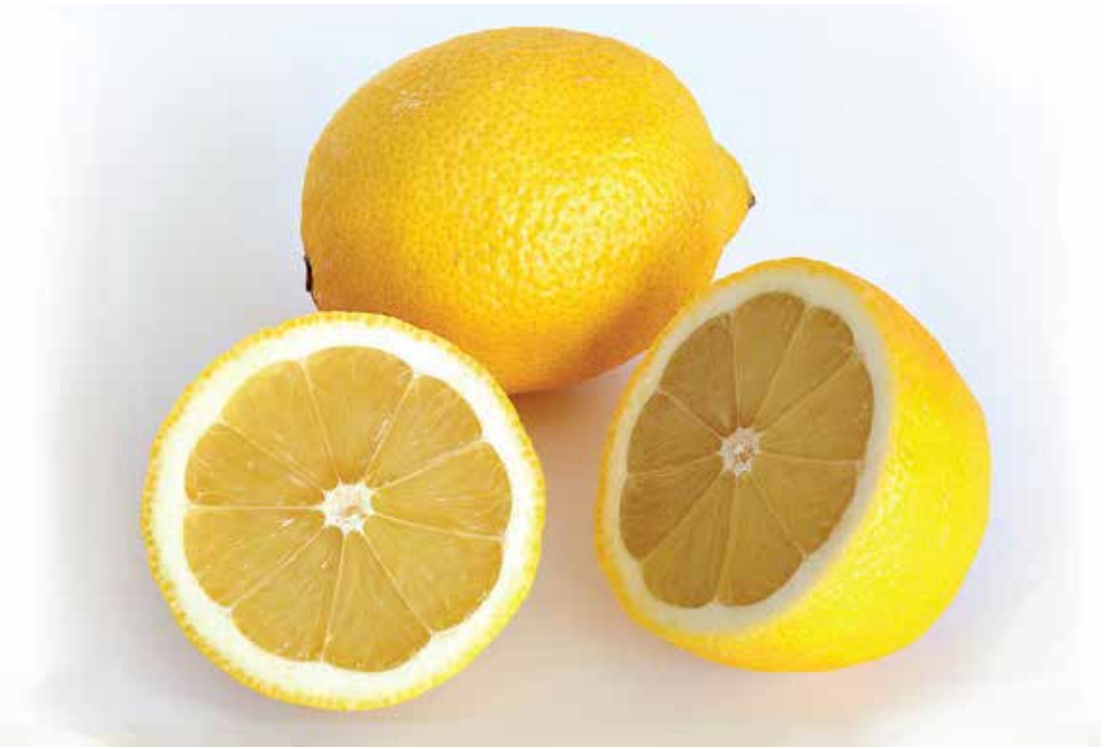
   a. What is non-cellulosic fiber?
   b. Why linen is called a natural fiber?
   c. Explain what type of clothes Arju should wear.
   d. Rationalize the fact that although cotton is comfortable in summer it is not comfortable in winter.

2. Mr. Milon has a PVC pipe manufacturing industry. He asked Emon and Mamun to supply raw materials. Raw material supplied by Emon was elastic and reactive to oxygen and moisture and, the physical property of the material supplied by Mamun is that it can be given any shape in molten state but it is chemically inert. Both the materials were non biodegradable in soil.

   a. What is monomer?
   b. Why melamine is called a polymer?
   c. How do the materials supplied by Emon and Mamun damage environmental balance? Explain.
   d. Which raw materials will you suggest for Mr. Milon to manufacture PVC pipe?

Chapter Seven

Use of Acid, Base and Salt



You have learnt about acid, base and salt in class VIII. Can you remember their characteristics? In this chapter, we shall discuss different uses of acid, base and salt. Here you will get a concept about how we can use these in our daily life. After studying this chapter, you will get a concept about pH, which is very important for measuring acid and base.

At the end of this chapter, we will be able to-

- describe the characteristics of strong and weak acids;
- explain the use of acid in daily life and caution in handling acids;
- analyze the social effect of misuse of acid;
- evaluate the acidity and alkalinity of different substances by using indi cator (litmus paper, extract from flowers and vegetables prepared in previous class);
- explain the reason for acidity in stomach and selection of the right food;
- explain the importance of pH of substances;
- explain the chemical characteristics of bases;
- explain the necessity of bases in daily life and caution in handling base;
- explain the importance of neutralization in daily life;
- explain the chemical characteristics of salt;
- explain the necessity of salt in daily life;
- prepare different types of salts by doing experiment (metal + acid, metal oxide + acid)
- recognize the contribution of acid, alkali and salt to our daily life.

7.1 Acid

7.1.1 Strong and Weak Acid

You have learnt about some organic acids in class VIII. You also know that acids release hydrogen ion (H^+) in water. There are some acids, particularly organic acids, which do not dissociate completely in water, i.e. they dissociate partially which means all the acid molecules present do not release H^+ ion. These acids are called weak acids (Fig: 7.01). On the other hand, mineral acids completely dissociate in water to release hydrogen ion (H^+) i.e. all the acid molecules present undergo dissociation.

There are some acids such as carbonic acid which is not an organic acid but a weak acid. That is, mineral acid doesn't ensure being strongest acid. Some important weak and strong acids are shown in table 1.

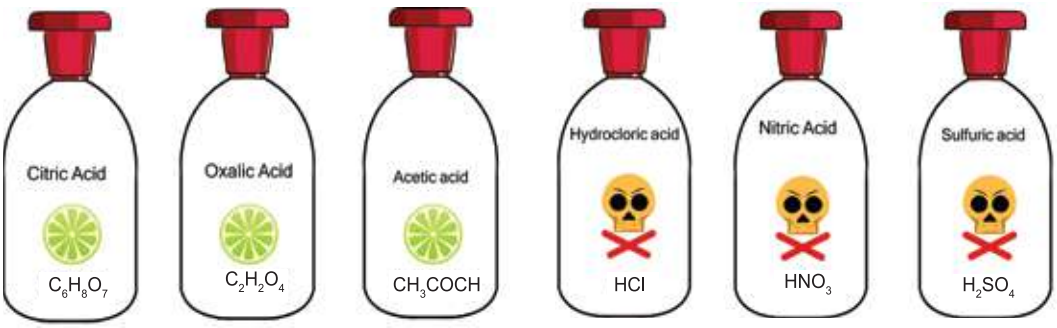


Fig. 7.01 : Strong and weak acid

Weak acid	Strong acid
Acetic acid (CH_3COOH)	Sulphuric acid (H_2SO_4)
Citric acid ($C_6H_8O_7$)	Nitric acid (HNO_3)
Oxalic acid ($HOOC—COOH$)	Hydrochloric acid (HCl)

7.1.2 Use of Acids in Daily Life and Caution

Do you know the reason for irritation and swelling when wasps or scorpion sting? It is due to the fact that, when they sting us, a base named histamine is released and this histamine is responsible for irritation and swelling. To treat the sting, the paste used contains vinegar and baking soda which are acids. They react with the base (histamine) and neutralize it; therefore, pain, irritation and swelling reduce.

Fig. 7.02 : Vinegar is used in preservation of pickles

It is common that after taking rich diet like Polao, Biriani etc, we drink soft beverage like Pepsi, Coca-cola, and Sprite etc. Do they help us in digestion? In fact, To digest food, specific amount of hydrochloric acid is required in the stomach. If this amount is altered significantly, it may cause indigestion or difficultly in digestion. Soft drinks are slightly acidic, and so, helps to digest food.

Fig. 7.03 : Lactic acid present in Borhani or yoghurt favours digestion

You have learnt in class VIII that lemon, orange, apple, guava, gooseberry, star fruit etc. contain different types of organic acids which are essential for us. Some of them prevent disease also, for example, vitamin C or ascorbic acid. Do you know that it helps us in repairing wounds and, lack of it in human body causes a disease named scurvy?

Do you know what is used to preserve pickles of mango, olive etc (Fig : 7.02)? It is none other than vinegar or acetic acid. Do you think that Borhani or curd (Fig : 7.03) is helpful in digesting rich food taken usually in parties? Yes, like soft beverage, lactic acid present in Borhani and curd favours digestion.

Do you know what is used to puff cake, biscuit and bread? It is done by using baking soda. In warm condition, baking soda reacts with yeast and releases carbon dioxide which puffs baked items.

Do you know which are the main ingredients in household toilet cleaner? The main ingredients are strong acid such as hydrochloric acid, nitric acid and sulphuric acid.

Moreover, the lead storage battery used in vehicles, to run IPS, to produce electricity by solar panel, requires sulphuric acid.

We know that, for crop production, we use fertilizers as plant nutrients. The inorganic fertilizers used widely are ammonium nitrate (NH_4NO_3), ammonium sulphate [$(NH_4)_2SO_4$] and ammonium phosphate [$(NH_4)_3PO_4$]. These are produced from nitric acid, sulphuric acid and phosphoric acid respectively.

From the above discussion, it is obvious that different types of acids are involved in our life inseparably. Therefore, the role of acids is immense and undeniable. However, some acids particularly strong acids (H_2SO_4, HNO_3, HCl) are very harmful not only to human health but also to other materials used in our daily life. Exposure of any human organ to concentrated strong acids results in severe burning leading to permanent lesion. You might watch on television or newspaper the burning of human body by acid throwing. Even most of the common cloth is also burned by acids. Similarly, most of the metals are corroded by strong acids. Therefore, we need to be very cautious in using acids. If acid falls on our body by chance, that part of the body should be washed using much water.

Group Work

Task: Observation of the Acidity/Alkalinity of Soil (Fig : 7.04)

Materials required: A beaker, soil sample, red and blue litmus paper, flower/extracts, glass rod, water, tong.

Procedure: Take about 100 gram of soil in the beaker and add 10-20 mL of water in the beaker. With the help of the glass rod, stir the mixture. Wait for sometime for sedimentation.

Now with the help of tong, dip the red litmus paper in the mixture first and, then the blue litmus paper. Note down the changes in laboratory note book. Now, take 2-3 mL of the soil mixture in each of several (the number depends how many extracts you have prepared) test tubes and add flower extracts one after another separately in the test tubes and observe the changes in colour and note it down. Soil can be acidic, alkaline or neutral and that depends on the chemical substance present in it. Now you can check the acidity and alkalinity of household materials like toothpaste, face wash and soap.

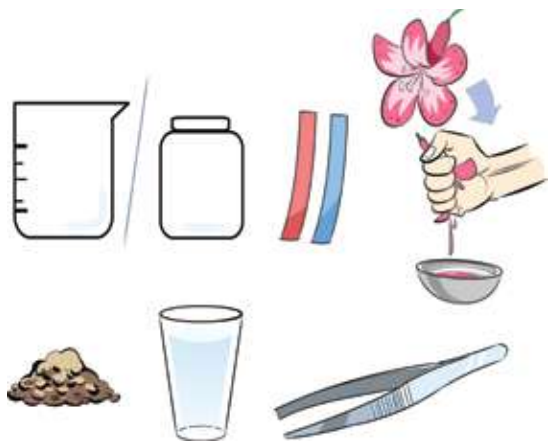


Fig. 7.04 : Test of acidity or basicity of soil

7.1.3 Misuse of Acids, Laws and Social Effects

Some wicked people (Fig : 7.05) are committing serious crime throwing acids on human body in one hand; on the other hand, they are misusing such valuable resources. As stated before, acids result in severe burning in human organ

leading to permanent damage that results in weird appearance. Hence, the acid victims whoa are mostly women because of their weird appearance hide themselves from the society and in some cases, they commit suicide. From a study, it is seen that acid victims are usually girl students or housewives. So, it is clear that due to acid terrorism, many talented and brilliant students cannot continue their study. When the victims are housewives, they lead an inhuman and miserable family life. So, we have to raise our voice against acid terrorism and also have to make people conscious of it.

Fig. 7.05 : Wicked people are committing serious crime throwing acids on human body

7.1.4 Penalty of Acid Throwing

Acid throwing is a serious crime. According to the Women and Child Repression Control Act-1995 of Bangladesh, the punishment could be life time imprisonment or death sentence. In one hand, the perpetrators of acid attack are doing harm to others, on the other hand, they cannot escape punishment. It is likely that they are confined in the jail for rest of the life. So, we need to make people careful and aware of the danger of acid throwing. Those who sell acid to the common people so easily must be warned or punished. At the same time if all should be taught how someone will save oneself if he/she fells victim to acid terrorism.

7.1.5 Identification of Acidity and Alkalinity of Different Substances by Using Indicators

You have prepared extracts from flowers and vegetables in the previous class and with that you have identified acids and bases. Now, let us check the acidity and alkalinity of some substances closely related to our daily life by using those indicators.

Group Work

Task : Observation of Acidity and Alkalinity of Toothpaste (Fig : 7.06)
Materials required: Toothpaste, litmus paper, a beaker, flower extracts, glass rod, water, tong, test tubes.

Procedure: Take about 4-5 gram of toothpaste in the beaker. Add 5-10 mL of water in the beaker and stir the mixture well with the help of the glass rod. Keep the mixture for sometime. Now, with the help of the tong, dip the blue litmus paper in the mixture first and observe the colour change. Similarly, dip the red litmus paper and observe the colour change. What do you see? The colour of the red litmus paper changed to blue and that of blue litmus paper remained unchanged. It means that toothpaste is an alkaline substance. Now take 1-2 mL mixture in test tubes, add the flower and vegetable extracts and observe the changes. Now you can check the acidity and alkalinity of fruit juice, soft drinks etc.

Fig. 7.06 : Test of acidity and alkalinity in toothpaste

Group Work

Task: Identification of Acidity and Alkalinity of Different Types of Drinks and Fruit Juice (Fig : 7.07).
Materials required: Different types of drinks (coca cola, sprite, seven up, fanta etc.) and fruit juice (mango, litchi, orange etc.), litmus paper, a beaker, flower extracts.

Procedure: Take the drinks and juices in the beaker one after another and dip the blue and red litmus paper. What kind of colour change do you observe? The colour of the red litmus paper has not changed but that of blue litmus paper has changed to red. What is understood from this? The drinks and juices, we usually drink, are acidic substances. Now, observe what changes occur in case of each drink and juice by adding previously prepared flower extracts one after another.

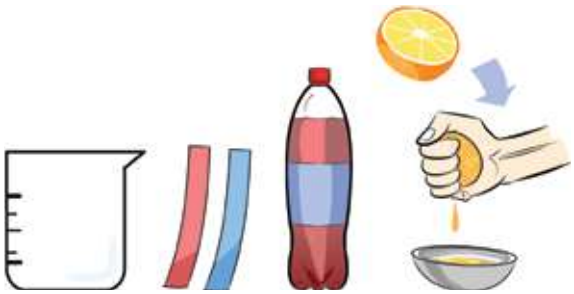


Fig. 7.07 : Identification of acidity and alkalinity of different types of drinks and fruit juices

7.1.6 Reasons of Acidity in Stomach and Selection of Proper Food

You all know that to digest food hydrochloric acid is required in the stomach in a particular amount. However, if the amount of acid increases in the stomach that condition is termed as acidity in stomach. Now, the question is how it happens? There are many reasons for this kind of acidity (Fig : 7.08). One of them could be the food we take. You have seen in your group work that most of the beverages and fruit juices we drink are acidic. Therefore, excessive intake of those items, particularly when the stomach is empty, may cause acidity. Other beverages such as tea, coffee, alcohol also result in increased acidity. In addition, fried food items, fats and oily foods are also responsible for acidity in stomach. According to the data obtained from Department of Health, USA, onion, garlic, chili and other spicy foods, chocolate etc. also could be the reason for acidity.

Other than food stuff, stress, irregular food intake, even irregular and insufficient sleeping habit may cause acidity. Moreover, bacterial infection often could be the reason for acidity in the stomach.

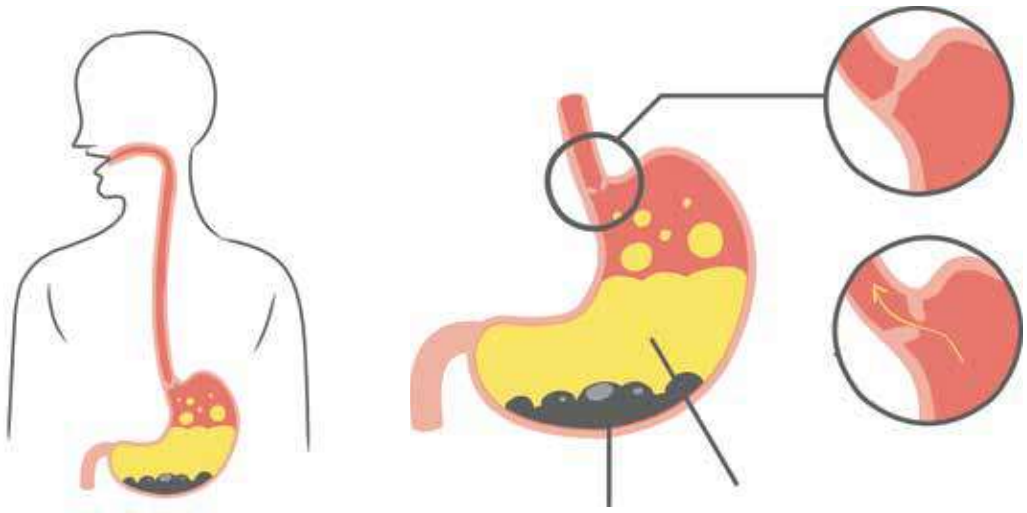


Fig. 7.08 : Amount of acid in stomach may increase due to various reasons

What can be done to protect us from acidity by selecting right kind of food ? At first, the food stuff responsible for acidity can be taken in small amount or if it is necessary, can be avoided temporarily. Secondly, there are food items which are alkaline in nature and can neutralize acidity; intake of such food items can protect us from acidity. Most of the food items in this category are vegetables such as broccoli, spinach, carrot, beans, beat, lettuce, asparagus, mushroom, maize, potato, cauliflower etc.

Moreover, there are some food grains which are able to reduce acidity. These are pulse, sweet maize etc. Among the milk based food items soya butter, butter produced from goat milk, soya milk, nut milk are alkaline and can decrease acidity. Excess acidity can be minimized by different types of nuts, herbal tea, green tea, and ginger tea as well.

7.2 Necessity of Knowing pH

We can identify whether a substance is acidic, alkaline or neutral by indicators. We cannot estimate how much acid or alkali is there i.e. we cannot quantitatively measure acidity or alkalinity by indicator. That can be done by measuring pH. In chapter 2, you have learnt about pH. You also know that aqueous solutions of

neutral substances containing no acid or base have pH 7. If acid is added to that, pH lowers. Further addition of acids lowers the pH further and so on. On the other hand, addition of alkali to the aqueous solutions of neutral substances increases pH and the more the alkali is added, the more the value of pH increases.

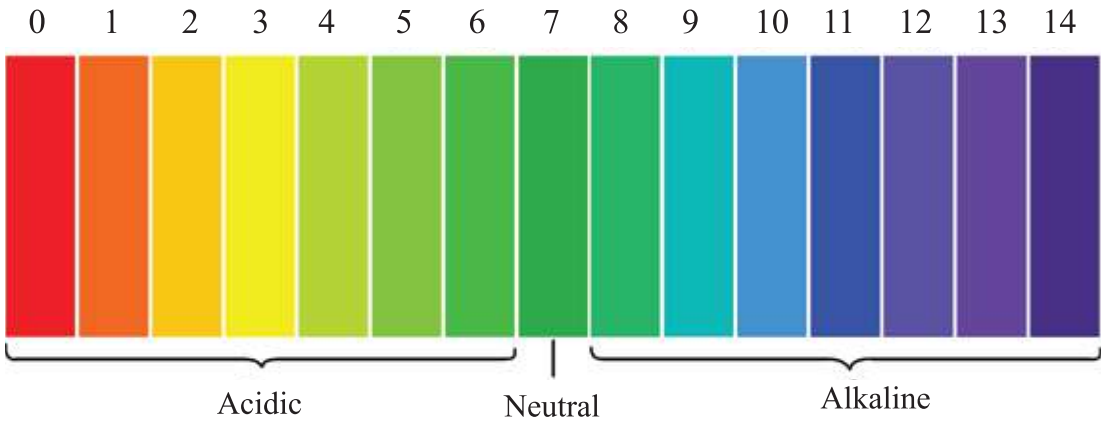


Fig. 7.09 : Universal indicator colour chart

So we can say-

For neutral substance or pure water, pH = 7

For acidic solution, pH<7

For alkaline solution, pH >7

It is very important to know the pH in many cases including human health, consumer products, agricultural practices, even in most of the industrial processes, pH is a very important parameter.

Do you know the pH of human blood? pH of human blood (arterial) is 7.4. i.e. it is slightly alkaline. Minor alteration of pH (± 0.4) may cause severe health problems, even death. Saliva is a very important part of food intake and digestion and it is very effective when its pH is about 6.6. The pH required for digestion in stomach is 2.0. An alteration of about pH 0.5 may hamper digestion. pH value less than 7.0 of urine indicates healthy condition.

Soil pH usually ranges from 4.0-8.0. If the soil pH becomes lower than 3.0, soil nutrients like calcium (Ca) and magnesium (Mg) are lost resulting in reduced fertility. Hence, for acidic soil, fertilizers containing calcium and magnesium are applied to adjust pH. On the other hand, if the soil becomes highly alkaline i.e. if soil pH is more than 9.5, the fertility decreases. In that case, aluminium ions (Al^{3+}) are easily transported to plant roots causing significant harm to the plants. pH of alkaline soil is controlled by applying nitrate and phosphate fertilizers. Highly acidic or alkaline conditions kill the beneficial microorganisms in soil; as a result, many physiological activities of plants are hampered. Face wash available in shops have pH 5.5, why? It is due to the fact that, the pH of matured human skin is acidic and it ranges from 4.0-6.0. However, the pH of skin of newborn babies is close to 7. Therefore, most of the cosmetics used for adult should not be used by kids; otherwise, there could be a severe damage to their skin.

pH is very important in industrial chemical processes. Medicines, inks, baby foods, lozenge, leather manufacturing among others are few examples where control of pH is essential. In addition, chemical reaction related to photography, manufacturing and use of dyes, electroplating on metallic substances etc. in all cases, controlled pH is required.

There is a chart to understand which standard of pH solution will assume which colour (Fig : 7.09). It is called universal indicator colour chart. The colour assumed by the solution after being added some drops of universal indicator to it, is compared with universal indicator colour chart and thus pH is measured.

7.3 Chemical Characteristics of Base

You have learnt about base and alkali in class VIII. Now, let us discuss their chemical characteristics.

7.3.1 Change in Colour of Indicators by Chemical Reaction:

All bases change the colour of red litmus paper to blue. Besides, they also change the colour of other indicators such as methyl orange, methyl red, phenolphthalein etc. which are widely used in chemical laboratory (see table 1).

Table 1: Change in Colour of Indicators Due to Chemical Reaction with Base

Indicator	Colour of Indicator	Colour of Indicator in Base
Red Litmus Paper	Red	Blue
Methyl Orange	Orange	Yellow
Methyl Red	Red	Yellow
Phenolphthalein	Colourless	Pink

Behavior in Water: Water soluble bases i.e. alkalis produce hydroxyl ion (OH^-) in water.

$$NaOH \longrightarrow Na^+ + OH^-$$
$$KOH \longrightarrow K^+ + OH^-$$
$$NH_4OH \longrightarrow NH_4^+ + OH^-$$

Reaction With Acid: Base reacts with acid and produces salt and water by neutralization reaction which will be discussed later in this chapter.

Group Work

Task: Observation of Chemical Properties of Bases (Fig : 7.10)

Materials Required: A base [$Ca(OH)_2$] an acid (HCl), indicator (red litmus paper or phenolphthalein), a beaker, apron, glass rod, dropper, and tong.

Procedure: Put on the apron and take 50 mL of dilute sodium hydroxide solution in a beaker. Dip the red litmus paper in the beaker. Do you see any change? The litmus paper has turned blue and it proves that a base changes the red litmus into blue.

Now, add dilute hydrochloric acid to the beaker with the help of the dropper and stir well. Dip the blue litmus paper you got before and observe the changes. At the beginning of adding HCl, there will be no change in the colour of blue litmus paper. Add more HCl gradually and check whether the blue litmus paper changes its colour or not. Continue the addition of HCl

gradually and observe how the litmus paper behaves. At a stage, upon the addition of HCl, blue litmus paper will change its colour to red. Why does it happen? The reason is, due to addition of acid, a chemical reaction occurs between the base (NaOH) and acid. When the entire NaOH reacts, further addition of acid makes the solution acidic and, therefore, the colour of blue litmus changes to red.

Fig. 7.10 : Observation of chemical properties of bases

7.3.2 Use of Alkali in Our Daily Life and Caution

Do you know the reasons for irritation, pain and swelling when bees sting or ants bite? When ants bite, they release formic acid resulting in irritation and pain. On the other hand, when bees sting, formic acid, melittin and apamin are secreted and all these three acidic chemicals result in irritation, pain as well as swelling in human body. Now, the question is what can we do in these cases?

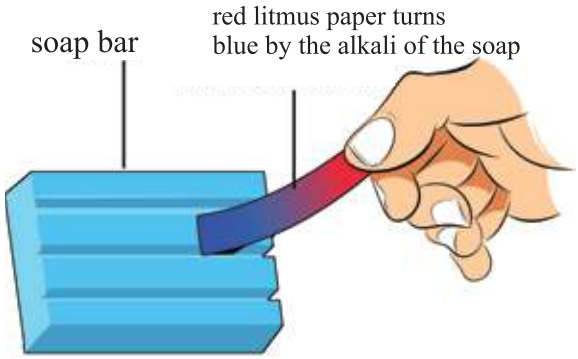


Fig. 7.11 : Test of alkalinity of soap

Since in all these cases, the acidic chemicals are responsible, so we can use chemical substances that are able to neutralize those acids. Calamine is a lotion which contains zinc carbonate ($ZnCO_3$); it can be used to solve the problem. Baking soda can also be used.

Use of Alkali to Neutralize Acidity of Soil: You all know that increased acidity in soil lowers the fertility. In such cases, alkalis/bases can be used to neutralize

the acid and fertility can be regained. The widely used bases are calcium oxide (CaO), and slaked lime [$Ca(OH)_2$] to adjust soil pH. Sometimes lime stone ($CaCO_3$) is also useful in this regard.

Bases as Household Chemicals: Ammonium hydroxide is broadly used as a household cleaner. Toothpaste, a very important substance in our daily life, is alkaline. After taking food, usually acidic condition develops in the oral cavity. Therefore, brushing with the help of toothpaste or powder, teeth is cleaned, at the same time, alkali present in paste/powder neutralizes acid in the mouth and therefore, corrosion of teeth is minimized.

In addition, to clean dishes, we use hard soap and liquid soap which contain bases (Fig : 7.11). Even the laundry soap that we use for washing clothe is made from sodium hydroxide and fats or oils. Similarly, soft soap like shaving foam is prepared from potassium hydroxide and fats or oils.
Do you know that antacid tablets or syrup taken to treat gastric pain or acidity are nothing but weak bases such as magnesium hydroxide [$Mg(OH)_2$] and aluminum hydroxide [$Al(OH)_3$].

From the above discussion, it is clear that bases and alkalis are very useful materials in our life. So, we must be cautious in their use and have to make people aware of their misuse.

Caution in Using Bases and Alkalis: Have you ever washed your clothes yourself? Washing a large amount of clothe by soaps with naked hand cause removal of skin from the surface of palm. The chemical responsible for this is NaOH. Alkalis like acids are equally corrosive and irritating to human body. So, whenever we use alkalis, we must wear latex hand gloves and apron.

7.3.3 Neutralization Reaction and Its Importance

How the stomach pain due to acidity is treated by antacids? Hydrochloric acid responsible for acidity undergoes a neutralization reaction with magnesium hydroxide and aluminum hydroxide present in antacids. Therefore, excess HCl generated in stomach no longer prevails there and we do not feel pain any more.

$$\text{acid} + \text{alkali} \longrightarrow \text{salt} + \text{water}$$
$$2HCl + Mg(OH)_2 \longrightarrow MgCl_2 + 2H_2O$$
$$3HCl + Al(OH)_3 \longrightarrow AlCl_3 + 3H_2O$$

You learned in previous section that soil acidity is removed by lime or slaked lime and the neutralization reactions happen there are shown below.

$$\text{alkali} + \text{acid} \longrightarrow \text{salt} + \text{water}$$
$$CaO + H_2SO_4 \longrightarrow CaSO_4 + H_2O$$
$$Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$$

You have already learnt that after taking food, acids created in oral cavity may corrode teeth and to protect our teeth, we do brushing using toothpaste/powder. Here also a neutralization reaction occurs between the acid generated in the cavity and the alkali present in toothpaste/powder. pH of toothpaste is usually 9-11 and alkaline substance such as calcium hydroxide, baking soda, tetrasodium pyrophosphate etc. are present in it. So it can be concluded that neutralization reactions are playing crucial roles in our daily life.

7.4 Salt

7.4.1 Chemical Characteristics of Salt

It is known to you that salts are the products obtained by the chemical reaction between acid and base. Let us discuss the chemical nature of salt.

Group Work

Task: Observation of Properties of Salt (Fig : 7.12)
Materials: A beaker, table salt (NaCl), pure water, red and blue litmus paper, glass rod.

Procedure: Take 5-10 grams of salt in the beaker and add 50 mL of pure water to that. Stir well with the glass rod to make a solution. Now, dip the litmus paper one after another and observe if there is any change or not.

Is there any change in colour of the litmus papers? No, there is not, because table salt is a neutral substance, it is neither an acid nor a base.

However, in some cases salt solution could be acidic or basic. For example, aqueous solution of baking soda is acidic which turns blue litmus paper into red although baking soda is a salt. This is due to the fact that baking soda produces hydrogen ion in water as follows:

Fig. 7.12 : To know about the characteristics of salt

$$NaHCO_3 \longrightarrow Na^+ + H^+ + CO_3^{2-}$$

On the other hand, aqueous solution of sodium carbonate is alkaline and turns red litmus paper into blue. The reason behind this fact is, in water sodium carbonate produces sodium hydroxide and carbonic acid.

$$Na_2CO_3 \longrightarrow NaOH + H_2CO_3 + H_2O$$

Sodium hydroxide is a strong base and dissociates completely in water whereas carbonic acid is a weak acid which does not dissociate completely in water. So number of hydroxide ion is higher than that of hydrogen ion in the solution. Therefore, the solution becomes alkaline and the colour of red litmus paper turns blue.

Carbonate salts react with acid and produce a new salt, carbon dioxide gas and water.

$$Na_2CO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

$$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$$

Almost all the salts are solid having high melting point and boiling point. Most of the salts are soluble in water. However, there are some salts such as calcium carbonate ($CaCO_3$), silver chloride (AgCl) etc. which are not soluble in water.

Individual Work

Task : Egg shell is mainly composed of $CaCO_3$ and it can be dissolved in acid. Immerse an egg in vinegar and add new vinegar cleaning at times. You will see that the hard eggshell getting dissolved has turned into a very soft egg.

7.4.2 Use of Salts

How do the kitchen vegetables or curry taste if they are cooked without salt? Probably it will be tasteless and many of us will discard it instead of eating. The salt which is making our dishes tasteful is none other than sodium chloride (NaCl) which is also known as table salt.

Other than kitchen vegetables or curry, many of our food stuffs including bread, pickles, chanachur etc. require salt for improved taste. To enhance the taste of food items, another salt known as tasting salt is used and it is sodium glutamate.

The soap we use for washing cloths is basically a salt named sodium stearate ($C_{17}H_{35}COONa$), whereas shaving gel or foam is another salt, potassium stearate ($C_{17}H_{35}COOK$). Moreover, soda used for washing cloth is also a salt and it is hydrated sodium carbonate ($Na_2CO_3.\ 10H_2O$). There are some salts such as blue vitriol ($CuSO_4.5H_2O$) and potash alum [$K_2SO_4.Al_2(SO_4)_3.24H_2O$] which have strong disinfecting power, and so, used for killing germs in many cases.

Use of Salts in Agriculture

It is known to you that soil acidity is neutralized by limestone ($CaCO_3$) which is a salt. Inorganic fertilizers such as Ammonium Nitate (NH_4NO_3), Ammonium Phosphate $(NH_4)_3PO_4$, Patassim Nitrate (KNO_3) etc. are applied as plant nutrients and they are salts.

Blue vitriol or copper sulfate is widely used in agricultural land to prevent harmful bacteria and virus. It is also very fruitful to control the growth of algae.

Industrial Use of Salts

In industry, salt is essential for many purposes. For example, salts are needed in leather industry for tanning leather, in industrial production of butter, to prepare soda for washing clothes, for producing baking soda, electrolysis of sodium hydroxide etc. Some salts such as Copper Sulphate, ($CuSO_4$), Mercuric Sulphate ($HgSO_4$) and Silver Sulphate (Ag_2SO_4) are used as catalysts in industry.

In textile and dye manufacturing industries, salt is essential to fix dye on fibre. Salt is required to purify metal in industry. Salt is used to separate rubber from latex in rubber industry. In pharmaceutical industry, salt is used for making saline and some other medicine. Salt is essential as a filler for manufacturing detergent. From the above discussion, it can be concluded that salts are playing very important role in our daily life, agriculture and industry.

Group Work

Task: Preparation of Salt from Metal and Acid (Fig : 7.13).

Do this experiment in school laboratory in the presence of your teacher.

Materials required: A metal (Mg), dilute HCl, 2 beakers, spatula/spoon, funnel, tripod, spirit lamp/burner, apron, filter paper.

Procedure: Wearing the apron, take 50 mL of dilute HCl in a beaker. Add 5-10 grams of magnesium powder/turnings with the help of spatula. Do you see any bubble? If there is no bubble, mildly heat the beaker putting it on the tripod. When the bubble ceases, add small amount of magnesium powder. If bubbles form, then continue the addition of magnesium in small amount until you see further bubble formation upon the addition of magnesium. Formation of no bubble indicates that HCl has been used up completely. After completion of the reaction, separate the

Fig. 7.13 : Preparation of salt from metal and acid

magnesium still intact with the help of funnel and filter paper and collect the filtrate in the second beaker. Heat the filtrate putting on tripod until the crystals of salt appear on the wall or at the bottom of the beaker. Stop heating and cool the beaker. What do you see? A lot of crystalline substance appears in the beaker. It is nothing but the crystals of magnesium chloride ($MgCl_2$) salt which is produced by the chemical reaction between magnesium and hydrochloric acid. The bubble observed was H_2 gas. $MgCl_2$ was dissolved in water, we have separated out this salt by evaporation of water.

Exercise

Multiple Choice Questions

1. Which is a weak acid?

a. HCl b. HNO_3

c. H_2CO_3 d. H_2SO_4

2. Upon the addition of sodium hydroxide to a colourless solution, it turns into violet. Which chemical is present in the solution?

a. Methyl red b. Methyl orange

c. Phenolphthalein d. Litmus solution

Read the following paragraph and answer questions 3 and 4:

Raji suffered from pain and swelling severely as ants bite on her foot. Her mother gave her a caramine lotion to apply on the wounded part. As a result she got relief from pain.

3. What is the cause of swelling on Rayi's foot?

a. Formic acid b. Oxalic acid

c. Acetic acid d. Citric acid

4. Lotion used on foot -

i. neutralizes acid

ii. is $ZnCO_3$ salt

iii. acid named melittin and apamin

Which of the following is correct?

a. i and ii b. i and iii

c. ii and iii d. i, ii, and iii

Creative Questions

1. Ontu prefers meat, oily food and chocolate. One day he had been suffering from indigestion after eating Biriani. His mother gave him a soft beverage to drink and he came round gradually. On the other hand, his sister Shoili, likes soya milk, soya butter, and fruits very much.

   a. Which acid is used for the preservation of pickles?
   b. What is meant by the term "weak acid"?
   c. How did Ontu come round? Explain.
   d. If you compare between the food choice of Ontu and Shoili, whose food is responsible for acidity? Explain.

2. Mr. Tuhin often suffers from stomach upset. He went to a doctor who advised to check pH of stomach and arterial blood. Diagnosis report showed that the pH level in stomach and blood was 1.5 and 7.5 respectively. When he was returning home with the report, he went to buy a lotion of pH 5.5 for her daughter who is two months old. But the shopkeepers suggested him to buy another lotion.

   a. Write down the chemical formula of ammonium sulphate.
   b. Why is vinegar called a weak acid?
   c. Why did the shopkeeper prohibit Mr. Tuhin to buy the lotion of pH 5.5? Explain.
   d. Is the level of pH in Mr. Tuhin's blood appropriate? Give your opinion.

Chapter Eight

Our Resources

Soil is a very vital natural resource. It grows plants and produces crops. Our responsibility is to protect this natural resource from various types of pollutions. Soil is the source of many mineral resources including oil, gas and coal. However, such a valuable resource is constantly being polluted in different ways. So, we shall enrich our country by extracting minerals from soil in one hand, on the other hand, we shall be careful that this valuable resource is not wasted in this process.

At the end of this chapter, we will be able to-

- explain the characteristics of soil and land;
- differentiate among different types of soil;
- explain the structure of soil;
- explain the necessity of knowing soil pH;
- describe the reasons and effects of soil pollution and conservation strategy of soil;
- explain the physical and chemical properties of minerals present in soil;
- describe the use and conservation strategy of minerals;
- explain the sources and structure of natural fuel;
- describe the structure, processing, use and conservation strategy of natural fuels;
- investigate the reasons and effects of soil pollution in the area where we live;
- determine the pH of soil with the help of pH paper or acidity and alkalinity of soil with the help of litmus proper;
- be careful in conserving our resources and make people aware as well.

8.1 Soil

8.1.1 Structure of Soil

Can you tell how is soil useful to us? First of all, soil grows plants which give us food. Oxygen gas, essential for our respiration, is also obtained from plants. If there were no soil, plants could not grow and supply of food and oxygen would stop. Secondly, we build houses, offices, roads etc on soil. Moreover, a major part of usable water, essential for living, is coming from the bottom of soil. The major part of valuable energy resources (such as oil, gas, coal) is extracted from soil. Similarly, many useful minerals like gold, silver, iron, aluminium, cupper etc. are also the gifts of soil.

Now, let us know about the composition of such an important resource, i.e. soil. Soil is a mixture of various types of organic and inorganic chemical substances. The composition of soil varies in different areas. The substances present in soil are divided into four groups and they are minerals, organic substances, gaseous substances and water. All types of substances are present in the form of a complex mixture in most of the cases and cannot be separated from each other. Minerals present in soil are usually inorganic compounds.

The main minerals in soil are Calcium (Ca), Aluminium (Al), Magnesium (Mg), Iron (Fe) and Sodium (Na). A small amount of Manganese (Mn), Copper (Cu), Zinc (Zn), Cobalt (Co), Boron (B), Iodine (I_2) and Fluorine (F) are also present. Moreover, carbonate, sulphate, chloride, nitrate and organic salts of Calcium, Magnesium, Potassium and Sodium are also present in soil.

Organic substances present in soil are known as humus which is a complex substance formed by the combination of amino acid, protein, sugar, alcohol, fat, oil, lignin, tannin, and other aromatic compounds. Humus is blackish in colour. It is made from residue of dead plants and animals. Composition of soil is shown in the Figure 8.01.

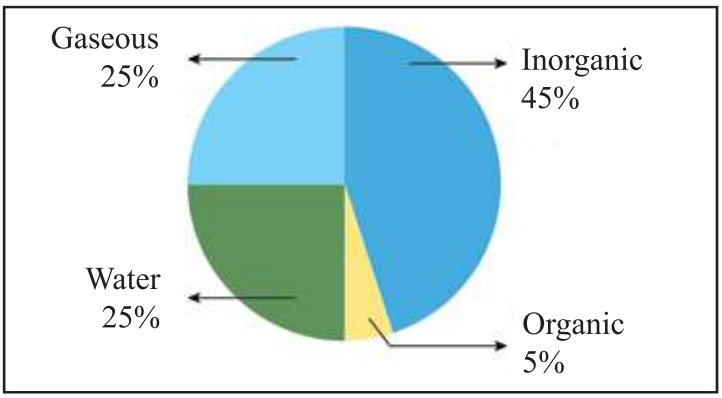


Fig. 8.01 : Composition of Soil

The role of water present in soil is very important, especially for plants. Can you imagine where and how water in soil is present? Water is present in the vacant spaces or pores among soil particles. The water retaining capacity of soil depends on the pore size. Do you know which of sand and clay can retain more water? It is clay, because the pore size is very small and fine and therefore it retains more water. On the other hand, the pore size is much bigger in case of sandy soil which allows more drainage and therefore, its water retaining capacity is poor. In addition to pores or vacant spaces, water is also found in soil in absorbed condition. Humus present in soil is able to absorb and retain water which cannot be transported to plants easily.

Is there any problem if water is not present in soil? Yes, it may cause lots of problems. Consider what happens in desert area. Most of the plants, with few exceptions, cannot grow without water. You know that one of the important components of plant cells is protoplasm and 85-95% content of protoplasm is water which comes from soil.

Plants absorb a small part of water through stomata, however, major part of water, they need, comes from soil through root. Water, obtained from soil, is basically utilized for photosynthesis by which plants produce food for them and release oxygen for us. Important plant nutrients such as minerals, nitrogen, phosphorus etc. cannot be absorbed directly from soil. They are taken up through root and water acts as a medium here. So, if soil becomes water depleted, above mentioned nutrients cannot be transported to plants and their growth is severely hampered.

Now let us talk about gaseous substances present in soil. Along with water, the pores in soil may retain gaseous substances which are usually nitrogen, oxygen and carbon dioxide. Interestingly exchange occurs between the gaseous substances present in air and that in soil. This process is called soil aeration. Now the question is– do the gases present in soil help anyway? Yes, they do. In soil there are different types of beneficial aerobic microorganisms which need oxygen for growth and survival and in fact, they cannot sustain in absence of oxygen. Oxygen also helps to convert water insoluble minerals chemically into soluble materials which can be transported to plants. In Figure 8.2, the soil particles, water and air are shown:

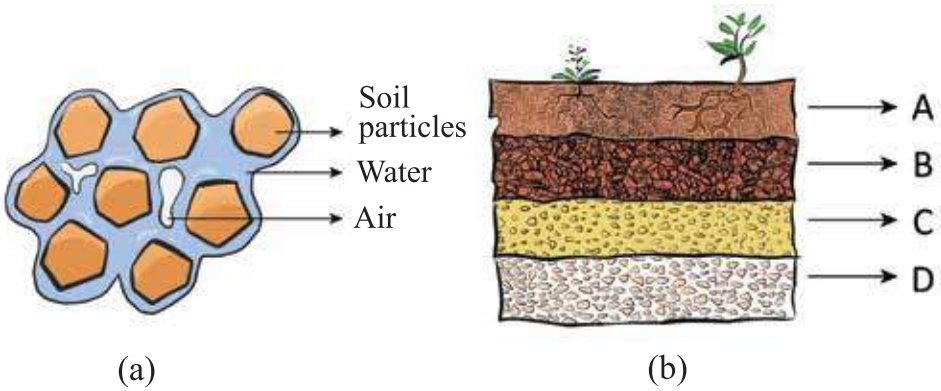


Fig. 8.02 : Composition of soil (a) and different layers of soil (b)

Do you think that the soil composition in all depth is identical? No, it is not. It is seen that soil is divided into four horizontal layers. Each layer is called a Horizon. The Horizon at the top is known as Horizon A or Top Soil. Biodegradation of dead plants and animals starts here and products of biodegradation, especially humus, and other organic substances stay in this layer. Minerals are not usually found in this layer, they penetrate to the layer below with the help of water. The soil in Horizon A is usually sandy.

The second layer is known as Sub Soil or Horizon B. Small amount of humus is found in this layer. However, this layer is full of minerals coming from the top soil.

The third layer of soil is called Horizon C. Soil is produced from rocks through a series of complex chemical reaction. Parent rocks gradually soften by chemical weathering and at a stage, convert to soil particles. Horizon C contains the soft rocks formed first from the hard parent rocks. This soft rocks, although softer than parent rocks, are much harder than soil particles. These soft rocks are later on converted into soil particles. Below the Horizon C, very hard parent rocks remain. The vertical structure of soil is shown in Figure 8.02 (b).

8.1.2 Types of Soil

Do you think soils of all places are identical? No, they are not. Soil quality is different in different places. Based on soil composition, colour, water retaining capacity etc; soil is divided into four categories. They are sandy soil, silt soil, clay soil and loamy soil. Now, let us know about the characteristics of different types of soil.

Sandy Soil

A notable characteristic of sandy soil is its very low water retaining capacity. You can prove it yourselves.

Individual Work

Task : Take a small amount of sandy soil and add little water to it. Now, taking this sandy soil in your palm, try to make small round balls. You will not be able to do it, because sandy soil cannot absorb water even if water is added to it. If the soil could do it, water would cling to the soil particles and you would easily make small ball-like beads.

Another important characteristic of sandy soil is that it has the largest particle size that lead to better aeration and higher drainage.

If you check sandy soil in your own hand, you can clearly see that this type of soil is granular. Sandy soil consists of small rocks and minerals. Presence of humus in sandy soil favours cultivation. However, as the water retaining capacity is very poor, it results in higher drainage and due to over drainage, plants lack water particularly in summer. So the crops which need a huge amount of water do not grow well in sandy soil. However, when there is a heavy rainfall leading to water logging, sandy soil could be suitable for cultivation, because sandy soil does not cause water logging; therefore plant roots do not rot. The main problem of water logging in agriculture is rotting of plant root for which crop production is hampered.

Silt Soil

Water retaining capacity of silt soil is higher than that of sandy soil. How can you identify silt soil? Take a small amount of moist soil. Rub in between your fingers. If it feels smooth and sticks to fingers, then it will be silt soil. Unlike sandy soil, silt soil is found to be the most fertile soil and size of soil particles is smaller than that of sandy soil. We all know about siltation on agricultural land. As the particle size is small, they can be present in water as suspended matter which at a stage, deposit as sediment on the land. Silt soil contains organic substances and minerals like quartz. Like sandy soil, it is also granular and contains a large amount of plant nutrients.

Clay Soil

Have you seen clay soil? The unique character of clay soil is its high water holding ability. They are sticky and stick to the surface. The soil particles in clay are very fine, and therefore, the air pores become too small and narrow. The drainage of water from clay is very low, and so water logging occurs easily upon rainfall. As a result, crops or plant roots rot. Crop production in clay requires organic fertilizers. Mineral content in clay is very high. This soil is used for making decorative handicrafts and even for making jewellery.

Loamy Soil

Loamy soil is created by the combination of sand, silt and clay. The properties of loamy soil depend on the proportion of sand, silt and clay. It has better water retaining capacity, at the same time, the drainage of water also occurs quickly. Therefore, loamy soil is very suitable for cultivation.

In addition to four types of soil discussed above, there are other two types of soil found in some places and, they are Peaty Soil and Chalky Soil. Peaty soil is basically formed due to accumulation of decomposed organic substances and so in this soil, the organic content is much higher than other types of soil. Usually this type of soil is available in swampy and marshy areas. The nutrient content in this soil is relatively low and that is why, it is not that suitable for cultivation. Chalky Soil is alkaline in nature and contains many stones. This soil dries up quickly and so it is not so good for crop production especially in summer. Moreover, the mineral nutrients such as iron and magnesium cannot be transported to plants from chalky soil.

8.1.3 Soil pH

Soil pH is very important for cultivation. You all know that by measuring pH we can easily assess whether a land is acidic, alkaline or neutral. Most of the crops grow well if the soil pH is maintained around 7.0. So,before starting cultivation, we have to check pH of soil of the land and if it is found that pH is significantly lower or higher, then we have to take proper steps. You have already learnt what to do to adjust soil pH. There are some crops such as potato and wheat that result in the highest production at the pH range of 5-6. On the other hand, some crops like barly, grows well in alkaline (pH 8) soil. Hence, it is clear that soil pH is a very important parameter for cultivation.

8.1.4 Reasons and Effects of Soil Pollution

In chapter two, you have studied water pollution. Water and soil pollution are related to each other i.e. the sources or activities responsible for water pollution are also responsible for soil pollution. Now, let us see how soil is being polluted.

Soil Pollution by Industrial and Domestic Waste

How the solid waste is managed in our country? Solid waste is managed in our country either by landfilling or open dumping (discharging to dustbin or open places) in municipal areas. In rural areas, domestic waste is just discharged in nearby places. After disposal, wastes undergo biodegradation and turn into organic manure. Can you imagine what will be the effects of this kind of pollution? As the wastes produced from industries, contain a number of toxic chemicals such as Mercury, Zinc, Arsenic, Lead, Chromium, acids, alkalis, salts, insecticide etc. their harmful effects are also manifold. For example, Mercury and other metallic substances kill the beneficial microorganisms in soil leading to decreased soil fertility. Similarly, excess amount of salts, acids or bases result in significant damage to plants and crops. Proteins or amino acids present in the waste are decomposed by bacteria and produce toxic gases like hydrogen sulfide, sulphur dioxide and phosphorus oxide gas. Most importantly, due to soil pollution in this way toxic chemicals enter into human or animal body through food chain and could be a potential health risk. Finally this kind of pollution may lead to change the biochemical properties of soil which could be devastating for crop production.

Soil Pollution by Release of Radioactive Substances

Soil can be polluted by the radioactive substances released from nuclear power plants or nuclear weapon manufacturing industries due to accident or experiments. Radioactive substances like Radon, Radium, Thorium, Cesium, Uranium etc. not only damage the soil fertility but also cause cancer in skin and lungs of humans and animals. High dose of radioactivity kills plants too. Like other harmful substances, they also enter into animal body through the food chain and cause diseases.

Group Work

Task : Collect information about Chernobyl accident and make a report on its dreadfulness.

Soil Pollution due to Excessive Siltation

River bank erosion is known to all. Soil particles from river bank erosion or from other sources and other water insoluble substances can flow with water and at a stage, settle down as a sediment either at the bottom of waterbodies (rivers, lakes, beals or haors) or on the agricultural land. The sediments may contain lots of harmful substances. Excessive sedimentation on agricultural land leads to the formation of a layer on top soil which plays important role in crop production. As a result, crop production is hampered. You have learnt the effects of sedimentation in waterbodies in chapter two.

Soil Pollution by Mining Operation

Huge amount of soil is excavated during extraction of valuable minerals such as oil, coal and gas from ore by mining. As a result, crop production is hampered in vast areas and also soil fertility is lowered due to soil pollution. Even, due to soil erosion for mining, the wetlands in the surrounding area can be filled up leading to environmental degradation.

Many ores are found in forest areas. Therefore, mining operations destroy forest resources and that cause environmental degradation, which ultimately causes soil pollution in those areas. Moreover, accidents in mine especially conflagration, a common accident in mine, can destroy the productivity of soil in vast surrounding areas. In addition, excessive use of fertilizers, pesticides, herbicides, plant residue, animal excreta, even excessive use of improved technology may also pollute soil.

Do you think that human excreta, animal excreta, bird excreta cause soil pollution? Yes, all of them pollute soil because those excreta contain disease causing microorganisms which can be incubated in soil and later on spread among humans or animals and, finally result in severe health problem.

8.1.5 Strategy for Conservation of Soil

Soil is a very valuable natural resource. All of our fundamental demands including food, cloth, and medicine are dependent on soil directly or indirectly. Such an important resource for our survival is being corroded and its fertility is

decreasing due to varieties of reasons like stormy wind, heavy rainfall, strong river current or river bank erosion etc. leading to soil erosion. Soil erosion not only decreases fertility but also destroys the soil completely.

Everyday we are eroding soil by destroying forest and cutting hills for industrialization (such as brick kilns). You know that recently in Chittagong area, because of soil erosion due to cutting mountains, land slide has caused loss of human lives and properties. If this kind of soil erosion is not prevented, it could be a potential risk for us.

Conservation of Soil by Preventing Erosion

How can we conserve soil by preventing soil erosion? One of the fruitful strategies to conserve soil is to plant trees more and more. If there is grass and shrubs or other plants planted on soil, then even heavy rainfall cannot erode soil. Roots of trees retain soil tightly. During harvest time, we should not uproot crops because roots kept in the field not only improve soil fertility but also reduce soil erosion.

Rainfall results in higher soil erosion in the places having steep slope. Therefore, steps can be taken to stop surface runoff through those slopes. But this is not so easy to do, in that case, a lot of grass and shrubs, dhoincha (Sesbania cannabina), bindweed and such type of plants can be planted to prevent soil erosion. In rural areas, domestic animals, like cattle, feed on grass and therefore, during grass collection, grass should not be uprooted. We can make people aware in this regard. Many a time it is seen that cattle, goat and sheep are let to graze in the field. Care should he taken so that these animals do not uproot the grass cover while grazing. Cutting trees in forest results in deforestation in vast area and leads to increased soil erosion. Therefore, without planting new trees, we should not cut down trees in forest. Otherwise, soil erosion will not be prevented.

For cultivation, organic fertilizers should be used instead of chemical fertilizers, because the elements and humus present in organic fertilizer can absorb water. As a result, soil does not erode in temperate rainfall. In addition, chemical fertilizers destroy the useful insects or microorganisms making the soil less fertile. If the same crop is cultivated in a land, its fertility decreases. So, variety of

crops should be cultivatied in different times in the same land. How can we prevent river bank erosion?

Prevention of Land Erosion Caused by River Erosion

We can plant dhonicha, bindweed type of plant on the bank of rivers. If the rivers have strong current, then erosion can be prevented by putting sand bags or concrete blocks.

8.2 Common Minerals Obtained from Soil

Various materials such as salts, lead of pencil, talcum powder, dishes of china clay etc. which we use in our life, are extracted from soil and rock. Most of them are available in solid state. They also have a definite chemical composition. So far, about 2500 different types of minerals have been identified in nature. Minerals could be both metallic and non-metallic. Among the metallic minerals, iron (Fe), copper (Cu), gold (Au) and silver (Ag) are notable. Among the non-metallic minerals, quartz, mica and mineral salts are well known.

Do you think that coal, gas, petroleum etc. are minerals? Yes, these are organic minerals and will be discussed later in this chapter.

Table 8.1 : Use of Some Common Minerals

1.	Magnetite (Fe_3O_4)	In iron manufacturing
2.	Lime stone ($CaCO_3$)	In building construction, cement, glass, iron and steel production and to adjust pH of acidic soil
3.	Quartz (SiO_2)	In glass, sand paper, radio and watch production
4.	Silver (Ag)	To make jewellery and metallic coins
5.	Mica	As insulator in electric appliances
6.	Gypsum ($CaSO_4.2H_2O$)	As raw materials of cement and Plaster of Paris
7.	Metal pyrites	To manufacture sulphur and various metals
8.	Gold and Diamond	To make jewellery
9.	Gas, Coal, Petroleum	Used as fuel in cooking, in vehicles and industry

Physical Properties of Minerals

Minerals are usually crystalline. There are many minerals whose chemical composition is identical but their crystal structures are different. So, their physical properties are also different. For example, graphite and diamond; although both the minerals are composed of carbon, due to structural difference, graphite is softer (used in pencil as lead) whereas diamond is the hardest of all minerals known so far. You know that minerals are usually solid and they differ in hardness. Minerals of higher hardness can scratch the minerals of lower hardness easily; however, vice versa is not possible. According to hardness, talc is the softest mineral which is used for manufacturing talcum powder. On the other hand, diamond in the hardest mineral as stated above. Most of the minerals have characteristic luster. Metallic minerals such as metal pyrites show lusture similar to metal. Although diamond is a non-metal, its unique lusture is well known.

Some minerals such as quartz are transparent and light can pass through them. There are some minerals which are transparent but other objects cannot be seen through them whereas some minerals, such as calcite or lime stone are not transparent and do not pass light through them. Usually each mineral has characteristic colour and, therefore, can be isolated from others easily. Most of the minerals possess cleavage which indicates the shapes of fragments to be produced on fracture. Majority of the minerals have specific gravity in the range 2.5-3.5 with few exceptions.

Chemical Properties of Minerals

Chemical properties of minerals depend on the chemicals present in it.

8.3 Sources of Natural Fuels in Bangladesh

What are the natural fuels that we use? The major natural fuels we use are natural gas, coal and petroleum. In addition, scrub wood, tree leaves, jute stick, rice husk, cow dung are also natural fuels used in cooking. Now, let us discuss widely used natural fuels in detail.

8.3.1 Natural Gas

Do you know what is actually present in the gas that we bum in our kitchen in oven or we load in cylinder from CNG pump station? These are nothing but natural gas which is basically methane gas (CH_4). However a small amount of other substances such as ethene, propane and butane are also present in natural gas. Moreover, it also contains a very small amount of carbon dioxide, nitrogen, hydrogen sulfide, hydrogen, argon and helium.

Now is the question is how is natural gas formed? There are different theory regarding formation of natural gas. According to the mostly accepted theory, they are formed from dead plants and animals in the ancient seas/oceans hundreds of millions of years ago. The organic matter present in plant/animal body accumulated on the bottom of the seas and decomposition occurred by the action of bacteria. Sediments of sand and mud on those organic deposits created conditions of high temperature and pressure that resulted in loss of oxygen. In this

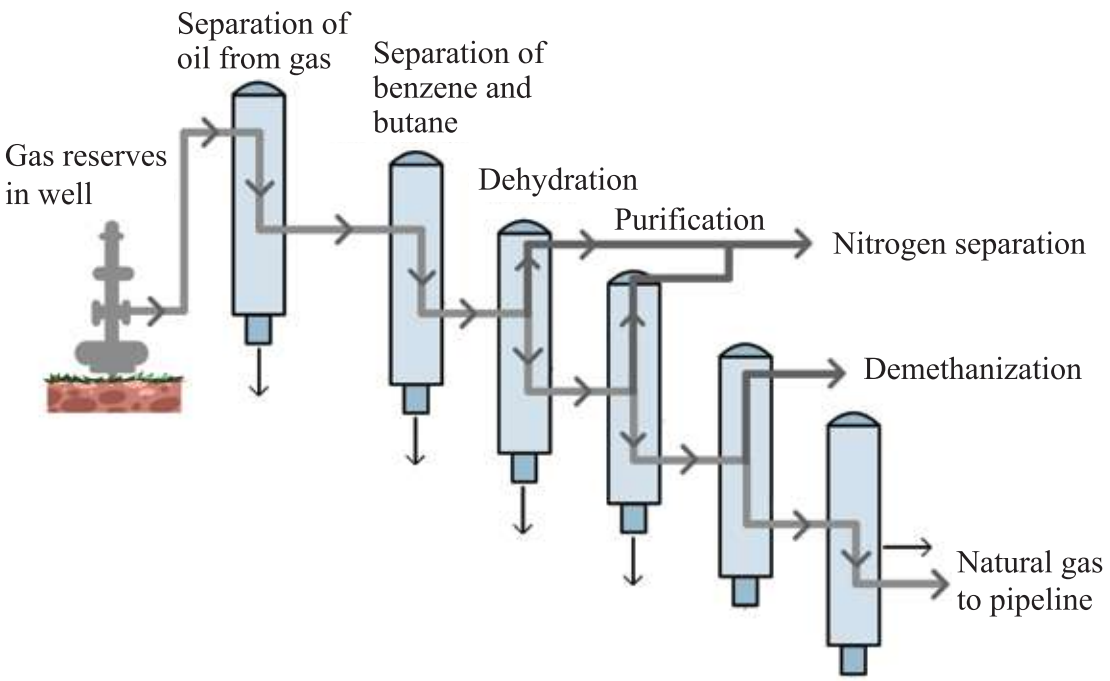


Fig. 8.03 : Processing of natural gas and petroleum

compaction, varieties of hydrocarbon molecules were formed. Natural gas and petroleum are composed of those hydrocarbons. The gas reserves formed in this way is called gas well.

Processing of Natural Gas

Processing of natural gas and petroleum is a complex industrial process which is carried out in several steps (Fig : 8.03). Usually processing begins at the gas well. Steps in processing depend on composition of the fuel. Usually in gas well, gas and petroleum are found together. So, in the first step, petroleum oil is separated from gas. Then benzene and butane present in gas are compressed and separated. To remove water from the gas, it is passed through a dehydration column. After that the impurities (H_2S, CO_2) present in the gas are removed. The gas mixture obtained at this stage contains nitrogen which is separated. After separating nitrogen, the gas obtained is pure methane gas and it is transported through pipeline.

Use of Natural Gas

We utilize natural gas for many purposes. One of them is in the production of urea. Approximately 21% of natural gas is used as a raw material for urea fertilizer in Bangladesh. Do you know that in our country, majority of electricity is produced from natural gas? About 51% of natural gas is utilized for producing electricity whereas 22% is consumed in industry, 11% in domestic purpose and 11% as fuel. About 1% of natural gas is used in commercial organization as non-energy use, rest 5% is system loss. In Bangladesh, natural gas has been used as a fuel in vehicles since 2003.

Limitation and Conservation

Do you think that the natural gas reserve we have is unlimited? No, it is not. We have a definite and a limited amount of gas reserve that will be depleted gradually after certain period due to consumption. Therefore, we have to be aware of using this valuable resource, we should not waste or misuse it anyway. You may have observed that some people keep their kitchen oven on all day long in their home unnecessarily and misuse such an important resource which is highly objectionable. In this regard, we must raise awareness among our family members and other people in our community.

8.3.2 Petroleum

Petroleum is a mineral oil, i.e. the liquid fuel that is found is the mine. Usually natural gas and petroleum oil are found together in the ore. Although propane and butane are gaseous substance in normal condition (25°C and 1 atmospheric pressure), they are compressed to liquid at higher pressure and that is why, they are included in petroleum. Gasoline, diesel, and kerosene are also petroleum.

Processing of Petroleum

The crude petroleum , obtained from oil field, is a mixture of various types of hydrocarbons and impurities like sulphur and, in most of the cases, it is not suitable for using directly. So the refining of crude oil is required. Crude oil is refined by fractional distillation by heating at 400°C.

Use of Petroleum

The major part of petroleum is used as fuel in vehicles. Substantial amount of petroleum is used by diesel engine for many purposes including irrigation. In addition, petroleum is used in industry such as fertilizer, wax, pesticide, coal tar, lubricant, grease etc.

8.3.3 Coal

Coal is a black or blackish brown sedimentary rock. The main chemical element in coal is carbon (C). Based on geographical location, coal contains variable amount of hydrogen (H_2), sulphur (S), oxygen (O_2) and nitrogen (N_2) in addition to carbon. Since coal is burnable, it is widely used as a fuel.

Although coal is a fossil fuel like natural gas and petroleum, the structure of coal is different from that of natural gas and petroleum. Coal was formed from the decay of huge fern, shrubs, algae and other plants that grew in swampy and marshy land 350 million years ago. The carbon present in organic substances of plants accumulated on the bottom of the wetlands. The carbon layer accumulated in this way was buried under the sediment of silt and mud and became anaerobic gradually. Initially the carbon layer decayed to a wet, spongy, porous and humus like material called peat. Later on, with high pressure and temperature, peat was converted into carbon enriched coal.

There are three types of coal and they are: Lignite coal, Bituminous coal and Anthracite coal. Anthracite is the oldest and hardest coal which formed 350 million years ago and it contains approximately 95% of carbon. Bituminous coal is 300 million years old and the carbon content in this coal is 50-80%. Lignite coal is 150 million years old and it contains maximum 50% of carbon.

Processing

Coal is extracted from mine with the help of machines. There are two methods for coal mining. One of them is Open Peat Mining and the other is Underground Mining. Usually layers of coal occur near the earth surface and that is why open pit mining is mostly used. After extraction from the ground, coal is transported to the processing plant by a conveyor belt and impurities such as dirt, rock particles, ash, sulphur etc. are removed from coal.

Use

Do you know where coal is used? In Bangladesh, coal is mostly used in brick kilns as a fuel. Small amount of coal is used as fuel in industry and residential purposes. Although coal is not used much for producing electricity in Bangladesh, most of the countries in the world use coal for that. In addition, coal is used in hotels and restaurants to make smoked food items such as Kabab. Goldsmiths and blacksmiths use coal as a fuel to melt metals.

Use of Renewable Fuel to Conserve Natural Fuel

All the natural fuels discussed above will exhaust one day. Therefore, we should increase the use of renewable energy to reduce the use of natural fuels and preserve them. We can use solar energy, wind, water current etc. to minimize the pressure on natural fuels. Thus, we can preserve natural energy for our future generation.

Exercise

Multiple Choice Questions

1. Which one is the softest mineral?

a. Diamond b. Talc

c. Silica d. Limestone

2. Soil of the subsoil layers

i. Full of rock particles

ii. Enriched with minerals

iii. Enriched with organic substances

Which of the following is correct?

a. i and ii b. i and iii

c. ii and iii d. i, ii and iii

Near the nuclear power plants in Tokyo, no plant grows well other than mushroom.

3. Which is abundant in that soil?

a. Rocks b. Minerals

c. Organic substances d. Radioactive substances

4. In which soil crop production will be good?

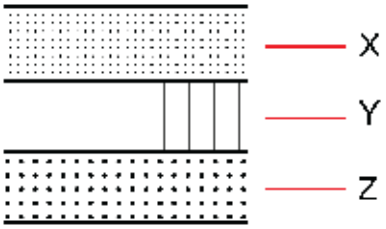
i. Soil containing sand and minerals

ii. Soil containing minerals

iii. Soil containing sand and silt

iv Soil containing sand, silt and clay.

Answer questions 5 & 6 from the following pictures:



5. Which layer contains rock particles?

i. X Layer ii. Y Layer
iii. Z Layer iv. Layer below Z

6. Crop production is good in the top most layer because this soil-

i. Contains organic substance
ii. Contains minerals
iii. Contains rock particles
iv. Contains microorganisms

Creative Questions

1. Soil in the area where Bokul lives contains rocks and minerals. The size of soil particles is big. Water drainage is very fast. On the other hand, soil in the area where Shaheen lives has small particles but enriched with organic and mineral substances.

a. What is aeration?
b. How does Horizon form?
c. Explain the type of soil in Bokul' s area.
d. Soil of which area will result in better cultivation? Justify your opinion.

2. See the figures below and answer the questions

Fig. A


Fig. B


Fig. C

a. What is petroleum?
b. What is meant by "fossil fuels"?
c. How the fuel in Fig.A is processed to make it suitable for use? Explain.
d. To produce energy shown in Fig.B which one is economical between A and C? Justify your answer.

Chapter Nine

Living with Disaster

Natural disasters like flood, cyclone, drought and so forth are very common in Bangladesh. The irreparable loss of lives and properties created by these types of disasters is the main barrier to the development of our economy. These disasters have become terrible at present because of different types of human interference on nature.

At the end of this chapter, we Will be able to-

- analyze the effects of climate change in Bangladesh and other parts of the world;
- explain the causes of environmental problems;
- describe the causes, prevention strategies and immedite measures to be taken;
- analyze the importance of standard and improved environment to lead a healthy life;
- explain the importance of conservation of nature;
- describe different ways of natural conservation;
- carry out an investigation on problems and challenges for maintaining standard and improved environment in our area;
- make posters on prevention of disasters and response after disasters;
- make poster for creating social awareness on conservation of nature;
- take steps to build social awareness for conserving environment.

9.1 Effects of Climate Change

9.1.1 Bangladesh Perspective

You have already learnt about the causes of weather and climate change. Now, let us know about the effects of climate change. The effects of climate change have already become visible in Bangladesh and these are as follows:

Seasonal variation

Bangladesh is a land of six seasons and each season had its own characteristis. A remarkable change is going on regarding seasonal cycle because of climate change. Though Ashar and Shraban make rainy season, heavy rainfall is occurring in the month of Ashwin and this is causing untimely flood. On the other hand, winter is getting shorter day by day.

It is also noticeable that summer has become hotter and sometimes at day time temperature reaches upto 45°-48° C in some parts of the country. Similarly, winter temperature especially in the northern part of the country becomes very low. Some people die because of this unusual and extreme weather condition.

Flood

Flood is a common annual phenomenon in Bangladesh, a land of river. In many cases it is beneficial because flood results in siltation on agricultural land and increases its fertility leading to better crop production. However, nowadays, due to climate change, frequent and devastating floods are occurring. Such destructive floods occurred in the past also but they were less frequent. In 1988, 1995, 1998 and 2005 catastrophic floods caused a huge loss to lives and properties. Consequently, the whole economy of the country is being affected. Even the areas like Dhaka, Jessore which usually are not flood-prone, being inundated currently.

River Erosion

Erosion of riverbank is a normal incident in Bangladesh (Fig : 9.01). However, recently it has been intensified. As a result, a large number of people are losing there houses and becoming poorer day by day. Also, a large amount of

farmland is lost in rivers and it is a serious problem for this over populated country. People who are losing there homes are leading inhuman life like nomads or in slums of towns and cities. From a study, it is seen that in last three decades, about 180,000 hectares of land has been engulfed by only three big rivers- the Padma, the Jamuna and the Meghna.

Fig. 9.01 : River erosion

Droughts

As Bangladesh is an agricultural country, drought is a very important issue here. Global warming is the main reason for climate change for which global temperature will increase and that will certainly affect rainfall severely. In some regions, rainfall will be extremely low leading to drought. Drought, caused by The Year climate change, may hamper crop production in Bangladesh.

Salinity of Water

You have already learnt in chapter two that due to global warming leading to global climate change, sea level will rise and a significant part of Bangladesh will go under water. As a result, sea water will intrude to main land and the salinity of surface water, ground water and agricultural land will increase. In that situation, there will be scarcity of water in one hand, on the other hand, due to increased salinity cultivation will be hampered. According to recent data, about 830,000 hectares of land in south-western part of Bangladesh has already become unsuitable for cultivation. Therefore, due to climate change leading to increased salinity in water, Bangladesh will be in a great risk regarding food security. As per expert opinion, 30% of food production will be reduced by the year 2100, whereas 8.8% of rice production and 32% of wheat production will be reduced by 2050 due to climate change.

In Bagerhat, Khulna and Sathkhira Districts in south-western part, about 13% of agricultural land has already been affected by saline water and that could reach 16% by 2050 and 18% by 2100 respectively.

Threats to Coral Population

Sea coral is very sensitive to temperature. Usually 22-28°C temperature is suitable for their survival. An increase in 1-2°C temperature works as a severe threat for coral. According to data obtained from a recent study, in the year 2010, approximately 70% of coral population in Saint Martin Island in Bangladesh has been depleted compared to that in 1960. It is to be mentioned that in addition to increase in temperature of water, lack of proper and planned management is also responsible for depletion of coral.

Forest

Only mangrove forest in Bangladesh is the Sundarbans which is not only full of biodiversity but also a very valuable resource for us. It is very important for our economy. Moreover, the Sundarbans works as a protection embankment to prevent natural disasters such as cyclone, hurricane etc in that area. Recent cyclone Sidr, damaged a large part of the Sundarbans. From a computational study, it is seen that, if the sea level rises by 45 centimeter, around 75% of the only mangrove forest will submerge in water and if the sea level rises by 100 centimeter, then the whole forest and biodiversity there will be lost.

Fish Population

Once fish was abundant in the river, canals, ponds and beels of Bangladesh. In the riverine Bangladesh, fish is not abundant now in many rivers as before. Due to climate change, fish habitats, food collection and many physiological processes are disturbed, even they may die. Many fish species and particularly fish fries cannot survive if water temperature is more than 32°C. As the higher temperature (35°C) favours the growth of pathogenic bacteria, higher water temperature spreads infectious diseases resulting in epidemic fish death. Besides this, due to saline water intrusion, fresh water fish cannot survive.

Health Risk

Climate change has been resulting in frequent natural disasters such as devastating floods, cyclones etc. which cause severe water pollution. As a result, water borne diseases like cholera, dysentery, diarrhoea etc. spread to a great

extent. Untimely flood and droughts hamper food production leading to food crisis, even it may lead to famine which will cause extreme health risk. Like water temperature, air temperature will also increase. As a result more germs will grow and transmission of diseases will increase. In Bangladesh, we never heard about the disease like Anthrax before. However, in some districts particularly in Sirajgonj and Pabna, in rainy season, anthrax has been found to be spread and, both people and domestic animals (especially cattle) are infected for the last few years. According to the opinion of veterinarians and dairy farmers, although anthrax in human can be treated, infected animals cannot survive. Due to climate change many deadly pathogens like anthrax may grow.

Biodiversity

Biodiversity is a very important factor for ecological balance. It is estimated that due to climate change, about 30% of biodiversity will be lost in Bangladesh.

Cyclone

Natural disasters like cyclones will be more frequent and devastating. We Shall discuss it later in this chapter in detail.

9.1.2 Global Perspective

IPCC (Intergovernmental Panel on Climate Change) is the body which has been formed to evaluate the effects of climate change. According to their fourth evaluation report (AR4), the effect of climate change is very severe and that is intensifying day by day. The average global temperature in last 100 years has been increased approximately by 0.7°C. During 1961-2003, sea level has risen 0.18mm/year. The ice deposit on mountains has already started to decrease. Summer in last 11 years out of 12 years was very hot from 1995-2006. According to AR4, in next two decades, atmospheric temperature may increase by 0.2-0.3°C/every 10 years. It is assumed that by 2100, the average global temperature may rise by 1.1-6.4 °C. At the same time, the availability of water will increase in moist tropics and high latitudes, and decrease in mid latitudes and semi-arid low latitudes.

By 2080, sea level may rise by 34 cm, as a result many low lying countries including Bangladesh will be submerged in water. Do you know that part of Maldives and India has already been submerged in water?In recent years, natural disasters such as cyclone, typhoon, hurricane etc. have been more frequent and will intensify in future. Devastating super storm Aila, Sidr, Hurricane Nargis, Katrina are well known to all of us. Such disasters may be more frequent and intense.

9.2 Environmental Problems

Almost all countries in the world including Bangladesh are now having lots of environmental problems. Can you realize these kinds of problems? One of the most important environmental problems is population growth which is also responsible for many other environmental problems. Do you know the total population in the world? It is approximately 7 billion. By 2050, the world population will reach approximately 10 billion with the present growth rate. From a study, it is seen that, after 1950 about 80% of the forest was lost due to increase in population. At the same time, thousands of plants and animals were destroyed. In Bangladesh, due to increased population, thousands of acres of agricultural land is being lost. This is quite logical because with the increase in population, all the basic needs like food, housing and clothing increase creating pressure on employment. To cope up with the increasing pressure for employment, new industries are set up leading to loss of agricultural land and forest. To supply large amount of fish to the increased population, increased amount of fish is caught leading to decrease in fish population in the rivers sharply nowadays. Bangladesh is the fourth largest fish producing country and to sustain the saying ``Bengali with fish and rice", we are to depend on farmed fish rather than natural fish.

In 1991-92, the total food production in Bangladesh was about 19.32 million metric ton which raised to 30 million metric ton in 2007-2008. In 2010-11, it reached 40 million metric ton. In 20 years, food production has been doubled, however, every year we are facing food deficiency, and we are to import 3 million metric tons of food grain every year. And, for that,we have to spend a

substantial amount of foreign currency hampering our economy. Do you know what the population of Bangladesh in 1991-92 was? It was about 100 million and at present, it is more than 170 million. If the population growth were much less, Bangladesh could be self sufficient in food grain production. Large amount of foreign currency could be saved and it might be utilized for infrastructure development. We all need to be careful and also have to make people aware of controlling our population growth.

Why and how the population increases? Increase in population basically depends on birth rate and death rate. Usually the birth rate is higher than death rate and that is why population increases. There are two other factors controlling the growth rate and they are expatriation and immigration. Expatriation results in the decline of population, while immigration increases it. The prime cause of population growth in our country is that birth rate is much higher than death rate.

Another important environmental problem is urbanization which is also related to increase in population. Due to increase in population, a significant part of rural people are migrated to urban areas. At the same time, population growth in urban areas is not that low. Due to migration of rural people and population growth, the residential crisis is becoming extreme in urban areas. As a result, unplanned urbanization is going on destroying the agricultural land and wetland in surrounding areas. Due to lack of proper waste management, water supply system or other facilities, residents in those areas are in deep trouble.

9.2.1 Global Warming

You have already learnt about global warming. Do you know the reason behind this? The reason behind this is nothing but the effect of increased Green House Gases (GHGs). There are several GHGs which are carbon dioxide, ozone, methane, CFCs, nitrous oxide and water vapour. The amount of these gases is increasing in the environment gradually. Now the question is how are they increasing? The main sources of these gases are vehicles, industries, power plants, refrigerator, air conditioner etc. In addition, some natural events like volcanic eruption, forest fire, natural decomposition of plants are also

responsible for releasing GHGs. Due to increase in population, demand of vehicles, industrial development and electricity are going up resulting in higher emission of GHGs. On the other hand, due to increase in population, forests are also destroyed leading to lower absorption of carbon dioxide by photosynthesis. Therefore, the amount of CO_2 is increasing gradually in atmosphere. If the emission of the green house gases is not reduced, the atmospheric temperature will increase significantly (Fig : 9.02) and that will change the global climate. You have already studied the effect of global climate change in this chapter previously.

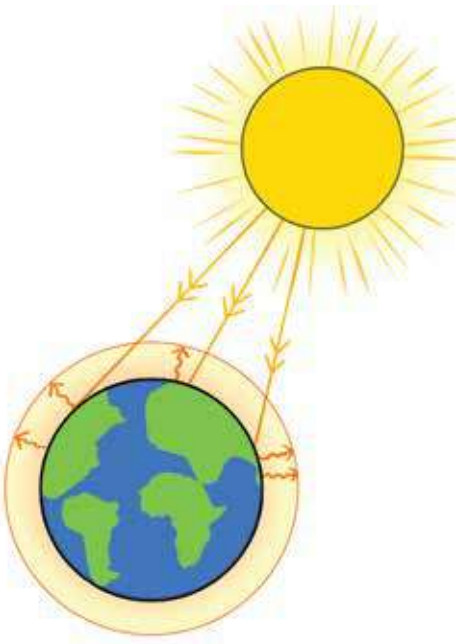


Fig. 9.02 : Green house effect

9.2.2 Carbon Pollution

Carbon pollution basically means increase of CO_2 in the atmosphere and you have studied that in the previous section.

9.2.3 Deforestation

Deforestation is a severe environmental problem and it is also linked with population growth. Due to increase in population demand for housing, road construction, foods, cloths increases and all these basic needs are directly or indirectly related to deforestation.

9.3 Reasons behind Disasters, Prevention, Strategies and Remedies

9.3.1 Flood

Flood (Fig : 9.03) has become a regular natural disaster for the reverine Bangladesh. Almost every year, a substantial amount of crops, livestock and other resources are damaged in some parts of the country and very, often, it becomes disastrous. In Bangladesh, floods in 1974, 1987, 1988, 1990, 1995, 2004 and

2007 caused irreparable damage. In 1974, the damage was so severe that it resulted in a famine. Now the question is what are the causes of floods? There are several complex reasons for floods. One of them is decrease of water holding capacity of rivers. Due to river bank erosion, mismanagement of waste etc. sediment is deposited in the river beds. As a result, heavy rainfall or water from upstream easily causes flood. Moreover, due to the effect of monsoon wind resulting in high tide in the Bay of Bengal, water coming from upstream cannot enter into the Bay and results in flood in surrounding areas. Besides these, a major part of Bangladesh is plainland and therefore, rain water cannot flow quickly; instead it becomes stagnant resulting in water logging that may cause flood. Sometimes, cyclones created in the Bay of Bengal result in water surge to the main land that cause flood especially in coastal area. Flood caused by cyclones Aila and Sidr in south western coastal area is well known to all of us.

Now, let us discuss prevention strategies, remedies and responses regarding flood. As we discussed before, one of the reasons for flood is sedimentation in river beds, so we have to dredge the rivers so that the water holding capacity increases. In that case, heavy rainfall or water from upstream cannot cause flood easily. Flood is controlled in many countries in South Asia including Bangladesh by Flood Control Embankment.

Fig. 9.03 : Flood

Since 1960, 8000 km flood control embankment has been built in Bangladesh so far. However, due to damage in the embankments in different parts of the country, particularly in Sirajganj district, a large area is being flooded every year and it happens basically due to lack of skills and corruption of the concerned department and officials.

River training can be an effective measure to control flood. River training covers flood control by putting stone, cement blocks, sand bags, wood, bamboo stack etc. on the bank of rivers. Moreover, tree plantation on the bank of river, construction of sluice gate etc are also parts of river training.

Flood Forecast and Warning

The damage caused by floods can be reduced by disseminating flood forecast and warning. But there are many (58) rivers in Bangladesh including the Ganges, the Brahmaputra and the Meghna originated in India, Nepal and Bhutan. Therefore, accurate flood forecast cannot be given due to lack of data. In that case, regional co-operation must be developed with those countries so that the data related with those rivers can be collected and steps can be taken based on those. To minimige flood damage, legal action may be taken in using and controlling land so that human settlement in law- lying areas can be stopped. Regarding effective flood control and responses, increase of public awareness works as a helpful tool, and so, steps must be taken to increase public awareness. One way to adapt with flood is to build shelter or storage facilities, construct roads, establish markets, schools, mosque, graveyard etc. in elevated places. During flood, most of the roads are inundated; in that case, arrangement of boats can be a great help to adapt with flood.

Prior preparation for flood could be a part of the strategies to face flood. If a large population is affected by flood and if prior preparation such as adequate food storage and supply, drinking water, medicine etc. cannot be delivered, the effects could be disastrous. When an area is flooded, usually people suffer from unemployment; particularly poor people have to suffer much. So, for their rehabilitation, adequate funds must be arranged.

9.3.2 Drought

Drought is a severe natural disaster when moisture in soil reduces to zero, and so plants or crops cannot grow. In England, if the rainfall is less than 0.25 mm for consecutive two weeks, the condition is called absolute drought and if it is not higher than 0.25 mm for four consecutive weeks, the condition is called partial drought. In Russia, a period of 10 days with a total rainfall not exceeding 5 mm is considered as drought. In the USA, if there is not at least 6.24 mm rain daily for consequtive 30 days, it is regarded as drought. Drought is a severe natural disaster (Fig : 9.04). It results in reduced crop production which may cause famine.

Fig. 9.04 : Drought

Due to drought, scarcity of animal feed becomes acute, agro based industries are hampered which becomes a great threat to employment. Soil fertility decreases due to drought and for long lasting drought, socio-political unrest occurs. Several north-western districts of Bangladesh (Rajshahi, Nowabganj, Dinajpur, Bogra, Kushtia, Jessore) are vulnerable to drought. In Bangladesh a devastating drought occurred in 1978-1979 and the damage in that drought was more than that caused by the flood in 1974.

Why drought occurs? There are several reasons for drought which are– prevalence of dry weather for a long time and insufficient rainfall. This kind of condition exists when evaporation and perspiration are higher than rainfall. Due to unplanned urbanization, deforestation and increased greenhouse gas, atmosphere is grad- ually becoming drier and drier, which disfavours the formation of cloud by con- densation and therefore results in reduced precipitation. Recently for drought in Bangladesh, El-Nino created in East Pacific Ocean is being considered to be responsible.

Another reason for drought is unplanned and excess groundwater pumping by deep tube wells. Because of this kind of activity, underground water level is going down abruptly and as a result, the soil in the upper layer becomes dry. In addition, diversion of river water flow, withdrawing water from upstream by upper riparian, depletion of ozone layer etc. are also responsible for causing drought.

How can we prevent and adapt with drought? As lack of water in soil is basically the reason for drought, the effective way to face drought is to increase the supply of water in soil.

There are some crops such as wheat, onion etc. that can grow in soil containing low moisture. Drought affected people must be encouraged to cultivate these types of food crops. At the same time, they should be discouraged to cultivate crops like, IRRI requiring huge amount of water.

To face drought, the common people must be motivated to dredge rivers, lakes, beals etc. to hold water to use during drought. In the developed countries, the efforts to make artificial rainfall to adapt with drought have not been successful.

9.3.3 Cyclones

The word 'cyclone' came from a Greek word "Kyklos" which means coil of snakes. It is seen from the satellite picture (Fig : 9.5) that wind with very high speed is whirling like a coil, i.e. due to depression, when wind with very high velocity travels in a circular motion, it is termed as cyclone. Cyclone is known as Hurricane in the USA, as Typhoon in Far East and as cyclone in South Asia.

Fig. 9.05 : Cyclone

Due to Geographical location of Bangladesh with the Himalayas in north, the Bay of Bengal in south and funnel shaped coast line, it is vulnerable to cyclone. Since 1960 about 50 cyclones have hit Bangladesh so far. Among those cyclones of 1960, 1961, 1963, 1965, 1970, 1985, 1991, 2007 and 2009 were very destructive. However, cyclone of 1970 is considered as the most devastating one, where 5 lacs deaths were recorded. In cyclone 1991, approximately one lac and forty thousand people lost their lives. In the super cyclone Aila and Sidr of 2007 (Fig : 9.06) and 2009, 10,000 and 7,000 deaths were recorded respectively. Moreover, millions of people became homeless for those cyclones. The economic loss in those two cyclones was US$ l. 7 billion and 600 million respectively. Apart from this, cyclones named Amphan in 2020 and Remal in 2024 also caused a lot of damage.

Fig. 9.06 : A cyclone affected area

Causes of Cyclone and Remedies

Cyclones originate in the deep sea. So, it is very difficult to know in detail how it forms. However, it is clear that two reasons play roles in creating cyclone and they are high temperature and depression. For the formation of cyclone, the required ocean temperature is more than 27°C. Unfortunately this temperature prevails almost all over the year in the Bay of Bengal. As the temperature lowers, it results in more rainfall leading to release of latent heat, which ultimately increases precipitation. Due to released latent heat, atmospheric temperature also increases and atmospheric condition becomes unstable and depression/low pressure is created. In this situation, wind from surrounding area moves to the center of origin and for the existence of increased temperature, the wind moves upward in a circular motion creating cyclone. Wind speed of cyclone formed in this way, is usually very high and if the wind velocity is 63 km/hour or more, then it is considered as cyclone. The strongest cyclone ever hit Bangladesh is the cyclone of 1991 when the wind velocity was 225 km/hour.

Now the question is what can be done to protect us from cyclone or what are the remedies for it? Cyclone has strong damaging power; even relatively a weak cyclone could be equivalent to thousands of Nuclear Bomb of megatons regarding energy.

Moreover, it is a natural hazard where we have no control and therefore, it is almost impossible to prevent it. Very recently in the USA, a way to reduce wind speed of cyclone during storm by spraying silver iodide has been discovered. However, due to varieties of limitations, it is not being used widely. In addition, by spraying oil or other chemical in the ocean, the intensity of cyclone may be controlled by reducing evaporation. However, in a poor country like Bangladesh, this kind of solution may not be feasible.

So, what would be the solution? At first, we have to strengthen the weather forecast and warning system and also take steps to minimize loss of lives and properties. One of the most dangerous aspects of cyclone is that it results in water surge. Therefore, durable shelter centre in high land must be built. People who are living in low land must be taken to the safer places. To prevent the water surge, coastal embankments must be constructed. At the same time a lot of trees can be planted in those areas to minimize the loss.

We must have prior preparation to cope with cyclone. There are some programs run by Ministry of Disaster Risk Management and Relief of Bangladesh Government and Red Crescent Society for the preparation. Under these programs, about 32000 volunteers are working for increasing public awareness and this activity needs to be strengthened further. In 2017, Cyclone Mora hit Bangladesh but due to taking timely proper steps, only seven people died then.

Tornado or Norwester

A very familiar natural disaster in our country is tornado or norwester. Usually norwesters occur within April to May. Generally, clouds gather in the north west direction and within a short while norwester begins. In this storm wind velocity may range from 55 to 80 km/hour. If the wind velocity of a storm exceeds 100 km/h, it is called tornado. Besides Bangladesh, tornado also hits many countries including America, Australia and Russia. The most harmful aspect of Tornado is that it results in severe damage abruptly within a very short time. The word "Tornado" originated form a Spanish word "Tornada" which means thunder storm. Like cyclone, in case of Tornado, high speed wind flows in a circular motion

and damages everything on its way. Wind speed in case of Tornado is generally higher than that of cyclone and it is usually in the range of 480-800 km/hour. The width and length of the Tornado is just few meters and 5-30 km respectively. The basic difference between cyclone and Tornado is that cyclone forms in the ocean and hits in coastal area whereas Tornado may form and attack in any place. Like cyclone, creation of depression/low pressure is also responsible for Tornado. Due to depression, warm air goes upwards and to fill that vacant space, cool air from surrounding areas moves to that place with high speed and as a result, Tornado is created. A devastating Tornado hit in Bangladesh in 1989 in Saturia of Manikganj district. Due to that attack, everything on the way of Tornado was demolished. In Bangladesh, usually Tornado is created in the month of Bioshakh (April-May) and that is why, it is also called Kalboishakhi. Since 1975, about 104 Tornado hit in Bangladesh. In the history of Bangladesh, the most disastrous Tornado attacked was in Demra thana in Dhaka district in 1969. Wind speed of that Tornado was 644 km/hr. As forecast and warning cannot be given in case of Tornado, so steps for preparedness cannot be taken. Therefore, quick supply of relief and rehabilitation in affected areas are the solutions to adapt with Tornado. In this case, measures must be taken by a co-ordination between government and non-government organization.

9.3.4 Tsunami

Tsunami is a Japanese word where "Tsu" means port and "nami" means wave. So Tsunami means wave of port. It is a natural hazard. According to expert opinion, Tsunami can be created by earthquake, volcanic eruption, land slide at the bottom of ocean/sea or by some incident happened in space. It is considered the third most dangerous natural disaster. Collision of the tectonic plates at the bottom of sea/ocean leads to severe earthquake. Sea water makes waves of millions of tons (Fig : 9.07). When such large waves reach near the coast, they become larger and converted to a severe water surge. The speed of this wave could be in the range of 500-800 mile/hour. In open sea, the height could be up to 3ft, however, as it comes closer to coast, gets higher energy and its height increases. It is seen that the distance

Fig. 9.07 : Tsunami

from one end to another end of the wave could be as long as 100 mile. In water where depth is not that much, Tsunami is converted to a destructive water surge. The high tidal wave could be as high as 100 ft before it recedes. A large coastal area may be flooded, even the human habitation could be demolished fully. One major problem to deal with Tsunami is like earthquake; forecast and warning cannot be given as it happens almost instantly. Therefore, it is practically impossible to save lives and properties of coastal area. Generally, tsunami is created due to an earthquake in the bottom of the sea. Starting from the epicenter of the earthquake and crossing the sea, the tsunami needs some time to reach the coast. Within this short time, usually warning is announced in the coastal area. In the history, the most disastrous natural hazard hit on 26 December, 2004. A tectonic earthquake was created at the bottom of the Indian Ocean near Sumatra Island of Indonesia. The severe earthquake occurred due to collision between Eurasian plate and Australian Plate and the epicenter of the earthquake was Sumatra. Due to this earthquake of 9 .1-9 .3 magnitude in Richter scale, a part of the Indian Ocean pressurize a part of Sumatra and, as a result, a length of 600 miles at the bottom of the sea was cracked. This cracking displaced millions of tons of water and the water stream moved towards the surface with extremely high speed and spread as large wave in the surroundings. The wave

ultimately was converted into a devastating flood and, was extended to Indonesia, Malaysia, Sri Lanka, India, Thailand, Maldives of South and Southeast Asia as well as 12 countries of Africa including Kenya and Somalia. About 3 lacs people died due to the high tidal effect. One lac people died in the Acheh Province of Indonesia. Next to Indonesia, lots of people died in Sri Lanka. Due to high tidal wave from Tsunami, many small islands of the Indian oceans have been demolished. Many Tribal populations have also been abolished in those islands. The badly affected groups due to that disaster were children and women and, lots of people were mentally disabled. Geologists and marine scientists said, the magnitude of the Tsunami was so high that even the earth itself was shaken while spinning in its own axis. In addition, due to the earthquake, huge amount of radiation emitted was as powerful as 9.5 thousand million bombs. Due to cracking at the bottom of the sea, the map of direction in Indian Ocean has been disrupted. According to expert opinion, a new map for water ways in Indian Ocean should be designed, otherwise, it may cause trouble in shipping.

Bangladesh was not affected much by the Tsunami hit on 26 December, 2004, because the centre of the earthquake that caused the Tsunami was far away from Bangladesh sea-coast. The centre was Sumatra Island of Indonesia, situated in the west side of the Indian Ocean. That is why the damage in Bangladesh was negligible compared to other Asian countries.

It was heard that two fishermen died due to a trawler capsize at Kuakata coastal line. Bangladesh was attacked by a Tsunami on 2nd April, 1762 due to an Earthquake originated at Arakan area in the Bay of Bengal. A huge damage occurred in Cox's Bazar and surrounding islands. Due to the Tsunami effect, the water level in the Buriganga raised abruptly and waves created from that capsized many boats and many people died by that accident.

9.3.5 Acid Rain

Generally rain water is slightly acidic. If it contains large amount of acids, then it is called Acid Rain. Do you know which acids are present in acid rain? In acid rain, sulphuric acid and nitric acid are present in higher proportion whereas hydrochloric acid is present in smaller quantity. Acid rain is very hazardous for

environment. There are many plant species which are very sensitive to acids and they may die due to acid rain. Moreover, some important plant nutrients such as Calcium, Magnesium getting dissolved in rain water are removed from soil. As a result, crop production is hampered. Because of acid rain, aquatic plants and animals are severely affected. You know that pH of water goes below 7 if acid is present in it. If pH of water becomes less than 5, most of the fish eggs are sterilized hampering fish production. Newly hatched fish or fries are vulnerable to acids. High concentration of acid even can destroy the biodiversity totally. Acid rain is also harmful to human health. It causes heart disease, lung disease, asthma and bronchitis in human body.

Why does acid rain take place? Both natural events and human activities are responsible for causing acid rain. Among the natural events, volcanic eruption, forest fire, thundering, natural decay of plants etc. are responsible for formation of acid rain. In all these processes among others, nitrogen oxides and sulphur oxides are released and, later on by chemical reaction with oxygen and water, they are converted into corresponding acids (nitric acid and sulphuric acid). On the other hand, among the man-made activities, industrial operation, particularly in coal burning power plants, brick kilns (Fig: 9.08) or other fossil fuel burning industries, vehicles, domestic oven etc. release sulphur dioxide and nitrogen oxide which are also converted into acids in the same way as explained before and finally mix with rain water and form acid rain. What can we do to control acid rain? As fossil fuel burning power plants are the dominant sources for releasing gases that form acids, sulphur and nitrogen must be removed from fuels before burning. In many developed countries, it is already in practice. If there is no arrangement for purification,

Fig. 9.08 : Brick-fields

alternative fuels instead of coal can be used. Due to acid rain, soil pH goes down, in that case, pH can be adjusted by using limestone. To control emission of gases causing acid rain, appropriate and stricter regulatory measures must be taken. In industry, pollution control devices must be installed. In our country, acid rain does not occur frequently, whereas in industrially developed countries, acid rain is very common. Acid rain frequently occurs in many East European countries, the USA, Canada, South coast of China and Taiwan.

9.3.6 Earthquake

When a vibration created inside the earth abruptly shakes the earth surface, it is called earthquake. An earthquake persists from few seconds to about a minute and may recur repeatedly. Mild earthquakes in most of the times are not felt, whereas severe or strong earthquakes can easily be felt.

Fig. 9.09 : A damaged building due to earthquake

Is earthquake a natural disaster? Yes, it is of course a violent natural disaster which can completely destroy a a country or a region within seconds (Fig : 9.09). Even it can divert the course of rivers. Owing to earthquake, Brahmaputra, one of our main rivers, has changed its course. Although violent earthquakes did not rock our country so far, experts believe that Bangladesh is in the greatest risk of earthquake. In the world, Japan and California of America are identified

as earthquake-prone area. You must have heard about the disasters resulting from Haiti earthquake in 2010, Japan earthquake in 2011 and Nepal earthquake in 2015. Tsunami after earthquake in Japan resulted in a nuclear accident in nuclear power plant.

Now the question is how does earthquake take place? Our earth's crust is divided into some layers which are called tectonic plates. These tectonic plates are not static, they are dynamic. Energy accumulates when a moving plate puts stress on another plate. Suddenly, when the plates slide, the stored energy is released and earthquake is created. The magnitude of earthquake is measured in Richter scale. We can feel the earthquake which is more than magnitude 5.0 in Richter scale. The increase of 1.0 magnitude in Richter scale means the rise of intensity by thirty times. The larger an earthquake is, the farther it can be felt from.

Figure 9.10 shows the earthquakes that occurred in and around Bangladesh. You can certainly see in the picture that lately no major earthquake has occurred in Bangladesh, but the earthquakes in the surrounding areas were felt. In 1884, a major earthquake of magnitude 7.0 occurred in Manikgonj. In 1897, a major earthquake of magnitude 8.7 occurred in Shillong. Since major earthquakes occurred in the past in this region, we must presume that this type of earthquake may occur in future as well. As we cannot predict when it will occur, we must always be ready for that.

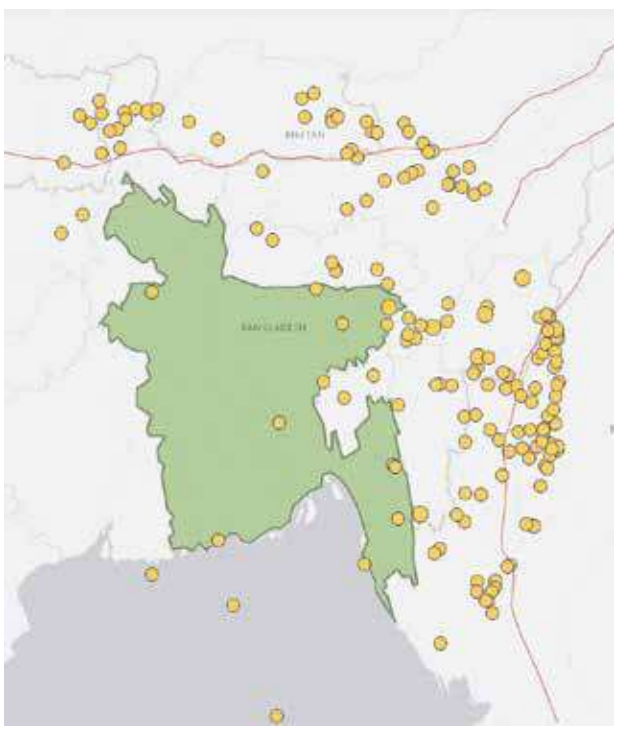


Fig. 9.10 : The earthquakes that occurred greater then 5 magnitude in and around Bangladesh from 1971 to present

What are the remedies of earthquake? Is there any way to protect us from earthquake? There is no way to escape from earthquake but proper precautions can minimize the loss of life and property. The most important thing is building houses and other infrastructures following building code. The high-rise buildings that are built in the urban areas of our country must have earthquake protective measures. Otherwise, any massive earthquake may cause catastrophic damage. In 2010, magnitude 7.0 earthquake in Haiti killed 300,000 people. But only six people died in magnitude 8.2 earthquake in Chile in 2014 that was more than thirty times stronger than this one. It was because the earthquake-prone Chile had started to build earthquake resistant buildings. Besides, in the event of an earthquake, quick relief supply and rescue operation, combining government and other organizations, must be ensured on emergency basis and for that prior preparation must be taken. There are several issues which should be taken seriously.

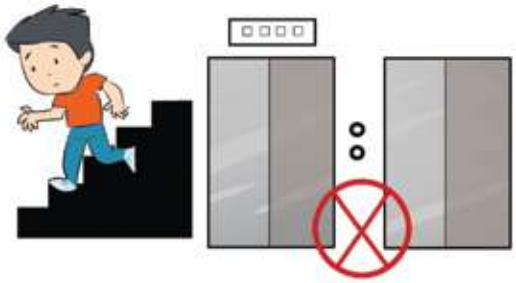
What to Do Before an Earthquake:

1. If possible, all houses should have fire extinguishing facilities. Along with this, first aid kit, battery-powered radio, torch light and some extra battery, dry food and water should be arranged.
2. Learning how to provide first aid.
3. Learning how to turn off gas, electricity and water supply in the house.
4. Making up a plan of where to meet your family after an earthquake.
5. Heavy things should not be kept on high shelves, during an earthquake they can fall down causing injury to people.
6. Learning earthquake plans through drilling in schools, colleges or workplaces.

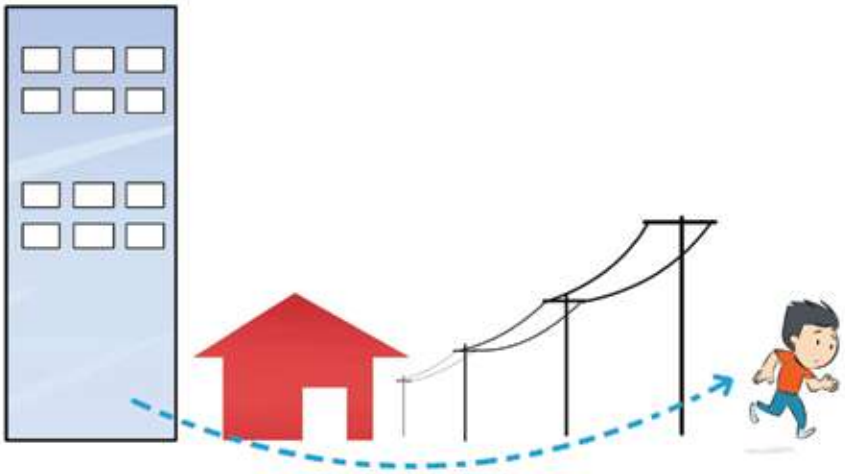
Take shelter under a hard table

Or, go to the corner of the room so that if anything falldown that cannot directly hit you

If you are outside then do not get or nervous and keep head cool



It is safe to use stair for climb down



Get away from electric poles or high buildings

Fig. 9.11 : What to do during an earthquake

What to Do During an Earthquake:

1. During an earthquake, we should not get terrified or nervous. We should convince ourselves that people of the world live with earthquake from birth and we can save ourselves from danger of a massive earthquake keeping our head cool.
2. If you're indoors, stay inside. Don't try to go out hurriedly. Stand by the wall. Stay away from glass window. If needed, take shelter under a hard table. Never try to descend by using elevators.
3. If you're outside, stay outside. Don't try to enter into the house. Get away from electric poles or high buildings, anything from above may fall on the head.
4. Never use matches, Gas from broken gas pipe may cause dangerous fire.

What to Do After an Earthquake:

1. In the event of a massive earthquake, check yourself and others for injuries. Provide first aid for anyone who needs it. If anyone is critically injured, take that person to hospital. Remember if really a massive earthquake occurs, numerous people are to be given emergency treatment. So, the person who needs most will be given treatment first.
2. Check water, gas, and electric lines. If damaged, shut off the valves. If you smell gas in the house, open doors and windows and get out of the house.
3. Listen to the radio news. Don't use the phone to spoil the network unless it's an emergency. Let the relief team use telephone for urgent situation. After a massive earthquake, there might be a possibility of telephone disconnection.
4. Stay out of damaged buildings. Don't walk barefooted so that your legs are not cut with broken glass and so on.
5. If you live by the sea-shore, stay away from the sea. A tsunami may hit the coastal area.
6. If you are trapped inside a damaged building, do not try to come out removing debris, rather wait for the rescue team. Save your own energy, try to draw attention of the rescue team by striking something repeatedly.
7. A major earthquake may be followed by after-shocks, be prepared for that.

Group Work

Task : Make poster and leaflet on what to do during earthquakes and distribute in your locality.

Group Work

Task : Arrange a drill on what to do during an earthquake.

9.4 Importance of Standard and Improved Environment

One of the important elements required for living is air. How long we can survive without air or Oxygen? Only about 40-50 seconds. If such an important element is polluted by various types of chemicals (such as CO, SO_2, SO_3, NO_2) and very fine dust particles or liquid droplets etc. ultimately we shall be affected because the pollutants enter into human body when we breathe air. They can cause different types of deadly diseases such as lung cancer, heart attack etc. In addition, those toxic chemicals could also be harmful to plants, soil or other animals. Like air, water is another essential element for our survival. If the natural water in rivers or other waterbodies is polluted, the aquatic flora and fauna including fish will be in great risk and, as a result, the balance of the environment will be disturbed. Like air and water, all the elements of the environment are essential for our living. Therefore, if the quality environment is not maintained and improved, it will be a potential threat for all biodiversities and our existence will be abolished. So, we have to be careful and also have to make people aware in this regard.

9.4.1 Significance of Conservation of Nature

Conservation of nature is to protect the nature and natural resources. Our very important natural resources are water, air, soil, minerals, plants, animals, oil, gas etc. All these resources are very important for us. It is true that if there is no supply of air and water or if they are destroyed, we cannot survive. At the same, it is also true that it is impossible to survive without oil, gas, plants etc.

There was possibility of that long time ago, there were natural environment and resources in the moon. However, due to lack of conservation, everything has been destroyed. Therefore, ifwe do not take appropriate measures, ifwe do not stop damaging plants, forest resources, ifwe do not stop polluting air, water, soil etc. then our nature and environment will no longer be habitable and therefore our existence will be at stake.

9.4.2 Strategies for Conservation of Nature

There are several strategies for conservation of nature which are described below:

1. Reduction in the Use of Resources:

We can conserve our resources by avoiding unnecessary use. For example, when buy anything from a shop, the shopkeeper gives a new packet. If we use the same packet repeatedly, then we can lessen the use of resources. Nowadays, we use or misuse tissue paper or napkin. If we are a little careful, we can reduce their uses. Now find out yourselves how we can conserve nature by reducing the use of resources in which activities

.

Once paper was used in all official activities. Now most of the works are done by using computer. So, the use of paper has been reduced. Many offices and educational institutions have launched a program named ‘’paperless office” to stop the use of paper entirely. Paper is made from trees. The reduction in the use of paper means cutting less number of trees. In this way forest resources will the saved i.e. nature will be conserved.

2. Protection of our Resources from Pollution

Pollution of resources makes them unsuitable for use. The best example in this regard is pollution of river water. You may have known about the pollution of water of the River Buriganga. The pollution there is so severe that aquatic fauna including fish can rarely be found. Like the Buriganga, many rivers in Bangladesh have been polluted and if steps are not taken immediately to prevent it, the rivers will be devoid of fish in near future. Because of uncontrolled mills and factories, vehicle smoke and so on, air has been severely polluted in many cities of Bangladesh. Eight cities of Bangladesh are included in the list of 100 cities of the world which are remarkable for air pollution.

3. Reuse of Resources if Possible

Nature can be conserved by reusing our resources if possible. Nowadays, a lot of paper is used in computer printer or photocopier. If you pay a little attention, you will see that only one side of the paper is used there. If we are a little careful, we can use other side of paper for various purposes. Polythene that is used for banner or billboard is of good quality, collecting those, we can make bags or use them for other purposes. Everyday we throw away many plastic bottles. Those can be easily recycled or reused. Many of the things we use come from nature directly and some others coming from industrial manufacturing and they also depend on nature indirectly at some stages. Therefore, reusing of material results in less pressure on natural resources and that is how nature is conserved.

4. Recycling of Used Materials

Instead of discarding old items, we can manufacture new items from those and nature can be conserved. In our culture, we have been doing it long since, kantha is an example of it. Old cloth or sharee, instead of throwing away, was used to make kantha. Similarly waste paper can be used to make paper containers, organic manure can be prepared from domestic rubbish, old radials can be recycled to manufacture sandals.

5. Protection of Natural Resources

The best way to conserve nature is to protect it completely or to do no interference there. You may know that groups of bad people of our society hunt deer, tiger etc. or cut trees from the Sundarbans. Catching migratory birds and selling them in the market, polluting sea water by establishing uncontrolled and unplanned ship-breaking industry—to stop these activities is called conservation of nature. Stopping these kinds of activities is a kind of conservation of nature. Like the Sunderbans, many natural resources of our country are getting extinct to a great extent and it has become mandatory for us to stop this.

Group Work

Activity: Identify the locations around your school where environmental pollution takes place. Write a report and send it to the authority concerned to stop pollution. Finding out the barrier/limitation to have a standard and improved environment and remedies.

Group Work

Make a group of 4-5 of your classmates. Find out the environmental problems in your area. Consider water pollution, improper management of solid waste, excretion in open place in this connection. Make poster or leaflet on the harmful aspects of these issues and distribute that among the people. Take help form senior people, school, college or university teachers, government officials, non-government officials and environmentalists.

Exercise

Multiple Choice Questions

1. Which occurs only in oceans?

a. Tornado b. Earthquake
c. Tsunami d. Flood

2. Cause of increasing Green House Gases-

i. Vehicles
ii. Industries
iii. Power Plants

Which is correct?

a. i and ii b. ii and iii
c. i and iii d. i, ii and iii

See the picture given below and answer questions 3 and 4.

3. Which gas is not released from the industry shown above?

a. SO_2 b. CO_2
c. NH_3 d. NO_2

4. Which disease is caused in human body due to the formation of acid rain from the gases released from the industry shown above?

a. Diabetes b. Asthma
c. Cancer d. Heart Attack

Creative Questions

1. Mr. Naoshad lives in Barguna. He is 70 years old. In Sidr attack in 2007, all his family members died. All his assets including his home were destroyed. Volunteers after receiving forecast asked him to go to cyclone shelter which is few miles away from his house, but he refused to go. On the other hand, Mr. Saad went to cyclone shelter and although his assets were destroyed, all his family members survived. Helpless old man Mr. Naoshad now regrets that why he did not go to cyclone shelter with Mr. Saad.
   a. What is cyclone?
   b. Explain the term "Global warming".
   c. Explain how the cyclone mentioned above is created.
   d. What steps Mr. Naoshad could take to protect him from the cyclone? Analyze.

2. After finishing her study, Tuli went to bed at 12 midnight. Suddenly she observed that her bed and ceiling fan were vibrating and the smaller things kept on shelves were falling down. In the next morning, Tuli noticed that some old buildings in surrounding area have been cracked, some have been broken,whereas some others have been inclined. Tuli realized that there was a natural disaster last night.
   a. What is earthquake?
   b. Explain why Bangladesh is a cyclone prone area?
   c. Explain how the natural disaster observed by Tuli is created?
   d. What steps can be taken to protect us from the natural hazards mentioned above? Analyze.

Chapter Ten

Let Us Know Force

We are pulling or pushing something every moment. To change the state of motion of an object we pull or push, that is, we apply force. An object at the state of rest can be brought in the state of motion. Again, an object in motion can be changed the direction and magnitude of motion even its motion can be stopped by applying force. We will discuss in this chapter inertia, force, the effect of force on a body at rest or in motion, Newton's first law of motion, nature of force, measurement of force, Newton's second law of motion, action-reaction of forces and Newton's third law of motion.

At the end of this chapter, we will be able to-

- explain the characteristic concept of the force and inertia of a body on the basis of Newton's first law of motion;
- explain practical experience of inertia;
- explain the nature of different kinds of forces;
- describe the advantage of friction in our practical life;
- explain the influence of force on a body at rest or in motion;
- measure force using Newton's second law of motion;
- measure force with the help of an easy experiment;
- explain several popular occurrences on the basis of Newton's third law of motion;
- understand the necessity of force in our life.

10.1 Push and Pull: Force

If we want to move anything away, we push it. On the contrary, if we want to bring anything near, we pull it. This push or pull on a body by another is the force. Whenever we push or pull, lift or lower anything, we actually apply force. When we twist or tear, expand or compress anything, we also have to apply force. However, in this chapter, we shall discuss only change of motion with force. We all have noticed that if force is applied on an object at rest, it starts to move, while an object at motion can be stopped if force is applied on it. It means that motion of an object can be changed by applying force. Scientist Newton published three laws creating relation among force, mass, inertia and motion. These three laws are known as Newton's laws of motion. From Newton's first law of motion, we get the concept of inertia and force of an object. In this context, Newton's first law of motion is:

> An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an external force.

No one has any problem regarding the first part of Newton's first law because we always see that any static object does not move unless force is applied on it. There is a problem regarding the 2nd part because we never see any moving object at motion perpetually. If we make an object move by pushing it, we see that the object stops moving even if we do not apply any force. From our day-to-day experience, it seems that if anything is to be kept on moving in uniform motion, force is to be applied on it continuously. From Newton's first law of motion, we have come to know that it is not true. If any object, moving with uniform motion, stops, we must understand that force has been applied there in any way or other. Friction, wind hindrance and many other such things stop an object applying force from the opposite direction. If actually all forces could be stopped, we would see that an object moving in uniform motion was moving perpetually.

10.1.1 Inertia

From our day-to-day experiences, we see that every object tries to maintain its present state. If an object is at rest, it tends to be at rest, and if it is in motion, it tends to be in motion. Until force is applied, the tendency of an object to remain in its present state is called inertia. The tendency of an object at rest to remain at rest is called inertia of rest and the tendency of an object in motion to continue its uniform motion is called inertia of motion.

Practical Experience of Inertia

When a stopped bus suddenly starts moving, the passengers of the bus lean backward due to inertia. When a bus is parked, the bodies of the passenger also remain at rest. But when the bus suddenly starts to move, the part of the passengers' body attached to the bus starts moving but the upper part tries to remain at rest for inertia, and so, the passengers lean backward.

Just the opposite thing happens at the time of getting down from a running bus. When the leg touches the soil keeping the whole body in the state of motion, the lower part of the body becomes static but the upper part remains in motion and the passenger stumbles.

Individual Work

Task: Put a card, board or hard paper on a glass and then put a coin on that (Fig : 10.01). Suddenly tap the card hard. What have you seen?

Why has the coin dropped into the glass? For sudden strike, the card was displaced but due to inertia, the coin has tended to retain its own static state and dropped down into the glass.

Fig.10.01: Experiment of inertia

When a car is driven, all the passenger of the car have to put on seat-belt to escape from the danger of inertia of motion. If a driver without seat-belt brakes the running car or falls in an accident, he will be leaning forward and struck by the steering or the wind-screen due to inertia (Fig : 10.02). The second part of the figure shows that the seat belt is saving the driver from being stricken by the windscreen.

Fig.10.02: Example of inertia of motion

We feel the impact of inertia in the case of changing the direction of motion of a body. If a bus or car suddenly takes turn, the passengers lean towards the opposite direction. The reason for this is that the passengers were in motion with the motion of the bus or the car. Though the bus or the car has suddenly changed direction, the passengers due to inertia want to remain in motion maintaining the main direction, and so, they retire to another direction in respect of the bus.

10.2 Amount of Force and Newton's Second Law of Motion

From Newton's first law of motion, we have come to know that, to change the state of an object, i.e. to change an object at rest into an object in motion or to change the velocity of an object in motion, force is to be applied. This force is to be applied due to inertia of the object. The more the inertia of an object is, the more force is to be applied on that object to change its state. The amount of inertia is mass. Therefore, the more the mass of an object is, the more force is to be applied on that object to change its velocity.

Newton's second law of motion explains how much force is to be applied on an object of a certain mass and how much change there will be in consequence. However, before knowing Newton's second law of motion, we have to know about two terms. One is momentum and the other is acceleration.

Momentum: Momentum is the product of mass and velocity. That means if mass is m and velocity is v, then the momentum p of the object is:

$$p = mv$$

If the mass is not changed, then the change of momentum is the product of mass and change of velocity.

That means, if the velocity of an object having mass *m* increases from *u* to *v*, the change of momentum is *m(v-u)*.

Acceleration: Acceleration is the change of velocity over time. That means if the velocity of an object changes from *u* to *v* over a period of time *t*, then acceleration *a* is:

$$a = \frac{(v-u)}{t}$$

If we have understood momentum and acceleration, then it is very easy to understand Newton's second law.

Newton's second law is that the rate of change of momentum of a body is proportional to the force applied. But force is defined in such a way that we can say equal instead of proportional. That means if the momentum of an object changes from *mu* to *mv*, over a period of time t, then the change of rate is *ma = m (v-u)/t*. The applied force will be equal to *F*. It means--

$$F = \frac{m(v-u)}{t} = ma$$

The unit of force is Newton. 1 Newton (N) is the force required to accelerate an object with a mass of 1 kilogram at the rate of 1 metre/second^2.

Example

The mass of an object is 20 kg. For applying a force, it produced an acceleration of 2 m/s^2. What was the value of the force?

Solution: We know, F = ma
= 20 kg×2 ms^2
= 40 kg-ms^2
= 40 Newton

Here,
Mass of the object, m = 20 kg
Acceleration, a = 2 ms^2
Force, F=?

Answer: 40 Newton

10.3 Action and Reaction Force

If you blow against a wall with your fist, you must feel pain in your hand. Through the blow, you have applied force on the wall. If the wall could feel, it also would suffer pain but why you have felt pain. You must have guessed the reasons for it. When you have applied force on the wall with your fist, the wall has also applied an opposite force on your fist. It is always true that wherever you apply a force on an object, it applies an opposite force.

Individual Work

Task: Take a rubber band in your hand and see how long it is. Now, tie a small book to the rubber band with a thread. You will see that the rubber band has extended to hang the book.

Gravitational force acts on every object, directed toward the center of the Earth, which means it acts downward for objects located on the Earth's surface. The gravitational force on the book pulls it downward If force is applied on an object, it gets in motion but the book is not in motion; it is at rest. It is because, from above the rubber band, by getting extended, has neutralized the weight force.

Thus, we can say that the book is pulling the rubber band downward (so, the rubber band has got extended) and the rubber band is pulling the book upward (so, the book is in static position instead of falling down).

From above examples, we see whenever and wherever we apply any force, another force is created from the opposite direction. If one force is called action (force), the other is called reaction (force).

Isaac Newton in his third law of motion has said: To every action force there is an equal and opposite reaction force.

Action-reaction force always acts on two different objects - never acts on the same object. That means if object A applies force on object B, then object B will apply equal force on object A from the opposite direction. The reaction force will act so long as the action force remains active. If action ceases, reaction will also cease.

These two action and reaction forces do not depend on whether the objects are in equilibrium or in motion or in contact with each other or not, that means an actionis always followed by a reaction.

Some Examples of Action-reaction

The easiest way to understand Newton's third law is to understand how we walk. We all can walk; everyone walks without knowing what physics is behind it. But as you have started learning physics, you may be asked an easy question. As you can walk from static state, so you actually have acceleration which means force is being applied on you. But we all know that nobody applies force on us. We walk ourselves. How is it possible?

If we did not know Newton's third law, we could never explain the matter of walking. When we walk, we push the ground with our feet (i.e. we apply force). Then the ground, according to Newton's third law, applies equal and opposite force on our body (Fig: 10.03). This equal and opposite force produces our acceleration, we walk! In the same way, when the boatman pushes the river-bed soil with his bamboo stick, soil also pushes back with the equal and opposite force, so the boat moves forward (Fig:10.04)

Fig. 10.03 : At the time of walking, when a man pushes the ground with feet, ground also pushes him equally.

Fig. 10.04 : Boatman pushing boat with bamboo stick.

Those, who find problems to understand the matter, can be reminded that it is easy to walk on hard soil but it is not easy to walk on dry sand, because force cannot be applied on sand, it skids -so, the opposite force of Newton's third law is not found properly. The matter can be made much clearer if one is asked to walk on a very rough floor making it slippery with soap water or oil. There friction is very low, so we will not be able to apply force at all and we shall get no force on us as a reaction of it. Therefore, we will not be able to walk (If you do not believe, you may try). If force is applied, opposite and equal force can be gotten. If we cannot apply force, how shall we get opposite force? How shall we walk? Stand on a weight machine. There you will see your weight which is the force you applied on the weight machine. Now, if you want to climb up, then certainly force has to be applied on you from below. Where will this force come from?

Individual Work

Try to jump standing on the weight machine. You will see that for a moment the indicator of the weight machine moves forward and shows more weight. As a reaction the extra force you have applied, the weight machine has applied the force upward upon you. Because of that reaction force, you have been able to go up.

Individual Work

Task: Taking a balloon, blow it up gently. Hold the opening of the balloon with your hand tightly. Then suddenly release the balloon from your hand (Fig : 10.05). What have you seen? You will see that the balloon is flying about. When the balloon was blown up, the balloon rubber getting extended has put pressure on the air inside. When you have released the opening of the balloon, it started to release air forcefully applying force on the air inside. When the balloon started to apply force on the air, the air also started to apply force on the balloon. As a result, the balloon started to move to the opposite direction of the outgoing air.

Fig.10.05: The balloon moving forward releasing air from the back

10.4 Nature of Force

10.4.1 Four Fundamental Forces

If you are asked how many kinds of forces there are in the world, you will certainly say that there are many. If we push anything, it is a force; when a truck drags a load, that is a force; when a tree is uprooted in storm, that is a force; when a magnet attracts iron, that is a force, when houses are blown off in bomb explosion, that is a force; when a crane lifts anything, that is a force. If you are given a little time, you will be able to make a list of many kinds of forces like these.

But do you know what the amazing fact is? There are only four types of forces in nature, if forces listed above are analyzed, it will be seen that no force is out of these four types. Actually fundamental forces are only four in number. These are gravitational force, electromagnetic force, weak nuclear force and strong nuclear force.

Gravitational force

In this cosmic universe, all objects due to mass attract every other object by a force which is called gravitation. Because of this gravitation, stars in the galaxies rotate or the earth moves round the sun; the moon moves round the earth. When the gravitation of earth works on us, we call it gravity. This gravity pulls us downwards (towards to the centre of the earth) and due to this, we have the feeling of weight.

In physics, gravity is one of the amazing forces. Any object having mass attracts other objects by this force.

Electromagnetic Force

Combing hair with a comb and then attracting paper pieces with that or attraction and distractions of one magnet with another were sometimes done by many of us. Though the forces of electricity and magnet seem to be separate, actually these two are same, they are only seen separately. Electromagnetic force is much stronger than gravitational force (1036 times or trillion trillion trillion times stronger). You will certainly be able to guess that the statement is true because when you pull paper pieces by attracting with the comb after combing your hair, the whole earth with all its gravity produced by the mass tries to pull it. But a little electricity of your comb defeats the whole gravity of this enormous earth.

Weak Nuclear Force

It is considered weak because weak nuclear force is weaker (about trillion times) than electromagnetic force but it is not as weak as gravitational force at all. Gravitational force and electromagnetic force can work from any distance but this force works within a short distance (10-18 m). This weak nuclear force is the cause of the beta (β) ray or electron that is emitted by radioactive nucleus.

Strong Nuclear Force

It is the strongest force in the cosmic universe. It is 100 times stronger than electromagnetic force but it also works within a short distance (10^{-15} m). This very strong force works on proton and neutron in the nucleus which stays at the centre of an atom and keeps them together. As they cling together with strong force, much energy is stored in it. So, dividing big nucleus or joining small nucleus, due to this force, much energy can be produced. For this reason, nuclear bomb is so powerful. This force is a product of light and heat obtained from the sun.

Scientists believe that the origin of these four forces is same and they are trying to explain them with a single formula. It has already been possible to explain electromagnetic and weak nuclear force with the same formula and it is an epoch-making success of theoretical physics. So, if you wish you can say that there are three types of forces: gravitation, electro-weak and nuclear force. (No one can find fault with it.) Scientists are working to unify all of the fundamental forces.

10.5 Frictional force

Let us consider a wooden piece on a table and we are trying to create acceleration by applying force on it. As shown in figure 10.06, we are applying force F on the mass from left to right. It will be seen that due to the friction of the wooden piece with the table, a frictional force f is developed in the wooden piece and this is lowering the applied force acting from right to left.

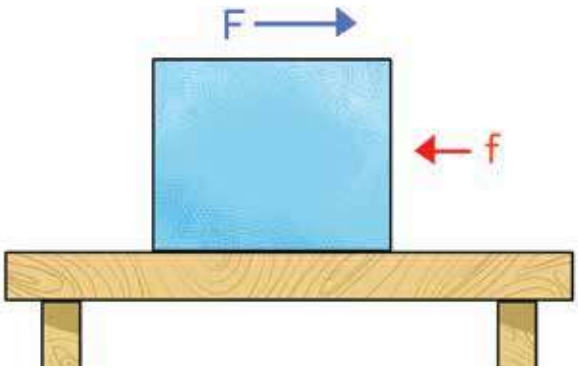


Fig. 10.06: Applying force on a mass, a opposite frictional force

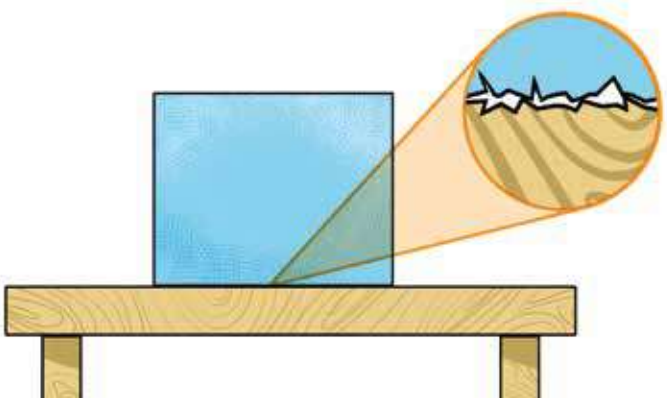


Fig. 10.07: Fricfion takes place because of two rough surfaces.

If some weight is put on the wooden piece it will be seen that the frictional force has increased also, though the weight and the force of friction is normal to each other. If we can understand how friction force is created, we will see that there is nothing to wonder in it. Though apparently wood, table seem to be very plain surfaces, through microscopes, it will be seen that all surfaces are uneven. When these rough surfaces come in touch with one another or the wrinkles fit together, speed is slowed down. Then we say that friction force has been created from the opposite direction. If the two surfaces are more pressurized, the uneven parts of both the surfaces will come in touch more closely. Thus, the wrinkles of one surface will get trapped in the wrinkles of the other one more deeply and the friction force will increase.

Due to friction heat is generated. It is a problem in most cases. When a piston in a cylinder moves back and forth in a car, due to friction heat is generated there and to control this heat, the engine of the car is to be cooled. So, many steps are taken to reduce friction there.

10.5.1 Types of Friction

Friction is divided into four types. These are, static friction, kinetic friction, rolling friction and fluid friction.

Static Friction: The frictional force that develops when two objects are at rest relative to each other is called static friction. Due to static friction we can walk, our legs or shoe sole is bounded to the ground and we don't slide.

Kinetic Friction: The frictional force that creates when an object is in motion relative to another object is called kinetic friction. When anyone grips the brake of a cycle, it presses the wheel and ceases the motion of rotating wheel due to kinetic friction. The kinetic friction depends on the weight of the moving body, the more the weight, the more the kinetic friction. Kinetic friction depends on the force applied perpendicular to the surface of the object. The greater the force applied perpendicular to the surface of the object, the greater the frictional force acting on the object.

Rolling friction: When an object moves by rolling or revolving on a surface, then the friction that develops is called rolling friction. Among the all frictional forces, this is less, so we attach wheel in all kind of vehicles. It is very easy to pull suitcases attached with wheels, if suitcases had no wheels, it would become very difficult for us to pull it on the floor.

Fluid Friction: The frictional force that is experienced by an object when it moves in a liquid or gaseous substance is called fluid friction. When anyone jumps from a plane with a parachute then due to the fluid friction of air he comes down slowly (Fig : 10.08).

Fig. 10.08: Uses of parachute, apollo 15 is landing on the sea

Individual Work

Fluid friction

Task : Release a paper from a certain height and guess the time required to reach the ground. Now shape the paper like a small ball and release. What is the time required now to reach the ground?

Individual Work

Static friction and Kinetic friction

Task : Take several blank boxes of matches. Fill up the boxes with soil and make them slightly heavier. Now put a match box on a book and increase the inclination of the book gradually. Due to the static friction the match will not slide on first. When the book becomes inclined, then along the sloping a force works. At the instant when this force equals the kinetic frictional force, then the match box will start sliding. You will see that

only for a particular angle of inclination the match will start moving. Putting one or more match boxes over the first one repeat the experiment; you will see that every time for a particular angle the match box will start moving.

We have already discussed that the frictional force always acts opposite to the applied force. Therefore, naturally the frictional force slows down the motion and it may be our assumption that perhaps we always try to reduce the friction. But that is not true. Sometimes you may have seen that a car or a truck is confined in mud. Though the wheel of the car rotates but due to less friction, the car or truck cannot come outside from the mud. The wheel slides. Then to rescue the car or truck, the friction between the wheel and the mud is tried to increase in an alternate way.

10.5.2 Increase and Decrease of Friction

We have already known that for our necessity sometimes friction has to be increased and sometimes it has to be decreased.

Reducing Friction

The measures we take to reduce friction are:

1. Smoothing the surface as much as possible where friction takes place. In smooth surface kinetic friction is less.

2. Oil, mobil or grease like substance is called greasy materials or lubricants. The friction is reduced to a great extent if lubricant is used in between the two surfaces.

3. Using wheel, friction can be reduced. If wheel is used we can do work by very small rolling friction instead of large kinetic friction. It is possible to reduce friction to a great extent by using ball bearings in the rotating wheel using the rolling friction of the small steel balls instead of the direct friction.

4. The design of the fast moving vehicles like car, plane is done in such a way that the wind can flow over the streamline surface without making any friction.

5. The surfaces where friction occurs touch one another in a very small region then friction can be reduced.

6. We have seen that if force is applied on the two frictional surfaces, friction increases. Therefore, if vertically applied force is reduced friction can be reduced.

Increasing Friction

If the procedures that are taken to reduce friction are not done or if the opposite steps are taken then friction will increase. Therefore the necessary steps we take to increase the friction are:

1. Making the two surfaces uneven or rough where friction takes place.

2. Pressing the two surfaces more tightly where friction takes place.

3. Making the surfaces stationary by stopping the motion which is present in the two frictional surfaces. Because the maximum static friction is more than the kinetic friction.

4. Making grooves or waving on the frictional surfaces. Then it can grip the bottom tightly. If there is water or liquid, it enters the groove thus increasing the friction of the surface.

5. To increase the density of air or water.

6. To increase the frictional area in air or water.

7. To remove wheel or ball bearing

10.5.3 Friction: A Necessary Evil

All of us certainly noticed that heat is generated due to friction. In winter, we create heat by rubbing our hands. The engine of a car becomes hot, that happens due to friction. Therefore, energy is dissipated by creating unnecessary heat due to friction. Car, plane, ship, submarine have to go forward by overcoming the frictional force, there also extra fuel has to be spent. If we treat this in this way, it may seem to us that friction is nothing but an evil in our life.

Meanwhile, we have seen that due to friction we can walk, drive car in the road, write on paper with pencil or pen, build a building, come down safely with the help of parachute. We can give many examples where without friction we could not do our necessary works.

Therefore, though friction is treated as an evil, we have to acknowledge that friction is a very necessary evil for our lives.

Exercise

Multiple Choice Questions

1. A fruit falls on the ground from a tree. Example of which type of force is it?

a. gravitational force b. magnetic force
c. electromagnetic force d. weak nuclear force

2. Force-

1. keeps the direction of motion of an object unchanged.
2. changes the shape of an object.
3. brings a body at rest to motion.

Which one of below is correct?
a. i and ii b. i and iii
c. ii and iii d. ii and iii

By reading the following article answer question no. 3 and 4.

An object is thrown on the floor with an acceleration of $4 m/s^2$ by apply ing a force of 2 N. After traversing a distance the body stopped moving.

3. What is the mass of the object?

a. 200 gm b. 400 gm
c. 500 gm d. 750 gm

4. For which cause of force the body ceases to act ?

a. frictional force b. gravitational force
c. magnetic force d. electromagnetic force

Creative Questions

1. Swapna was going to Dhaka from Kushtia. The mass of the bus was 1400 kg and it was moving with an acceleration of 4m/s². When the driver applied brake on moving bus, the passengers along with Swapna were leaning forward. Again, when the bus started to move, then they were bended backward.
   a. What is inertia?
   b. What is meant by force?
   c. Calculate the amount of force acting on the bus.
   d. Analyse the cause of the passengers leaning forward at first and next time the cause of bending backward.

2. Turjo investigates about the various incidents in his daily life. One day, in his house sitting on a chair in front of a heavy table, he began to pull the table. But he himself along with the chair moved towards the table. Next day he rolled on a marble on the smooth floor of his room with a fixed amount of force. Next time he rolled on the same marble with the same force on the pucca road outside his house.
   a. What is Newton's second law of motion?
   b. What is meant by inertia?
   c. Why did Turjo along with his chair move towards the table? Explain.
   d. Analyse the cause of traversing different distance by the marble on two different surfaces.

Chapter Eleven

Electricity in Daily Life

Among the various forms of energy, electric power is one of the mostly needed one because it illuminates our houses, rotates fans and operates radio, freeze, TV or computer. Electricity is used to cook food. Hence, for better understanding of its uses, we are to realize some general functions of electricity. This basic conception will help us ensure the proper use of electricity, prevent the misuse of electricity and raise public awareness of the proper utilization of electricity.

After the lessons of this chapter we will be able to -

- express the electrical components and instruments (accessories) by symbols;
- explain the functions of battery;
- design the electric circuits to use in residential houses;
- explain the effects of electrolysis and electroplating in our daily life;
- describe the importance of electrolysis and electroplating in our daily life;
- explain kilowatt and kilowatt-hour;
- calculate electrical power;
- explain the advantage of energy saving bulb;
- explain the functions and uses of I.P.S and U.P.S;
- explain the system loss and load shedding;
- explain the contribution of electricity to development activities;
- exhibit the use of suitable circuit useful for houses;
- exhibit electrolysis by experiment;
- use electrical components and instruments properly;
- be careful about preventing the misuses of electricity and making others conscious of it.

11.1 Current Electricity

11.1.1 Symbol of Electric Circuit

For the convenience of drawing a figure or designing electric circuits, we use different symbols for each instrument or connection. The symbols of some of these instruments or connections are given in the diagram below:

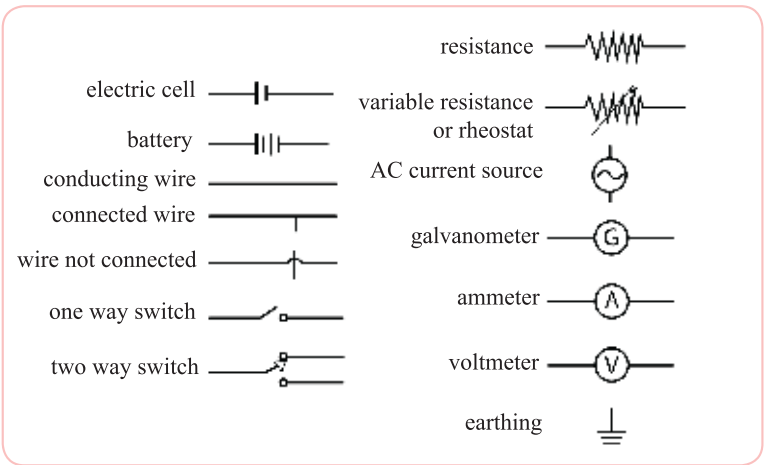


Fig. 11.01: Symbols used in electric circuits

11.1.2 Function of Battery

In our daily life, all of us have used battery cell in torch light or mobile phone. Although in our daily conversation, we use the word 'battery' for an electric cell, scientifically battery is a combination of more than one cells. Though it is mentioned as an electric battery, actually battery is a combination of more than one electric cell. Electric energy is stored in the battery cell. Figure 11.02 shows the construction of a battery. Generally there are three parts of a battery—one anode, one cathode and an electrolyte inside the cell. In the chemical reaction in a battery cell, electrons dissipate in the cathode from anode. As a result, a potential difference between the anode and the cathode appears. In

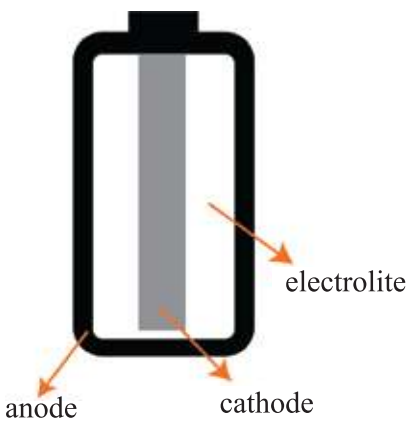


Fig. 11.02: Battery cell

this position, if anode and cathode are connected with a conducting wire, electrons flow from cathode to anode. In the opposite direction of the flow of electron, the flow of electricity begins. We say electric current is flowing from anode to cathode.

When the chemicals in a normal battery cell get exhausted, the flow of electricity stops as it cannot create any potential difference between the anode and the cathode.

The batteries that we use in mobile telephone are recharged when their power of making flow of electricity exhausts. After being recharged, the chemicals in the battery get ready to produce electricity through chemical reaction again.

11.1.3 Electric Circuit

To know about how electricity works, we have to know about electric circuit.

a) Battery Cell in Series: If battery cells are connected in a series (Fig :11.03), that is, the positive terminal of a cell is connected to the negative terminal of its next cell, then potential is added to the battery. It means if we get 1.5 volt from one battery cell, we can get 3 volt from two battery cells and 4.5 volt from three battery cells.

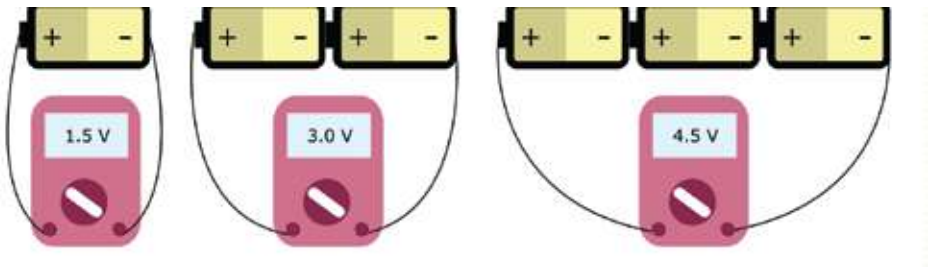


Fig. 11.03: Battery cells in series

b) Battery Cells in Parallel Connection: If some cells are connected in parallel system, that is, all the positive terminals of cells are connected together and all the negative terminals of cells are connected together then the potential does not change but more electricity can be flowed or electricity can be flowed for a longer period of time.

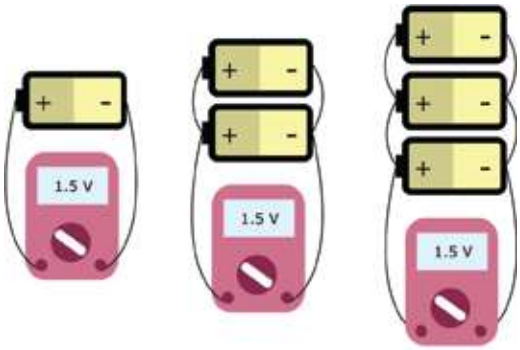


Fig. 11.04: Battery cells in parallel connection

(c) Suppose, we want to illuminate some bulbs with battery. That can be done in two ways—by series circuit or by parallel circuit.

Series Circuit

In a series circuit (Fig :11.05), a bulb will illuminate much brightly but if two or three bulbs are connected, the flow of electricity will decrease proportionately and the bulbs will illuminate less brightly . If a series circuit is connected with single switch, all the bulbs will go out together when the switch is turned off.

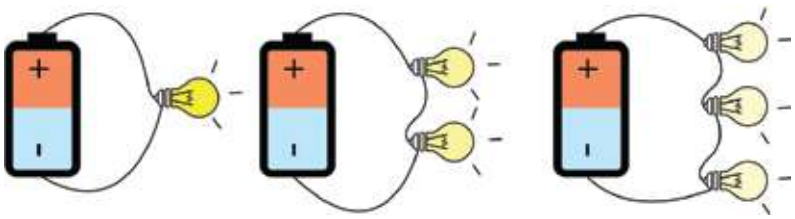


Fig. 11.05: Series circuit

Parallel Circuit

In a parallel circuit (Fig : 11.06), all the bulbs will illuminate with equal brightness as potential difference is applied from both ends of the battery cell. If we desire, separate switch can be used for each bulb which can be switched on and off separately.

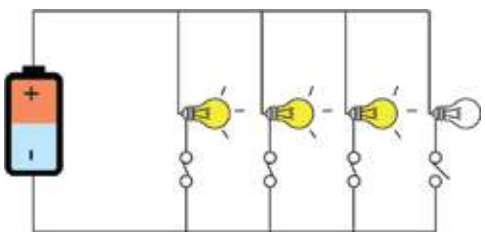


Fig. 11.06: Parallel circuit

As the potential difference of the battery always remains the same, these are called DC supply. The electricity that is supplied in our houses is called AC (Alternating Current) because they change from positive to negative fifty times per second. In a normal battery cell, the potential difference is only 1.5 V. Compared with it, the electric supply in our houses is 220V. It may be mentioned here that if the electric supply is more than 50V, we can feel it and the electric flow of 220V can cause a huge shock. If adequate electricity can flow through the body, even a man can die.

11.1.4 Design of Electric Circuit or House Wiring

There is electric connection in most of our houses. Do you know that a design is to be drawn before giving this connection? The design of an electric supply in the house shown in Fig. 11.07. Series circuit is not suitable for electric connection in the house because all the bulbs will illuminate and all the fans will start moving as soon as the switch is on. Again, all of them will stop operating when the switch is turned off. Above all, in the series circuit, no bulb or fan will get necessary voltage, sharing of electricity will decrease voltage. In fact, parallel circuit system is followed for electric connection in the house.

Now, a detailed figure of house wiring is given below (Fig : 11.07). In this figure, it is shown how, by connecting the main line, other components like fuse, main switch, plug-socket, distribution box and necessary lights or fans are connected.

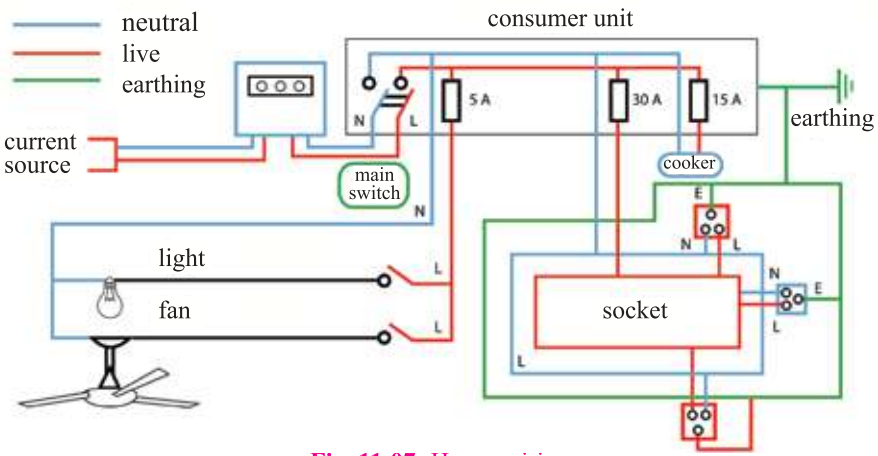


Fig. 11.07: House wiring

For electric supply in the house, between two wires, one is live wire (generally of red colour) and another is neutral (generally of black colour). There is an electric voltage (220 volt) in the live wire. The neutral wire has no electric voltage as it is connected with earth. It ensures the flow of electricity by fulfilling the circuit. The main wire is connected with the meter through the fuse or circuit breaker. The electric energy consumed by the house is recorded in the meter through this connection. Two wires from the meter are connected with the main switch. The flow of electricity in the house can be completely stopped with the help of this switch.

Two wires from the main switch are connected with the distribution box. From there, the two wires are distributed to different branch lines. There is individual fuse for each branch line. In the figure, circuit breakers 5A for light, 10A for fan and 30A for plug-socket have been shown. Each of them has connection with the live wire and for each light and fan, individual switch has been connected.

At the time of electrical wiring in the house, special eye should be kept on wiring so that all the fuses of the bulb or power switches are connected with the live wire. Moreover, all the wires should be covered with PVC or any other insulator.

Lately, concealed wiring (wiring cable connected inside the plaster of the wall) is preferred. Other than this, we must ensure that all types of instruments are connected with the fuse. The use of suitable fuses with the types of instruments like freeze, television etc. must be ensured. Besides, a cable which can bear necessary load is to be used. Otherwise, at the time of the flow of electricity, the wires may be heated and it may cause accident.

11.2 Electrolysis

The process of separating the positive and negative parts of the molecules by passing electricity through a solution is called electrolysis.

The solute of the solution that is separated or analyzed into two parts by passing electricity is called electric solute or electrolyte. We have already seen that if potential difference is created connecting battery cell on both sides of a conductor, the free electrons of the conductor flow and that is called electricity. How will electricity pass through the solution at the time of electrolysis? At the

time of electrolysis, electricity passes in the electrolyte through positive and negative ions. All acids, bases, some neutral salts, acid-mixed water etc. are electric solutes or electrolytes, such as, H_2SO_4, HNO_3, $CuSO_4$, $AgNO_3$, NaOH.

We know that normally the number of electrons of an atom is equal to the number of protons located in the nucleus. But if any atom, molecule or radical, have more or less electrons than the normal number, then it is called ion. If the number of electron is less than its normal number, it is called a positive ion. Again, if the number of electron is more than its normal number, it is called a negative ion.

The electrolytes are divided into positive and negative ions by electrolysis. The electrolytes, mentioned a little while ago, will be divided into ions as shown in equations.

$$H_2SO_4 \longrightarrow 2H^+ + SO_4^{--}$$
$$HNO_3 \longrightarrow H^+ + NO_3^-$$
$$CuSO_4 \longrightarrow Cu^{++} + SO_4^{--}$$
$$AgNO_3 \longrightarrow Ag^+ + NO_3^-$$
$$NaOH \longrightarrow Na^+ + OH^-$$

In 1881, the renowned scientist Arrhenius explained electrolysis. According to him, if all the acids, bases and some salt-like compounds are dissolved in liquid, they are ionized and divided into equal amount of positively and negatively charged ions. Chemical properties are not expressed in the state of charged ion. But if these are uncharged, they can take part in chemical reaction. The ions move sporadically in the liquid. As electrons can create the flow of electricity in the conductor, so the ions in the solution can flow electricity. Now, if electricity is passed in the solution introducing two conducting plates or electrodes, negative ions are attracted by the anode and the positive ions are attracted by the cathode. For this oppositely directed motion of the ions, electricity is produced between the two electrodes.

11.2.1 Explanation of the Electrolysis of $CuSO_4$ Solution

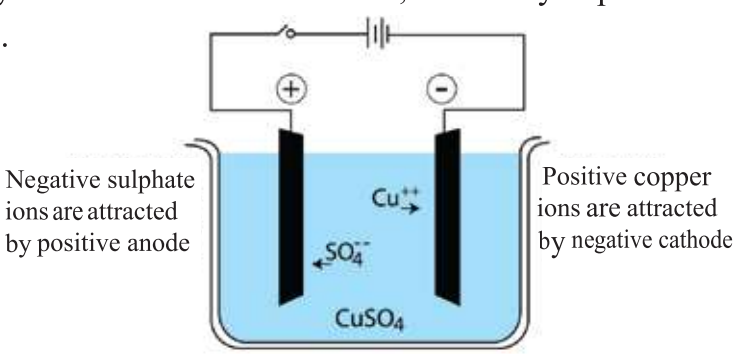


Fig. 11.08: Electrolysis

Certain amount of $CuSO_4$ and water is taken in a glass beaker. Dissolved in water, $CuSO_4$ is separated into Cu^{++} and SO_4^{--} ion (figure 12.08). Now, immersing two copper plates in the solution, if they are connected with an electric cell, the flow of ion will start. Cu^{++} ions, attracted by the cathode, take two electrons from the cathode and, being converted into neutral copper, accumulate in the cathode. On the other hand, SO_4^{-} ions, attracted by the anode, go there and metallic copper of anode dissipate two electrons and become copper ion (Cu^{++}). This copper ion and SO_4^{2-} ion combine to increase concentration of $CuSO_4$ in solution. This $CuSO_4$ again dissolves in the solution and keeps the concentration of the solution unchanged. Copper ion (Cu^{++}) of solution take two electrons from cathode to form neutral copper (Cu).

Therefore, it is seen that the amount of Cu accumulated in the cathode and the amount of Cu coming to the solution are same. The total result is that the amount of mass decreased in the anode is the same as increased in the cathode though it may seem to us that Cu is being accumulated in the cathode from anode. But if the electrodes are of any neutral metal other than copper, the copper molecules will accumulate in the cathode as before. However, SO_4^{--} produces H_2SO_4 by the chemical reaction with water and O_2 gas comes out in the form of bubbles. As a result, the concentration of the solution will decrease gradually.

11.2.2 Importance of Electrolysis in Everyday Life

1. Electroplating

The process of coating any metal with another suitable metal is called electroplating. Generally the things made from the metals of inferior quality (like copper, iron, bronze etc.) are coated with costly metals like gold, silver or nickel to save it from climate or to make it beautiful. The substance which will be coated should be washed gently and kept in a container. It will be used as a cathode electrode. The metal on which the coating will be applied is to be used as electrolyte. Now, by using battery or power supply, electricity is passed from anode to cathode and, due to electrolysis, the substance is coated (Fig : 12.09).

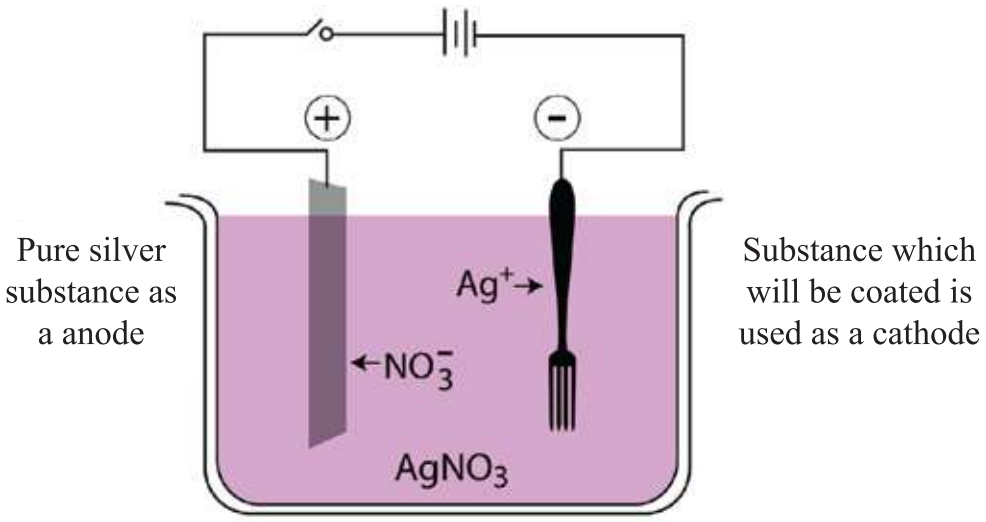


Fig. 11.09: Electroplating

2. Electrotyping

By applying a special process of electroplating to make letters, block models etc. is called electrotyping. For electrotyping, first the text is composed by common typewriter, and then an impression is taken on wax. It is made electricity conductive by spreading dust over it. Then it is immersed into copper sulphate solution as cathode and a copper plate is used as anode. Now, if electricity is passed through the solution, a copper coating will be layered on the wax mould. When the copper coating becomes thicker, it is taken out from the mould.

3. Extraction and Purification of Metals

Generally, metals are not found in pure state in mine. There is a mixture of various metals and this mixture is called ore. It is easy to extract and purify the metals from this ore by electrolysis. The ore from which the metal is to be extracted is used as anode. The metal which is to be extracted, any salt solution of that metal is used as electrolyte and a small plate of pure metal is used as cathode. Now, if electricity is passed through the solution, pure metal will be extracted from the ore and stored in the cathode.

11.3 Electric power

In physics, the term 'work' has a definite meaning. The unit of work and energy is joule. Work can be done by applying energy and the rate of doing work or the work done per unit time is called power. The amount of electrical energy spent or changed into another energy (heat, light, mechanical energy etc.) per second by an electric machine is called electric power.

Kilowatt

When the potential difference between the two ends of a conductor or an electric device is one volt, and if one ampere electric current flows through it, then the electric power of that device is one watt.

1 Watt = 1 Volt × 1 Ampere

When a large amount of electric power is used, then it is convenient to express it in kilowatt or megawatt.

1 Kilowatt = 1 000 Watt = 10^3 Watt and
1 Megawatt = 1000000 Watt = 10^6 Watt.

Kilowatt-hour

If electricity flows for one hour through an electric device of power one watt, then the amount of electrical energy changes to another energy (for example- if bulbs are lighted, it is light energy and when fan rotates it is mechanical energy) that is one watt-hour.

1 Watt-hour = 1 Watt × 1 hour

Sometimes, kilowatt-hour is also used instead of watt-hour
If we want, we can also calculate how much energy is one kilowatt-hour.

Or, 1 Kilowatt-hour = 1000 Watt × 3600 seconds
= 3,60,0000 Watt-second
= 3,60,0000 Joule

That means in the unit of power it is 3.6 mega Joule.

Internationally, the unit of electric supply is measured by kilowatt-hour unit. This unit is called Board of Trade unit or BOT unit. The electric bill we pay is also calculated according to this unit.

Calculation of Electric Power

We know that electric supply company submits an electric bill to our houses or institutions per month. This institution fixes the value per unit. Accordingly we pay the electric bill. That means,

expense of consumed electric energy = consumed units of electric energy× expense per unit.

All electric devices (light, fan, computer) mention what amount of electricity or electric power is required. So, we can easily calculate the consumed energy from there.

We want to calculate the consumed unit of energy in kilowatt. If the power of a machine is p watt and we use it for t hours, then the consumed energy E is:

$$E = P \times t \text{ Watt-hour}$$
$$E = (P \times t)/1000 \text{ Kilowatt-hour (or, unit)}$$

Therefore, if we know the power of an electric device, then by counting the time we can easily calculate the consumed electric energy. For example, if a bulb of 60 watt (p=60 watt) is enkindled 5 hours per day for thirty days (t=30×5 hour), then what amount of electric energy is consumed?

We know, Consumed energy = (P×t)/1000 unit
= 60× (30×5)/1000 unit
= 9 unit

Now, if the price is 8 taka per unit, then total expense for that consumed amount of electricity will be—

Total electric expense = 9×8 taka
= 72 taka

The Meaning of 220 V - 60 W

On the body of bulbs we use for electrical light, V and W are written beside two numbers. If there is written 220V-60 W on a bulb, it means when the bulb is connected with 220V potential difference, the bulb will be enkindled with maximum luminosity. Then it will convert 60 Joule electrical energy into light and heat energy.

Advantage of Energy Saving Bulb

Once we would use ordinary bulb. In this bulb, light is created by heating a metal filament, and so, a huge amount of heat energy was required. Due to technology, energy saving bulb has become available for domestic use. There are two types of energy saving bulbs—CFL (Compact Fluorescent Lamp) and LED (Light Emitting Diode) bulbs. This energy saving bulb can save 20%-80% electricity and can last 3 to 25 times more than normal bulbs.

Statistics show that if each family, in one year time, uses one energy bulb instead of a normal bulb; the energy which is saved can be used to give electric connection to thirty thousand families. If we can reduce misuse of energy by using energy saving bulbs, we can lessen our dependence on fuel because producing electricity by burning fossil fuels has an adverse effect on the environment.

Energy-saving bulbs last longer than normal bulbs. So, fewer bulbs are disposed. For this, there is an advantage in dirt and rubbish management.

Individual work

Task : Make a poster on why everyone should use energy-saving bulbs.

11.4 Use of Electric Energy

11.4.1 IPS and UPS

In our day-to-day life and in professional career, we are entirely dependent on electricity and in many cases, all our activities come to a halt if electric supply is stopped. Then, we temporarily use alternative supply of electricity. If this alternative source of electricity is late by one or two seconds, it does not hamper our lights or fans that much. But in the case of computer and such type tools, sudden discontinuation of electricity causes big problems for us. It may spoil information kept in the computer and even its parts may be damaged.

IPS and UPS (Fig : 11.10) have been made to quicken the process of uninterrupted electric supply through an alternative source after the stoppage of main electric supply.

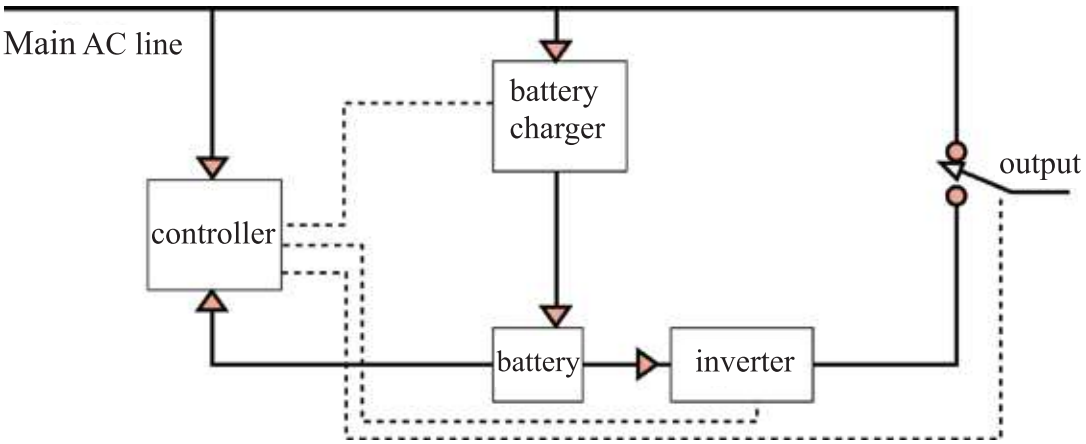


Fig. 11.10 : IPS/UPS

In the house IPS is used because there is no harm if lights and fans become operative a little later. It takes one or two seconds for IPS to be operative and generally it is used in domestic work like supporting lights or fans. Therefore, IPS can supply sufficient electricity for a fairly long time.

UPS is used in the case of desk-top computer and such like sophisticated tools. It is because UPS can ensure electric supply within ten milliseconds after the electricity goes off. So, there is no interruption of power supply in the computer.

Electric supply capacity of UPS is inadequate; generally it gives enough time to sum up the computer activities, save files and shut down the computer.

The work procedure of IPS and UPS are shown in Fig : 11.10. When the normal electricity remains functioning, the batteries of IPS and UPS get charged. Suddenly normal electricity and its main switch are removed from the main supply and they are connected with the battery circuit. As the battery provides DC supply, it has to be changed into AC by using inverter. As soon as the normal supply stops, the control circuit starts inverter circuit as well.

11.4.2 System Loss of Electricity

We know that the power plants at various locations of the country produce electric power. This electricity is distributed to different places according to needs. For electric distribution, first it is sent to various substations. Substations use electricity distribution management to reach electricity to the consumer level.

The conductive wire which is used to distribute electricity from one place to another has resistance though it is little in amount. Whenever electricity flows through a resistance (R), heat is produced (12 R) and it is a loss of electricity or power erosion. This loss is called system loss. You have already known that if high voltage electricity is supplied for a definite electric energy, then the loss, resulting from resistance related heat energy, decreases. For that, the electric energy that is produced in the power plant is transformed into high voltage by using step up transformer. For the consumer's use, that voltage is further lowered into usable voltage before distribution, by using step down transformer.

11.4.3 Load-shedding

Each power plant produces a definite amount of electricity and the electricity produced by all the power plants adds to the national grid. It was earlier said that this electricity is distributed among the consumers through local sub-station. The national grid supplies electricity to various locations according to their needs. If the demand of electricity in a location is more than production, nat urally necessary electricity cannot be supplied there. Then, the substations are compelled to suspend electricity in an area to supply it to other areas. This process is named load-shedding. As soon as the substation is supplied with necessary electricity, supply of electricity commences in that area.

11.5 Role of Energy in Development

The development of a country has a close relation to the use of energy. To speak the truth, the use of energy can be considered the first yardstick to understand how much a country is developed.

For the development of our country, we should put emphasis on education. In this country, a large number of boys and girls study in schools, colleges and universities. To run the educational institutions well, the supply of necessary electricity is to be ensured there. Light is required for the students to read at night, and their study is hampered if electric supply cannot be ensured. In the case of higher education, learners have to use laboratory, computer and networks are to be kept operative and, for all these, the supply of electricity has no other alternative.

In the economy of our country, agriculture plays a vital role. The country, being small, the area of cultivable land is small and it is getting further reduced. Growing two or more crops on this agricultural land, our country has acquired self-sufficiency in food. For this reason, we cannot depend only on natural agriculture; rather we have to irrigate the cultivable lands and that is not possible without energy. Electricity or fuel is required to operate pumps for irrigation. Fertilizer is needed for cultivation and fertilizer factories cannot produce necessary fertilizer without the supply of gas or electricity. To plough land and process crops, tractors are used and necessary fuel must be supplied for the tractors.

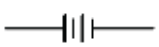
After agriculture, supply of energy is needed to ensure health service. A healthy environment is required to have a healthy physique. In the densely populated areas like Bangladesh, energy is needed for healthy environment and waste management. Energy is necessary to supply pure water. Uninterrupted power supply should be ensured for medical treatment.

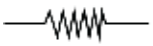
Besides education, agriculture and health, energy is needed to build up communication system, industry, mills and factories and infrastructure. That is why power plants have to be built in the country through proper planning so that there is no shortage of energy in future. The wastage of energy has to be stopped and gas exploration by digging new gas wells should be continued. For the increase of the demand of electricity in the country, establishing nuclear power plant is considered to be a likely solution.

Exercise

Multiple Choice Questions

1. Which one is the symbol of ammeter?

a.  b. 

c.  d. 

2. In the process of electrolysis coating is given-

i. nickel on iron ii. iron on zinc iii. gold on copper

Which one below is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

Read the paragraph below and answer the question 3 and 4.

Ripon lives in Bakhsiganj. Here usually load shedding occurs. For this reason he is facing difficulty in many works. Ripon has set an IPS in his house.

3. Applicable for the instrument fitted as an alternative of electricity that?

i. It is run by alternating current.
ii. It is also charged in low voltage
iii. It is connected with the outputs of the current.

Which one below is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

4. The causes of the problem of Bakhsigonj ?

i. The system loss of electricity.
ii. The defects in the method of supply.
iii. The production of electricity is less than the demand.

Which one below is correct?

a. i and ii b. i and iii
c. ii and iii d. i, ii and iii

Creative Questions

1. Mrs. Monsura Khanom is a conscious house-wife. She is very cautious of using electricity in the house. She enkindles 5 bulbs of 100 watts for average 6 hours daily. She observed that the electric bill submitted to her is excessive recently. For this, she replaced the bulbs and fitted 5 energy saving bulbs of 20 watt each.

a. What is electric power?
b. There is written 220 volt: 60 watt on the body of a bulb, what is the meaning of this?
c. What amount of total electric bill Monsura Khanom was charged before at the rate of 5 taka per unit?
d. Subsequently by changing the bulbs what was the benefit of Monsura Khanom? Give your opinion with arguments.

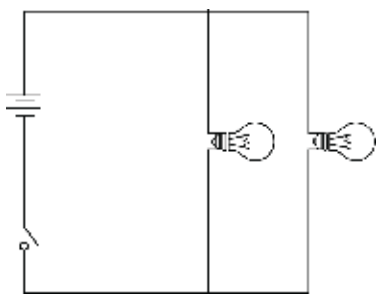


Figure-P

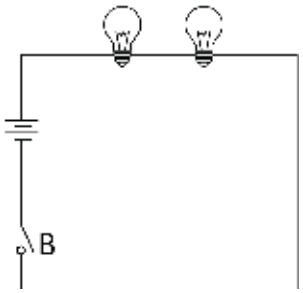


Figure-Q

2. See the two figures above and answer the questions?

a. What is electrolysis?
b. What is meant by anode?
c. How the electron will flow at the point B? Explain.
d. Which one of figure P and Q is suitable for house wiring? Give your reasonable opinion.

The End

2025 Academic Year

Nine and Ten : Science

‘দেশ তোমাকে কী দিতে পারবে সেটা জিজ্ঞেস করো না,
বরং নিজেকে জিজ্ঞেস করো তুমি দেশকে কী
দিতে পারবে।’

– জন এফ কেনেডি

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