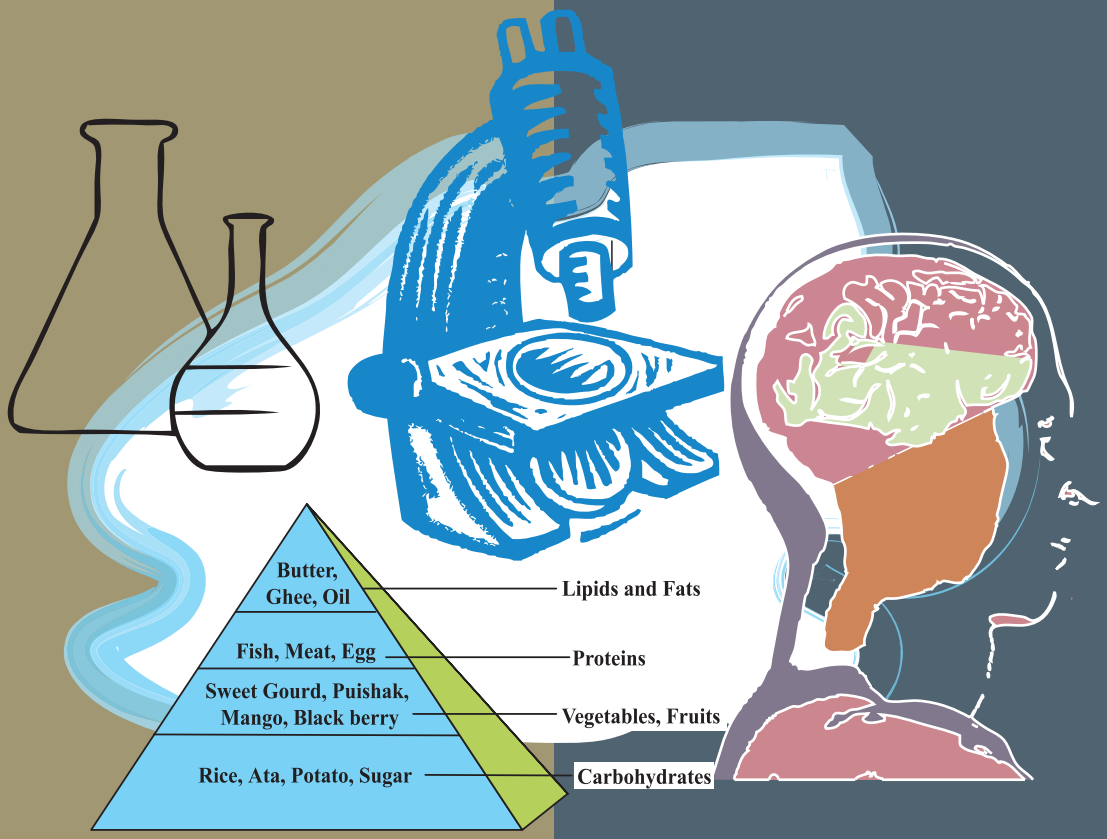
Science

Classes 9-10



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Science

Class : Nine - Ten

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Preface

Education is the pre-requisite for the holistic development in our national life. To cope with the challenges of the fast changing world and to lead Bangladesh to the doorsteps of development and prosperity, a well educated and skilled population is needed. In order to build up a nation imbued with the spirit of the Language Movement and our Liberation War, the secondary education aims at flourishing the talents and prospects inherent in the learners. Besides, the other aims also include expansion and consolidation of the basic knowledge and skills of the learners acquired at the primary level in order to make them fit for entry into higher education. The aims of secondary education further emphasise on developing these learners as skilled and competent citizens of the country through the process of acquiring knowledge at the backdrop of socio-economic, cultural and environmental settings.

Keeping the aims and objectives of National Education Policy 2010 ahead, the curriculum at the secondary level has been revised. In the revised curriculum the national aims, objectives and contemporary needs have been reflected. Along with these expectations, learning outcomes have been determined based on the learners' age, merit and level of acquisition. Besides, efforts have been made to raise, starting from the level of moral and humanistic values down to awareness on history and tradition, the spirit of the Liberation War, passion for art-culture and literature, patriotism, feelings for nature and equal dignity to all irrespective of religions, castes, creed and sex. Efforts have also been made to apply science in all spheres of our life in order to build a nation advanced in science. Attempts are also here to make the learners capable of implementing the goals envisioned in Digital Bangladesh-2021.

In the light of the present curriculum, almost all the textbooks at the secondary level have been introduced. While introducing the textbooks, the capacity, aptitude and prior knowledge of the learners have been taken into utmost consideration. While selecting the contexts and their presentation, special attention has been given on the expansion of the learners' creative faculty. Adding learning outcomes, at the beginning of each chapter, hints about the achievable knowledge of the learners have been given. By adding a variety of activities, creative and other questions, evaluation has also been made creative.

The purpose of science education is the development of observational capability and formation of positive attitude of the learners to the elements of the environment through creation of curiosity on various natural phenomena. Basically keeping an eye to these factors, the book entitled *Science* has been written in light of the revised curriculum. To make the book more interesting to the learners, different types of hands-on tasks have been included along with the theoretical aspects of science.

Considering the challenges and commitments of the 21st Century and following the revised curriculum, this textbook has been written as a trial edition. Therefore, we welcome with our highest consideration any constructive and logical suggestions for further improvement of the book. Amidst huge activities needed for introducing textbooks, this one has also been written within a very short span of time. Therefore, some errors may remain in this book. We will continue our efforts to make the next edition free from errors, more beautiful and decent.

We appreciate the endeavours of those who assisted very sincerely with their merit and hard work in the process of writing, translating, editing, illustrating, introducing sample questions, and printing of the book. We hope this book will ensure joyful reading and achievement of the expected skills from the learners.

Prof. Md. Mostafa Kamaluddin
Chairman
National Curriculum and Textbook Board, Dhaka

CONTENTS

Chapter One

Healthy Life, Better Living

We cannot live without food. Regularly several types of food are necessary for the growth and development of 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 time of respiration the chemical energy of food is transformed into heat energy. Every living being takes food from the environment according to its need. Every food is a complex chemical compound. This complex food turns into simple food by different types of enzyme. This process is called digestion. After digestion, foods are absorbed by the protoplasm of the cells. This is called metabolism. After digestion the indigested part of food comes out of the body through a special process.

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

- explain the types of food and the ideal food pyramids.
- describe the needs of the preservation of food.
- explain the sources of vitamins and its deficiency symptoms.
- explain the sources of minerals and its deficiency symptoms.
- explain the necessity of body mass index.
- 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.

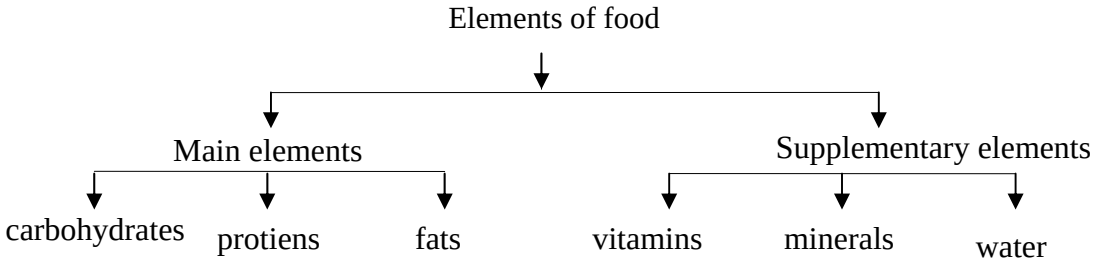
Food and Nutrition

According to the science of nutrition, all that we eat are not food. Then, what is 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 vital force of the 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 foods 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 six elements of food e.g. - carbohydrates, proteins, fats, vitamins, minerals and water. Among them carbohydrates, proteins and fats are nutrients; these help the body to produce nutrition, ensure development and give energy. Fats and carbohydrates are called the energy producing foods and proteins are called the body building foods. Vitamins, minerals and water are called the protecting elements because these protect the body from diseases:



Carbohydrates

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

There are various types of carbohydrates. Their sources are also different e.g.—

Plant source

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

Glucose: It is less sweet than sugar. This carbohydrete is available in grapes, apple, 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 and mammals.

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. 4.1 kilo calorie energy is produced by the oxidization of one gram carbohydrate. 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. The pentose sugar ribose and de-oxiribose form the nucleic acid- DNA and RNA. Besides, proteins and fats are synthesized from carbohydrates.

To get rid of the deficiency diseases of sugar we have to take optimum amount of sugar every day. On the other hand if the amount of sugar is more than the need the extra fat is accumulated as fat cell in the body. Eating more carbohydrates causes the obesity and diabetes. The needs of carbohydrates depend on age, weight, height and amount of labour. According to nutritionists 58-60% of daily needs of calories should be taken from carbohydrates. 4- 6 gram of carbohydrate is needed for per Kg of body weight. An adult person should take minimum 300gm of carbohydrates per day so that he gets 1200 to 1800 kilo calories energy.

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 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 carbohydrate and protein is almost equal- 4.1 kcl/gm, while fat has the highest amount of calorie that is 9.3 kcl/gm. The food calorie means the amount of energy released by the complete oxidation of that food.

Protein

Protein is composed of carbon, hydrogen, oxygen and nitrogen. There is 16% nitrogen in protein. Protein is converted into amino acid after digestion. Protein is identified by its amino acid. 20 types of amino acids have been found so far in human body. Amino acids are the unit of protein formation. According to their sources, there are two types of protein-- animal protein and plant protein. 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, nut, 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 protein 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 part of body is formed by protein. The bone, muscle, hair, bird feather nail, 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 protein.

The amount of protein and its calorie in fish, meat, milk and milk product:

	Food (100gm)	**Protein (gm)**	**Colorie**
Fish	Ruhi	16.6	97
	Katla	19.5	111
	Mrigel	19.5	9.8
	Climbing fish	14.8	156
	Magur	15.0	86
	Catfish	28.8	124
	Hilsha	21.8	273
	Prawn	19.1	89
	Vetki	14.9	79
	Shol	6.2	94
Meat	Mutton	21.4	118
	Lamb	18.5	194
	Chicken	25.9	109
Egg	Hen	13.3	173
	Duck	13.3	173
Milk Product	Cow’s Milk	3.2	67
	Buffalo Milk	8.3	117
	Curd	6.9	176
	Kheer	6.9	176
	Posset	18.3	265

The daily protein need of a normal adult person is one gram of his per kg body weight. That means, if the body weight of a person is 57 kg, his daily protein need is 57 gram. According to this calculation eating daily 100 gram protein is good for health. For the kids and for the growing boys and girls 3-4 grams and for the pregnant and lactating mother 2-3 grams of protein is suggested. For the determination of protein needs the quantitative and qualitative standard of protein should be considered. The supply of essential amino acids in the body should be ensured by the food protein.

Fats and Lipid

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

1. **Animal lipids:** Meat with fat, butter, ghee, cheese, yolk of eggs are the sources of animal fat.
2. **Plant lipid:** Different types of vegetable oils are the sources of plant lipid. Mustard, soyabean, sesame, linseed, maize, coconut, sunflower and palm oil are the sources of plant lipid. Cashew, pistachio and peanut are also the sources of lipid. Role of lipid in human body:
   1. Lipid is the highest source of heat and energy in the body.
   2. Lipid is essential for the growth and nutrition of the body.
   3. Lipid prevents the misuse of heat and works as a source of food storage for future.
   4. Lipid 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 its remedies

The deficiency of lipid causes the skin diseases and eczema. Skin becomes dry and rough and loses its beauty. The protein and the long time deficiency of lipid break down the stored protein and body loses its weight. On the other hand much amount of lipid disturbs the blood circulation of the body. So the fat body is easily attacked with diseases. Essential fatty acid rich medicines are helpful for skin diseases and eczema. 1-2% of daily total calorie should be linolenic acid rich lipid for the protection of skin diseases. The daily food should contain 15 gram of animal lipid and 5-10 gram of plant lipid. The baby food should contain much amount of lipid; 10-15% should be lipid of the

total source of calorie of an adult person. Near about 9.3 kilo calorie heat energy is produced from one gram lipid.

Vitamins

Even if the food contains the sufficient amount of carbohydrates and proteins, a special type of food is necessary for the normal growth and nutrition of the body. This element is called vitamin. Very small amount of vitamin is present in the food and acts as a co-enzyme with enzyme in metabolism.

Vitamin is essential for normal growth and healthy body. Normal growth and repair along with different metabolic activities are disrupted for vitamin deficiency. Vitamin is an organic compound. Some vitamins are soluble in fats and some are soluble in water.

1. Fat soluble vitamins are: Vitamin A, D, E and K.
2. Water soluble vitamins are: Vitamin B complex and Vitamin C.

Co-enzymes are non protein. These co-enzymes increase the activities of enzyme.

Vitamin A

Animal sources of vitamin A are egg, 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's finger, cabbage, pea nut and different types of fruits e.g.- mango, ripe papaya, jackfruit are the great sources of vitamin A. Large amount of vitamin A is present in carrot. 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 bone healthy.
4. It keeps the eye sight normal and protects the eyes from night blindness.
5. It protects the body from contagious diseases.

Deficiency symptom and remedies

Night blindness is the result of the deficiency of vitamin A. Cornea ulcer also results from its deficiency. This is called xerophthalmia. Due to this disease a person becomes totally blind. The growth of the body is also disturbed for the deficiency of vitamin A. Sometimes the symptom of scabies, cold and cough, throat pain is seen taking. Sometimes the small rash is also seen in the skin. Night blindness can be cured by vitamin A capsule. The best remedial way to get rid of this disease is to eat the vitamin A rich foods. The teenagers, the adult men and women and the pregnant women need daily 2500 IU of vitamin A.

Vitamin D

Animals are the only source of vitamin D. Vitamin D is synthesized in human skin by the ultraviolet ray of the sun. Yolk of egg, milk and butter are the main sources of vitamin D. Cabbage, liver and oil rich fish are also the sources of vitamin D. Taking more vitamins than the need is harmful for body. So a huge amount of calcium and phosphorus are absorbed. As a result, a large amount of calcium is stored in 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 E is available in corn oil, cotton seed oil, sunflower oil and lettuce leaf. In human body vitamin E is the anti oxidant. This anti oxidant inhibits the accumulation of fat in vein and keeps the skin healthy. Besides this vitamin E also helps to develop the cell and also participates in various metabolic activities. Vitamin E also removes the infertility of human beings and of other animals. The embryo can die in the uterus for the deficiency of vitamin E. Eating a balanced diet every day can fulfill the demand of vitamin E.

Demand : Infants, teenagers and the adults need at least10- 30 milligram of vitamin rich food per day.

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. Thiamin (B_1); riboflavin (B_2) niacin, pantothenic acid, pyridoxine (B_6) cobalmine (B_{12}) are important among the vitamin B.

The presence of vitamin B is essential for the growth of the body especially for the work of brain and nervous system, metabolic activity of the cell and for reproduction. The source, deficiency symptoms and the amount of different types of vitamins in B complex are tabulated below:

Vitamin	Source	Different symptoms	Amount needed
Thiamin (B_1)	Plant source: husked rice, flour, pulse, oil seed, nut, fresh fruits, and vegetables.	The severe deficiency of vitamin B1 causes the symptom of beriberi disease, weak nerve, depression, tiredness, loss of appetite, weight	amount needed according to age: infant 0.5-0.7 mg Adult- 1.2-1.5 mg Pregnant women- 1.5-1.7 mg

	Animal source: Liver, egg, milk, fish etc contain small amount of B_1.	loss are also caused for 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, burning sensation of eyes, uneasiness in opening eyes in light, cataract in the eye.	Adult men need daily 1.7 mg. adult women daily 1.3mg, infant 1- 3 years old baby daily 0.8mg. 14-15 years teenage boys need daily 2.0 mg and girls need 1.3mg vitamin B_2.
Niacin or Nicotinic acid (B_5)	Meat, liver, ata, pulse, nut, oil seed, chick-pea and vegetables	Its deficiency causes pellagra disease. Melanin is accumulated in skin for this disease and melanin increases in the sun light. As a result skin becomes reddish and rough. Besides, the patient suffers from atrophy for accumulation of melanin in the tongue.	An adult male or female needs to eat 12-18 mg of this vitamin per day. This demand depends on the amount of protein in the food.
Pyridoxine (B_6)	Rice, atta, fish, meat, vegetables, chick-pea, fungi, kidney and yolk of eggs.	Loss of appetite, vomiting tendency and anemia occur due to its deficiency	An adult person needs 1.4-2.0 mg daily.
Cobalamin or Cyanocobalmin (B_{12})	Liver, milk, fish, meat, egg, cheese kidney etc.	Anemia and nervous system disorder occur due to its deficiency.	An adult person needs 4-8 mg of this vitamin per day.

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 amount of vitamin C. Dry fruit, seed and canned food 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 the important role in the metabolism of fat, protein and amino acid.
5. If 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) The bone cannot become strong. (ii) Skin diseases are caused for 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.

Task: Make a chart of the deficiency diseases of the vitamins what we have discussed.

Minerals and water

For the normal growth and nutrition of the body, minerals are also essential as vitamins. Minerals mainly help in the formation of cell. 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 50mg iron. It is stored in liver, pancreas, bone and red blood cells. The need of iron for a male is 9 mg, female 28 mg, pregnant and lactating mothers 12- 14 mg and a baby needs 10 mg. 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 anemia. The symptoms of anemia are pale eyes, swelling of hands and legs, weakness, headache and palpitation.

Calcium (Ca)

The main element of bone and teeth are calcium. About 2% of human body weight is calcium. The amount of calcium is the highest in the minerals. Among them 90% are accumulated in the bone and teeth accompanied with phosphorus and magnesium. The amount of calcium is significant in blood and lymph. The need of calcium per day for a growing baby is 500-600mg, adult 450mg, and pregnant women 1000mg. The plant sources of calcium are: pulse, sesame, soyabean, cauliflower, carrot, spinach, kochu leaf, red amaranthus and kalmi leaf. The animal sources are milk, egg, small fish and dry fish.

For the strong bone and teeth calcium is essential. 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 occurs due to deficiency of calcium. Calcium deficiency delays in the formation of teeth of babies and disturbs in blood circulation.

Phosphorus (P)

Regarding amount in the body, the importance of phosphorus is next to calcium. Like calcium, phosphorus is also an element of bone. Phosphorus is accumulated in bone, liver and plasma. Phosphorus plays a vital role in the formation of nucleic acid and nucleo protein and in carbohydrate metabolism. The daily need of phosphorus for a growing baby is 0.5-1.5gm and for an adult 10 gm.

Plant source- cereal, bean, peanut and nut are sources of phosphorus.

Animal source- Egg, 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 an element of food. Water is essential for human body. The structure and function of the body cannot be maintained without water. Water constitudes 60-75% of our total body weight. Water is essential for the formation of our blood, muscle, nerve, teeth, bone etc.

What is the percentage of water in protoplasm of cells?

It is not possible to form the body cell and physiological function of the body without water. It works as a solution for 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 source of water in body-

1. Drinking water, 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 for lack of water. The balance of acid and alkali become imbalanced and it causes acidosis. 10% of water loss of the body causes faint 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. An adult person should take 2-3 liters of water per day because this amount of water comes out of the body daily.

Body Mass Index (BMI)

A body 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. This is also called the Quete Let Index. If the body weight is balanced with the height, then it can be considered a nutritionally healthy body.

The law of BMI is the 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.

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

BMI is the indicator of the amount of fat in the body.

What will be the daily food?

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

Table: The daily calorie need of a Bangladeshi man. (The number in the bracket is for female and without bracket is for male)

Age	**Caloric need (kilo calorie)**	**Age**	**Caloric need (kilo calorie)**
0- 1	820 (820)	40-49	2620 (1900)
1- 3	1360 (1360)	50 – 59	2480 (1800)

4- 6	1820 (1820)	60- 69	2210 (1600)
7- 9	2190 (2190)	70- 79	1930 (1400)
10- 12	2600 (2350)	Pregnant mother 1st three months	+150
13- 15	2680 (2260)	Next six months	+350
16- 19	2820 (2100)	Lactating mother	+750
20- 39	2760 (2000)		

Body weight adult male- 60 kg, adult female 50 kg.

Source: Nutritive value of Bangladeshi common foods. Institute of Nutrition and Food Science, University of Dhaka.

The common food for all according to calorie content are-

1. Protein- 15% of total calorie.
2. Carbohydrates (most of them are complex carbohydrates not the sugar) 50- 60% of total calorie and
3. Fats (a) saturated- 7% (b) unsaturated (Mono-unsaturated) 50% of total calorie

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, butter, honey, ghee, basil, jackfruit, mango.

Make a chart of food elements with the 21 food items mentioned above:

Carbohydrate	**Protein**	**Fat**	**Vitamins and minerals**	
			Vegetable	**Fruit**

According to the table below make a list of low cost and high cost food.

List of the foods (low cost food)

Name of the food elements.	Name of the food
1. Carbohydrate 2. Protein 3. Fats 4. Vitamin enriched vegetables /fruits 5. Mineral enriched vegetables /fruits	

List of the foods (costly food)

Name of the food elements.	Name of the food
1. Carbohydrate 2. Protein 3. Fats 4. Vitamin enriched vegetables/fruits 5. Mineral enriched vegetables/fruits	

Balanced Diet

We 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 for health. So, we have to take balanced food for good health.

Balanced diet does not mean a specific food. Balanced diet is a food which is the collection of all the food items with a specific amount and from which we can get the necessary calorie for our normal activity. Balanced diet is a diet which contains all the six elements of food and eating this food we get necessary calories for our normal activities. For example an adult, active healthy male needs daily 2500- 3000 of kilo calorie energy. We get this calorie from food. So in our daily food list we need to select such food items in which all the six elements of food are present in a certain amount.

For preparing a list of balanced food we have to consider the age, sex, and labour done by the person that is hard labour, medium labour and low labour. For the preparation of the list of food for the baby and aged it needs to consider easily digestible and fat free food. Growing babies need protein and calcium and phosphorus enriched food for the growth of bone and teeth. Extra protein, calcium, and iodine are very important for producing blood and for the development of the embryo of a pregnant lady. No definite balanced food is available in nature. We have to prepare the balanced food.

Fibre

Fibre or roughage is mainly obtained from plant. Entire seeds, pulse, potato, fruit with peel and vegetables are the source of roughage. Besides this, dry fruit, cumin, coriander and pea contain a large amount of roughage. Roughage is mainly cellulose contained 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 does not create any mold on the wall of intestine. So it can protect diseases. The importance of roughage food is as follows:

1. If 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 the gallbladder diseases, cancer of intestine and colon, piles, appendices, heart diseases and obesity.

So we should take 20-30 gram of fiber food every day. This fiber is obtained from vegetables and fruits.

Menu of Balanced Diet

The menu of balanced diet should be prepared to serve the balanced diet for the family members. Nutritious and attractive diet can be prepared by a menu planning. Some points should be considered while preparing a menu-

1. The demand and taste of food are different according to age, labour and sex. These points should be considered for preparing a menu.
2. Weather and season also influence menu planning. Available seasonal food should be included in the menu so that the minerals and vitamin demands of the family members can be fulfilled.
3. Body building elements should be included in the menu. Fish, meat, egg, milk and pulse build our body. This should be considered for preparing a menu.
4. Heat and energy producing food e.g. rice, wheat, potato, molasses, sugar should be included in the menu in a specific amount.
5. The food with necessary nutrients and calorie should be included in the menu.
6. A balanced diet should be considered while preparing a menu.
7. Considering food habit is also an important part for planning a menu.
8. The economic condition of the family should be considered in menu planning.
9. The diversity of food should be considered for preparing a menu.
10. While preparing the menu, one should be careful so that no food is wasted.

A daily balanced food list for the teenager (15- 18 years):

Food	Quantity (gram)
Rice/Wheat	438
Pulse	50
Leafy vegetables	88
Potato/Sweet Potato	116
Other vegetables	88
Fish/Meat/Egg	58
Fats/Oil	30ml
Sugar/Molasses	58
Fruit	1 pc

Daily balanced food list for an aged male and female:

Food	Amount (Male)	Amount (Female)
Rice/Wheat	468 gram	350 gram
Pulse	88 gram	44 gram
Leafy vegetables	88 gram	146 gram
Potato/Sweet Potato	116 gram	88 gram
Other vegetables	88 gram	58 gram
Fish/Meat/Egg	58 gram	58 gram
Fats/Oil	58 ml	55 ml
Sugar/Molasses	58 gram	58 gram
Fruit	1 pcs	1 pcs

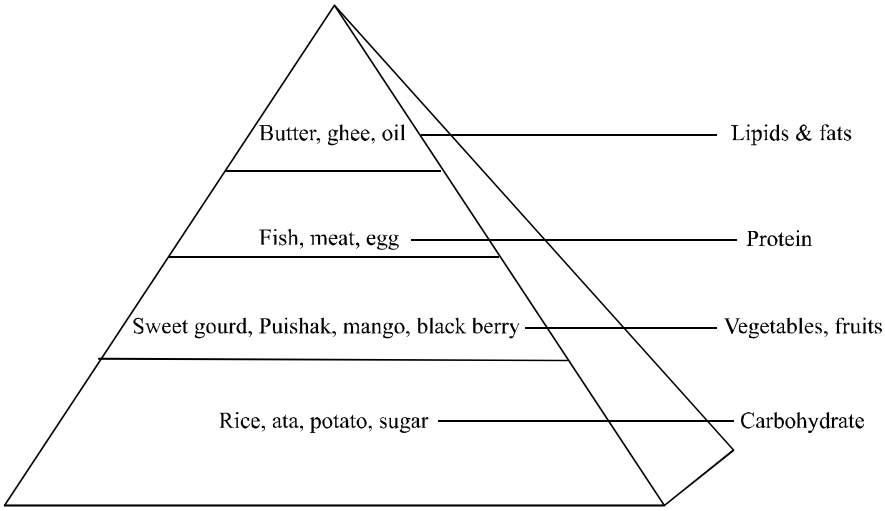
Source: Pushti Biddya, Institute of Nutrition and Food Science, University of Dhaka.

The preparation of balanced food:

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

The Pyramid of Balanced Diet

It is important to include carbohydrate, vegetables, fruit, protein and fats in a balanced diet menu. It is seen that the amount of carbohydrate is highest in a menu of a teenager or an adult. In food pyramids of balanced diet, carbohydrates are placed in 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. So the fats are placed on the top of this pyramid.



Selecting food for high standard living

The food habits of all men are not same. The availability of food is not same in all countries for the geographical and natural causes. The need of foods is different in winter and in summer to adjust with every situation in 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.

The nutritionists have divided the source of nutrition into four classes. These are meat, milk, fruit/ vegetables and cereals.

The equivalent food of meat are fish, egg, pulse (peanut, chick pea and nut). Cheese and yogurt are in the class of milk.

All kind of edible vegetable and fruit are in the class of vegetables and fruits. Cereals and its product are in the class of cereals. To get balanced food we should take all these four types of food every day. The nutritionists think that the selection of food from these four classes should be a variety.

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

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

In our country the students and the 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 nutrient value of the food.

The food for dinner should be easy to digest. So the less amount of protein should be taken in this meal. Taking leafy vegetables and any sour food at night is harmful for health. The students should take milk or any other energy producing food according to economic condition. High standard of living can be maintained by this type of selection of food.

Fast food or junk food

The 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 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, crisps, cake and biscuit have lots of animal fat. There are high amount of sugar in sweets and cola or lemon. When we take these fat foods, it turns into fat cell in our body. Lots of 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.

Preservation of food

All types of food get spoilt or become unsuitable for eating due to natural cause. The causes of poisoning food are germs and fungi. These germs and fungi multiply quickly and produces enzyme in the food. The humidity, temperature and acidity of environment help to multiply these germs.

Bacteria produce toxic elements in the food. These toxic elements are called toxin. This toxin is of different types. This condition of food is called food poisoning. Some toxins attack the nervous system and causes 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 there grows an ash colour layer on it. These are the mold fungus like mucor and aspergillus. Orange, pickle, tomato and cheese get rotten by this type of fungus.

Various processes of storing food

Actually foods are spoilt by the multiplications of germs and the enzyme secreted by the germs. Humidity and temperature help to grow germs and increase the activities of enzyme. So, this condition helps to spoil the foods. If the factors which help to ruin the foods can be controlled, then the food can be preserved for a long time.

Commercially the foods are preserved and supplied in the market in a special method. At home foods are preserved by preservatives and using machineries. Some 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:** In this process the multiplication of germs and the activities of germs cannot be prevented for a long time. Mainly vegetables, fruit, cooked food and sweetmeats can be preserved by refrigeration method for several days.
3. **Freezing:** In this method foods are kept in a temperature of 0^0C or below so that the foods remain in good condition for a long time. Not only the fresh vegetables, fruits, juice, fish, meat but also ready food and ice cream are preserved by using this method.
4. **Preservatives:** The chemicals which are used to preserve food are called preservatives. These preservatives have no nutritional value. The preservative should be used in a specific amount. There are various types of preservative and their uses are also different. Fungi and bacteria cannot grow in food for using preservative. Some important preservatives are mentioned below.

   i) Vinegar is a common preservative. It is used in pickle and sauce. 5% acetic acid is called the 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 baby food items.

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

5. **Preservation in sugar or salt:** Salt and sugar 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 the 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 food has deteriorated and started rotting. One should avoid taking this kind of food because it will tell upon health.

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

Now-a-days a toxic chemical called formalin is used for the preservation of milk, fruit, fish and even the meat. Use of formalin is prohibited for preservation of food. Some dishonest businessmen use formalin for food preservation. The long time use of formalin causes, indigestion, diarrhoea, asthma, damage of liver and kidney or cancer. The long time use of formalin causes defective baby in the embryo of women.

Ripen and ethylene are used for the quick ripening of mango, tomato, banana or papaya. If ethylene is used in the fruit, these should be sold in the market after 7-8 days of its use. But this is not done and fruit is supplied in the market within 2-3 days. So, the effect of chemicals remains there and causes diseases in human body. Besides this, calcium carbide is used for ripening the fruits. This calcium carbide forms acetylene gas in the presence of air vapour. Then this acetylene gas is transferred into acetylene ethanol which is very harmful for health.

A hormone called culter is used for the delayed ripening of mango. The culter is used as spray on the mango tree. So, the mango cannot ripe quickly and stay on the tree for a long time. Culter is also very harmful for 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.

Tobacco and Drugs

The leaf and brunch of *Nicotiana tobacum* and *N. rustica* are dried to make tobacco. Cigarette or biri which is used for smoking are made from tobacco. The nicotine of tobacco refreshes the nerve as well as endangers the body. Besides nicotine, other toxic chemicals also enter into the body by smoking. The cigarette contains some toxic gases, chemicals and narcotics. These substances decrease the oxygen carrying capacity of hemoglobin. Besides, there are some sticky substances and hydrocarbons which cause cancer.

Bad effects of smoking

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 bad effects and diseases caused by smoking are as follows:

i) The smokers are attacked with diseases and embrace premature death.

ii) The smokers get some diseases e.g. Lung cancer, lip, mouth, laryngs, throat and urinary bladder cancer, bronchitis, ulcer in stomach, heart and blood- related diseases.

iii) The life expectancy of the smokers reduces and they fall victim to many deadly diseases.

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

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 at a public place is a punishable crime. There is a law in our country for that. But it is sad that there is no enforcement of this law and people smoke anywhere they like and pollute the surroundings. This law should be strictly enforced. Government should take bold steps for anti-smoking campaign.

ii) It is mandatory to print the sentence, “Smoking is taking poison” or “Smoking is harmful for health” on the packets of the tobacco products.

iii) Advertising tobacco or tobacco products has been banned.

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

Drug Addiction

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

Drugs are called the narcotics in general term. Continuous drug taking leads a person to such a situation when a mental and physical relation develops with the drugs and without taking drugs they feel problems, and that is called drug addiction.

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 parents are addicted to drug there is a possibility of drug addiction for the children.

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) getting away from others (viii) anxiety and tension (ix) less attentive, stealing money and other things from the 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 drug	i) Lack of control of parents
ii) Unemployment	ii) Depression
iii) Unsocial environment	iii) loneliness
iv) Drop out from school.	iv) Indulgence in desperate behaviour of children.
v) Watching cinema or TV serial	v) Detachment from family.
vi) Drug business in the surrounding areas	

vii) Professional cause viii) Living in the place where unsocial work or crime take place frequently ix) Living in a place where opportunity to take drugs is rampant or where a group of addicts stay	vi) Carelessness to children. (vii) Rough and violent livelihood or mentality viii) Bad company.

Control of Drug Addition

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 treatment, but in this case the role of addicted person is very important. The person should be admitted to drug cure center or hospital and treatment should be done very sympathetically. 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 for development of society and country. Some dishonest people become rich by doing drug business, but on the other hand life of some people envelops in darkness. Talented students are spoilt 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 drug the role of law enforcing agencies e.g. the role of government is more effective than the personal or social institutes.

Social Attempts

1. Finding out the addicted persons and providing treatment to them.
2. Counseling for the addicts.
3. Rehabilitation of the addicted persons and getting them back to the normal stream of life.

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. This is mentionable that there is drug control law in our country. If the law is strictly applied, the people and the country can be saved from the harmful effects of drugs.

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 by which we can protect us from diseases. In this case the lymphocytes of blood create antibody for the protection 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 is the cause of this disease. HIV destroys the natural immunity of the body. So the body is attacked with some rare diseases. Among them respiratory diseases, brain diseases, gastro intestinal diseases and tumour are mentionable. It has been marked that the symptoms of HIV are not normally seen in the body for five years. These persons thus act as a carrier of this disease.

Lots of information about 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. Uncontrolled sexual intercourses and homo sexuality are the causes of 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 cocaine and LSD is also the cause of this disease. This disease cannot be transferred by food, water, insects or external touch of the body. The most probable carriers of this disease are blood, sperm, saliva or tears of the body.

The most important thing about the prevention of the disease is to inform all about how AIDS is transferred. The spreading of this disease cannot be decreased only by not infecting others and protecting oneself from contagion. The knowledge about the uncontrolled sexual intercourses, being conscious about the syringe of drug users, being careful about donating and receiving blood can reduce the risk of this disease. The government and the social organizations are creating awareness for the prevention of this disease.

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. Physical exercise is essential for healthy body. Physical skills also develop from the physical exercise. Sleep, food and rest are essential for human life because these help the different parts of human body to work properly. But it should be kept in mind that it cannot develop the hidden treasure of the body. This development is possible only by

taking regular exercise. Everything of a plant depends on its roots. In the same way the movement, thinking of a man depends on the activity of nervous system. For developing a healthy nerve proper physical exercise is needed.

We know that the nervous system controls the muscles of our body. So if we do the regular exercise of muscle; it can make the nervous system fresh and active. The physical exercise activates the physiological and metabolic system of the body. So our capacity for daily work increases. Only few minutes' exercise 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 muscle has a great role in this matter. We have to do a regular exercise so that the main muscle of the body can become active and stimulated. The habit of physical exercise should be chosen depending on age, general health and body structure.

The physical exercise of the male is not suitable for the female. But there are some physical exercises which are common to both male and female e.g. running, walking, swimming, jumping, shipping, kabadi and different types of yoga. Normally wrestling, dumbling, barbell, football, tennis, hokey, gollachut and free hand exercises are done by the male. But now-a-days the female also do these exercises.

The female should not do heavy physical exercises for their special body structure. The female can do skipping, running, swift walking etc. for increasing blood circulation, so the extra fat will be decreased and the body will become slim. Besides these, yoga, free hand exercise, and different types of dance can move our body. Moderate exercise is good for health. Either less or excessive exercise is harmful.

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 the 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 be kept in sound sleep. In this way the body and the mind gets proper rest. It has been found that body and mind gets rest by giving attention from one work to another. This is called rest by change by 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 foundation pen for hours together. He is getting rest by this work. Some people take rest by gardening, rearing pets, doing amateur vegetable gardening or by recreation. All these are called rest by change by work.

Exercise

Multiple Choice Questions

1. What is available in carrots?

(a) Glucose (b) Fructose

(c) Sucrose (d) Cellulose

2. 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 (ii) i and iii

(c) ii and iii (iv) i, ii and iii

Read the paragraph below and answer the question 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 becomes 47 kg for water loss.

3. For the lack of essential element Rahima's-

(i) Blood circulation is disturbed

(ii) Muscles become weak,

(iii) Salt gets balanced

Which is correct?

(a) i and ii (ii) i and iii

(c) ii and iii (iv) 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 Questions

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

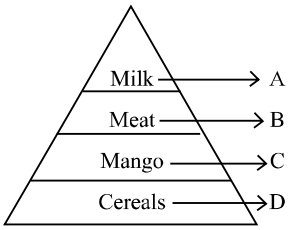
   (a) What is BMI ?

   (b) What is meant by zeropthalamia ?

   (c) How much energy is consumed for two days' metabolism?

   (d) Find the way to solving the problems of Tonu?

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



   (a) What is fiber?

   (b) What is vitamin?

   (c) Find out the substitute foods for 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

Introduction: Life is the other name of water. We obtain water from different sources. The sources of such an important resource are being polluted in many ways.

After studying this chapter we will be able to-

1. describe properties of water
2. explain structure of water
3. describe different sources of water
4. explain the necessity of water for aquatic flora and fauna and also standard of water.
5. analyze the role of water in recycling steps of water for water conservation.
6. describe the needs of water of good quality.
7. explain the purification of water.
8. explain the reasons for water pollution at sources in Bangladesh
9. explain the effects of water pollution.
10. explain the effects of global warming on fresh water in Bangladesh.
11. describe the strategy to prevent water pollution and responsibility of civil society.
12. analyze the role of water in the development works.
13. analyze the threats at sources of water.
14. describe the necessity for conservation of water sources and strategy for that.
15. explain that getting water is a fundamental right of all citizens.
16. describe the universality of water and international rules.
17. make investigation on use of pure water and its effects on healthy living.
18. investigate the reasons of crisis of water (in domestic /agricultural /industrial use).
19. draw poster to make people aware about water use and water conservation.
20. make people aware of normal water flow and prevention of water pollution.
21. raise public awareness on the issue “water is a fundamental human right”.
22. be aware of preventing misuse of water and doing proper use of water.

Properties of water: Water is one the natuarally abundant liquid matter.In human body, around 65-75% is water. Similarly meat, fish, vegetables etc. may contain 60-90% water. Seventy five percent of the earth surface is covered by water which is also very important for human survival. So it is said "water is the other name of life". Now let us know some important 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 which 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 99.98^0Celsius which is very close to 100°Celsius. That is why we generally say that bioling point of water is 100°Celsius.

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

Electrical conductivity: Pure water does not conduct electricity; however, 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 presence of an acid, water behaves like a base whereas, in presence of a base, it behaves like an acid. However, pure water is completely neutral i.e its pH is 7.

Structure of water

Do you know what does water consist of ? Water consists of two hydrogen atoms and one oxygen atom. So in Chemistry water is written as H_2O which is the chemical formula of water.

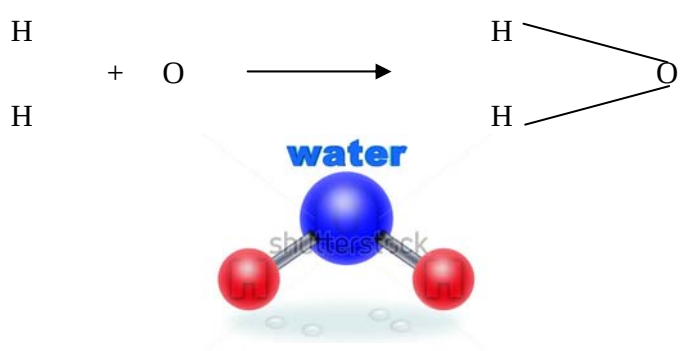


Fig. 2.1: Structure of water

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

Sources of water

What are the sources providing water to us? The largest sources of water are seas or oceans which contain approximately 95% 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 them directly for many other purposes. Sea water is also called *marine water*. The other sources of water are glaciers and snow where water is present in the form of water. 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, beals, lakes, ponds and ground water. We get groundwater through tube well. Of course, ice or snow accumulated on mountains may melt and create fountain. 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 amount of water for cultivation (for example, to grow IRRI rice). Where do we get this water from? Fountain is not that available in our country, therefore, main sources of fresh water in our country are rivers, canals, beals, ponds, lakes and earth's crust. However due to the presence of hazardopus 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.

Importance of water for aquatic flora and fauna and water quality

Importance of water for aquatic fauna: 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. 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 up. *What would happen in that case?*

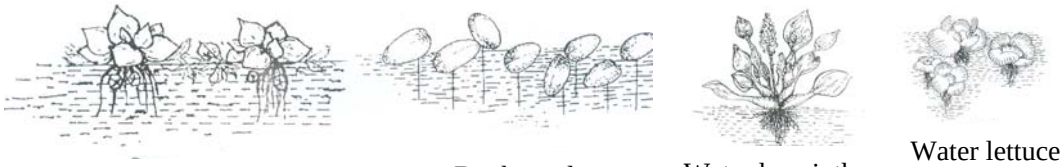
In that case, the aquatic ecosystem could be hampered because the aquatic flora produce oxygen by photosynthesis and maintain the level of dissolved oxygen in water in one hand, on the other hand, they also work as food reserves for aquatic animals like fish. So if there was no aquatic flora, aquatic fauna could not survive which would be disastrous for the environment.

You know that the plants basically 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 soft which is suitable to adapt with water current and movement of aquatic fauna.

If they grow in land instead of water, they would breakdown and could not grow up and even they could not survive.

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



Water nuts Duckweed Water hyacinth Water lettuce

Fig. 2.2: Some aquatic plants

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't survive without air or oxygen, we die of breathing problem, in case of fish, it happens in the same way. Fish takes oxygen by gill which is suitable to take up oxygen only from water not from air. If there were no water, no fish could sustain. Not only fish but also other animals respiring through gill by taking up oxygen would not live. 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 protein needed for us comes from fish. Therefore, if there were no water, we might not have necessary protein. Therefore, all physiological activities including physical growth could be disturbed.

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 being utilized for irrigation. Moreover, mariners, boatmen and people who are in the similar profession depend on water for drinking and other purposes.

So, if the quality of water is not maintained, it will be threatening for the environment in one hand, on the other hand, the use of water for other purpuses will be limited. Now, let us know about the water quality parameters.

The quality of water depends on the purposes where water to be used. At first, let us know about the required quality of water of river, canal, beal, and seas.

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

Turbidity: Turbid water could be harmful for aquatic flora and fauna because turbid water hinders the penetration of sunlight resulting in reduced photosynthesis in 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.

Now the question is how water becomes turbid? Water becomes turbid due to the presence of insoluble substances like soil, sand, oil, grease etc. If these type of substances especially soil and sand increase significantly, at a stage, they settledown as sediment at the bottom of the river. As a result, navigability decreases resulting in huge problem for the water vehicles like ships, launches, boats etc. In Bangladesh, it is common problem of getting stuck of launch or steamer 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 surface water can cause dangerous diseases like cancer in aquatic biota. Therefore, suface water, a habitat for aquatic biota should be free of radioactive substances.

Presence of waste: Surface water must be free of 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 respiration 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 5mg/Litre.*

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

pH: Do you know what is 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. Higher the amount of acid in water, the lower the pH, while higher the amount of alkali, the higher the pH. pH is a very important water quality parameter. Usually surface waters 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 fish 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 to aquatic biota.

Salinity: Do you know why our national fish Hilsha comes to fresh water during spawning? Although Hilsha is a sea fish, it comes in fresh water for spawning because sea water is saline i.e; it contains huge amount of salt which sterilizes fish eggs which cannot produce young fish.But there are some aquatic fauna including certain species of fish which can spawn in water of high salinity.

Recycling of water and role of water in conservation of water: 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's why they can't 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 details in this chapter). Even the underground water being used everywhere including drinking purpose, 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, 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 reuse of water, indeed.

Do you think that water is being recycled naturally? Yes, it is. You have already learnt previously from water cycle that water from surfaces evaporates at day time with the help of sunlight and enter into the atmosphere as vapour which goes upwards and at a stage condenses to cloud and finally comes back as rain water. A major part of the rain water flows as surface runoff and falls into water bodies 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 turn 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. Is it possible to recycle water that is used once? Of course we can. Water obtained after being used i.e; wastewater can be collected, treated and used again. The whole process can be considered as recycling of water.

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 were no water, plant would not grow, there will be no food production and our existence i.e. the whole environment will be destroyed.

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

shower to cooking food we need water. Finally, we have to drink water. If such an important thing in our life is not of good quality, we have to face lots 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 had to collect rainwater, purify it and use. 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.

Purification of water

Surface water may contain harmful substances including toxic chemicals and pathogenic microorganisms. Contamination of groundwater by toxic chemicals is also well known. So whatever the sources, water must be purified before use. Methods of purification of water depend on the purpose of use of 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.

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 place. 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 pollute water in rivers, canals, beals 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 of 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 in 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 by discharging human excreta and petroleum oil like materials from boats, launch, 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.

Effects of water pollution on plants, animals and human beings

Pollution of water of different sources like rivers, lakes and underground may pose deleterious effects and sometimes that may cause disasters. The deleterious 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, coocking or washing food or come in contact with that water, those pathogens are transported 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 the waterbodies will not be able to sustain lives there. These types of rivers or lakes which are not able to sustain lives are called dead rivers or dead lakes.

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 algal 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 Buraganga, 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 for aquatic biota.

Drinking of 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:

Mercury (Hg): Brain damage, skin cancer and deformation.

Lead (Pb): Dizziness, eye irritation, anemia, kidney damage and at high dose brain damage.

Arsenic: Cancer in skin and lungs, gastrointestinal disease

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 in this regard is the nuclear accident happened recently in Fukushima city (11March, 2011) from nuclear power plant. In that accident, due to Tsunami, huge amount of radioactive substances have released to the surroundings and starting from water to food items have been found to have radioactivity. Other than accident, radioactive substances are released during mining, from wastes of nuclear power plants and nuclear weapons manufacturing and they contaminate water.

Discharges from launch, steamer, ships etc. contain diseases causing microorganisms that may destroy the biodiversity in water. In addition, presence of insoluble matters in water makes water turbid and the corresponding effects have already been discussed before.

Effects of global warming on fresh water

Global warming means the increase in atmospheric temperature. If the atmospheric temperature increases, temperature of surface water shall 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 in sea or ocean level. Therefore, the low lying countries will be submerged in water, marine saline water will extrude to surface 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 in 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 aquatic biodiversity.

Precipitation: Due to global warming precipitation and its pattern may change. Computer modeling shows that in some region there will be excessive precipitation

whereas in some region particularly in temperate region there will be reduced precipitation that may create droughts which may make that area a desert. Change in precipitation will alter the flow and amount of water in waterbodies which may cause disasters. Computer model also shows that in some region the precipitation in winter will increase significantly which may cause devastating untimely flood.

Do you see any 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 to fresh water and basically there will be a scarcity of fresh water. In southwestern part of Bangladesh including Sathkhira 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.

Strategy for preventing water pollution and responsibility of citizens: We already know how water is being polluted. The most important aspect of strategy to prevent water pollution is to find out the reasons of 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 wild lives. 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.

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 the pollution in this way 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 in watering tubs, even we can wash cloths or use in 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 rainwater 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.

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 increase public awareness. For that, appropriate educational programmes and warnings can be broadcasted by radio or telvision. 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, 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: Banglaseh is a land of agriculture. 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 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.

Threats at water sources in Bangladesh: Do you think that water sources at Bangladesh (rivers, canals, bills, haors, and lakes) are in threats? Yes, certainly water sources in our country are in several threats. Firstly, the threats due to climate change may be mentioned. You have known before that one third of Bangladesh may be submerged in water due to this kind of change. As a result, our water sources will be destroyed. From a study, it is found that, a 2 metre rise in sea level will submerge one tenth of Banglaseh. Certainly, you have seen the recent Tsunami in Indonesia and Japan and their disastrous after-effects on television. Bangladesh is also at risk of natural disasters like Tsunami.

Threats due to flood and soil erosion: Geologically Bangladesh is a flood prone country. Majority of the rivers in Bangladesh have strong water current and effect of that is 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 deep river the Padma is now in danger. You might see the movement of cart below the Pakshi Bridge on the river Padma. The reason for this 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 Buriganga, the Shitalakkha and the Balu rivers will die soon. The condition of the rivers surrounding Chittagong city is also similar.

Diversion of water flow: In 1975, Indian Government diverted water flow in the Ganges. In 1977, Bangladesh and India signed an agreement on distribution of water of the Ganges. Later on in 1966, another agreement was signed for equitable water distribution. Due to diversion in water flow in Ganges, many rivers in northern part of Bangladesh has been water depleted converting those areas into almost desert. Besides this, India has planned to divert water of Brahmaputra to bring to western India through Shiliguri corridor. If the project is implemented, the water resources of entire southern

part of Bangladesh including 300km^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 of water sources and development: 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.

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, 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 Nation 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 in 1982 and 1987, the Ramsar Convention was amended.

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 watercourse 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.

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

iii. swimming at the bottom of water

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 reduced 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 will happen if pH of water decreases?
   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 the Heart

The blood circulatory system is one of the most vital systems in human beings and other higher 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 structure 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 between normal blood pressure, heart beat, heart rate and pulse rate.
- explain the physical problems related to blood pressure, and its prevention technique.

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 chemicaly 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 as bicarbonate ion.

The elements of blood and their function: The main elements of blood are plasma and blood corpuscle. Plasma is 55% and corpuscle is 45% in blood. Blood corpuscle and plasma can be separated by centrifuge. Plasma is pale yellow in colour and blood corpuscles are deep in colour. Actually blood corpuscles float on plasma.

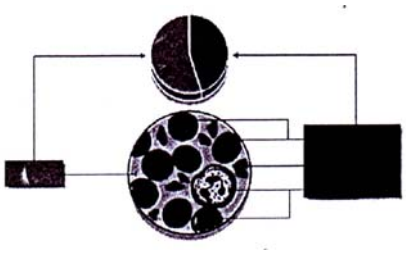


Figure: 3.1 Elements of human blood

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. Extracts the residue from the tissue and transfers to kidney for excretion.
3. The byproduct of respiration that is CO_2 as bicarbonate is transferred to lungs.
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.

Blood Corpuscles

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

Red Blood Cell

The red blood cell of human body is biconvex and disc shaped. 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. RBC

can not multiply. This RBC is produced continuously from bone marrow and they come to the plasma. The life expectancy of bone marrow is near about four months or 120 days. 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. These are approximate and average counts.

Figure: 3.2 RBC

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 for physical excretion.

iii. RBC works as buffer stock to keep balance between acid and alkali.

White Blood Cell or Leukocytes

There are no specific structures 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. 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 higher in the bodies of children and patients.

Types

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

(a) Agranulcytes: This type of WBC is non-granular and transparent. Agranulocytes are of two types e.g. - lymphocytes and monocytes. They are produced in lymph node, 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.

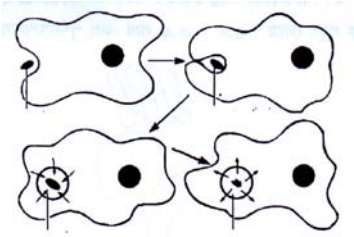


Fig: 3.3 The fagocytosis process of WBC

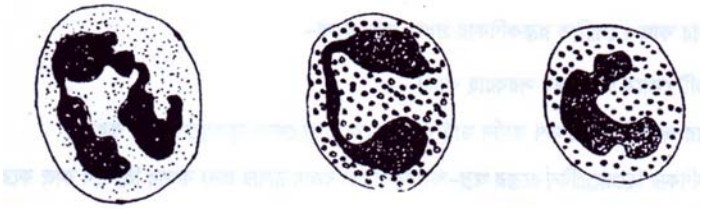


Fig: 3.4 Different types of WBC

(b) Granulocytes: Their 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 histacin 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 2.5 lac per cubic milliliter. The number is higher in a sick body.

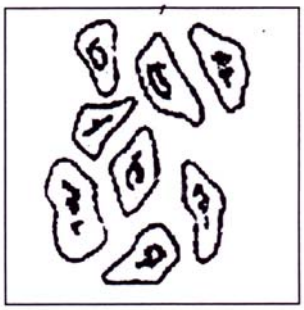


Fig: 3.5 Thrombocytes

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 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.

Exercise: Make a table to differentiate between RBC, WBC and Platelets

The functions of Blood

1. Respiration: Blood transfers CO2 from tissue to lungs and transfers the O_2 from lungs to tissue. Manly 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 controls body temperature 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.
   (b) Hemoglobin } Male : 14-16 gm/dl
   Female : 12-14 gm/dl
3. Platelets: 150000 – 400000 per cubic ml

Other organic substances:

i) Serum Urea: 15 – 40 gm/dl
ii) Serum Creatinine : 0.5 – 15 mg/dl
iii) Cholesterol : 0 – 200 mg/dl
iv) Bilirubin : 0.2 – 1 mg/dl
v) Blood sugar (before meal) normally 3.6 – 6.0 mmol/L
dl = deciliter

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) **Polycithimia:** The number of RBC increases than the normal condition.

(ii) **Anemia:** The number of RBC or hemoglobin decreases than the normal condition.

(iii) **Leukemia:** The number of WBC increases due to pneumonia, plague or cholera. If the number of WBC is abnormally high, that is, 50000 – 100000 then that is called leukemia or blood cancer.

(iv) **Leucocytosis:** If the number of WBC increases to 20000 – 30000 then that is called the leucocytosis. Pneumonia and whoofing cough are the causes of this disease.

(v) **Thrombocytosis:** The number of platelets becomes higher than the normal. Clotting 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: Perpura is caused by dengue fever. The number of platelets decreases than the normal.

(vii) Thalassemia: Thalassemia is a hiredatory disease of blood that affects a person's ability to produce hemoglobin, resulting in anemia. 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 after every three months.

Human Blood Group

When the amount of blood is low or the blood is needed for some reasons, then blood is donated to sick persons from the healthy persons. Blood donating and receiving person should have the same group of blood. It is seen that the blood of donor and receipient normally gets mixed outside the body. But in some cases the blood of donor and receipient does not get mixed, instead the blood coaguletes.

Before knowing of about blood coagulation, we have to know about Antigen and Antibody. If an unexpected protein comes into the blood, a special type of chemical is formed which reacts with the external protein. This substance created by blood is called the antibody. Large amount of antibody is created in blood. The external protein which influences to create the antibody in the blood is called the antigen. When antigen and antibody come to the same solution, a special type of reaction occurs that is called the antigen antibody reaction. In the case of blood cell for the reaction of antigen and antibody the blood corpuscles change into clusters.

In 1900 Dr. Karl Landsteiner while working in a medical laboratory saw that when the blood corpuscles of one person are mixed with the blood of another person the blood corpuscles coagulate. He did more experiments on this matter and found that there are two types of antigen in blood cell and in the same way two types of antibody in the serum.

What is Serum?
Serum is a pale yellow or brown liquid which is separated from the clotting part of blood after blood clotting. There is a difference between plasma and serum. There are blood corpuscles in plasma but no blood corpuscles in serum.

For easy understanding, these two types of antigens are named as A and B. Human beings have any one or both of the antigens or no antigen in their blood. There are four types of blood according to the type of antigen they contain. The human beings who have the antigen A are called the group A, who have the antigen B are called the group B, who have both the antigen A and B are called the AB group and who have no antigen is called the O group. The types of antigen in blood cell must not be the same antibody in serum. It is clear that, if an A antigen carrier in serum has the antibody A then the blood gets clotted and causes death. So A blood group persons have the antigen A and no antibody against it, but there are no B antigen in their body but contain B antibody. The antibody in the blood are called the α (Alpha or anti A) or β (Beta or anti B). Thus, based on the presence of antigen and antibody, the blood of all the human beings are divided into four groups A, B, AB and O.

The table bellow shows that the relation of A, B, O blood group and the relation of donor and receipient.

Blood Group	**Antigen in RBC**	**Antibody in plasma**	**The group to which can be donated**	**The group which can receive**
A	A	Anti- B	A and AB	A and O
B	B	Anti- A	B and AB	B and O
AB	A, B	No antibody	AB	A, B, AB and O
O	No antigen	Both the anti-A and anti- B	A, B, AB, O	O

Antigen is called the Aglutinogen and the antibody is called the Aglutinin. Antigen or aglutinogen stays outside the plasma membrane of RBC. Antibody or aglutinin stays in plasma. Near about 42% of human beings have the blood group ‘A’, 9% have ‘B’, 3% have ‘AB’ and 46% have ‘O’.

It is clear from the above table that the antigen which is not present in the blood only that antibody will be found there. That is, blood group A has the A antigen, B has the B antigen, AB has both A and B antigen. None of them has the same type of antibody. As there is no antigen in blood group O, it contains both the antibody A and B. The antibody of group A clots the RBC of group B, on the other hand, the antibody of group B clots the RBC of group A. But blood group AB cannot clot the RBC of other groups

because there is no antibody in this group. The O group blood clots the other three groups of blood but not its own group because this group has two types of antibody. So the O group can only receive the blood of group O but it is able to donate blood to all the groups.

It is clear from the table that the group A can donate blood to the A and AB. In the same way the group B can donate blood to the group B and AB. The group AB can receive the blood of all the four groups -- A, B, AB and O. That is why AB group is called the universal receipient. In the same way any group can receive the blood of group O. That is why no blood test is required. O group is called the universal donor.

Rh Factor

Rh is an aglutinogen of RBC of a monkey called Rhesus. This antigen is called the Rh factor according to the name of the monkey called Rhesus. The presence of Rh factor in human body is called Rh^+ (positive) and the absence of Rh factor in the blood is called Rh^- (negative).

The Importance of Rh factor: If the Rh^- blood is donated to Rh^+, there will be no reaction for the first time. But antibody in the plasma of the receipient will continuously produce the opposite antibody of Rh^+ antigen. This antibody is called anti Rh factor. If the receipient receives the Rh^+ group for the 2nd time then the RBC of donor will be clotted for the effect of anti Rh factor of plasma of receipients. But if the receipient does not receive the blood for the second time then all the anti Rh factor will be damaged gradually and the receipient will get the normal blood.

Rh factor is very important for pregnant women. If a Rh negative woman gets married with a Rh^+ man, their first child will be Rh^+, because Rh^+ is the dominant character. In the embryo stage RBC of Rh^+ factor of child will reach to the blood through placenta and as the blood of mother is Rh^- then her plasma will create anti Rh factor or antibody.

The blood of the mother of anti Rh factor reaches to the blood of embryo through placenta and kills the RBC of the embryo. So the embryo is damaged and abortion occurs. Even if the baby survives, it suffers from severe anemia and jaundice.

As the opposite antibody is produced very slowly to the mother’s body, no harm is caused to the first child and it remains healthy. But the complexity starts from the next pregnancy and the embryo dies. So, blood test should be done for the bride and bridegroom before marriage. Couple should have the same Rh fector (either Rh^+ or Rh^-).

The importance of classification of blood

i. Blood test should be done for both the donor and receipient before donating because the blood of different group 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 O 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 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.

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.

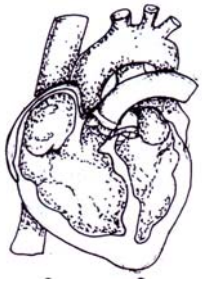


Fig: 3.6 Heart

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 of 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.

In modern language of physiology the upper chamber of heart is called atrium instead of auricle. So, here artrium is used instead of auricle.

Artery

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

Fig: 3.7 T.S. of 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, the artery starts from heart and ends in capillary. Oxygenated blood is transferred from heart to different parts of the body through artery. But pulmonary artery carries blood with carbon dioxide from heart to lungs.

Vein

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

Fig: 3.8 T.S. of Vein

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

Capillary

Any of the minute blood vessels that form networks throughout the body tissues are called capillaries. It is through the capillaries that oxygen, nutrients and wastes are exchanged between and tissues.

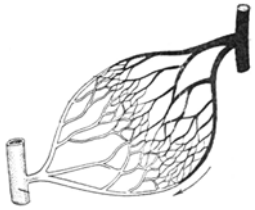


Fig: 3.9 Capillary Net

Functions of the heart

We know that the blood circulatory system of human body is formed by heart, vein, artery and capillary. The human heart continuously expands and contracts and circulates blood through veins and arteries. 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. The blood circulates in human body in the following way-

i. When atrium is in diastole stage, all the blood with carbon dioxide comes to the right atrium through superior and inferior vena cava and oxygenated blood from lungs to atrium by pulmonary vein.

ii. When two atriums are filled with blood, they contract, that is, systole begins in atrium. The blood with CO_2 comes to the right ventricle from the right atrium and oxygenated blood from left atrium to left ventricle. The ventricles are in diastole stage at that time.

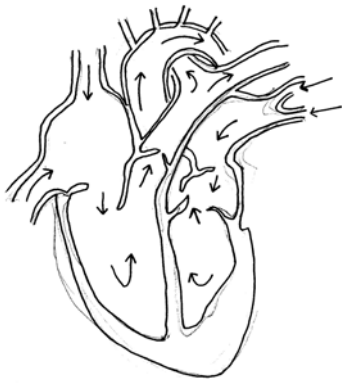
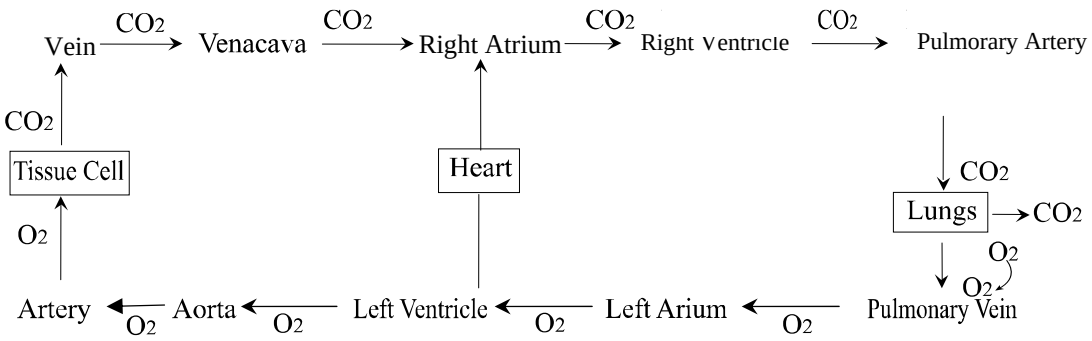


Fig: 3.10 L.S. of Heart

iii. When the ventricles are filled with blood, it goes to systole.

Thus, the heart circulates blood by systole and diastole in the human body. At this time the oxygenated blood reach from left ventricle to aorta and CO_2 rich blood from right ventricle to pulmonary artery. Blood is circulated by different arteries and sub arteries to different capillary of body and they supply nutrient and O_2 to the cell. On the other hand CO_2 rich blood is transferred to pulmonary net from pulmonary aorta. The blood receives oxygen from the lungs and forces it to the left atrium through pulmonary vein. On the other hand CO_2 rich blood again reaches to the atrium from capillary through different veins and vena cava. The heart circulates blood to the different parts of the body by expansion and contraction in a rhythmic way.



The graphic picture of blood circulation

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. 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. This cardiac cycle is related to expansion and contraction of the heart. Cardiac cycle consists of four steps-

1. **Diastole of Atrium:** This time the atrium is expanded so that blood reaches to left and right atrium.

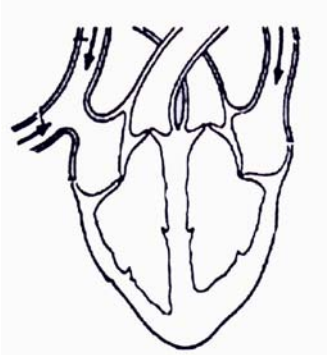


Fig: 3.11 Cardiac cycle A

2. **Systole in Atrium:** When the atriums are filled with blood, they contract. So, blood is sent to the ventricle.

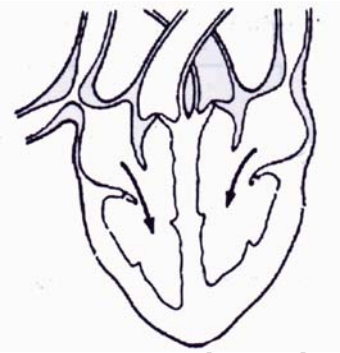


Fig: 3.12 Cardiac cycle B

3. **Systole of Ventricle:** The 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 ‘Lab’.

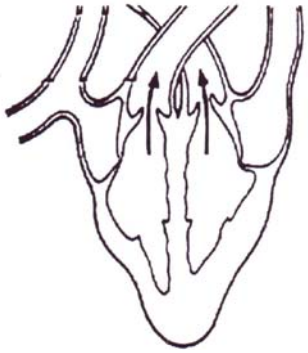


Fig: 3.13 Cardiac cycle C

4. **Diastole of Ventricle:** The diastole of ventricle starts just after the systole of the ventricle. At the time of diastole and the closing time of valve the second sound is called the 'Dab'.

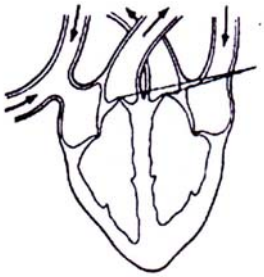


Fig: 3.14 Cardiac cycle D

So the sounds of the heart are-
The systole of ventricle- Lab
The diastole of ventricle- Dab

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 special 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, it is called pulse rate.

The method of counting pulse rate or heart beat: The wrist of 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 fight pointer is placed towards the heart and middle finger is in the middle and the ring finger is near to the fingers of the patient. Now, the heart beat per minute can be felt by the middle finger. This is pulse rate. The pulse rate in resting stage is-
adult: 60 – 100 times per minute
child: 100 – 140 times per minute

Fig: 3.15 Pulse rate

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. The 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. The pulse rate increases 10 per minute for increasing 1degree 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.

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 expressed as 140/90 mm Hg. Sphygmomanometer is the machine for determining blood pressure.

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 160 mm Hg and the diastolic blood pressure is higher than 95 mm Hg that is called the 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. 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. The 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 and prawn.
4. Take a balanced diet.
5. Don't take more food than you need.
6. Keep away from smoking and dinking wine.
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.
11. Always follow the advice of doctor.

Heart Block

Irregular heart beat or if the flow of heart is not on the right way that is called heart block.

Heart Attack

If the coronary artery fails to supply blood to the heart muscle then it causes heart attack.

Heart Failure

If the ventricle or atrium or both fail the capacity of contraction, that is called heart failure.

ECG

When the heart contracts and expands an electric flow originates from the muscles of the different parts of the heart. This electric flow graph is printed on papers by a machine. This graph is called ECG (Electro Cardiograph). The machine which records the activity of cardiac muscle is called the Electro Cardiogram.

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. There are two kinds of Lipoprotein according to the amount of fat- High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL). If the LDL of blood increases, 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 100–200 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 the 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 the 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.

Ways to keep the heart healthy

We knew from the first chapter that we need balanced diet for healthy body. Rest and exercise are needed to keep the body active. Eating balanced diet is important. Develop some good habit 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 causes the weak heart.
2. Food should have a combination of both animal and plant proteins.
3. There should be control in carbohydrates, sugar and fat food. Vegetables 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.
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, deciplined life, that is, sleeping on time, avoid smoking and drinking wine, can save from heart diseases and high blood pressure.

Diabetes

Diabetes is a metabolic disease. The normal amount of glucose in human body is 80–120 mg/dl. If the amount is higher in blood, that is called diabetic mellitus. The amount of glucose increases permanently for this disease. 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.

High risk people of diabetes

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

1. Hereditary- Father, mother or close relation who have diabetes
2. Over weight and fatty body
3. No physical exercise or physical work
4. Taking steroid medicine for a long time

Symptom 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) Food Control: If a fat person gets diabetes he/she has to take food according to doctor's recommendation until the weight does not become normal. Diabetes patients should not take sugar or sweet. 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) Avoid 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 have in blood?
   a) O_2 b) CO_2
   c) Cl_2 d) N_2

Creative Questions

1. See the figure below and answer the question:

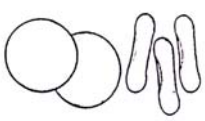


Figure- A

Figure - B

Figure – 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 the Figure A and Figure C are located in the same connective tissue but their functions are different. Explain.

2. 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 saw 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.

Chapter Four

Starting a New Life

It is thought that life 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 position and has a more or less specific climate. Many species live on this earth. That is the first created early life evolved to these species. The events for creation of earth are called the chemical evolution. Biological evolution means the change of life in any population, which creates a new species.

Man is the greatest creation of the Creator. Man's life begins with a cell in the mother's womb. In the early part of life it takes the shape of a baby. Later the baby 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 shall 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.

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 beings 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. The 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. Adolescence is the middle period of childhood and youth.

Changes at Puberty

Among the changes of adolescence the physical changes are noticed first. These changes give clear ideas about one's adolescence.

Fig: 4.1 Girls become conscious about the changes

Fig: 4.2 Boys and girls become tall rapidly

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. Many more changes occur in boys and girls from the age of ten and it continues for three to four years.

The boys of more than ten years of age have to face many changes. The great change is night pollution or involuntary loss of semen. They have no control over it. This can happen frequently and this is normal.

There are three kinds of changes in adolescence.

1. Physical
2. Mental
3. Behavioural

Physical Change

(a) Growing taller rapidly.
(b) Increase of weight
(c) Rigidity in body.

(d) Change of physical structures towards adulthood.
(e) Developing beard and moustache at the age of 16/17.
(f) Growing hair in different parts of the body.
(g) Coarseness of voice.
(h) Ejaculation in boys
(i) The chest and shoulder of boys becoming broader
(j) Beginning of menstruation in girls
(k) Expansion of the hip bone in girls

Mental Change

(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) Getting attracted to drugs i.e. cigarette
(f) Starting the stage of mental maturity
(g) Starting to become self dependent instead of depending on others

Behavioural Change

(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

Activity Sheet

Exercise: Fill up the table below (individual work)

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

The cause of changes in adolescence

Normally the adolescence period ranges from 10 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 chemicals called hormones are the causes for the changes of adolescence period. Hormone is produced in the body in a natural way. The hormones for boys and girls are

different. So the changes are also different. Main two hormones are responsible for the changes of girls. These are estrogen and progesterone.

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. Menstruation cycle takes place after 28 days or once a month and it lasts 3-7 days. Regular menstruation is the sign of capacity for giving birth to a baby.

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. Morbid hoarseness in voice, growth of beard and moustache and rapid physical developments occur in this time.

Fig: 4.3 Boys grow moustache and beard in adolescence

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 physical changes along with the mental changes. They become imaginative and act with emotion. They want to keep themselves smart and tidy. They feel attraction for the opposite sex. Thus, the teenagers step in adulthood.

Fig: 4.4 The teenage girl is beautifying herself.

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

Statement	True	False
• 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 10-19 years is called the adolescence period. You also know that physical and mental changes happen in this period. Keeping healthy body is related to this subject.

Keeping proper physical health

Beard and moustache grow and ejaculation happens occasionally in sleep to boys in adolescence period. This is also called the night pollution. This is not a matter of fear or shyness. This is a normal change in body. Normally the sperms start to be produced at the age of 13 to 19. Sometimes this sperm comes out of the body in sleep. Production of sperms is a natural and continuous process. Bathing is necessary after ejaculation. In this time nutritious food, especially vegetables and water, should be taken. If any physical or mental problem happens in this period, it should be consulted with the parents or intimate relatives. In further complexity a doctor should be consulted. Sometimes, itching around sex organ or scars in thigh joints may occur. Cleanliness is important to be safe from this problem. If it is not cured within few days, a doctor should be consulted.

Fig: 4.5 Teenage boys and girls should take nutritious food during this time.

Like boys changes also take place in the girls. Menstruation is an important change for girls in this period. Normally at the age of 9-13 menstruation starts. It is a normal process for the girls and continues for 3-5 days. This duration can be longer or shorter. Girls should keep clean, take regular bath, eat nutritious food and should drink sufficient water. Girls should take sufficient rest in this period. As blood is lost during menstruation, they should take lots of fish, meat, vegetables and fruits for recovering the loss. Abdominal pain may occur during menstruation. In that case fomentation with hot water can be comfortable. Headache and lumbago can happen. Seeing all these symptoms girls should not be afraid. If the pain is severe a doctor should be consulted.

A clean and dry piece of cloth can be used as absorbent. Germ-free cotton or pad is better. If the cloth is needed to be reused then it should be washed with soap and hot water and then dried in the sun. This cloth should not be kept in a dark or humid place.

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 the 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 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.

Necessary mental help and counseling should be provided to the adolescents so that they grow healthily and can build a better future.

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	•

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?

Pregnancy is a special change of the body. This change occurs when a child develops in the womb. When a sperm and an ovum unite, a baby is born in the womb. The women face some uneasy symptoms in the early few months of pregnancy.

These symptoms are-

- Stoppage of menstruation
- Nausea and vomiting
- Giddiness and headache
- Frequent urination
- Swollen or tender breast

Fig: 4.6 There may be vomiting in pregnancy

So, you know what pregnancy is, how it happens, and what its symptoms are. Now, you will know the consequences of early pregnancy and mature level pregnancy.

Health risk

The physical and mental problems for pregnancy in proper age are not many. The 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.

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 mother's womb. So, low weight baby is born. This baby has low immunity. This baby cannot grow as a healthy and successful man.

Education 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. So, she drops out of school.

Family problem

The girls cannot do the household work for immature pregnancy. Frequent physical sickness leads to unhappiness in the family.

Fig: 4.7 The girl dropped out of school

Fig: 4.8 Difficulty in household works

Financial Problem

Doctors have to be consulted regularly for the whole nine months of pregnancy. Besides this, a pregnant woman needs to see the 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.

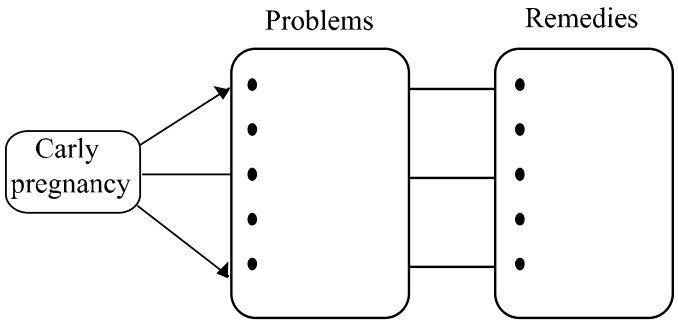
Fig: 4.9 Need to see doctor frequently so the family faces financial pressure.

Miscarriage and its complexities

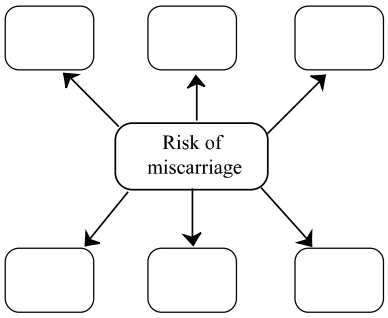
When a foetus grows in its mother's womb, in the first stage, it develops in the uterus. In the developing stage of embryo, if the embryo comes out spontaneously from the uterus,

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 influenced by others or for frustration. This causes risky abortion. Such an abortion has mental and emotional effects. All should be made aware of this.

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



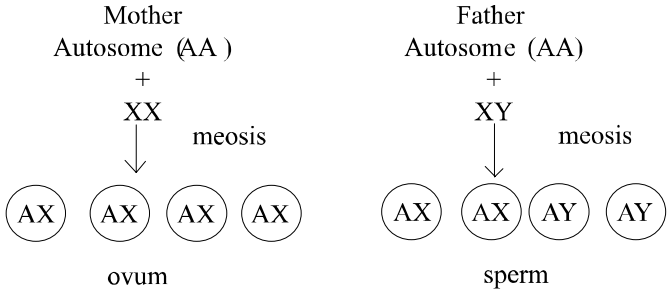
Task: Describe the risks of miscarriage.



Test tube baby

If the ovum and sperm are fertilized outside the body, then this early embryo is placed in the uterus of 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. It includes collection of ovum and sperm from a sexually capable couple, fertilizing them in a culture medium to produce early embryo, placing the embryo in the uterus of a woman, taking care of the pregnant woman and finally child birth.

We know that each cell of a species has a specific number of chromosomes. But sex is determined by a specific pair of chromosome. These are called the sex chromosomes. They are identified as X or Y chromosome. The other chromosomes are called the autosomes. Autosome is denoted by the letter A. In diploid stage, the female has XX chromosome and the male has XY chromosome. Thus, the chromosome of man and some other animals is shown as 2A+ XX for female and 2A+XY for male. Human cell has 23 pairs of chromosomes. So, how many pairs of autosomes and sex chromosome will be in human cell? Try to understand from the index. There are 22 (11 pairs) autosomes with one X chromosome in the mother's reproductive cell. Female sex cell is divided by meiosis into four ova and each of the ovum has one sex chromosome. So, the ovum has X chromosome. In the case of male, after meiosis cell division, it produces four sperm cells. In two sperm cells, each of them has 11 pairs of autosomes and one X chromosome. In other two sperm cells, each of them has 11 pairs of autosomes and one Y chromosome. So, the sperms are of two types –containing either X chromosome or Y chromosome. If the ovum is fertilized with a sperm having X chromosome, it gives birth to a girl child because XX chromosomes get united. On the other hand, if the ovum is fertilized with a sperm containing Y chromosome, it gives birth to a boy child because X and Y chromosomes get united.



Development of sex cells in human body

		Male sex cells	
		AX	AY
Female sex cells	AX	AAXX (girl)	AAXY (boy)
	AX	AAXX (girl)	AAXY (boy)

Sex determination

In our country, the village people think that mother is responsible for producing a female child because of their lack of knowledge and superstition. But there is no role of mother in this matter. It only depends on the sperm cell of the father which carries X or Y chromosome. Giving birth to a boy or a girl depends on the fertilization of ovum with X chromosome sperm or Y chromosome sperm. So, the mother has no role in producing a boy or a girl. The father is also not responsible for that. Producing a boy or a girl is determined by nature.

Origin of life on earth

Among the known living beings more than ten lac animals and about four lac plants have been identified. In ancient times, people thought that there were no changes of earth in shape and area. According to their opinion there are no differences between the living beings of ancient time and those of the present time. But in 5th Century BC a scientist named Xenophanes discovered some fossils. He proved that there are differences between the ancient and present living beings. That is, the structure of living beings is not constant.

In 4th Century BC Greek philosopher Aristotle proved that the living beings of one class are higher than other classes. They have come to the present stage after a long process of changes through evolution. Evolution is a slow and continuous process. Structurally complex lives are evolved from simple life. According to many scientists the earth was a burning gaseous substance. This gaseous substance continuously lost its heat and condensed to a liquid substance. Then this substance became solid from the outside to inside and its byproduct water vapour turned into cloud. That cloud turned into rain. That rain produced the water of outer portion of the earth. This water of outer portion of the earth is called the ocean. The present living beings are created from the living beings of that ocean through continuous changes.

After deep thinking and experiments the modern men have developed the idea that, evolution is the root of creation. The word ‘evolution’ came from the word ‘evolveri’. An English philosopher and educationist Herbert Spencer at first used the word ‘evolution’. Evolution is a slow and continuous process by which a simple living being changes into a complex and higher living being. When a living being is transformed into a new species, the process is called the biological evolution.

How, When and Where Life was 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: the presence of different salt in cell, blood and other fluid of the body which have similarities with

minerals of sea water. Secondly, the sea water has many unicellular simple organisms. About how life was originated on this earth, the scientists have estimated that near about 260 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, this chemical 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. Proto-virus 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 was 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. Then photosynthetic life began to increase. Then multi-cellular organisms evolved from unicellular organisms. Then evolution of plants and animals began in two lines. The stages of hypothetical evolution are shown below:

Carbon dioxide, nitrogen, hydrogen

↓

methane, ammonia, water vapour

↓

amino acid

↓

nucleic acid, protein

↓

nucleoprotein

↓

proto-virus

↓

virus
↓
bacteria
↓
protozoa
↓
multi-cellular life
↓ ↓
plants animals

Evidences for evolution

Two concepts are tried to establish for the concepts of 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:

(a) 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.

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. 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 evolutionists 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.

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.

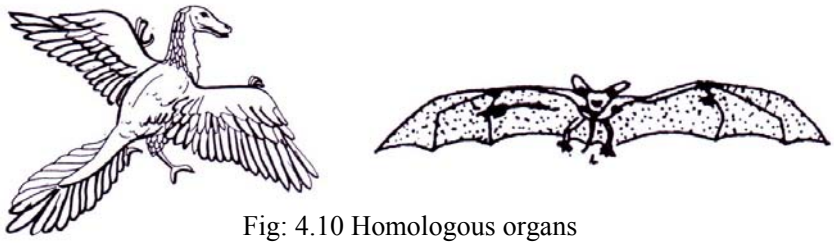


Fig: 4.10 Homologous organs

Vestigial Organs: There are some body parts which are active in some animals and inactive 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 inactive but in guinea pigs they are active. 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 active.

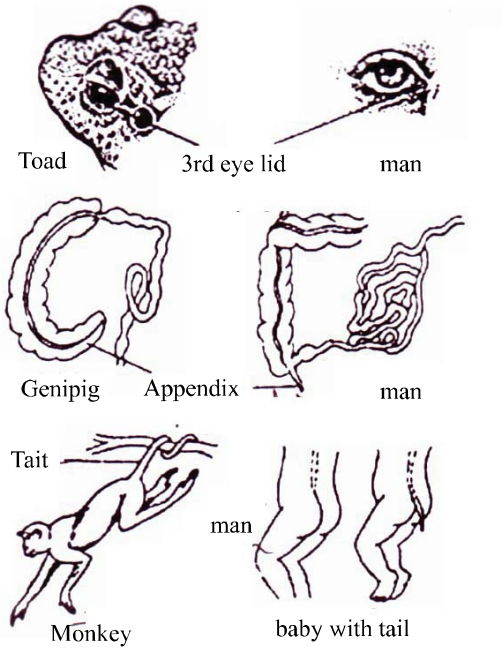


Fig 4.11: Vestigial organs

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.

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, platypus 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.

Fig: 4.12 Platypus

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.

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.

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.

How the information of fossil experiments proves the theory of evolution is discussed below:

After the experiment of extinct archaeopteryx 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.

Fig: 4.13 Archaeopteryx

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.

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 the living fossil. The arthropod *Limulus*, reptile *Sphenodon*,

mammal platypus are the examples of living animal fossils. Equisetum, Gonium, *Zinco biloba* are the examples of living plant fossils.

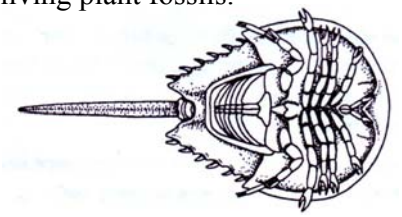


Fig: 4.14 Limulus-a living fossil

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.

Theories of evolution

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

Lamarck's theory

Lamarck 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:

Fig: 4.15 Lamarck

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 character of living beings.

3. Transmission of acquired character 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 character in every generation, some new characters 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 legs finger and that legs turned into webfoot.
- 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 modern 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.

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) 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."

Fig: 4.16 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) Intra-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) Inter-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 unfavorable 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 livings beings are not the same, there are some differences among them. The differences among the two living beings are called variation. The favorable 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 favorable 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 unfavorable variety cannot adapt with the nature and gradually becomes extinct.

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

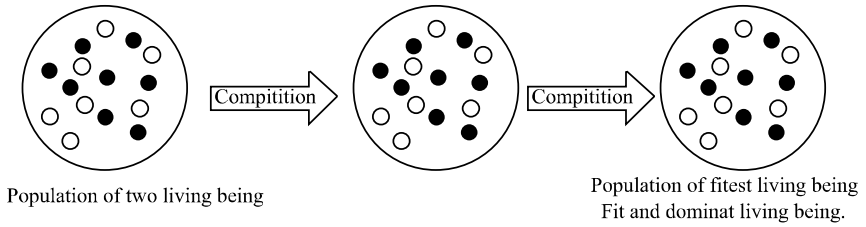


Fig: 4.17 Illustration of struggle between two living beings

7. Origin of new species: The plants and animals which have the favorable variation, the nature selects them and rears them. Favorable varieties of plants and animals can adjust with the environment and can multiply more compared with unfavorable varieties. Favorable variation is inherited in their generation. Nature selects the generation that have more favorable 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 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.

Darwin is called the father of evolution but his theory of evolution is not absolutely correct. He could not explain some aspects of his theory and many scientists do not regard his explanations scientific.

Exercise

Multiple Choice Questions

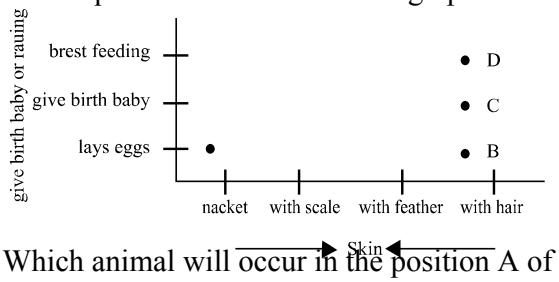
1. In which water did life first originate?
   (a) River water (b) Fountain water
   (c) Sea water (d) Pond water
2. Before the creation of proto-virus the atmosphere had the gas-
   i. Oxygen ii. Hydrogen iii. Nitrogen

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 theory explained by the father is more acceptable? Give your opinion with comparative study.

Chapter Five

Light for Sight

The necessity of light is unlimited in our daily life. If we close our eyes we cannot see anything. Again in a complete dark place we cannot see anything in spite of opening our eyes. Light is that cause, with the help of which we can see. You have been acquainted with the different phenomena of light at junior secondary level. In this chapter, other than the uses of mirrors, you will know more about the refraction of light. Moreover, you will know about the functions of eyes, the least distance of distinct vision, power of lens, defect of vision and uses of lens and the way of keeping eyes normal.

After the lessons of this chapter we will be able to—

1. explain the uses of mirrors.
2. explain the refraction of light.
3. explain the function of eyes in the activities of vision.
4. explain the least distance of distinct vision.
5. explain the power of lens.
6. explain the causes of defects of vision.
7. describe the way of rectifying by using lenses for the defects of eyes.
8. explain the way of keeping eyes normal.
9. investigate the causes of creating defects in eyes.
10. take care of eyes and will make others conscious.

Uses of Mirrors

There are manifold uses of mirrors in our day to day life. In this lesson we will discuss about two special uses of mirrors. These two are safe driving and the other use of mirror is in the dangerous invisible turning of hilly roads.

Safe Driving

One of the conditions of safe driving is to keep attention in all times on what is happening on all sides of the driver's car. Usually two (convex) mirrors are used facing on the two sides of both the front doors of the car. Besides, on the middle of the inside front of the car there remains one (convex) mirror. These mirrors help to see the view of both sides and back side of the car. So, the driver does not require twisting or moving his body in any way.

As a result of this, to show any reaction for any occurrence it is easier for the driver to keep his eyes on the front and back side of the car keeping his hand on the steering wheel all the times. Before starting the car both the mirrors are to be adjusted in proper

places, so that the driver can see clearly both sides and back side of the car sitting on the driving seat.

Figure-5.1: Safe driving

It is to be noted that mirrors should be cleaned properly so that there remains no dirt or dust and sand particles. Otherwise the position of the image of another car may be changed. For any reason if it requires to take the car back then at first you are to throw your eyes on the three mirrors and keep the eyes on three mirrors all the time till the car is not stopped. Moreover, before changing the lane of the car you should be attentive to the three mirrors so that you can understand the positions of the cars behind and both sides of you.

The invisible turn of hilly roads

The hilly roads are usually zigzag. There is often such an invisible turn that the next road is situated at 90^0 angle. For these reasons it is dangerous to drive in hilly roads. Considering these problems there are big size spherical mirrors on the stands kept standing at different turning of hilly roads. As a result, coming nearer to it by looking at the mirror it is seen whether any car is coming from the other side of the turning and accordingly the driver can cautiously control the speed of the car to drive safely.

Figure-5.2: The invisible turn of hilly roads

Refraction of light

You have seen the refraction of light and its real application in class eight. We know that in a transparent homogeneous medium light always travels in a straight line. When a ray of light incident not perpendicularly but obliquely from one transparent medium to another transparent medium the direction of the ray changes at the surface of separation of the two media. The phenomenon of this change in direction of a ray is called the refraction of light.

Observe the figure below. Here XOY is the surface of separation of two media and NON′ is the normal at the surface. If a ray of light incidents along the line AO then AO is the incident ray and the point O is the point of incidence. The first medium is air and the second medium is glass. Glass is optically denser than air; so, the ray of light AO travels from air into glass, it is refracted towards the normal ON′ and passes along the line OC instead of going along OB. Here OC is the refracted ray. ∠AON is the angle of incidence and ∠CON′ is the angle of refraction. It is mentionable that, if the incident ray was not along AO but along the line NO (normal incidence) then it would be refracted straight way along the line ON′.

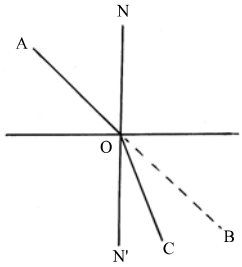


Figure-5.3: Refraction of light

Laws of refraction

On the basis of the nature of the travelling light ray at the time of refraction the general decision can be given that it may be expressed by two laws.

1. The incident ray, the normal drawn at the point of incidence on the surface of separation and the refracted ray all lies 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 and the sine of the angle of refraction remains always constant.

The constant number mentioned in the second law, that is the refractive index of the second medium relative to the first medium for the particular colour of light. That is, for different colour of light, the magnitude of these refractive indices is different.

How we can see— Functions of eyes

You have known about the structure of eyes in class eight. In this current lesson we will discuss about how we can see through functioning the eyes. Among the components of the eyes, cornea, eye lens, aqueous humour and vitreous humour collectively act as a converging lens. Whenever any object remains in front of us, the reflected rays of light coming from that object is refracted by that lens of our eyes and creates inverted image of the object on the retina. When light falls on the retina, the small rods connected with the nerves and fovea centralis or cone cell (yellow spot) receiving that light, converts into electric impulses. That nerve instantaneously transmits the electric impulse to the brain through the optical nerve. It is mentionable here that the yellow spot (cone cells) responds at intense light and helps to understand the perception of colours and differences in colours. On the other side, the rods are even sensitive to insufficient light

and help to understand the movement of the object and a sharp increase or decrease of light intensity. The inverted image (negative) created on the retina is again inverted (positive) by the brains. As a result, we see the object straight as it was initially.

The least distance of distinct vision

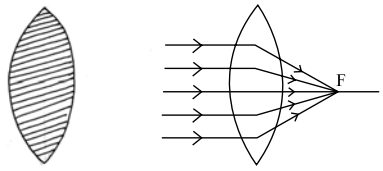
The accommodation capacity of a normal eye is not infinity. If the position of an object nearer to an eye is less than the least distance of distinct vision then the eye cannot see it distinctly. The minimum possible distance with respect to the eye at which point an object is seen distinctly without fatigue, that is known as the near point of distinct vision and the distance of near point from the eye is known as the least distance of distinct vision. This distance varies with the age of the man. This distance may be 5 cm for a child and the least distance of distinct vision of a normal eye of an adult is 25 cm.

What is lens

The transparent refracting medium surrounded by two spherical surfaces is known as lens. Most of the lenses are made by glass. But lenses are also made by quartz and plastic and the uses of these are increasing day by day.

Mainly lenses are of two types, namely, a) Convex or converging lens, and b) Concave or diverging lens.

In figure 5.4, (a) is the convex lens. It is also called as thick-middle lens. Because its middle part is thick and both the edges are thin. The ray of light is incident on the convex surface of the convex lens. This lens generally converges a parallel beam of light at a point [figure 5.4(b)]. On the other hand, the middle part of a concave lens is thin and both the edges are thick [figure-5.5 (a)]. The ray of light is incident on the concave surface of this lens.



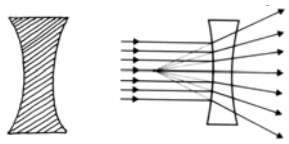
(a) (b)

Figure-5.4 Convex lens

This lens diverges a parallel beam of light to infinity. So, if the diverging rays are extended backward, they meet at a point and it seems that diverging rays are coming from that point.

Generally the centre of the sphere of which the spherical surface of the lens is a part is called the centre of curvature of the lens and there are two centers of curvature of a lens for two surfaces.

The straight line going through both the centre of curvature of the lens is the principal axis of the lens. The incident parallel beam of light parallel and nearer to the principal axis of the lens after refraction converges at a point (convex lens) or appears to diverge from a point (concave lens) of the principal axis of the lens, that point is called the principal focus of the lens. In figure-5.4 (b) and 5.5 (b), the point F is the principal focus. The distance from the optical centre to the principal focus is the focal length of the lens.



(a) (b)

(a) Figure-5.5 Concave lens

Power of lens

We know that the incident parallel rays parallel to the principal axis of the lens converge at a point on the principal axis after refraction by a convex lens. On the other hand the incident parallel rays parallel to the principal axis of the lens diverge after refraction by a concave lens and it appears to diverge from a point of the principal axis. This capacity of converging and diverging of light rays by a lens is the power of the lens.

Actually the tendency of converting a parallel beam of light into converging (convex lens) or diverging (concave lens) beam of light by a lens is the power of the lens.

The conventional unit of power of a lens is diopter. Its S.I unit is radian/meter. The power of a lens may be positive (convex lens) or negative (concave lens). The power of any lens +1D means it is a convex lens and it will converge a parallel beam of light at a distance 1 meter on the principal axis from the optical centre of the lens.

Similarly the power of lens is -2D means the lens is a concave lens and it diverges a parallel beam of light parallel to its principal axis in such a way that it appears (seems) that the rays are diverging from a point 50 cm away from the optical centre of the lens on the principal axis.

Defect of eyes and its remedy

Have you any idea regarding the problem of eyes? In this lesson we will discuss different defects of eyes and its remedy. We know that the near point of a healthy and normal eye of an adult remains at about 25 cm far from the eye and the far point remains at infinite distance from the eye. Within this long range of vision (25 cm to ∞) wherever an object lies the eye will see that object without any difficulties. This is the normal range of vision of eyes. If this normal range of vision of eyes is obstructed then it is called the defect of vision.

The defects of vision of eye are of four types. These are—

a. Myopia or short sight.
b. Hypermetropia or long-light.
c. Presbyopia.
d. Astigmatism.

Among these the first two are the main defects of vision. These two defects are discussed below.

Myopia or short sight

When an eye can see the object near to it but cannot see the object at a far distance from it then this defect of eye is called short sight. The far point of such an eye remains at bit closer which is less than infinity and the eye can also see the object more distinctly when it comes nearer than the least distance of distinct vision. Two causes for which this defect arises are mentioned below:

1. If the converging power of the eye lens increases or the focal length of the eye lens decreases.
2. If the radius of eye-ball increases for any reason.

As a result, the reflected rays of light coming from an object at a far distance falls on the eye and after refraction by the eye lens forms an image (F) in front of the retina [Fig 5.6 (a)] So eye cannot see the object.

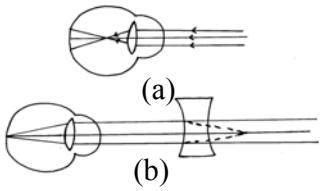


Figure-5.6 Short sight and its remedy

Remedy

To rectify this defect, the person of defective eye is to use such a spectacle of concave lens so that the focal length of the lens is equal to the distance of the far point of the short sighted person. The lens of this spectacle decreases the increased converging power of the eye lens by the diverging power of the concave lens used accordingly. So the reflected parallel rays of light coming from infinity or beyond the far point of the defective eye before falling on the eye will be diverged as per requirement by the auxiliary concave lens [Fig 5.6 (b)] and these diverged rays after refracting through the eye lens will converge on the retina (R). If the diverging rays are extended backward then they will meet at a point T. Hence eye will see the virtual object at T which is the far-point of short sighted person.

Hypermetropia or long sight

When an eye can see the object at a far distance but can not see the object near to it then this defect of eye is called long sight. Generally this defect is seen with the elderly persons. Two causes for which this defect arises is mentioned below.

1. If the converging power of the eye lens decreases or the focal length of the eye lens increases.
2. If the radius of the eye ball decreases for any reason.

As a result the reflected rays of light coming from the normal near point (N) falls on the eye and after refraction by the eye lens converges at a point F behind the retina [Fig 5.7(a)]. So eye can not see the object.

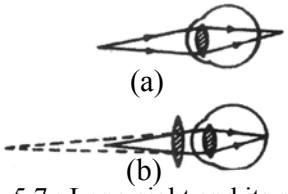


Figure-5.7 : Long sight and its remedy

Remedy

To rectify this defect one is to use a spectacle of convex lens in front of the eye. For this the reflected rays of light coming from the near point (N) of the eye [Figure-5.7 (b)] falls

on the auxiliary convex lens and then on the eye lens and after refracting consecutively twice converges as per requirement then it will fall on the retina (R). If the refracted converging rays of auxiliary lens are extended backward it will meet at a point N_1. Hence the eye will see the virtual object at that point N_1, and this point N_1 is the least distance of distinct vision of the far sighted eye.

The way of keeping eyes normal

Our eyes are very important organs. It is necessary to take proper care of these so that these are kept normal and functional. There are many ways to keep the eyes normal. Among these are mainly to take genuine nutritious food, to lead a disciplined life, to use sufficient light in daily activities, to read books, or to use computer in proper method. Detail of these is described below.

It is essential for the eye to take genuine nutritious food. For this, it is necessary to select proper food. Among these are mainly vitamin A, C and E enriched food, fatty acid related food, zinc enriched food, deep green vegetables, and different types of fruits, especially of yellow colours are good for the eyes. These types of food help to keep the eyes disease-free. Sweet potato, carrot, oily fishes, broccoli, wheat, sweet pumpkin, fruits etc should be eaten more.

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 for this, 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 sun-glass 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. Moreover, it is not wise to touch the eyes with hands after working with chemicals.

Insufficient light is harmful to eyes. 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 computer for a long time, your eyes become tired. Through research it is found that, long time using computer is harmful to the eyes. So, to save the eyes from these harms, the computer should be used keeping it at a distance and giving proper interval.

Exercise

Multiple Choice Questions

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

   a. 5 cm b. 10 cm

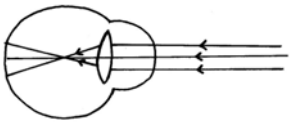
   c. 25 cm d. 50 cm

2. For convex lens it is applicable that—
   i. its power is positive.
   ii. the middle part of the lens is thin and both the edges are thick.
   iii. it converges the parallel rays at a point.

Which one is correct below?

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

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



3. What is the name of the defect of eye mentioned in the figure?
   a. Short-sight b. Long-sight
   c. Presbyopia d. Astigmatism
4. What type of lens should be used to rectify the afore-said defect?
   a. convex lens b. concave lens
   c. convexo-concave lens d. plano-concave lens

Creative Questions

1. Sejuti cannot see clearly the writings on the blackboard by the teacher from a far distance. On the other hand Sejuti's father faces problem to see the things nearer. Subsequently Sejuti and her father having taken to a doctor, the doctor advised to use one kind of lens for Sejuti and a different kind of lens for her father.

a. What is called refraction of light?
b. What does it mean by the least distance of distinct vision?
c. What type of defect of eye attacked Sejuti? Explain.
d. Analyse logically the reason of doctor's advised for Sejuti's father to use different kind of lens.

2. See the figure below and answer the question.

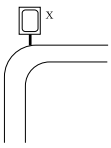


Figure-1

Figure-2

a. What is called lens?
b. What does it mean by power of a lens?
c. What is the cause of using the mirror X in fugure-1? Explain.
d. Explain the role of the mirrors P, Q, and R in the car in fugure-2.

Chapter Six

Polymer

Introduction: In our daily life different types of polymer substances are closely related. Some of them are natural while others are synthetic. Some of the polymer substances are environment friendly and some of them are harmful for the environment.

After studying this chapter, we shall be able to-

1. Explain natural and synthetic polymer.
2. Explain the polymerization process.
3. Describe the sources, characteristics and usage of natural and synthetic polymers.
4. Explain the process of yarn manufacturing from fiber.
5. Explain the characteristics of different types of yarn.
6. Explain the physical and chemical properties of rubber and plastic.
7. Explain the role of rubber and plastic for environmental imbalance.
8. Identify the characteristics of different types of yarn by applying heat.
9. Be aware of using rubber and plastic.

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. So, if many small parts are linked together to form a large object, it can be termed a polymer. Consider the structure of an iron chain where small pieces of iron are connected to make the chain. So the chain here can be considered as a polymer. In chemistry, polymer is formed by chemical linking of monomer molecules.

Polythene bag used widely 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.

Polymerization

The process of making polymer from a monomer is called polymerization. Usually polymerization requires high pressure and temperature. Now let us see how we can represent polymerization. If two monomers are linked together, the product will contain only two units of monomer i.e. it can be written as-

$$1 \text{ monomer} + 1 \text{ monomer} \rightarrow \text{monomer-monomer or } (\text{monomer})_2$$

If three monomers are joined together, the product will contain three monomer units and we can write-

$$1 \text{ monomer} + 1 \text{ monomer} + \text{monomer} \rightarrow \text{monomer- monomer-monomer or } (\text{monomer})_3$$

If the polymer is produced from n number of monomers, then the polymerization process can be written as-

$$n \text{ monomer} \rightarrow (\text{monomer})_n$$

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

$$n(\text{ethylene}) \xrightarrow[O_2 \text{ catalyst}]{200°C,\ 1000\text{-}1200 \text{ atm}} (\text{ethylene})_n$$

Or

$$n(CH_2\text{-}CH_2) \xrightarrow[O_2 \text{ catalyst}]{200°C,\ 1000\text{-}1200 \text{ atm}} (\text{-}CH_2\text{-}CH_2\text{-})_n$$

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.

Fiber and Yarn

You know that cloth is one of our fundamental rights. Cloth saves us from heat and cold, and helps us to maintain our privacy. 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 modern 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.

Fibers are very valuable resources and can be divided into two categories according to their sources. 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. made synthetically by the chemical reactions are called man made fiber.

Among the natural fibers, cotton, jute, linen, 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, asbestos and metallic fibers 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.

Characteristics and Use of Fibers

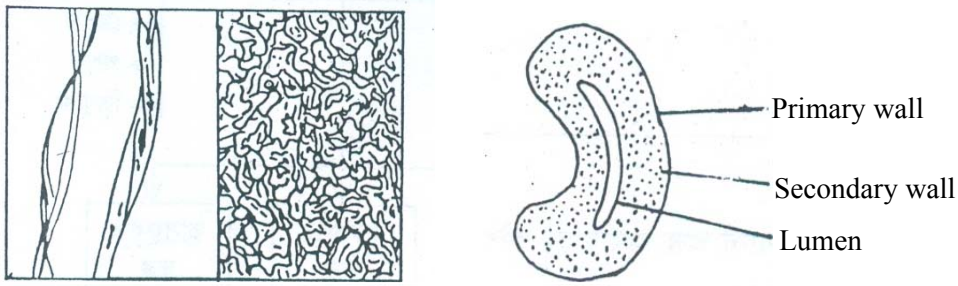
Whether a textile or garment is comfortable or not that depends on what type of yarn has been used, which in turn is related with the type of fibers. So characteristics of fibers are very important. Now let us discuss that.

Characteristics of Cotton Fibers: *Why do we feel comfortable with cotton cloths in summer?* 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 to other fibers allowing easier air passing which gives us comfort.

Cotton is the main plant fiber. From microscopic observation, 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 the 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 can not. 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.



Vertical view Horizontal view

Fig: 6.1: Cotton fiber under microscope

Characteristics of 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 empress. 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* (*guti* in Bengali) which is produced by silk worms by a process named sericulture. Chemically 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, it can be stored in a small space.

Characteristics of Wool: To save us from cold, our first choice is the garments/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 sometimes 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.

Characteristics of 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 burn but melt and after melting, it forms transparent bead like borax bead. Nylon is used for parachute cloths, rope, tyre etc.

Characteristics of Rayon: Rayon is the main amongst the synthetic fibers. It is made from cellulose obtained from plants and animals. There are three types of rayon which are viscose rayon, cuprammonium rayon and acetate rayon. Rayons are well known for their brightness, intense lusture, luxury, aristocracy and attractive beauty and finally good texture. 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.

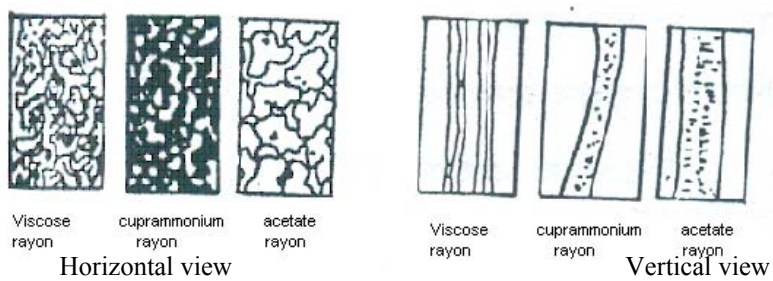


Fig 6.2: Rayon fibers under microscope

Yarn Manufacturing 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 about the different steps involved in yarn production.

1. Collection of fiber: Collection of fiber is the first step for all fibers 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 lint 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 10-15days 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. The 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 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. Collected wool is then taken to a spinning mill for making yarn.

2. Spinning: Spinning is carried out in spinning mill. 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/blow room. The fiber is then broken 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 is 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 smaller and fine.

Fig 6.3: Yarn manufacturing in spinning mill.

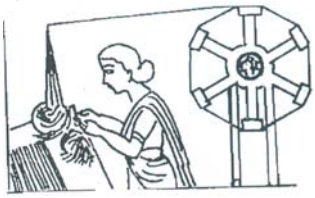
The fiber obtained after carding and blending is like a thin layer and it is known as sliver. When the sliver is twisted, yarn is produced. Spinning is basically nothing but twisting. At this stage, sliver is gradually stretched to make it thinner. Finally at the end of the sliver, a few bunch of fiber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

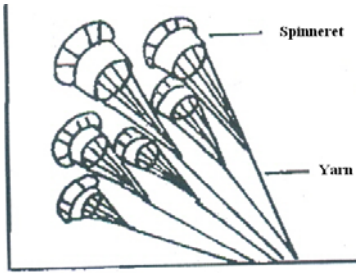
Preparing Silk from Silk Fiber

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. 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 Fig 6.4.

Silk worm, cocoon and butterfly coming out from cocoon



Spinning with jenny



Spinning with a spinneret.

Fig 6.4: Preparing silk from silk worm.

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/Man-made Fibers

Methods to manufacture 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**.** The 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.

Rubber and Plastic

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. 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 about 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 most important property 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 noticed ever 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.

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 by plastic.

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

Physical Properties: *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 happen to plastic on heating? Polythene, PVC pipe, polyester, toys etc. soften on heating and when they are cooled in molten state, they hardened. This type of plastic 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: 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 are burnt, they produce many toxic substance. For example, PVC on burning produces hydrogen chloride gas. On the other hand, polyurethane (used or making furniture) on burning releases carbon monoxide (CO) and hydrogen cyanide (HCN) gas.

Role of Rubber and Plastic in Environmental Imbalance

Majority of the plastic and synthetic rubbers are not biodegradable. So if they are discharged as waste without recycling, then they accumulate in nature and cause lots of problems. *Have you noticed that sewerage lines in municipal area 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 o 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 municipal authority managing solid waste.

Activity: Characterization 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 burn 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 characteristic smell on burning like paper.
What did you observe when nylon was burnt? Nylon did not burn as quickly by 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.

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 above 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:

$$\text{n(ethylene)} \xrightarrow[O_2 \text{ catalyst}]{200°C,\ 1000\text{-}1200 \text{ atm}} \boxed{}$$

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.
   i. What is non-cellulosic fiber?
   ii. Why linen is called a natural fiber?
   iii. Explain what type of clothes Arju should wear.
   iv. 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.
   i. What is monomer?
   ii. Why melamine is called a polymer?
   iii. How do the materials supplied by Emon and Mamun damage environmental balance? Explain.
   iv. Which raw materials will you suggest for Mr. Milon to manufacture PVC pipe?

Chapter Seven

Use of Acid, Base and Salt

Introduction: 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.

After studying this chapter we shall be able to-

1. Describe the characteristics of strong and weak acids.
2. Explain the use of acid in daily life and caution in handling acids.
3. Analyze the social effect of misuse of acid.
4. Evaluate the acidity and alkalinity of different substances by using indicator (litmus paper, extract from flowers and vegetables prepared in previous class).
5. Explain the reason for acidity in stomach and selection of the right food.
6. Explain the importance of pH of substances.
7. Explain the chemical characteristics of bases.
8. Explain the necessity of bases in daily life and caution in handling base.
9. Explain the importance of neutralization in daily life.
10. Explain the chemical characteristics of salt.
11. Explain the necessity of salt in daily life.
12. Prepare different types of salts by doing experiment (metal + acid, metal oxide + acid)
13. Recognize the contribution of acid, alkali and salt in our daily life.

Strong and Weak Acid

You have learnt about some organic acids in class VIII. You also know that acids produce 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 produce H^+ ion. These acids are called weak acids. On the other hand, mineral acids completely dissociate in water to produce 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. Some important weak and strong acids are shown in table 1.

Table1: Common weak and strong acids

Weak acid	Strong acid
Acetic acid (CH_3COOH)	Sulphuric acid (H_2SO_4)
Citric acid [HOOC-CH(COOH)-COOH]	Nitric acid (HNO_3)
Oxalic acid (HOOC-COOH)	Hydrochloric acid (HCl)

Use of Acids in Daily Life and Caution

Do you know the reason of 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.

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?*

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 carbonated beverages have dissolved baking soda ($NaHCO_3$). High protein containing diet results in increased amount of acid in stomach. In this situation, if we drink a soft beverage, the baking soda present in it neutralizes excess acid produced by the rich food taken. Therefore, indigestion due to excess acid is stopped. It is to be mentioned that baking soda is acidic, however, gastric acid (HCl) is much stronger than baking soda and the following reaction occurs between them:

$$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

You have learnt in class VIII that lemon, orange, apple, guava, gooseberry (amloki), 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 daily wear and tear 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? It is none other than vinegar or acetic acid. Do you think that Borhani or curd 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 that baking soda is used to make cake, biscuit and bread? Yes, baking soda is used as a livener in those cases, because it reacts with yeast and releases carbon dioxide which puffs baked items. *Do you know which the main ingredients are 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), and ammonium phosphate

[$(NH_4)_3$ PO_4] ammonium sulphate [$(NH_4)_3PO_4$]. 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 very important and significant. However, some acids particularly strong acids (H_2SO4, HNO_3, HCl) are very harmful not only for human health but also for 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 cautions in using acids.

Misuse of acids, Laws and Social Effects

Some ill-motivated people 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 who are mostly women because of their weird appearance (permanent scar) 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 be aware against acid crime, we must protest it and also have to work for building public awareness against acid terrorism.

Punishment/Penalty of Acid Throwing: Acid throwing is punishable, hateful and violent 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 hampering others, on the other hand, they themselves are punished, and as a result it is creating instability in the society. In Bangladesh, particularly in rural area, there are large areas where a brilliant girl student may rarely be found and if that girl is victimized by acid throwing, it will be an irreparable loss for that area and for the nation as a whole. So, we need to make people careful and aware of the danger of acid throwing.

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/alkalis. Now let us check the acidity and alkalinity of some substances closely related to our daily life by using those indicators.

Activity 1: Observation of the acidity/alkalinity of soil

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

Procedure: Take about 100 grams 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. Now with the help of tong, merge 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.

Activity 2: Observation of acidity and alkalinity of toothpaste

Materials required: Toothpaste, litmus paper, a beaker, flower/vegetable extracts, glass rod, water, tong, test tubes.

Procedure: Take about 4-5 grams 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 1-2ml of the toothpaste 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.

Activity 3: Identification of acidity and alkalinity of different types of drinks and fruit juice.

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 you observe? The colour of the red litmus paper was not changed but that of blue litmus paper 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.

Reasons of Acidity in Stomach and Selection of Proper Food

You all know that to digest food hydrochloric acid is required in 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. One of them could be the food we take. You have seen in activity-7.3, 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. are also could be the reason for acidity.

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

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; uptake 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, maze, potato, cauliflower etc. On the other hand, there are some alkaline fruits such as resins, dates, papaya, pear, melon, peach, strawberry etc. which are also effective in reducing acidity.

Moreover, there are some food grains which are able to reduce acidity. These are beans, *Dewa* rice, sweet maze 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.

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/base to the aqueous solutions of neutral substances increases pH and the more the addition of alkali, the higher the value of pH.

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. Minor alteration of pH (~0.4) may cause severe health problems, even may cause 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, aluminum 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.

Chemical Characteristics of Base

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

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 2).

Table 2: 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.

Activity: 7.4: Observation of chemical properties of bases

Materials required: A base (NaOH), an acid (HCl), indicator (red litmus paper or phenolphthalein), a beaker, apron, glass rod, dropper, and tong.

Procedure: Put on the apron and take 50ml 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 into 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. Merge 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?* Because due to addition of acid, a chemical reaction occurs between the base (NaOH) and acid. When all the NaOH react, further addition of acid makes the solution acidic and, therefore the colour of blue litmus changed to red.

Use of alkali in Our Daily Life and Caution

Do you know the reason of irritation, pain and swelling when bee sting or ants bite?

When ants bite, they release formic acid resulting in irritation and pain, on the other hand, when bee sting, formic acid, melittin and apamin are secreted and all these three

acidic chemical result in irritation, pain as well as swelling in human body. *Now the question is what can we do in these cases?*

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 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. 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 the antacid tablets or syrup taken to treat gastric pain or acidity are nothing but weak bases such as magnesium hydroxide [$Mg(HO)_2$] and aluminum hydroxide [$Al(HO)_3$].

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: H*ave 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 are equally corrosive and irritating to human body like acids. So whenever we use alkalis, we must wear latex hand gloves and apron.

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.

The reaction is shown below:

$$2HCl + Mg(OH)_2 \longrightarrow MgCl_2 + 2H_2O$$

$$3HCl + Al(OH)_3 \longrightarrow AlCl_3 + 3H_2O$$

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

$$CaO + H_2SO_4 \longrightarrow CaSO_4 + H_2O$$

$$Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$$

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/power. 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.

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.

Activity 7.5: Observation of chemical characteristics of salt.

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, merge 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:

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

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; 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 hydrogen ion in the

solution, therefore, the solution becomes alkaline and the colour of red litmus paper turns into 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.

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 ($Na_2CO_3.10H2O$).

There are some salts such as blue vitriol (CaSO4) and potash alum [$K_2SO_4.Al_2(SO_4)_3.24H_2O$] which have strong disinfecting power and, therefore 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 NH_4NO_3, $(NH_4)_3$ PO4 etc. are applied as plants nutrients and they are salts.

Blue vitriol or copper sulfate is broadly 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 $CaSO_4$, $HgSO_4$, Ag_2SO_4 are used as catalyst in industry.

In textile and dye manufacturing industries, salt is essential to fix dye on fiber.

Salt is required to purify metal in industry. To separate rubber from latex in rubber industry, salt is utilized.

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 different sectors as well as in over daily life and industry.

Activity 7.6: Preparation of Salt from Metal and Acid.

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

Procedure: Wearing the apron, take 50ml of dilute HCl in the 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 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.

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 lotion to apply on the wounded part. As a result she got relief from pain.

3. What is the reason of pain and swelling on Raji'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.
   i. Which acid is used for the preservation of pickles?
   ii. What is meant by the term "weak acid"?
   iii. How did Ontu come round? Explain.
   iv. If you compare between the food choice of Ontu and Shoili, whose food is responsible for acidity? Explain.
2. Mr. Tuhin suffers from stomach upset sometimes. 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.
   i. Write down the chemical formula of ammonium sulphate.
   ii. Why is vinegar called a weak acid?
   iii. Why did the shopkeeper prohibit Mr. Tuhin to buy the lotion of pH 5.5? Explain.
   iv. Is the level of pH in the blood of Mr. Tuhin appropriate? Give your opinion.

Chapter Eight
Our Resources

Introduction: Soil is a very vital natural resource. It grows plants and produces crops. 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.

After studying this chapter we will be able to-

1. Explain the characteristics of soil and land.
2. Differentiate among different types of soil.
3. Explain the structure of soil.
4. Explain the necessity of knowing soil pH.
5. Describe the reasons and effects of soil pollution and conservation strategy of soil.
6. Explain the physical and chemical properties of minerals present in soil.
7. Describe the use and conservation strategy of minerals.
8. Explain the sources and structure of natural fuel.
9. Describe the structure, processing, use and conservation strategy of natural fuels.
10. Investigate the reasons and effects of soil pollution in the area where we live.
11. Determine the pH of soil with the help of pH paper or acidity/alkalinity of soil with the help of litmus proper.
12. Be careful in conserving our resources and make people aware as well.

Structure of Soil

Can you tell how soil is useful to us? At first, soil grows plants which give us food. Oxygen gas essential for our respiration is also obtained from plants. If there was 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 etc. are also the gifts of soil.

Now let us know about the composition of such an important resource, 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), Aluminum (A1), 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 table1:

Table1: Composition of soil

Sl. No.	**Type of Substances**	**Amount %**
01	Inorganic	45
02	Organic	5
03	Water	25
04	Gaseous	25

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 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 anyhow? 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 Fig. 8.1, the soil particles, water and air are shown:

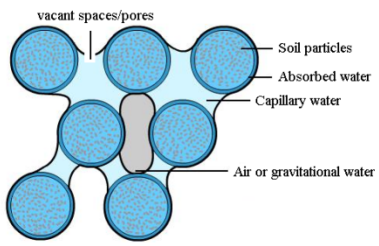


Fig. 8.1: Soil particles, water, gas in soil

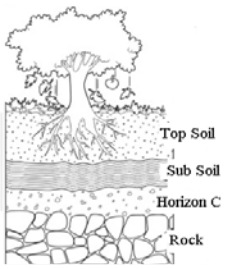


Fig. 8.2: Soil layers

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 us Sub Soil or Horizon B. small amount 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 but 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 Fig 8.2.

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, color, water retraining 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 yourself. Take a small amount of sandy soil and moisten it by adding a small amount of water. Now try to make soil ball with your palms. *Can you make a ball?* No, you can not. *What do you observe?* The soil crumbles and falls through the fingers. This is due to the fact that although the soil was moistened, the soil can not retain water. If it could, then you would be able to make a soil ball.

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 in your own hand, you clearly can see that this type of soil is granular. Sandy soil consists of small size 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 or decomposition of plant root.

Silt soil: Water retaining capacity of this soil is higher than that of sandy soil. *How can you identify silty 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?* The unique character of clay 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 spaces/pores become too small and narrow. The drainage of water from clay is very low and therefore water logging occurs easily upon rainfall. As a result, crops or plant roots rot. Crop production in clay must require organic fertilizers. Mineral content in clay is very high.

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 suitable for cultivation.

In addition to four types of soil discussed above, there are another 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 soils. 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 consists of stones. This soil dries up quickly and so it is not so good for crop production especially in summer. Moreover, from chalky soil, the mineral nutrients such as iron and magnesium can not be transported to plants.

Soil pH: Soil pH is very important for cultivation. You all know that by measuring pH we can easily evaluate 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 barely, grows well in alkaline pH (~8). Hence, it is clear that soil pH is a very important parameter for cultivation.

Reasons and Effects of Soil Pollution:

In chapter two, you have studied water pollution. Water and soil pollution are related with each other i.e. the sources or activities responsible for water pollution are also responsible for soil pollution. Now let us see how our valuable resource 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 a nearby places to the source. After disposal, wastes undergo biodegradation and pollute soil.

Can you imagine what will be the effects of this kind pollution?

As the wastes generated 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 when crop production is the concern.

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 and trees. We all know that mushroom is a nutritious vegetable, however, it can accumulate radioactive substances including Cesium. So if soil is polluted by radioactive substances and Mushroom is cultivated there, then uptake of those mushroom can cause severe health problems. *Do you know about Chernobyl disaster?*

Soil Pollution due to Excessive Siltation:

River bank erosion is known to all of us. 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 water bodies (rivers, lakes, bills or haors) or on the agricultural land. The sediments may contain lots of toxic chemicals. 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. The effects of sedimentation in water bodies have been discussed in Chapter two.

Soil Pollution by Mining Operation:

Huge amount of soil is excavated during extraction of valuable minerals such as gold, silver, oil, coal, 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.

Most of the 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 remain full of disease causing microorganism which can be incubated in soil and later on spread among humans or animals and, finally result in severe health problem.

Strategy for Conservation of Soil:

Soil is a very valuable 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 strong wind/stormy wind, heavy rainfall, strong river water current or river bank erosion etc. leading to soil erosion. Soil erosion not only destroys fertility but also

destroys land completely. Every day we are eroding soil by deforesting and cutting maintains and hills for industrialization (such as brick kilns). You may know that recently in Chittagong area, because of soil erosion due to cutting mountains, land slide has caused a huge damage to lives and properties. If this kind of soil erosion is not prevented, it could be a potential risk for us.

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 trees planted on soil, then even heavy rainfall can not 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 to move through those places. But this is not so easy to do, in that case, a lot of grass and shrubs, dhonicha (*Sesbania Cannabina)*, bindweed and these type of plants can be planted to prevent soil erosion. In rural area, domestic animals like cattle feed on grass and therefore, during grass collection, grass should not be up rooted. We can make dairy farmers and concerned people aware in this regard.

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 trees in forest. If we do so, soil erosion can 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 rain water prohibiting formation surface runoff easily and, therefore, soil erosion is minimized at least when rainfall is low. In addition, chemical fertilizers destroy the useful pests or microorganisms making the soil less fertile.

How can we prevent river bank erosion?

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

Common Minerals Obtained from Soil:

Thousands of materials such as varieties of salts, lid of pencil, talcum powder, dishes of china clay etc. 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, approximately 2500 different types of minerals are found abundant in nature. Minerals could be both metallic and non-metallic. Among the metallic minerals, iron, copper, gold and silver 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, those are organic minerals and will be discussed later in this Chapter. Common minerals obtained from soil and their uses are shown in Table 2.

Table 2: Use of common minerals.

Sl No	Minerals	Uses
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 jewelry 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 metal and sulphur
8.	Gold and Diamond	To make jewelry
9.	Gas, Coal, Petroleum	As fuel in cooking, transport, industry, power plants

Physical Properties of Minerals:

Minerals are usually crystalline. There are many minerals whose chemical composition is identical but their crystal structures are different and 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 lid) whereas diamond is the hardest of all minerals known so far. You all 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 lustrous similar to metal. Although diamond is a non-metal, its unique luster 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 can not be seen through them whereas some minerals such as calcite or lime stone which are not transparent and do not pass radiation/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 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 and you may learn about that in higher classes.

Sources of Natural Fuel 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 and are used. Now let us discuss in details about widely used natural fuels.

Natural Gas: *Do you know what is actually present in the gas that we burn 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 ether, propane and butane are also present in natural gas. Moreover, it also contains a very small amount of carbon dioxide, nitrogen, and hydrogen sulfide, hydrogen, oxygen and helium.

Petroleum: Petroleum includes all liquid fuels including propone and butane. Natural gas and petroleum are found together in 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, kerosene, lubricating oil all are petroleum.

How natural gas and petroleum are formed? There are different theory regarding formation of natural gas and petroleum. 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 plants/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 loss of oxygen. In this way, with increasing burial 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 and Petroleum:

Processing of natural gas and petroleum is a complex industrial process which is carried out in several steps. Usually processing begins at the gas well head. Steps in processing depend on composition of 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 and it is transported through pipeline.

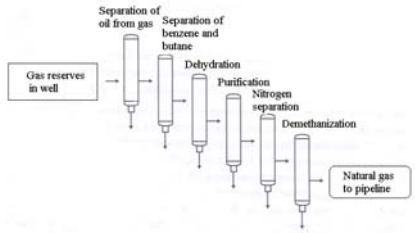


Fig. 8.3 : Processing of Natural Gas and Petroleum.

Use of Natural Gas: We utilize natural gas for many purposes. One of them is in Urea Production. 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 by 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 anyhow. You may observe 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.

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, pesticide, coal tar, lubricant, grease etc.

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.

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

Although coal is a fossil fuel like natural gas and petroleum, the formation of coal is different than that of natural gas and petroleum. Coal has 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 becomes anaerobic gradually. Initially the carbon layer decayed to a wet, spongy, porous and humus like material called pit. Later on, with increasing burial compaction that lead to high pressure and temperature, water was completely removed and pit 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 has 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 of Coal: Coal is extracted from mine with the help of machines. There are two methods for coal mining. One of them is Open Pit Mining and the other is **Underground Mining.** Usually layers of coal occur near to 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 of Coal: 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 a fuel in industry and residential purposes. Although coal is not being 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 Kebab and Barbeque. Goldsmiths and Blacksmiths use coal as a fuel to melt metals.

Exercise

Multiple Choice Questions

1. Which is the softest mineral?

i. Diamond ii. Talc

iii. Silica iv. Lime stone

1. Soil in Horizon B

i. Full of rock particles

ii. Mineral enriched

iii. Organic substance enriched

Which of the following is correct?

1. i and ii ii. i and iii

iii. ii and iii iv. i, ii and iii

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

2. Which is abundant in that soil?

i. Rocks ii. Minerals

iii. Organic substances iv. Radioactive substances

3. In which soil crop production will be good?

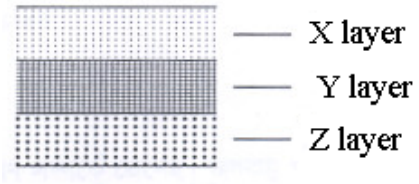
i. Soil containing sand and minerals

ii. Soil containing minerals

iii. Soil containing sand and salt

iv Soil containing sand, salt and clay.

Answer questions 5 & 6 from the following pictures:



4. Which layer contains rock particularly?
   i. X Layer ii. Y Layer
   iii. Z Layer iv. Layer below Z
5. 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 microorganism

Creative Questions

1. See the figures below and answer the questions

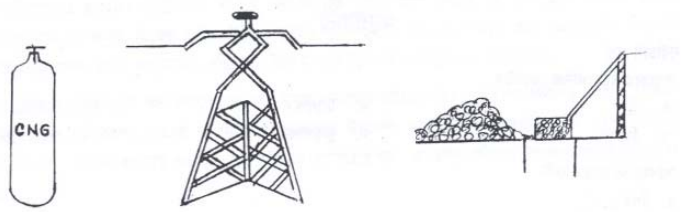


Fig. A Fig. B Fig C

   i. What is petroleum?
   ii. What is meant by “fossil fuels”?
   iii. How the fuel in Fig.A is processed to make it suitable for use? Explain.
   iv. To produce energy shown in Fig.3 which one is economical between A and C? Justify your answer.
2. Soil in the area where Bokul lives contains rocks and minerals. The size of soil particles is big. Water drainage is very faster. On the other hand, soil in the area where Shaheen lives has small size but enriched with organic and mineral substances.
   i. What is aeration?
   ii. How does Horizon C layer form?
   iii. Explain the type of soil in Bokul’s area.
   iv. Which soil will result in better cultivation? Justify your opinion.

Sandy Soil: A notable characteristic of sandy soil is its very low water retaining capacity. You can prove it yourself. Take a small amount of sandy soil and moisten it by adding a small amount of water. Now try to make soil ball with your palms. *Can you make a ball?* No, you cannot. *What do you observe?* The soil crumbles and falls through the fingers. This is due to the fact that although the soil was moistened, the soil cannot retain water. If it could, then you would be able to make a soil ball. 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 in your own hand, you clearly can 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 this soil is higher than that of sandy soil. *How can you identify silty 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?* The unique character of clay 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 spaces/pores become too small and narrow. The drainage of water from clay is very low and therefore 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.

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 soils. 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.

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.

Reasons and Effects of Soil Pollution

In chapter two, you have studied water pollution. Water and soil pollution are related with 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 pollute soil. *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.

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Processing of Natural Gas and Petroleum

Processing of natural gas and petroleum is a complex industrial process which is carried out in several steps. Usually processing begins at the gas well. Steps in processing depend on composition of 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 and it is transported through pipeline.

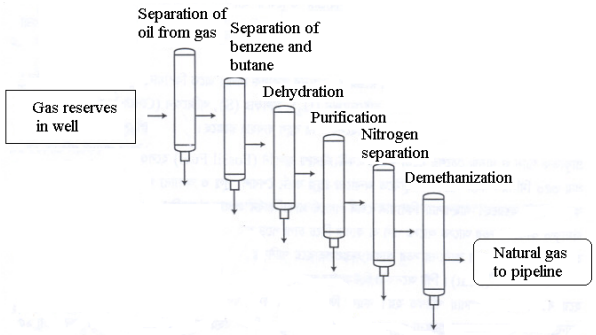


Fig. 8.3: Processing of Natural Gas and Petroleum.

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 anyhow. You may observe 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.

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, pesticide, coal tar, lubricant, grease etc.

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.

Coal: Coal is a readily combustible 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, sulphur, oxygen and nitrogen 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 has 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 increasing burial compaction that lead to high pressure and temperature, water was completely removed and pit 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 has 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 of Coal:** 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 to 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 of Coal: 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 a 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 and Barbeque. Goldsmiths and Blacksmiths use coal as a fuel to melt metals.

Exercise

Multiple Choice Questions

1. Which one is the softest mineral?
   a. Diamond b. Talc
   c. Silica d. Lime stone
2. Soil of the subsoil layers
   i. Full of rock particles
   ii. Enriched with mineral
   iii. Enriched with organic substance

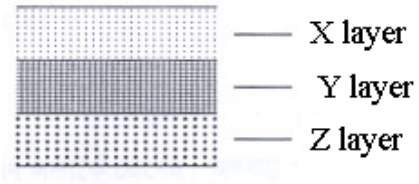
Which of the following is correct?

   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.

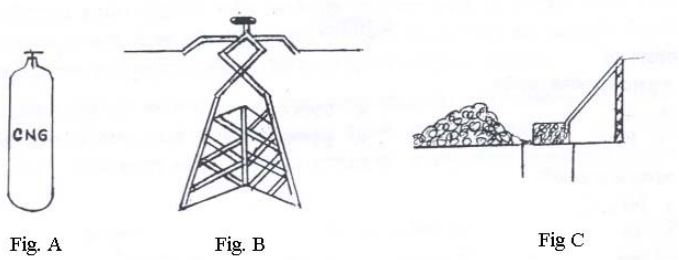
Answer questions 5 & 6 from the following pictures:



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. See the figures below and answer the questions



   i. What is petroleum?
   ii. What is meant by “fossil fuels”?
   iii. How the fuel in Fig.A is processed to make it suitable for use? Explain.
   iv. To produce energy shown in Fig.B which one is economical between A and C? Justify your answer.
2. 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 particals but enriched with organic and mineral substances.
   i. What is aeration?
   ii. How does Horizon C layer form?
   iii. Explain the type of soil in Bokul’s area.
   iv. Soil of which area will result in better cultivation? Justify your opinion.

Chapter Nine

Living with Disaster

Introduction: 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 stumbling-block for the development of our economy. These disasters have become terrible at present because of different types of human interference on nature.

After studying this chapter we shall be able to-

1. Analyze the effects of climate change in Bangladesh and other parts of the world.
2. Explain the cause of environmental problems.
3. Describe the causes, prevention, strategies and immedite measures to be taken.
4. Analyze the importance of standard and improved environment to lead a healthy life.
5. Explain the importance of conservation of nature.
6. Describe different ways of natural conservation.
7. Carry out an investigation on problems and challenges for maintaining standard and improved environment in our area.
8. Make posters on prevention of disasters and response after disasters.
9. Make poster for creating social awareness on conservation of nature.
10. Take steps to build social awareness for conserving environment.

Effect of Climate Change: 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 effect of climate change has already become visible in Bangladesh and thereare as follows:

1) Seasonal variation: Bangladesh is a land of six seasons and each season had its own characteristic. A remarkable change is going on regarding season 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 up to 45-48 °C in some parts of the country. Similarly, winter temperature especially in the northern part of the country becomes very low. Many people die because of this unusual and extreme weather condition.

2) Flood: Flood is a common annual phenomenon in Bangladesh, a land of river. In many cases it is beneficial because that flood results in siltation on agricultural land increasing 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 damage 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.

3) River Erosion: Erosion of riverbank is a normal incident in Bangladesh. 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 have been engulfed by only three big rivers the Padma, the Jamuna and the Meghna.

Fig 9.1. River bank erosion

4) 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 climate change. May hamper crop production in Bangladesh.

5) 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 consequence, sea water will intrude to main land and the

salinity in surface water, ground water as well as 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 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.

6) 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.

7) Forest: Only one 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.

8) Fish Population: The old saying, “Banglali with fish and rice” is not true today. In Bangladesh, a land of rivers, 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.

9) Heath 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 disease 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 starvation which will cause extreme health risk. Like fish population, human health will

also be affected by infectious organism grown at higher temperature. 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.

11) Loss of 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.

12) Natural Disasters: Natural disasters like cyclones will be more frequent and devastating. We will discuss it later in this chapter in details.

Climate change: 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 are intensifying day by day. The average global temperature in last 100 years has been increased approximately by 0.74°C. During 1961-2003, sea level has risen 0.18mm/year. The ice/snow deposit on mountains has already been started to decrease. Summer in last 11 years out of 12 years were 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 and Sandy are well known to all of us. Such disasters may be more frequent and intense.

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 6.6 billion. By 2050, the world population will reach at 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 are lost. This is quite logical because with the increase in population, all the basic demands like food, housing and clothing increase creating pressure on employment. To cope up with the increasing pressure for employment, industrialization is occurring 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. The saying "Bangali with fist and nice" has become a fairy tale.

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, in 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 in Bangladesh in 1991-92 was?* It was about 100 million and at present, it is more than 150 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 with increase in population. Due to increase in population, a significant part of rural people are migrated to urban areas. At the same time, the 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.

Global Warning

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 and that will change the global climate. You have already studied the effect of global climate change in this chapter previously.

Carbon Pollution

Carbon pollution basically means increase of CO_2 in the atmosphere and you have studied that in the previous section.

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 with deforestation.

Reasons behind Disasters, Prevention, Strategies and Remedies

Flood: 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 reasons of floods?* There are several complex reasons for causing floods. One of them is water holding capacity/navigability of rivers. Due to river bank erosion, mismanagement of waste etc. sediment is deposited in the river beds. As a result, heavy rainfall or flash from upstream easily causes flood. Moreover, due to the effect of monsoon wind resulting in high tide in the Bay of Bengal, water flash coming from upstream cannot enter into the Bay and results in flood in surrounding area. Beside these, a major part of Bangladesh is plain 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 about prevention strategies, remedies and responses regarding flood. As we discussed before, one of the reasons for causing flood is sedimentation in river beds, so we have to dredge the rivers so that the water holding capacity/navigability will

be increased. In that case, heavy rainfall or water flash from upstream cannot cause flood easily. Flood is controlled in many countries in South Asia including Bangladesh by Flood Control Embankment. Since 1960, 8000km 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. 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 several (58) rivers in Bangladesh including the Ganges, the Brahmaputra and the Meghna originated in India, Nepal and Bhutan. Therefore accurate flood forecast cannot be done 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 that. To minimize the flood damage, legal action may be taken to stop establishments in low-lying areas to use and control land. Regarding effective flood control and responses, increase of public awareness works as a helpful tool, and therefore, steps must be taken to build increased 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 place. During flood, most of the roads are iniundated; 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.

Drought

Drought is a severe natural disaster when moisture in soil reduces to zero and therefore plants/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 0.25mm for four consecutive weeks, the condition is called *partial drought*. In Russia, a period of l0 days with a total rainfall not exceeding 5mm is considered as a drought**.** In the USA, if there is not at least 6.24mm rain daily for consequtive 30 days, it is regarded as drought. Drought is a severe natutal disaster. It results in reduced crop production which may

cause famine. 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, and Barisal) are vulnerable to drought. In Bangladesh a devastating drought occurred in 1978-1979 and the damage in that draught was more than that caused by the flood in 1974.

Why drought occurs? There are several reasons for occurring drought whuch are-prevalence of dry weather for a long time and insufficient rainfall are basically responsible for causing doaught. This kind of condition exists when evaporation and perspiration are higher than rainfall. Due to unplanned urbanization, deforestation and increased green house gas, atmosphere is gradually becoming drier and drier, which disfavours the formation of cloud by condensation 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 drolught is unplanned and excess groundwater pumping by deep tube wells. Because of this kind of activity, underground water table 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 draught? As lack of water in soil is basically the reason for drought, the effective way to face draught is to increase the supply of water in soil. As said before, diversion or withdrawal of water by upper riparian, India, causes drought in Bangladesh. Therefore, that kind of activity should be stopped by bilateral agreement. Previously, India utilized water of the Ganges river unilaterally but according to the Water Sharing Treaty of 1996 Bangladesh is now getting equitable amount of water. Water sharing of other trans-boundary rivers like Teesta could be solved in the same way.

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 mass must be motivated to dredge rivers, lakes, bills etc. to hold water to use during drought. In developed countries, the efforts to make artificial rainfall to adapt with drought have not been successful.

Cyclones

The word cyclone came from a Greek word “Kyklos” which means coil of snakes. It is seen from the satellite picture (Fig. 9.2 A) 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.

A B

Fig 9.2: A) Satellite picture of cyclone. B) A cyclone affected area

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 attacked 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 of deaths were recorded. In cyclone of 1991, approximately one lac and forty thousand of death were recorded. In the super cyclone Aila and Sidr of 2007 and 2009, 10,000 and 7,000 deaths were recorded respectively. Moreover, millions of people became homeless from those cyclones. The economic damage in those two cyclones was US$1.7 billion and 600 million respectively.

Causes of Cyclone and Remedies

Cyclones originate in oceans. 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 speed 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 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 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 damage to lives and properties One of the most dangerous aspects of cyclone is it results in water surge. Therefore, strong 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 preparedness 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.

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 incident happened in space. It is considered as the third most dangerous natural disaster. The important characteristic of Tsunami is crashing of the tectonic plate at the bottom of sea/ocean, which lead to severe earthquake. Sea water makes waves of millions of tons. When such a large size waves go 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 from one end to another end of wave could be as high 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. 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 magnitude of 9.1-9.3 in Richter scale, a part of the Indian Ocean pressurizes 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 to a devastating flood and, was extended to Indonesia, Malaysia, Sri Lanka, India, Thailand, Maldives of South and Southeast Asia as well as12 countries of Africa including Kenya and Somalia. About 3 lacs of people died due to the high tidal effect. One lac and ten thousand 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 inr shipping.

Bangladesh was not affected much by the Tsunami hit on 26 December, 2004, because Tsunami loses its energy when reaches water of low depth. On Bangladesh part in the Bay of Bengal, the depth of water up to 160 km is not high. When Tsunami reached that zone of low depth, it weakened. 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 was raised abruptly and waves created from that capsized many boats and many people died by that accident.

Acid rain

Rain water is usually 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 properties. 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 dissolve in water from soil and are removed. 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 water pH 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 for human health. It causes heart disease, lung disease, Asthma and bronchitis in human body.

How does acid rain form? 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 or other fossil fuel burning industries, vehicles, domestic oven etc. release sulphur dioxide and nitrogen oxide which are also converted to acids in the same way as explained before and finally mixed with rain water and form acid rain.

Fig.9.3: Emission of gases that 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 form fuels before burning. In many developed countries, it is already in practice. If there is no arrangement for purification, 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 country acid rain is very common. Acid rain frequently occurs in many East European countries, USA, Canada, South coast of China and Taiwan.

Tornado

Tornado is a very well known natural calamity in our country. Besides Bangladesh tornado also hits in USA, Australia and Russia among other countries. The most harmful aspect of Tornado is that it results in severe damage abruptly within 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 hits every year 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.

Earthquake

When a vibration created in earth’s crust abruptly shakes the earth. It is known as Earthquake. Earthquake persists few seconds and can occur repeatedly. Mild earthquakes in most of the time are not felt, whereas acute or strong earthquakes can easily be felt.

Is earthquake a natural hazard? Yes, it is a violent natural calamity which can destroy a region or country within a few second; even it may divert the river water course. Due to earthquake, one of our main rivers, Brahmaputra has changed its course. Although large earthquake did not rock our country so far, however, according to the opinion of scientist, Bangladesh is in the greatest risk of earthquake. In the world, Japan and California of America are the earthquake-prone area. You may know about the disaster happened in Haiti and Japan (Tsunami followed by earthquake). In the latter country, earthquake happened after Tsunami, resulted in nuclear accident in nuclear power plants.

How earthquake forms? The earth’s crust is composed of tectonic plates which are not static; they are dynamic. Due to their movement tectonic plates undergo collision with each other and, as a result earthquake is created. The magnitude of earthquake is measured in Richter scale. In Banlgadesh, an earthquake of magnitude 7.0 struck the districts of Bogra, Sirajganj, Jamalpur, Sherpur and Mymensingh on 14 July, 1885, with epicenter near Manikganj causing substantial damage. On 12 June, 1897, an earthquake

of magnitude 8.7 in Richter scale rocked Dhaka, Comilla and Chittagong. The epicentre of the earthquake was Shillong, India. The shock was felt over 400,000 km^2 and about 10,000 people were killed. An earthquake of 7.6 magnitude in Richter scale, on 8 July, 1918, struck Srimangal causing significant damage to the surroundings.

What are the remedies of Earthquake? *Is there any way to protect us from earthquake?* Earthquake is a disaster that cannot be prevented, however, taking proper measures, damage to lives and properties can be minimized. In that case, the important aspect is construction of building and other establishments. You may know that in Japan, most of the buildings were built by paper or wood long time ago. This is because of the fact, that if houses are made of lighter raw materials instead of heavier raw materials, the rescuing can be done easily and, also the deaths and damage would be less. During building construction, we must install earthquake prevention technology like Japan; otherwise a big earthquake could be disastrous for us. In addition, if an earthquake strikes, the rescue operation and relief supply must be ensured as early as possible on urgent basis. In this case, co-ordination between government and non-government organizations is required. Also prior preparation must be taken.

There are several issues to be taken seriously and they are:

1. We must have clear idea about our residence and we have to know the risk of earthquake. We should not stay in a risky high rise building.
2. We must have arrangements so that we can survive even if there is no supply of food, water etc. for few days.
3. We also should keep in mind that in addition to ourselves, family members and neighbours, we have to take care of other people also.
4. We must have preparation for immediate response. In that case, fire service, hospitals, medicine, schools or law enforcing agencies etc. should be considered.
5. For faster rescuing, electricity, water, roads, cell phone everything should be arranged.
6. For the rehabilitation of the affected people, short and long term measures need to be taken.
7. We should have estimation for probable damage to be caused by earthquake and a prior planning is necessary for that.
8. Some dry food, water, torch, small radio, battery, first aid kit, medicine, whistles, fire extinguisher etc. should be kept within reach of our hand.

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, particulate matter

(very fine dust particles or liquid droplets), toxic, metallic substances (Hg, Pb, Cd) 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 for 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, then 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.

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, coal, gas etc. All these resources along with others 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.

Is there any animal or plant in the Moon? No, there is none, because the environment prevailing there is not life sustaining. There was every 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, if we do not take appropriate measures, if we do not stop damaging plants, forest resources, if we do not stop polluting air, water, soil etc. then like the moon, our nature and environment, will no longer be habitable and therefore our existence will be demolished.

Strategies for Conservation of Nature

There are several strategies for conservation of nature which are described below:

a. Reduction of use of resources
b. Protection of resources from pollution
c. Reuse of resources if possible
d. Recycling of used materials
e. Protection of natural resources

Now let us discuses in details about these conservation strategies.

a. **Reduction of use of resources**: We can conserve our resources by avoiding excess or unnecessary use. For example, previously we used papers and pen for writing letter; bank statements were also delivered in paper. Now a days, because of technological advancement, use of paper and pen can easily be avoided, instead, we can send E-mail or text message for the same purpose mentioned above. It is clear that these kinds of practices reduce the use of paper and pens. Similarly, we can avoid the practice of having too many clothes. There are some people using 20-30 shirts or pants. Certainly

that can be reduced. You may notice that in some consumer products especially in ready-made garments, sometimes 7-8 stickers are used. *Do you think that it is necessary?* Not at all. Only one sticker may work well.

Now you find out where we can reduce the excessive use of our valuable resource in our daily life and can conserve our nature. Papers are made form plants/trees, reduction of use of paper, therefore means, less plants need to be cut and forest resources will be protected and our nature will be conserved.

b. **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 know about the pollution of water of the river Buriganga. The pollution there is so extreme 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.

c. **Reuse of Resources if Possible**: Nature can be conserved by reusing our resources if possible. For example, old garments can be reused just after washing instead of disposing. Similarly, thousands of materials starting from furniture can be reused several times. 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.

d. **Recycling of used materials**: Instead of discarding old items, we can manufacture new items from that and nature can be conserved. Like reusing, recycling also results in less demand on natural resources. For example, waste paper can be recycled to produce toilet paper, organic manure can be prepared from kitchen waste; new plastic can be manufactured from old plastics.

e. **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. Stopping these kinds of activities is a kind of conservation of nature. Like the Sundarbans, many of our natural resources have been destroying and it must be stopped right now.

Activity: Finding out the barrier/limitation to have a standard and improved environment and remedies.

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 on these issue and distribute that among public. 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. Reason 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 Bagruna. 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.
   i. What is cyclone?
   ii. Explain the term “Global warming”.
   iii. Explain how the cyclone like Sidr mentioned above is created.
   iv. What steps Mr. Naoshad could take to protect him from the cyclone? Analyze.
2. After finishing her study, Tuli went to bed at 12 AM. 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.
   i. What is earthquake?
   ii. Explain why Bangladesh is a cyclone prone area?
   iii. Explain how the natural disaster observed by Tuli is created?
   iv. What steps can be taken to protect us from he natural hazards mentioned above? Analyze.

Chapter Ten

Let Us Know the Force

We are pulling or pushing something in 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 about the inertia, the 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.

action-reaction of forces

After the lessons of this chapter we will be able to—

1. explain the characteristic concept of the force and inertia of a body on the basis of Newton's first law of motion.
2. explain the practical experience of inertia.
3. explain the nature of different kinds of forces.
4. describe the advantage of friction in our practical life.
5. explain the influence of force on a body at rest or in motion.
6. measure force using Newton's second law of motion.
7. measure force with the help of an easy experiment.
8. explain several popular occurrences on the basis of Newton's third law of motion.
9. understand the necessity of force in our life.

Push and Pull: Force

If any one of your friends wants to displace you by keeping his hand on your body then you will say that he is pushing you. If we want to displace anything then we push it. If we want to bring anything near to us we pull it. This push or pull on a body by another body is the force. Whenever we push or pull, raise or bend, twist or tear, expand or compress anything, then we actually apply force. Scientist Sir Isaac Newton in 1667 published three laws making relation among force, mass, inertia and motion of objects. 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 a body. 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 externel force.

Inertia

Sometimes we get stumbled during walking being obstructed by door-sill, high or low roads or something lying on the road. In case of the game of football sometimes a player is to scramble when he commits a foul. All these happen due to inertia. What is inertia?

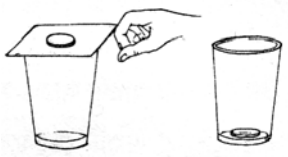
From our daily experiences we see that everybody tries to maintain its present state. If a body is at rest, it will continue to be at rest or if it is in motion it will continue to be in motion. From Newton's first law of motion we know that, to change the state of rest or of motion of a body force has to be applied.

The tendency of an object to remain in its own state forever or the property of maintaining its own state is called the inertia.

Everybody has inertia as the mass is the measure of inertia. The tendency of an object at rest to remain at rest forever or the property of maintaining its state of rest is called inertia of rest and the tendency or property of an object in motion to continue its uniform motion in a straight line forever 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 the bus was parked, body of the passenger was at rest. But when the bus suddenly started to move the part of the passenger's body attached to the bus started moving but the upper part tried to remain at rest for inertia. So, the passengers lean backward. For this reason suddenly coming down from a running bus accident occurs.

Task: 10.1 Placing one card or hard board upon a glass, keep a five taka coin on it (Fig 10.1). Suddenly strike the card horizontally. What do you see?	 Fig. 10.1

Why the coin drops down into the glass? For sudden strike, the card was displaced but due to inertia of rest the coin continues to be at rest and finding no support it drops down into the glass.

During driving a car the driver is to put on seat-belt for inertia. If a driver without seat-belt suddenly applies brake of a running car then due to inertia of motion, he will be leaning forward and be struck by the steering-wheel and wind-screen (Fig 10.2). In the figure 10.3, it is seen that the seat-belt is saving the driver from the struck by the wind-screen.

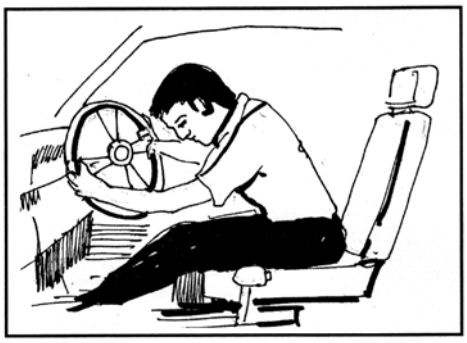


Fig 10.2

Fig 10.3

In case of traffic signal-light of big towns, we know that the green light indicates clearance to go forward and the red light indicates danger to stop. We see that after green light red light does not illuminate directly, in between yellow light illuminates. The reason for this is, if the red light illuminates right after the green light then to stop the speedy car the driver has to apply hard brake as a result there is every possibility of sustaining injury to the driver and the passenger for inertia of motion. The driver gets time and can take preparation to stop the car slowly after seeing the yellow light.

We realize the influence of inertia in case of changing the direction of motion of a body. If any bus or car suddenly takes turn, then it seems that some one is pushing the passenger towards opposite side. The reason for this is that the passenger was in motion with the motion of the bus or car, although the bus or car suddenly changes the direction but due to inertia the passenger wants to remain in its original direction as a result he is displaced to one side.

The characteristic concept of the force from Newton's first law of motion

From Newton's first law of motion we know that, an object does not want to change its state by itself. An object at the state of rest tries to remain at rest forever and if it is in motion it wants to move in a straight line with uniform speed forever. To change its state, something is to be applied from outside. The external cause which changes or tries to change the state of an object is called the force. So, we get the characteristic definition of force from Newton's first law of motion. According to Newton's first law of

motion—the external cause which when applied on an object at rest changes or tries to change the state of rest or when applied on an object in motion changes or tries to change its state of motion, that is called the force.

The concept of force will be clearer from the event shown below.

In the figure 10.4 and 10.5 it is seen that a boy is pulling and pushing a boat. Do you think in both the cases the boat will be in motion? Actually it depends on that how much strong the boy is. If the boy is strong enough then the boat will move. Again if the boy is not strong enough, then the boat will only try to be in motion remaining at rest. Similarly you can stop an object in motion only when you will be able to apply sufficient force required to stop it. If you cannot do that, then you will only try to stop it. Therefore, we can say that the external cause which when applied on a body at rest changes or tries to change the state of rest or when applied on a body in motion changes or tries to change its state of motion that is called the force.

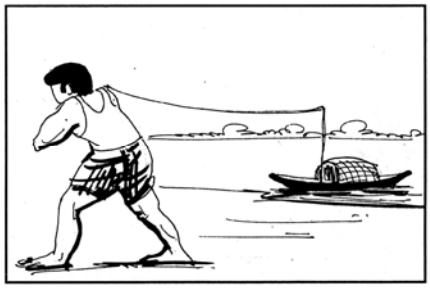


Fig 10.4

Fig 10.5

Task: 10.2 Take some substances, for example, one football or tennis ball, spring, plastic pot, rubber band etc. and apply push or pull force on those substances. What do you observe? Make a checklist of different things (compress, extend, bend, twist etc) that the force can do.

Effect of force

Force can cause the following events—

a. The force can change the state of a body from rest to motion and a body in motion to rest.
b. The force can change the direction of motion of a body.
c. The force can increase or decrease the velocity of a moving body.
d. The force can cause changes in shape or size of a body temporarily or permanently.

Nature of force

Force of contact: Some of the applied forces come in contact with body directly or physically. Suppose you want to carry a bucket then you will have to apply force by holding the handle of the bucket. If you want to raise your school bag then you will have to apply force holding the handle of the bag. These are muscular force. The force which

comes in contact with only two bodies physically applies each others, that is called force of contact. These types of forces are muscular force and frictional force. Here we will discuss frictional force in detail.

Frictional force : Two bodies remaining in contact with each other, when one body slides or tries to slide over another body in contact then a resistance arises against the direction of motion at the surface of contact of the bodies, this resistance is called friction. And the force produced as a result of this resistance is called frictional force. Friction is a very simple force. When a body tries to slide over another body, friction tires to stop that body. Friction always resists motion.

Task: 10.3 Applying an amount of force rolled on a marble on the floor of your house. See how far it goes. Now applying the same amount of force rolled on the marble on the road and see how far it goes. In which case the marble traversed the distance more?

It is seen from this task that the more the floor is smooth that much less is the friction. So the marble goes further on the surface of smooth floor than the floor of rough surface. The frictional force not only stops the body in motion but also opposes the movement of a body at rest. So it is difficult to move a stone on the unsmooth or rough surfaces. The frictional force depends on two factors. These are—

1. **Mass of the body:** The more the mass of the body the more the friction is produced.
2. **Nature of the surface:** If the surface is more unsmooth or rough the more the frictional force is produced.

There remain some high-low grooves in every surface which we cannot see by normal eyes. When an object is slided or pulled over another object, then this high-low grooves of the surface prevent each other like saw-tooth. So, that opposes the relative motion between the objects. The more this high-low grooves that is the surface is unsmooth, the motion of one object over another object will get more resistance, and hence the frictional force will be that much more.

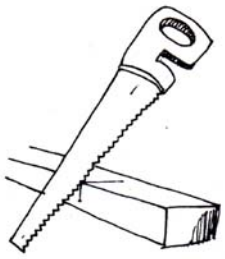


Figure-10.6

Advantage and Disadvantage of Friction

Friction is of much importance in our day to day life. We could not walk but would slip if there was no friction. We could not fix a nail or a screw in the wood; it would not be possible to make a knot in a rope. As there is friction, we can hold khatas, pens, books and everything by our hands. Our life depends on the friction of brakes of car or cycle's tyres. Anybody can come down from flying plane safely by using a parachute as there is friction in the air. The shooting-star (a meteor) burns to ashes by the heat produced by the friction of air at the time of coming into the atmosphere of the earth.

We are also not to face a less of disadvantage due to friction. The parts of machines which face friction with each other waste away due to friction. The tyres of cycle, rickshaw and cars corrode away with the time. The edge of pencil becomes blunt at the time of writing. Have you

observed the difference between the soles of new shoe and old shoe? The sole of the shoe wastes away due to friction. The mechanical efficiency of a machine decreases and the unnecessary heat produced due to friction is also harmful to the machine.

Limiting the friction: To make our work and life easier we are to increase the friction sometimes, and sometimes we are to decrease the friction. So, it is necessary to limit the friction as per different requirements. Any surface can be made smooth by decreasing the friction. There are many sliders in schools or parks for children to play. It is made very smooth so that the children can slip down easily. Oil or grease makes surfaces smooth and decreases friction. For this reason the moving parts of the machine is covered with oil or grease which decreases the friction and saves the machine from waste away. The oil or grease like substances used to decrease the friction is called lubricant. Another way of decreasing the friction is to move an object over a surface by rolling rather than by slipping.

You have surely noticed that some of the suitcases are fixed with wheels. At the time of pulling the suitcase without wheel and the suitcase with wheel over the floor will you feel any difference between the two suitcases? You will surely say that, to pull the suitcase fixed with wheels is easier to move. To move a heavy object from one place to another place, roller is used to move it easily. Similarly to decrease the friction between the moving parts of the machine sometimes ball bearings are fixed and the movement becomes easier. Ball bearings are very small balls of steel.

To decrease the friction of a surface it is made unsmooth or rough. When a match-stick is rubbed over the side of a match box then due to the friction between the top of the stick and the rough surface of the box inflame the chemical substances of the top of the match stick. We get fire.

Friction is essential to walk. If you examine the sole of your shoe, you will see that the sole is corrugated. It is done to increase the friction between the shoe and the road so that the shoe can restrain the road excellently. Similarly to restrain the road excellently there are threads in the tyres of the car so that it does not fall by skidding from the road.

Although the friction is the cause of our many sufferings yet we cannot imagine our life without friction. So the friction is called essential trouble or evil-designer.

Force without contact

There are some forces which act on an object even without coming physically in contact with the body. These types of forces are called force without contact. These types of forces are: gravitational force, magnetic force, electro-magnetic force, weak nuclear force and strong nuclear force.

A. Gravitational force: If you throw a stone upward what happens? Why the ripe mango falls on the ground from the mango tree? The reason for this is that in this universe every object exerts force to each other due to their masses, that is, every object attracts every other object towards itself. This force is called the gravitational force. For the reason of this force the earth attracts every object towards itself. This attraction of earth is called gravity. The earth orbits the sun keeping it at the centre;

the moon orbits the earth keeping it at the centre for this gravitational force. The magnitude of this force depends on their masses and the distance between them. The magnitude of this force increases with the increase of masses of the bodies and decreases inversely proportional to the square of the distance that increases between the two objects. Gravitational force is always attractive in nature.

B. **Magnetic force:** Magnet attracts nails, pin, iron and all the things made of iron. When two bar magnets are being brought closer then both attract or repel each other. So the magnet has a capacity of attracting or repelling. When two magnets are brought closer the force of attraction or repulsion applied by two magnets and the force applied by any magnet to other magnetic substances (iron, nickel, cobalt, steel etc) is called the magnetic force. Magnetic force may be attractive or repulsive, that is, of both the nature.

C. **Electro-magnetic force:** The force of attraction or repulsion applied by two charged particles due to their charges is called the electro-magnetic force. The electro-magnetic force is directly proportional to the product of the charges of two particles and inversely proportional to the square of the distance between them and the force acts along the straight line joining the two particles. This force may be attractive or repulsive that is of both the nature. This force controls atomic structure, chemical reaction and other electro-magnetic occurrences.

D. **Weak nuclear force:** This force is 10^{10} times weaker than the electro-magnetic force (the short range and short valued force which acts within the fundamental particles of the nucleus to make the nucleus unstable is called the weak nuclear force). This force is applied in decaying the fundamental particles lepton and hadron. This force is also responsible for the beta-decay of any particle and nucleus.

E. **Strong nuclear force:** We know that all the matters are constituted of atoms. Nucleus remains at the centre of an atom and the electrons rotate round the nucleus keeping it at the centre. There are proton and neutron in the nucleus. They are called nucleon. The strong attractive force that keeps the nucleons in a nucleus is called the strong nuclear force. The range of this force is very short and this force does not act outside the nucleus. But this force is about 100 times stronger than the electro-magnetic force. This force is attractive in nature.

Newton's second law of motion: Measurement of force

We know that force is to be applied to change the state of an object that is from rest to motion or to change the state of motion of a moving object that is to increase or decrease the velocity of the moving object or to change the direction of motion. This force is to be applied as there remains inertia in an object. The object that has more inertia the more force has to be applied on that object to change its state. As the mass is the measure of inertia so the object that has more mass that much more force has to be applied on it to change the state. Again to change the velocity or to produce acceleration of two objects of same masses is it required to apply equal forces? The body for which the acceleration will be more, that much more force is required for that body. Hence, it is realized that, force depends on both the mass and the acceleration of the object.

The force is measured by the product of mass and acceleration of the object. Therefore,

force = mass × acceleration

Newton's second law of motion is, *the rate of change of momentum of a body is directly proportional to the force exerted and the change of momentum takes place along the direction of force.* From this law we can measure the amount of force.

The momentum of a body is mass × velocity. The rate of change of momentum= mass × the rate of change of velocity = mass × acceleration, because the rate of change of velocity is the acceleration. Hence from Newton's second law of motion we get, force = mass × acceleration.

In physics force, mass and acceleration is denoted by the symbol F, m and a respectively. Hence, $F = m\,a$

As the force has both magnitude and direction so force is a vector quantity. The unit of force is Newton. The amount of force applying on a mass of one kilogram produces an acceleration of one meter/second^2 is called one Newton.

Problem 10.1: The mass of an object is 20 kg. Applying a force on it produces an acceleration of 2 m/s^2. What is the value of the force?

Solution:

We know, $F = ma$

$= 20\text{ kg} \times 2\text{ ms}^{-2}$

$= 40\text{ kg-ms}^{-2}$

$= 40$ Newton

Answer : 40 Newton.

Here,
mass of the object, m=20 kg,
acceleration, a = 2ms^{-2},
force, F= ?

Action and reaction force

We see many men, burst into anger strongly slap or strike with the palm on the table. For that whatever happens with the table but he gets hurt. Why? Actually when he applied force on the table, then the table also applies force on him. In nature forces always applied in pairs. When a body A applies force on a body B then the body B also applies force on the body A.

Task 10-4: Sit down on a chair in front of a heavy table. You try to pull the table towards you. Perhaps you will not be able to move the table towards you because it is very heavy, but what about your chair? The chair is moving towards the table. Why it does happen? As a result of your pull force applied on the table an opposite force is produced on the chair, which moves the chair towards the table.

Task 10-5: Take a strong rubber band. Keep it in extending position as far as it is possible by the two fingers of your two hands. After some time you will see that your fingers are hurt. The place of the finger where the rubber band touches the skin of that place is a bit deformed (wrinkled up). Why? You have applied force to create tension and change the size of the rubber band, consequently the rubber band is also doing something to deform or to change the size of your finger.

From the task mentioned above we see that, whenever we apply any force then there appears an opposite force. If one force is called action the other force is called reaction. Sir Isaac Newton told that these action and reaction are always equal and opposite. He expressed in his third law of motion that—*To every action there is an equal and opposite reaction.*

The action and reaction force always act on different objects—never act on the same object. The reaction force will act so long as the action force remains in action. When the action force ceases to act the reaction force also ceases. The action and reaction forces do not depend on whether the objects are in equilibrium or in motion or they are in contact with each other or not—are present everywhere.

Some examples of action-reaction

When a cricket player hits the ball with the bat, then the bat applies force on the cricket ball. This is action. The cricket ball also applies an opposite force on the bat. This is reaction.

Table and position of a book on the table

If any book is kept on a table the attractive force of gravity of the earth on the book, that is, the weight of the book will act vertically downward. If there would have been only the force of gravity acting on the book, then the book would not be in equilibrium position rather go through the table downward. But that is not happening. This is because on the way there is a table and the book applies force on the table equal to its weight. Consequently the reaction of the table is pushing the book in the upward direction with the same force of gravity.

Standing on the ground

When you stand on the ground, your legs apply force on the ground equal to your weight. This force is the action of your weight on the ground. So long you stand still the ground also pushes your legs vertically upward direction with the equal force of the ground is the reaction. At this stage the action and reaction forces are equal and opposite to each other.

Walking

At the time of walking we apply force on the ground vertically by the front foot and obliquely along PQ by the back foot. The ground reaction (R) of the force on the back foot acts along PR (Figure-10.7) the horizontal component of the reaction force takes us to the forward direction and the vertical component supports to bear our weight.

Rowing of a boat

To row a boat when a boatman pushes the ground by his bamboo stick obliquely the ground also applies equal and opposite reaction force on the bamboo stick. The horizontal component of this reaction force moves the boat forward (Figure-10.8).

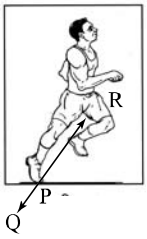


Figure- 10.7

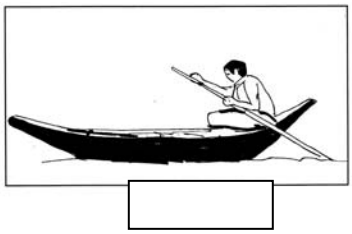


Figure- 10.8

Task 10.6: Taking a balloon blow up it gently. Hold the opening of the balloon by your hand tightly to close it so that no air can go out from it. Then suddenly leave the hand. What will you see?

The air inside the blown up balloon exerts force on it. This force is action. For this force air comes out from the opening face of the balloon. This air also applies equal reaction force on the balloon. As a result the balloon moves to the opposite direction of the outgoing air.

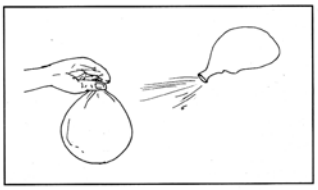


Figure- 10.9

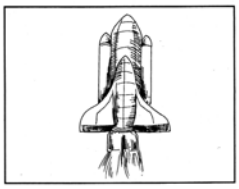


Figure- 10.10

The modern jet plane, rocket etc also operated on the basis of Newton's third law of motion that is based on action-reaction force. Rocket produces abundant gas by burning the fuel. Rocket applies force on that outgoing gas. This force is the action. Due to this action the gas that is released with tremendous velocity from the backside of the rocket also applies equal and opposite reaction force on the fuel and rocket at the time of releasing. So the rocket moves in opposite direction of the outgoing gas (Figure-10.10).

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 ms^{-2} by applying 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 (stopped).

   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 $4ms^{-2}$. When the driver applied brake on moving bus the passengers along with Sawpna were leaning forward. Again when the bus started to move then they were bended backward.

   a. What is called force in contact?

   b. What does it mean by force?

   c. Compute 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 road of pitch outside his house.

   a. What is Newton's second law of motion?

   b. What does it mean by inertia?

   c. Why Turjo along with his chair moved towards the table? Explain.

   d. Analyse the cause of traversing different distance by the marble on two different surfaces.

Chapter Eleven

Biotechnology

The base of modern genetics was founded near about 150 years ago by the research of an Austrian Priest called Johan Gregor Mendel. The main topic of his invention was every character of living being is controlled by a pair of factors. In 1908, Batson termed Mendel's factors as genes. At the beginning of the 20th century, genetics began to develop in many ways. It began to get enriched with lots of information. Biologists have explained the different process of cell; knew about cell division, chemical structure of chromosome and gene etc. Along with the nature of gene elements its chemical structure, control of biological process the biologists began to think another thing. They saw that all the genes of a living being are not good for that living being. The scientists began to investigate, how gene can be transferred from one cell to another cell without fertilization, how the harmful gene can be deleted and good or suitable gene can be inserted in that place. Herbert Boyer and Stanley Cohen, the researchers of California University, in 1973, at first were successful in inserting gene artificially, without fertilization. In the history of biology, it was an unimaginable event. It instituted a new branch of biology called biotechnology or genetic engineering. We will discuss chromosome, gene, DNA and RNA before discussing biotechnology. We have got an overall knowledge about chromosome, gene, DNA and RNA in class Eight. We shall know it in detail in this chapter.

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

- Explain the techniques of inheritance of genetic traits.
- Explain the importance of DNA test.
- Describe the genetic disorder and its result.
- Explain biotechnology and genetic engineering.
- Explain the social effects of cloning.
- Explain the use of genetic engineering and biotechnology and its good effects.

Chromosome

Every Eukaryotic cell has a nucleus. The nucleus has nucleoplasm with chromatin fiber. In the normal stage of cell they remain scattered in the nucleus. During cell division dehydrolysis occurs and this chromatin reticulum becomes clear and appears like a thread. This is called chromosome.

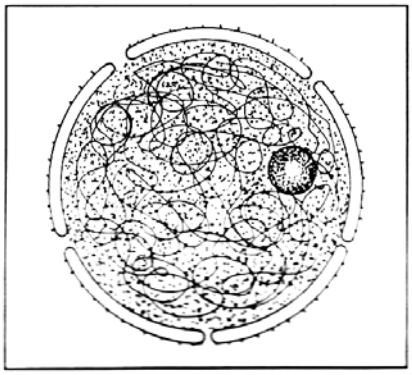


Fig: 11.1 Nucleus

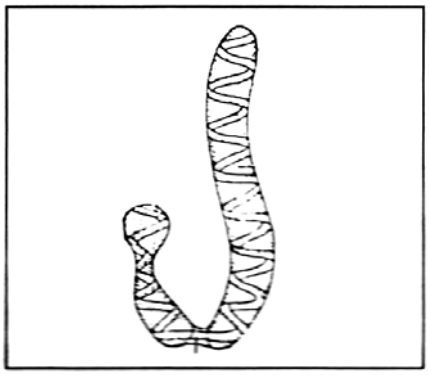


Fig: 11.2 Chromosome

The chromosomes become clear during the prophase and metaphase stage of cell division. The number of chromosome in every species is fixed. That is, if a plant or animal species have 12 chromosomes in its cell, every member of that species has 12 chromosomes in each cell.

Shape and structure: Chromosome is normally long. Every chromosome has two thread-like part. Every thread-like part is called chromonema, in plural chromonemata. During cell division they divide into two parts. Each of them is called chromatid. Every chromatid is made of a chromonema.

Nowadays the cytologists think that the chromatid and chromonema are the same part of chromosome with two names. In metaphase stage of mitosis each chromosome has a round and constricted site that is called centromere. Many termed this kinetocore. Both sides of a centromere of a chromosome is called arm. It was thought before that chromosome is covered with a matrix. But in fact it is a collection of protein and inorganic substances which is not seen on electron microscope.

Classification of chromosome

The higher plant and animal have different types of chromosomes. There are specific number of chromosome in a somatic cell among them one pair of chromosome is different from the other. This different chromosome is called sex chromosome. The other chromosomes are called autosomes. Normally the sex chromosome is named as X and Y. In human body each somatic cell has 23 pairs, that is, 46 chromosomes. Among them 22 pairs are same in both male and female. These are autosomes. But 23rd pair is different in male and female. If the 23rd pair of chromosome is XX, then that person is female. On the other hand, if the 23rd chromosome is XY, then the person is male. All the traits are controlled by autosomal genes but sex is determined by the sex chromosome.

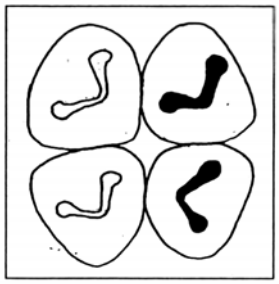


Fig: 11.3 Sex chromosomes

Chemical Composition of Chromosome: In chemical composition of chromosome there are nucleic acid, protein and other elements.

Nucleic Acid: Nucleic acids are of two types e.g. (1) Deoxyribonucleic acid (DNA) and (2) Ribonucleic acid (RNA).

DNA: The full name of DNA is Deoxyribonucleic Acid. DNA is the basic element of all the living beings. It is located in the chromosome of nucleus. After knowing this information the scientists tried to know the structural elements of DNA. In 1953, two scientists named James Watson and Francis Crick discovered the structure of DNA molecule. They received Nobel Prize in 1962 for this revolutionary discovery. DNA is double helix structure with a long chain of polynucleotide. They are composed of many nucleotides. So, they are called the polynucleotide. One unit is called a nucleotide.

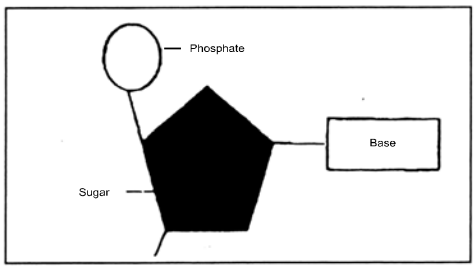


Fig: 11.4 Nucleotide

DNA molecule is like spiral stairs. Both sides of spiral structure are composed of 5 carbon sugar and a phosphate. There are nitrogen base with the sugar of both sides. This pair of nitrogen base makes a step of that stair.

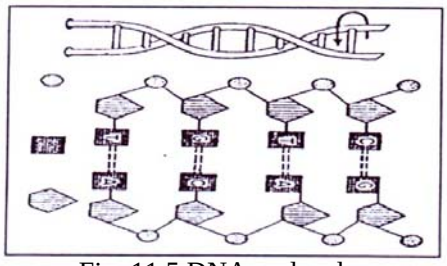


Fig: 11.5 DNA molecule

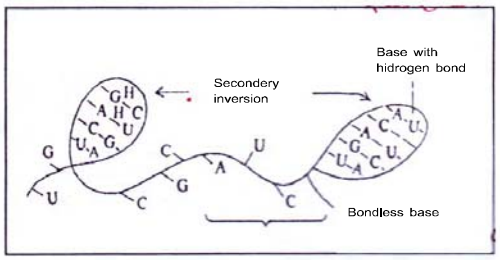


Fig: 11.6 RNA molecule

RNA : RNA is Ribonucleic Acid. It is folded in a single nucleotide. RNA has a side chain of five carbon ribose sugar with a phosphate of which four types of nitrogen base is similar to DNA. The main difference is, DNA has thiamine in pyrimidine and RNA has uracil instead of thiamine. There are three kinds of RNA in a living body e.g. - (1) Messenger RNA or m RNA (2) Ribosomal RNA or r RNA and (3) Transfer RNA or t RNA.

Protein: There are two types of proteins in chromosome such as histone and non-histone protein. Besides these chemicals chromosomes have lipid, calcium, iron, magnesium and a very little amount of other chemicals.

Gene: In the second chapter of class eight we have known what genetics is. We have also come to know the role of chromosome in genetics. Mendel termed this factor as the unit of hereditary feature and added that these factors carry the characteristics from parents to the subsequent generations. Nowadays by the improvement of genetics, knowledge about the techniques of genetics has enriched. In 1908, Bateson named Mendel's factors as genes. Besides peas, extensive research commenced about the process of genetics of other living beings. In 1909 Johansson called gene as character determining unit of generations. Gene or the unit of generation is located in the chromosome. Gene is controller of variants of living beings. Gene controls the structure and nature of unicellular bacteria; germs of dysentery amoeba to big structures like banyan tree, elephant, and whale etc. even intelligent animal human beings.

A living being gives birth to offsprings simillar to it for the need of population growth. All these are determined by the gene. Avery, Macleod and McCarty (1944) differentiated the chemical structure of proteins, fats, sugar and nucleic acids of a bacterium named pneumococci which causes pneumonia. They examined every element separately and proved that only the DNA is the hereditary material in humans and almost all other organisms.

Now, it is the question how DNA transfers the genetic properties to the next generations. DNA chains are longitudinally divided and form two complementary side structures by self duplication. Thus, one DNA is divided into two parts. And each DNA molecule has an old side structure and a new side structure. So each DNA molecule is an exact replica of the original DNA. Thus DNA molecules preserve the hereditary properties without any change and send it to the next generation.

From the above discussion we have come to know that for transferring hereditary character; chromosome, DNA and RNA are responsible. The main element of chromosome is DNA. DNA is the carrier of genetic character. RNA helps DNA to control character. Chromosome contains DNA and RNA. Chromosome directly carries the DNA and RNA and sends it to the next generation. This process continues by the meiotic cell division. So chromosome is called the physical basis of heredity.

DNA Test: When there is confusion about the fatherhood and motherhood or when someone claims a child as their own child; then DNA test is necessary. For the DNA test

the mucus of mouth is taken by something like cotton bud. Then the DNA profile is made in the laboratory by many chemical reactions. Then DNA profile of father is compared with the DNA profile of the child. If there is a similarity of 99.9% then it can be confirmed that he is the actual father or biological father of that child.

Genetic disorder in human beings

The diseases caused by genetic disorder are a matter of tension in medical science. But nowadays it is known how these diseases are transferred from the parents to the child and what type of genetic disorder happens. These diseases may occur for the causes described below:

1. Point mutation or gene mutation.
2. Increase and decrease of chromosome number.
3. Increase or decrease of any part of chromosome.
4. Deletion of homologous chromosome during meiosis cell division.

The genetic diseases which are created for these causes are described below:

1. **Sickle cell Disease:** These diseases occur in red blood cell of human body for point mutation. Normally RBC is flat in shape. But in case of sickle cell the shape is like sickle. This sickle cell causes disturbances in artery. So, a severe pain is felt in that place. Anemia is also caused by this because the blood cells break so rapidly that red blood cells are not produced so speedily to make up the loss.
2. **Huntington's Disease:** This disease is caused by point mutation. The brain does not work properly for this disease. This disease reduces muscular strength and causes mental imbalance and finally leads to death. The symptoms of these diseases are not seen before the age of forty.

During anaphase stage of meiosis the homologous chromosomes do not separate from each other and go to any pole with pairs. This is called the non disjunction. If any chromosome has got the non-disjunction then some symptoms are seen. All these symptoms are called syndrome.

3. Down's Syndrome: The non disjunction of 21st chromosome of humans causes this disease. So swelling in eyelids, long tongue, flat nose and short hands are seen. These people are short and mentally imbalanced.

4. Klinefelter's Syndrome: This disease occurs for the disjunctions of sex chromosome. So the male sex cell gets an extra X chromosome with XY chromosome. So their chromosome is XXY. Klinefelter's syndrome boy gets the normal symptoms of male. Their voice is very rough, breasts are big, growth is slow and they are sterile.

5. Turner's Syndrome: This disease is caused for the non disjunction of female sex chromosome. The female has X chromosome instead of XX chromosome. These females

are short with long neck. Their breast and sex organ do not develop in adult stage. So, they are infertile.

Besides, there are some other traits which occur due to sex linked gene which may also be called disease. Some of them are X linked, while some others are Y linked. X linked gene remains only in X chromosome, not in Y chromosome. In most of the cases they are recessive. So their characters are expressed only in homozygous stage of the female. On the other hand Y linked characters are expressed in the male, because the female do not have Y chromosome. Sometimes, all the sons of a sex linked female get all the traits, and daughters are only carriers.

Some conceptions of genetics are as follows-

Recessive gene- The gene which does not express its traits.

Dominant gene- The gene which expresses its traits.

Homozygous gene- When two recessive or two dominant genes remain in pair.

Heterozygous- When one gene is dominant and the other is recessive.

The problem caused by sex linked gene in human body are given below-

Name of the traits or problems	**Symptoms**
Colour blind	Cannot understand the differences of colours.
Hemophilia	Abnormal delaying in blood clotting; so continuous bleeding happens and may cause death.
Night blindness	Cannot see clearly at night.
Optic Atrophy	Decay in optic nerve.
Juvenile glaucoma	Rigidity in eye ball.
White forelock	A bunch of white hair in front of the head.
Myopia	Low vision.
Muscular dystrophy	Complexity in muscle, losing capacity of movement even at the age of ten.
Ectodermal dysplasia	Absence of sweating gland and teeth.

Besides these genetic disorders there may be a genetic disorder in embryo for radioactive ray. So the child may be defective.

Biotechnology and Genetic Engineering

The subject genetic engineering is well known to us for publicity. But in fact its application started many years ago with the development of civilization, when human

beings started a settled life leaving nomadic life. Since then biotechnology has originated because at that time high yielding and nutritious plant and healthy animals became important to human beings. Thus, by favourable selection biotechnology started. Men have been producing wine, bear, vinegar, bread etc. with microbes or bacteria from ancient times. Now they use the biological activity of microbes in industry and human welfare. Thus they enriched biotechnology with new products. The research related to biotechnology opened the new aspects of Biology. Biotechnology can be defined in various ways. Some say that the mechanism to make different products by the use of different animals for the welfare of human beings is called biotechnology. It is yet not possible to give a universally accepted definition of biotechnology. According to National Science Foundation of America, biotechnology is controlled use of cell or microbes for the welfare of human beings. Yogurt, vinegar, bread, wine, cheese are the products of biotechnology. These are called the old biotechnology. Recently by the research of molecular biology, the biotechnology has been expanded and that is called new biotechnology.

In fact biotechnology is the combination of three subjects e.g.-

1. Microbiology
2. Tissue culture
3. Genetic engineering

So biotechnology is a combined science with the combination of three subjects, this modern branch of biology has opened a new horizon of human civilization.

Genetic Engineering

After the invention of nature, chemical structure of genetic elements and process of controlling biological activity, scientists began to think about a new subject. They saw that all the genes of a living body are not good for it. After this thinking, a new subject called genetic engineering has been established. A process, by which specific gene carrier DNA part of a living being is separated and placed it in a different living body is called genetic engineering. We can say more simply that the process of changing DNA of an organism to get a desired character is called recombinant DNA technique. The process by which this gene is replaced is called recombinant DNA technique. Desired part of DNA molecule is cut separate and placed it in another DNA molecule, thus a new DNA molecule is produced. This DNA is called the recombinant DNA. The process by which recombinant DNA is made is called recombinant DNA technique or gene cloning.

A bacterium called *Escheretia coli* lives in human intestine. Most of the techniques of genetic engineering are invented by research on this bacterium. These steps are followed by recombinant DNA technique-

1. At first desired DNA part is separated from the donor of living beings, then plasmid DNA of bacteria is separated as carrier of this gene. Plasmid is a separate DNA molecule able outside bacterial chromosome. It is capable of self replicating.

2. In this step plasmid DNA and donor DNA is cut with a special enzyme. This part of donor DNA has the desired gene.
3. In this stage donor DNA is placed to the detached part of plasmid DNA with an enzyme called lygase, here lygase acts as a glue. So, recombinant plasmid DNA is created with desired gene. This recombinant plasmid carries the DNA part of donor.
4. Now this recombinant plasmid is inserted in bacteria by transformation process. Inserting DNA part in the receiver cell is called the transformation. After transformation the bacteria or any living being with new gene is called transgenic living organism.
5. Then recombinant plasmid carrier bacteria are separated and specific gene career bacteria are identified and multiplied. This is gene cloning. So, several copies of gene are made. Thus, the gene having desired characters is multiplied.

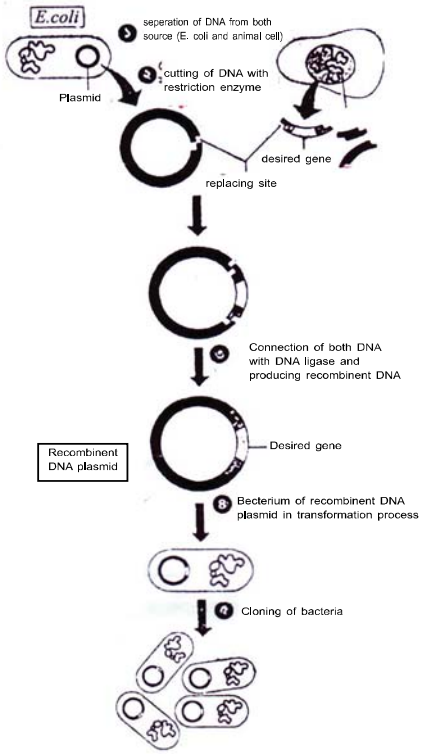


Fig: 11.7 Cloning of bacteria with desired gene

What is cloning?

Natural clone means a living beings or group of living being, which are produced by vegetative reproduction. They are very much similar to the mother. When a cell or group of cell is produced from one cell and their character is similar to the mother cell they are called clone. In case of genetic engineering a specific gene is multiplied and its

replication is made. Sometimes a cell is placed in a culture media of cell division to produce a group of cell with the same character. On the other hand to produce many microbes, plants or animals with the same characters are called the cloning. Cloning is of three types.

1. **Gene cloning:** To produce many copies of gene is called the gene cloning. Gene cloning can be done by recombinant DNA technology.
2. **Cell cloning:** To produce many cells of the same character from a single cell is called cell cloning.
3. **Living Being Cloning:** To produce one or many living beings with same genetic character from a single parent is called the living being cloning. In nature vegetative reproduction of plant is also a clone. Monozygotic twins are clone to each other.

Recently it has been possible by biotechnology. A nucleus is separated from the somatic cell of an animal then this nucleus is injected to fertilize ovum of the same animal. Before placing the somatic nucleus the nucleus of fertilized ovum should be separated. So the animal created from this ovum is the copy of its mother. The sheep Doli is the first mammal which was cloned from an adult somatic cell. This cloning process is used for, rat, hare, cow, and goat and even in monkey. After cloning of rat, sheep Doli, then monkey; now the scientists are keeping an eye on human beings. This process is not very difficult. So, many developed countries have made law forbidding human cloning.

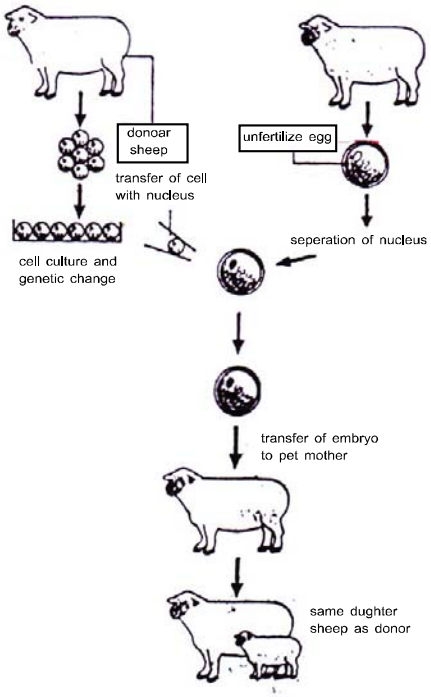


Fig: 11.8 **C**reation of Doli

Social Effects of Cloning

The whole living body cloning is reproductive cloning. The sheep Doli is a reproductive clone. There is not so much debate on animal cloning but scientists have begun to think about human cloning. Now it is a question of morality. The issue of morality is that when the clone baby will grow up what will be the character and personality of that baby. Will it be like the parents or different. Secondly, this cloned baby will face tremendous social pressure. But it is good news that there is no news about cloned baby. The cloned baby may not be healthy and there is a possibility of abnormal or defective baby. Human cloning will be big interferences on nature. According to the common people, religion and science are not same. We should respect the religious canon.

Human cloning will be the interferences on religious rules. It is true that the monster of Arabian Nights could not be recaptured in the bottle after release. Like atomic power biotechnology has a boundless power. So our duty is to use biotechnology for welfare of human beings following justice and truth.

Use of biotechnology for the invention of higher plants and animals

Scientists are trying to invent higher animals using biotechnology and they have been successful. It resulted in transgenic plants and animals. The process of producing transgenic life is called transgenesis.

It is possible to create transgenic life from bacteria to plant and many animals. Thus the transgenic life creates a new possibility. In agriculture and for the development of domestic animals transgenic living organism easily brings success. Applying recombinant DNA and microinjection techniques transgenic lives were invented.

Transgenic animal: Gene can be transferred by genetic engineering. Thus transgenic rat can be invented which is capable of producing antibody of man. Transgenic cattle, sheep, goat, pig, birds and fish have been produced.

Transgenic plant: When a gene of a plant cell is transferred by the genetic engineering process, that plant is called a transgenic plant. By using recombinant DNA technique a desired gene is inserted to the protoplasm of plant cell.

Economically important plants are transferred into transgenic plant. So they become resistant to virus, bacteria and fungi. Transgenic plant can resist cold, salinity, draught, nitrogen and phytohormine deficiency. So far 60 transgenic plants have been created successfully. These are tomato, tobacco, potato, lettuce, cabbage, soya bean, sunflower, cucumber, cotton, pea, carrot, apple, radish, papaya, rice, wheat, maize etc. The peel of tomato does not become soft as they are made transgenic tomato. Not only that their ripening time is delayed and amount of sucrose increases.

Use of biotechnology in agricultural development

Food is the basic need of human body. Land is limited but population is growing. How it is possible to be self sufficient in food or how sufficient food can be produced and get financial profit, is an undeclared battle in the world. Biotechnology is a tool to win in this battle.

The use of biotechnology in agricultural development is described below:

1. Tissue culture: In this process the growing tips of plant that is root, stem, leaf and different parts of germinated seedling are cultured in a controlled environment in a culture medium. Many seedlings are grown from these growing parts in the culture media. Each of the seedlings then turns into a plant in suitable environment. In limited space and in controlled environment hundreds of thousands of desired seedlings are grown commercially using this process.

2. Producing high yielding plant: It is possible to produce high yielding variety by transferring some good gene of wild plant to the crop plant or changing in arrangement or structure of gene. Thus the high yielding variety of rice, wheat and oil are produced.

3. For qualitative improvement: The structure colour, taste, nutrient etc of plant and animal product has been improved by using biotechnology. e.g. sulfur amino acid producing gene of sunflower is transferred to glover grass by recombinant DNA method. When the Australian sheep eat this grass their hair become high quality hair automatically. No need to supply extra sulfur in sheep food.

4. Invention of super rice: The scientists of Sweden have invented rice called super rice or golden rice. This rice is enriched with vitamin A.

6. Sterile insect technique (SIT): The harmful insect of vegetables, fruits and dry fish or other insect can be controlled by SIT method of biotechnology. This method is mostly used in Japan, Philippines, Thailand, Guatemala, Brazil and other countries. Some scientists of Atomic Energy Research Institute of Savar in Bangladesh are doing research for controlling the vegetable insects by this method.

7. Transgenic Plant: Up to now transgenic DNA technique has been applied in 60 plant species. There are tobacco, tomato, potato, sweet potato, lettuce, sunflower, cabbage, cotton, soya bean, pea, cucumber, carrot, radish, papaya, grapes, krishnachura (Caesalpinia pulcherrima) rose, apple, pears, neem (Azadirachta indica), rice, wheat, mustard, maize etc. These are insects, virus, bacteria and fungi resistant. They can face any unfavourable condition.

Use of biotechnology in pharmacy

Every year population and complication of diseases are on the rise. Scientists have developed pharmaceutical industry by using biotechnological method. Severe diseases have been identified along with the development of medicine production process. These are described below in brief:

1. **Producing Vaccine:** Many vaccines have been produced by using biotechnological method. These vaccines are used for polio, tuberculosis, measles, small pox, and many other contagious diseases.
2. **Producing Interferon:** Interferon has an important place in modern medicine industry. This element is composed of small protein molecule and it has an important place in modern medicine industry. It is possible to produce interferon commercially by using genetic engineering. This is used for hepatitis treatment and interferon is used on cancer patient to keep it under control.
3. **Hormone production:** Different types of hormone such as insulin for diabetes, growth hormone production are the important side of biotechnology. Production of growth hormone by biotechnology is easy and cheap.
4. **Antibiotic production:** Within a short time large amount of antibiotic can be produced by using biotechnological method. Nowadays more than one thousand antibiotics are being produced. Among them the most important are penicillin and cephalosporin antibiotic.
5. **Enzyme production:** Some enzymes like amylase, protease, lipase, are used for the treatment of diseases of digestive system. Physin is used for lukewarm and it is produced from the banyan tree. Thrombin is made from the plasma of cows, and it is used for stopping bleeding. For injury treatment trypsin is used. These enzymes can be produced as a benefit of biotechnology.
6. **Collecting medicine from the transgenic animal:** Necessary medicine is colleted from the blood, urine and milk of trangenic animals. This is called molecular farming.

Use of biotechnology for the development of domestic animals

The aim of producing high yielding animal is (1) to produce fat free meat (2) to make them sellable quickly (3) to grow immunity. Meanwhile transgenic sheep has been produced. There is up to 35 grams of human alpha antitrypsin protein in per liter milk of trangenic sheep. A badly harmful disease called emphysema occurs for the deficiency of this protein. The method of increasing flesh and wool has been accelerated by using gene technology. To produce fat free meat and increase production of human hormone is

successful by the invention of transgenic pig. Transgenic goat has been produced. The milk of this goat contains a protein which can melt clotted blood and protect human beings from coronary thrombosis. Transgenic cow can produce more meat and also produce lactoferin which is an important element of mother's milk.

Use of biotechnology for the production of milk products

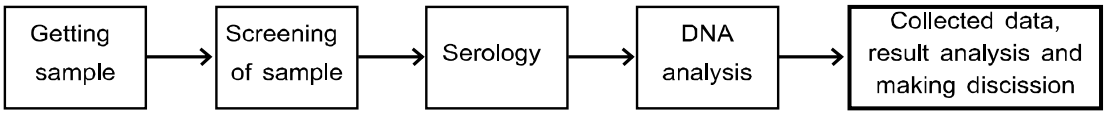
Globally the main source of milk is cow. Buffalo, goat and sheep stand next to cow. Milk has various types of direct use but different milk products are made by various technologies. For example, butter, cheese, yogurt are produced from milk. Different types of bacteria are used in biotechnology for producing milk products. The manufacturing process of some milk products is described below:

1. **Butter:** The enzyme of special bacteria can create a special taste and flavour of butter.
2. **Cheese:** In our country cheese is produced from cow's milk or buffalo milk. Bacteria or fungi are applied for producing cheese. So the taste, colour and flavour of protein are different. Italy, France, Netherlands and UK are famous for producing cheese. The production of high quality cheese has been possible for biotechnology.
3. **Yogurt:** Production of yogurt or yogurt product is possible by applying bacteria because there is lactose sugar in milk. Lactic acid of bacteria makes the milk thick and clotted to make yogurt. A kind of bacteria called lactic acid bacteria is used to produce yogurt. The quality of yogurt depends on the quality of bacteria.

Forensic Test

Criminals are identified by forensic test of DNA or antibody of blood, sperm fluid, urine, tears, saliva etc.

Using biotechnology process of forensic test is described below:



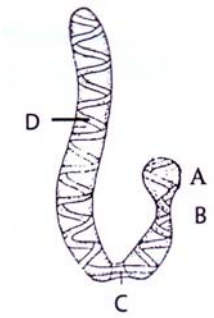
The human blood, sperm and saliva can be identified by serological test. Thus, a criminal is identified by serological test. We have discussed the application of genetic engineering and its benefits. Besides this, the location and function of genes in the chromosomes of human body is possible to know by Human Genome Project. Using genetic engineering, harmful gene can be replaced by beneficiary gene. This is called gene therapy.

Exercise

Multiple Choice Questions

1. What is the number of sex chromosome-?
   a. 1 b. 2
   c. 22 d. 44
2. The basic elements of chromosome is-
   i) Calcium and Magnesium
   ii) Iron and Magnesium
   iii) Calcium and Aluminium
   Which one is correct?
   a. i and ii b. ii and iii
   c. i and iii d. i, ii and iii

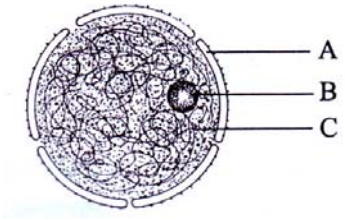
Answer the question no 3 and 4 from the picture below:



3. What is the picture about?
   a. DNA b. RNA
   c. Chromosome d. Nucleus
4. Which one is centromere in the picture?
   a. A b. B
   c. C d. D

Creative Questions

1. See the picture below and answer the questions:



   a) What is the full name of RNA?

   b) What is DNA test? Explain

   c) Explain this picture in the light of protocell.

   d) Which one of A and C is more important for determining sex? Explain.

2. Fariha visited an agricultural field with her father. She saw there that tomato, tobacco, maze, papaya and many species were healthy and germ free. But those plants planted in her house were sick. She wanted to know the causes of this. Her father said, “The plants in the farm have used gene transfer technology”.

   a) What is nucleus?

   b) What is meant by sickle cell disease?

   c) Explain the technology referred to in the above paragraph.

   d) How the technology mentioned in the paragraph is applied for the development of agriculture?

Chapter Twelve

Electricity in Daily Life

The purposes of using the electricity are unlimited in our daily life. Electricity rotates the fan, illuminates the light and operates radio, fridge, television etc. Cooking can be done by electricity. Hence for better understanding of its uses we are to realize some general functions of electricity. This basic conception will ensure the proper use of electricity, help prevent the misuse of electricity and raise public awareness about the proper utilization of electricity.

After the lessons of this chapter we will be able to

1. express the electrical components and instruments (accessories) by symbols.
2. explain the functions of battery.
3. design the electric circuits to use in residential houses.
4. explain the effects of electrolysis and electroplating in our daily life.
5. describe the importance of electrolysis and electroplating in our daily life.
6. explain kilowatt and kilowatt-hour.
7. calculate electrical power.
8. explain the advantage of energy bulb.
9. explain the functions and uses of I.P.S and U.P.S.
10. explain the system loss and load shading.
11. explain the contribution of electricity in development activities.
12. exhibit the use of suitable circuit useful for houses.
13. exhibit electrolysis by experiment.
14. use electrical components and instruments properly.
15. will be careful to preventing the misuses of electricity and make others conscious of it.

The symbols 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 and connections are given below.

electric cell

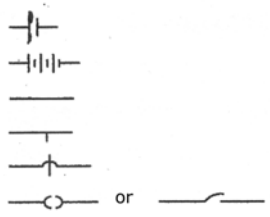
electric battery

conducting wire

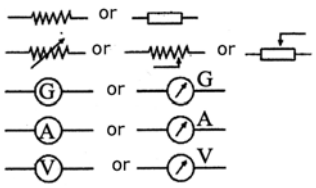
connected wire

wire not connected

switch



resistance or resistor or resistance box
variable resistance or rheostat
galvanometer
ammeter
voltmeter



Functions of Battery

Although we mention one electric cell [Figure-2.1 (a)] as a battery in our daily life actually the combination of more than one cell is the battery. In figure 12.1 (a) the construction of battery is shown. The electrical energy is stored in a cell or battery to use in future. There are three parts in a cell or battery. One anode and one cathode both outside the cell and electrolyte inside the cell. These anode and cathode are connected with an electric circuit. The anode is the positive terminal and the cathode is the negative terminal of the electrode. Due to the chemical reaction of the electrolytes inside the battery major portion of electrons dissipates in the cathode and a minor portion remains in the anode. As a result, there appears a potential difference between the anode and the cathode [Figure- 12.1(b)]. In this position if anode and cathode are connected with a conducting wire then the flow of electricity begins.

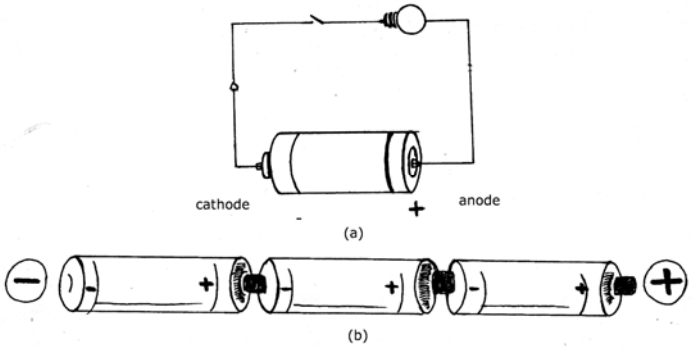


Figure- 12.1

The design of electric circuit for house or house wiring

Many of our houses have electric connection. Do you know that design is to be drawn before giving this connection? In case of small type of connection although the design is not drawn, there must be a plan according to which connection can be given. Generally in the houses the circuits in series connection is not suitable because the main problem of this is, all the bulbs, fans and connected components will begin to operate simultaneously as soon as the switch is on. Again all of them will stop operating when the switch is off. usually for the connection in the house the circuit in parallel system is followed. In figure 12.2 (a) one switch (S) and two bulbs (B,B) are connected with the battery (E) in parallel connection. For this both the bulb will get the full voltage of the battery. Now a detailed figure of house wiring is given below [Figure-12.2(b)].

It is shown in this figure how by connecting the main line other components like fuse, main-switch plug-socket, distribution box and desired light or fans are connected.

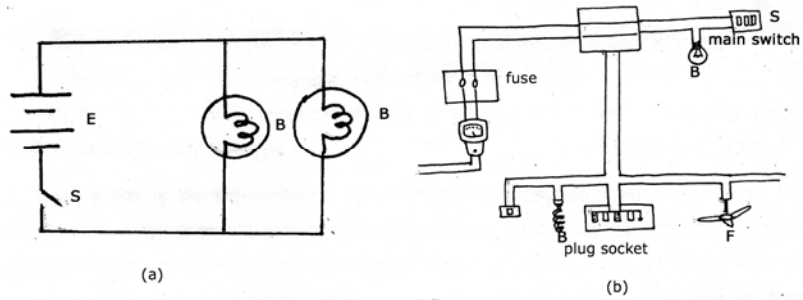


Figure- 12.2

Between two main wires one is live wire (generally of red colour) and another is neutral wire (generally of black colour). There is an electrical voltage in the live wire. If anybody touches this wire keeping his bare foot in contact with the ground he will be electrically shocked and electricity will flow through his body. For this, he may die. Those who work in this electrical connection usually put dry plastic or rubber shoes. The neutral wire has less voltage because its connection is given with the earth.

The main wire is connected with the meter through the fuse. The electrical energy consumed by the house is recorded in the meter through this connection. From the meter two wires are connected with the main switch. The flow of electricity in the house can be stopped or started with the help of this switch. It prevents excessive pressure in the main line.

The two wires are connected with the main box from the main switch. From there the two wires are distributed to different branch lines. For each branch line there is individual fuse. The connections of two bulbs, one fan and one plug-socket are shown above. Each of them is connected with live wire and there is individual switch or connection separately for each bulb or fan.

At the time of electrical wiring in the house, keep special eye on the wiring so that all the fuses of the bulb or power switches are connected with the live wire. If by mistake it is connected with the neutral wire the current will not flow. Moreover, electrical accident may happen for this. Other than this, the wiring is covered with poly vilyn chloride (PVC) or any other insulator. Sometimes rubber is used as an insulator.

Recently concealed wiring, that is, wiring cable connected inside the plaster of the wall is preferred. Here consider that there is no perforation or leak in the wire. Other than this ensure that all types of instruments are connected with the fuse. The use of suitable fuses with types of instruments like fridge, television etc must be ensured. Besides, a cable is to be used which can bear the necessary load.

Electrolysis

The process of separating the positive and negative parts of a molecule by passing electricity through a solution is called electrolysis.

The solute of the solution which was separated or analyzed into two parts by passing electricity is called electric solute or electrolyte. The electricity passes in the electrolyte through positive and negative ion. All acids, bases, some neutral salts, acid mixed water are electric solute or electrolytes. For example, H_2SO_4, HNO_3, $CuSO_4$, $AgNO_3$, NaOH etc. are electrolytes.

We know that normally number of electrons of an atom is equal to the number of protons located in the nucleus but if any atom, molecule or compound elements have more or less electros than the normal number then it is called anion. If the number of is remains less than its normal number, then it is called a positive ion. Again if the number of electrons is more than its normal number, then it is called a negative ion. The electrolytes are divided into positive and negative ions by electrolysis.

In 1881 the renowned scientist Arrhenius at first explained the electrolysis. According to him if all the acids, bases and some salt like compound matters are dissolved then it is ionized and divided into equal amount of positively and negatively charged ions. Chemical properties are not expressed in the state of charged ion. But when it is uncharged, it can take part in chemical reaction. The ions move scattered in the liquid. Now if by introducing two conducting plates or electrodes and passing electricity in the solution we will see that the negative ions are attracted by anode and the positive ions are attracted by the cathode. For this oppositely directed motion of the ions between the two electrodes, electricity is produced.

Explanation of the electrolysis of $CuSO_4$ solution

Some $CuSO_4$ and water is taken in a glass beaker. Dissolved in the water $CuSO_4$ is separated into Cu^{++} and $SO^{- -}_4$ ion [Figure-12.3]. Now immersing two copper plates in the solution if they are connected with a electric cell then the Cu^{++} ions are attracted by the cathode and take two electrons from the cathode and being converted into neutral copper molecule accumulate in the cathode. On the other hand $SO^{- -}_4$ ions attracted by the anode, goes there then dissipate two electrons and becomes neutral. This neutral SO_4 takes Cu from the anode and produces $CuSO_4$.

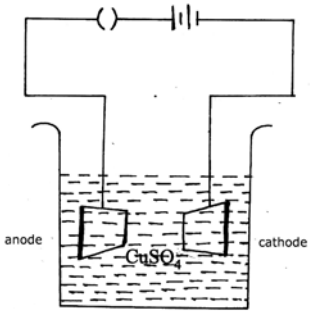


Figure-12.3

This $CuSO_4$ again dissolves in the solution and keeps the concentration of the solution unchanged. Hence it is seen that the amount of Cu accumulated in the cathode and that amount of Cu coming out from the anode in the solution are the same. That is total result is that Cu accumulates in the cathode from anode, for the amount of mass decreased in the anode the same amount of mass is increased in the cathode. But if the electrodes are of any neutral metal other than copper then the copper molecules will accumulate in the cathode like before but the $SO_4^{- -}$ 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.

The importance of electrolysis in our daily life

1. **Electroplating:** The process of coating any metal with another suitable metal by electrolysis is called electroplating. Generally the things made from the metals of inferior quality like copper, iron, bronze, etc are coated with gold, silver and nickel to save it

from the climate (moisturising) and to make it beautiful and attractive the substance which will be coated is used as a cathode of a voltammeter after cleaning it gently and the metal of which coating will be applied is to be used as an anode. Now by passing electricity through the electrolyte in the voltammeter, due to electrolysis the substance of the cathode is coated with the intended metal.

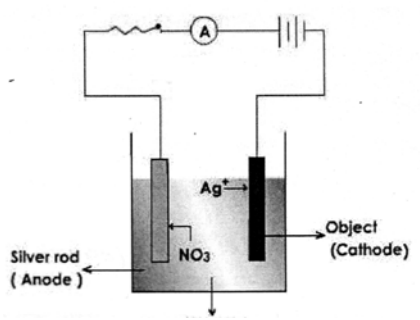


Figure- 12.4

2. **Electrotyping:** A special process of electroplating is called electrotyping. To make a letter of the alphabet, block, model etc by the process of electrolysis is called electrotyping. For electrotyping the writing is first of all composed in normal type then a print or impression is taken on wax. It makes electric conductor by spreading graphite dust over it. Next, it is immersed into copper sulphate solution as a cathode and a copper plate is used as an anode. Now if electricity is passed through the solution, the mould of the wax will be coated with copper. When the coating becomes thick then releasing it from the mould it is used for printing purposes.
3. **Extraction and purification of metals:** The metals from the mines are not generally found in pure state. There is a mixture of various metals which are called alloys. It is easy to extract and purify the metals from these alloys by electrolysis. The alloy from which the metal is to be extracted is used as a cathode in the voltmeter. The metal which is to be extracted the solution of that metal related salt is used as electrolyte and the plate of that pure metal is used as an anode. Now if electricity is passed through the solution then the pure metal will be extracted from the alloys and will be stored up (accumulated) in the cathode.
4. **Testing of polarity of an electric circuit:** In the direct current main line which one of the two wires is positive can be determined with the help of electrolysis. Taking some water in a pot a small amount of salt is mixed with it. Now the two wires of the main line are immersed in the salt solution. The electricity flowing through the two wires when immersed in the salt water it will be seen that many bubbles are coming surrounding one wire. Those bubbles are of hydrogen gas and that wire is negative and another one is positive wire.
5. **Electric repairing:** The parts of a machine are repaired applying this technique. In this case the entire upper part of the breakable and damaged parts of the machine is covered with weave. For this it is immersed in the electrolyte and used as the cathode. If necessary it can be converted into another shape.

Electric power

The rate of doing work or the work done per unit time is called power. The amount of electrical energy spent or changes to another energy (heat, light, mechanical energy etc) per second, is called electric power.

What is kilowatt?

The S.I unit of electric power is watt. When the potential difference between the two ends of a conductor or an electric device is one volt and if one ampere of electric current flows through it then the electric power of that device is one watt.

$\therefore$ 1 watt = 1 volt × 1 ampere

The unit of electric power is also expressed in kilowatt and megawatt.

1 kilowatt = 1000 watt = 10^3 watt and

1 megawatt = 1000000 watt = 10^6 watt.

Kilowatt-hour

Again 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 when bulb is lightened it is light energy and when the fan rotates it is mechanical energy) that is one watt-hour.

1 watt-hour = 1 watt × 1 hour

and 1 kilowatt-hour = 1000 watt × 1 hour

= 1000 watt × 3600 second

= 36×10^5 watt-second

= 3.6×10^6 joule

Internationally, the unit of electric supply is measured by kilowatt-hour unit. This unit is called Board of Trade unit or in short (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 electric bill in our houses on the basis of electric energy consumed per month. This company fixes the value per unit. Accordingly we pay the bill. Generally the total expense of the consumed electric energy = consumed units of electric energy × expense per unit. Here, if electric power is expressed in watt and the time in an hour, then the consumed energy will be as below:

Consumed energy = (power × time) watt-hour

$$= \frac{\text{(power} \times \text{time) kilowatt-hour}}{1000}$$

$$= \frac{\text{(power} \times \text{time)}}{1000} \text{ unit}$$

Hence if we know the power of on electric device then by counting the time we can easily calculate the consumed electric energy. For example, if a bulb of 60 watt is enkindled 5 hours per day for 30 days then what amount of electric energy is consumed?

We know,

$$\text{Consumed energy} = \frac{\text{(power} \times \text{time)}}{1000} \text{ kilowatt-hour}$$

$$= \frac{60 \text{ watt} \times 5 \times 30 \text{ hour}}{1000 \text{ watt-hour}} \text{ kilowatt-hour}$$

$$= \frac{9 \times 1000}{1000} \text{ kilowatt-hour}$$

$$= 9 \text{ kilowatt-hour} = 9 \text{ unit}$$

Now if the price is 8 taka per unit, then what will be the total expense for the above consumed amount of electric energy?

We know that,

Total expense of the consumed electrical energy = consumed unit of electricity × expense per unit

= 9 unit × 8 taka = 72 taka

The meaning of 220 V – 60 W

In the bulb we use to get electric light there is written two words V and W beside two numbers on the body of the bulb. If there is written 220 V – 60 W on the body of a bulb then the meaning of this is that, when the bulb is connected with 220 V (e.m.f) potential difference then the bulb be enkindled with maximum luminosity and it converts electrical energy into light and heat energy at the rate of 60 joule per second, that is, 60 watt.

Advantage of energy saving bulb

Recently energy saving bulb is available alongside normal bulb in the market. Electric energy is consumed excessively by using normal bulb. For this, use of energy saving bulb is increasing. As a result of using energy saving bulb, there is advantage in self economical development side by side in different aspects of environment. The advantages of using energy saving bulb is mentioned below.

Saving expense

Although it costs much at first time to buy an energy saving bulb, it lasts longer than the normal bulb. Besides, electric bill will be less. So, there will be savings in expense.

Use of energy : It requires less energy to operate an energy saving bulb. In a statistical report it is seen that if each family uses one energy saving bulb in lieu of a normal bulb then the amount of energy thus saved can be used to give electric connection to 30 lac families per year.

Fossil fuel : If we can reduce the misuse of energy by using energy saving bulb then we can reduce our dependence on fossil fuels because, for producing electricity using fossil fuel has an adverse effect on the environment.

Pressure of Disposal

Energy saving bulbs last longer than normal bulbs. So fewer bulbs are disposed. For this, there is an advantage in rubbish garbage management.

IPS

IPS means instant power supply. It is an ideal solution for instantaneously continuous supply of electricity immediately after the normal flow of electricity is obstructed. In this, there is same different type of advantage over our ordinary generator. The design of IPS is drawn generally according to the condition of the power line.

Originally it supplies direct current (dc). It has the capacity to be charged with low voltage. So we get back-up from it in spite of obstruction created by normal electric

supply or load shedding. The IPS is generally connected with the input of the electricity used in our houses.

This instant power supply is entirely automatic, that is, its functioning starts within no time when normal electricity goes off and continues to run till the charge of battery exists. It can run many outputs simultaneously according to its power. Some of the IPS available in the market can operate two bulbs, two fans, while some others can operate four bulbs and four fans continuously for two hours. Even air conditioner and computer can be operated by some IPS.

UPS or uninterruptible power supply

The uninterruptible power supply (UPS) is a system which is connected in between the source of electricity and the computer. For this, in spite of any disturbances in the flowing of electricity, the computer is run by it and there is no interruption in the electricity for the computer. Its role is different from the function of a generator. For using it the information or data collected in the computer is not hampered. Because, it gives enough time to save the file. Basically the UPS has three parts, namely—rectifier, battery and inverter. Generally, three kinds of UPS are available in the market, they are off-line, online and line interactive UPS. On the basis of the design of UPS it helps to run the computer usually from half an hour to two hours.

System loss and load shedding

Electricity is produced from different sources in Bangladesh. It depends on the source where and how the electricity will be produced. We cannot use the entire amount of the electricity which is produced by us. System loss is related with electricity inseparably. So it is inevitable to fall on the trap of load shedding which has adverse effects on the society. Now, we will discuss the contribution of electricity to the socio-economic development.

Electricity is produced in different areas of Bangladesh in different ways and it depends on the easy availability of the constituent parts required for the production of electricity. Electricity is produced in Bangladesh generally from the flow of water, gas etc. Previously oil was used as a fuel for the production of electricity. Preparation is going on to produce electricity extensively using coal in future.

Do you know that the electricity you are getting in your area, where is its production centre and how this electricity is produced? The electricity produced daily in Bangladesh at present, the source is gas for some electric plants, again a few plants produce electricity by using the current of water, that is, hydro-electricity. Moreover, preparation is going on to produce electricity extensively in future by using the coal obtained from the mine at Boropukuria in Dinajpur.

System loss

The wastage of electricity on the way within production centre and place of supply is generally known as a system loss. The entire amount of electricity produced in the production centre does not reach the customer level. Electric line (wire) is pulled from the supply centre to the customer’s house to reach electricity. In this case, the meter is placed in the house of the customer. But it is seen that before reaching to that meter on

the way someone is taking illegal connection from the line and using electricity. Moreover, the resistance of the wire and the naked wire dissipate some electrons in the air, and thus, electricity can be wasted. These losses of electricity are not shown in the meter reading. Therefore, it creates an imbalance (short fall) between the production and consumption of electricity.

The causes of system loss

1. The defect in the method of supply.
2. The illegal connection of electricity.
3. There is no preservation system, so if the electricity produced and not used then it will be wasted.
4. Weak monitoring system.

Remedy

1. Development of the method of supply.
2. To disconnect the illegal connections.
3. The production of electricity according to the demand by proper adjustment.
4. To employ an efficient and successful monitor.

Load shedding

It is not possible to supply electricity everywhere if the production of electricity is less than the demands. In that case, stopping the supply of electricity to some areas, the produced electricity is supplied to other areas according to their demands. If the production of electricity is much less, then the supply of electricity is to stop continuously in all areas. This method of stopping supply of electricity for the distribution of produced electricity is called load shedding.

The causes of load shedding

1. The production of electricity is less than the demand.
2. The excessive system loss of electricity.
3. The waste of electricity.
4. The instrumental errors of the electrical device.

System loss and load shedding in the society—its effects

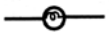
Widespread effects of system loss and load shedding are noticed in the society. Let us first come to the story of system loss. For this, the terrific disruption of morality is noticed in the society. Perhaps some of the people of the society feel pleasure by doing this evil work, cheating all the people of the society and degrading self morality. Now let us come to the story of load shedding. The direct effect falls on the load shedding for the system loss. For this, people suffer a lot of troubles. There appear a lot of problems in all spheres of systems that depend on electric management. Even our time passes without any cause in our daily life for load shedding. Suppose you have determined to start some work at night. At that time due to load shedding if the electricity goes off then you will have to sit for some time without any work. Moreover, the production of mills and factories is extensively obstructed. Actually adverse reaction falls on our society for the load shedding and system loss.

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 question no. 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 is—
   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 come to Monsura Khanom 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.

2. See the two figures below and answer the questions.

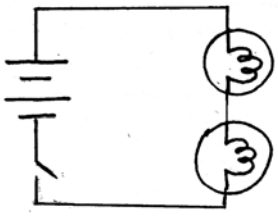


Figure-P

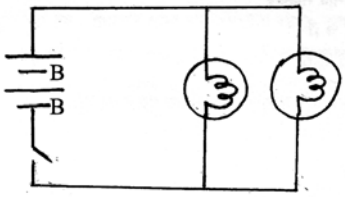


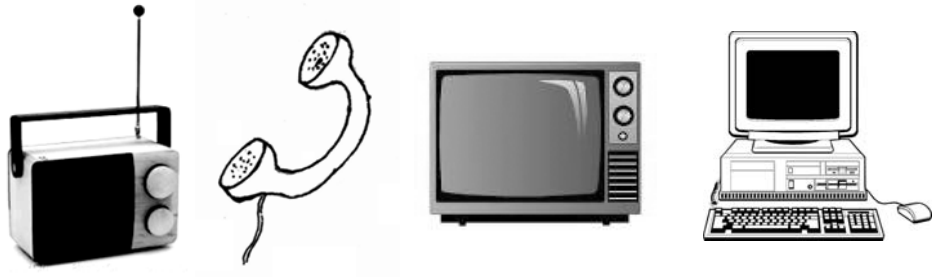
Figure-Q

a. What is electrolysis?
b. What is meant by anode?
c. How the electron flows at the point B? Explain.
d. Which one of figure P and Q is suitable for house wiring? Give your opinion.

Chapter Thirteen

The World is Getting Smaller

Communication is a very important factor in human life. Communication has brought men, countries, societies all close to each other. Since the creation of human beings in ancient times men have been communicating with each other in various ways. Now, we can communicate within a moment from one end of the world to the other through radio, television, satellite, telephone, internet, fax and e-mail. Communication has changed the standard of life of men bringing them to the apex of development. To lead a successful and prosperous life in the society, country and world we will have to maintain communication with different people, countries and societies.



In this chapter we will discuss communication, its principles, different techniques (skill) and instruments of communication.

After reading this chapter we shall be able to-

- explain the basic principles of the information and communication.
- describe the different steps of communication system by using a block-diagram.
- explain the functions of microphone and speaker.
- explain analogue and digital signal.
- describe the advantages of digital signal.
- describe the functions of main machines related to information and communication technology with the help of block-diagram, its advantages and their uses in our life.

What is communication?

All of us are acquainted with the term ‘communication’. We are making thousand types of communication daily. For example, communication by road (land way), water way and air way. The meaning of these is to go from one place to another or to reach any message or goods by using car, horse, rail, boat, steamer and aeroplane as a carrier. Today we will tell you about a different type of communication. It is called informational communication.

You get up from sleep when alarm of the clock rings early in the morning. It is your communication with the clock. You are listening to news of television or radio or watching or hearing any programme?it is also one kind of communication. After conversation, you tell your friend ‘bye bye’. You call any taxi driver to your house over

telephone. Just now you are reading this writing or paying attention to the lecture of your teacher in the class or raising question to him or giving answer to his question, all these are communications. Hence, communication is to give-and-take or exchange of talks, thought or information from one place to another place or from one person to another or from one instrument (device) to another instrument (device).

The Basic Principles of Communication

1. There must be one sender and one receiver for communication. Without any sender or receiver communication is not possible. There should be mutual understanding and confidence, should be eagerness and acceptability between the sender and the receiver in communication.
2. The language of communication is to be easy, simple, very clear and complete. Communication is actually an art. Its information or signal or language is to be understandable and clear to the sender and the receiver.
3. Correct information is to be sent the right person.
4. There must be courtesy in languages talk and information.

The Process of Communication and Its Steps

The sender sends messages in the form of signals through any media. The receiver receiving this message in the form of signals and comprehends its meaning then responds to send the answer. This response or answer is delivered to the sender and this act is called feedback. In this way, communication system proceeds on.

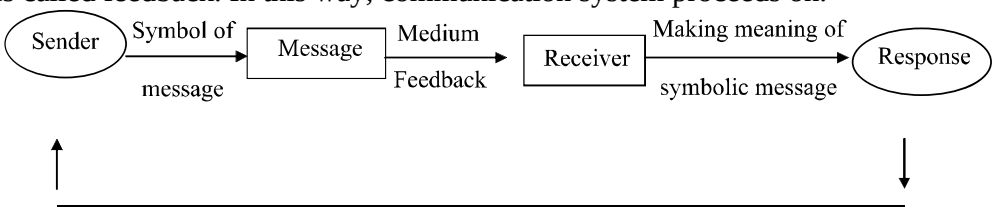


Figure- 13.1 : Process of Communication made by man

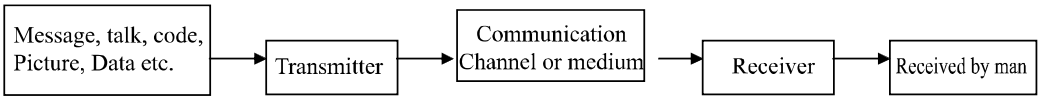


Figure- 13.2 : The Main Elements or Steps of Electronic Communication

Any electronic communication system has one transmitter, one communication medium and one receiver. In most of the communication systems the message is made by a person. Later he sends the message through the communication medium with the help of the transmitter. The receiver receives it and delivers it to another person. These are the steps of electronic communication.

Purpose and Importance of Communications

Communication is the main process of exchanging information. Through it a person expresses or reaches his thoughts, ideas, and feelings from one person to another person. Since the creation of human beings in ancient times men have been communicating with each other in various ways. Now we can communicate within a moment from one end to the other end of the world through telephone, internet, fax and e-mail.

Solution of any problem and development of relation depend on the successful and effective communication. Study, research, trade-business, industry, politics, economics, diplomacy, transport management, arresting criminals, controlling crimes etc can be performed successfully and very quickly because of the developed communication.

To influence the people by advertising the commodity exchange of information, to make any plan and its implementation, initiative for any co-operative enterprise are possible by communication. Electronic communication technology is taking us to the peak point of prosperity day by day. Every day we are proceeding. So, this generation is called the generation of information and communication technology.

Microphone and Speaker

All of us are acquainted with microphone and speaker. In any big meeting or function the speaker at the time of delivering his speech stands in front of an electronic device; that device is called microphone (in colloquial language mike). The instrument from which the listeners hear the speech loudly is known as loud speaker or speaker. Perhaps you have seen the uses of microphone and loud speaker in different functions of your school. There is both the microphone and loud speaker in tape recorder, VCR etc.

Microphone and Its Function : Microphone is such an instrument which converts sound energy into electrical signal. A thick netted plate of metal called diaphragm is fitted in the microphone. This plate vibrates when sound wave falls on it. Diaphragm is that part of microphone which is designed for converting the vibration of sound to electrical energy. Different types of sound vibrate the diaphragm in different ways. Microphone converts these vibrations to alternating electrical energy. It is known as audio signal. Amplifying this audio signal it can be transmitted far away through telephone line or radio. Hence microphone plays a very important role in in the field of broadcasting television and radio, in recording and telephone.

Figure- 13.3 : Microphone

Speaker: It is known as loud speaker or mike to the common people or in rural areas. Speaker does just the opposite work done by a microphone, that is, it converts electrical signal to sound. This sound is similar to the sound previously converted to electrical signal with the help of microphone.

Functions of Speaker

There is a permanent magnet in the speaker. A small voice coil is kept hanging in the air gap of the speaker. When the alternating current converted from the sound is connected with this coil then there happens an interaction of static field (magnetic field) with moving field. As a result the coil moves to and fro. This creates compression and expansion in the air, and, as a result sound is produced.

Figure- 13.4 : Speaker

Signal and Its Types

What is signal? Signal is a mark or sign or activity or sound which conveys a particular message. For any electric device or radio signal is any pulse or sound wave which can be transmitted. Further, signal may be the radio wave transmitted from any satellite (artificial satellite). Considering the source signal is of two types: 1) Audio signal, 2) Video signal.

The signal of electronic communication can be classified in another way. Considering the transmission of signal it is generally of two types: 1) Analogue, 2) Digital.

Audio signal: The source of audio signal is sound. The speech or voice of a speaker or an announced (who appears in presentation) or any sound wave is converted into electrical signal by a microphone. Its name is audio signal. The frequency or power of audio signal is so poor that it cannot be transmitted far away.

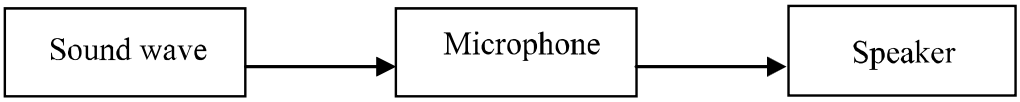


Figure- 13.5 : Audio signal

Video signal: The source of video signal is any picture or scenery. Television camera takes scene. It is converted to radio signal by scanning. The name of this signal is video signal. Camera's scenery cannot be transmitted directly as scenery. So, it is transmitted by converting into video signal along with the audio signal.

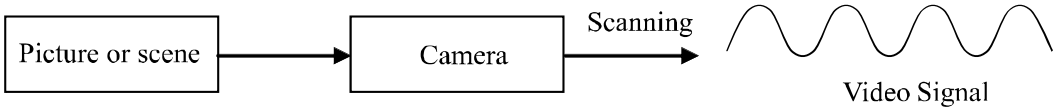


Figure- 13.6 : Video signal

Analogue signal: The event whose magnitude changes continuously, is called an analogue signal. The magnitude of sound, temperature, pressure may be of any value within any fixed range. The analogue data are transmitted continuously. Telephone, radio, television broadcasting or cable TV generally transmits analogue data. Hence analogue signal is continuously changing voltage or current. Audio and video signals (voltages) are the examples of analogue signal.

Figure- 13.7 : Analogue signal

Figure- 13.8 : Digital signal

Digital signal: Generally the meaning of the word digit is number. The term 'digital' has come from the word digit or number. Now, the digital signal means that communication signal which can be recognised separately. In this system any information, number, letter, special signal etc are indicated and are transmitted with the help of binary code that is O or 1.

Figure-13.9 : Convering analogue signal to digital signal

Hence digital signal means that signal which can be identified individually. The computer preserves processes and transmits any data as digital data. Analogue data can be converted to digital data and digital data can be converted to analogue data with the help of a modem. In analogue clock the hands of the clock by rotating continuously gives time but in digital clock the number changes after each and every minute to give time.

Advantage and Disadvantage of Analogue and Digital Signals

The analogue technology is a bit old communication system. In this system telephone, radio, video etc. are used in the field of communication. The digital technology is widely used in communication system as for example in computer system in recent times. Which is better between analogue and digital signals is judged considering three factors. These are the standard or merit of signal, the materials and cost or expense.

The power of analogue signal by decreasing slowly once may be lost if the distance is far away. To keep it alive it is to be re-amplified, but the noise increases for it. As a result, the magnitude of signal decreases or the signal is distorted, whereas the digital signal is amplified during proceeding. As a result the signal remains as it was. For analogue signal in a small quantity of computer network the benefit is more compared to expense but for digital signal in large quantity of computer network the benefit is more compared to expense. Although the digital devices are costlier than the analogue devices, in case of digital service the total expenditure is less. There may be cross connection in analogue device but it does not happen in digital system.

Information and Communication Technology

In the twentieth century and early part of the twenty-first century, the activities of men are much more influenced by the communications. From ancient time people found out various ways of communication. They communicated by talking facing each other, even starting from displaying a sign they communicated by binding message or letter on the foot of pigeon. With the invention of new technology communication has expanded much. Printing press, telephone and telegraph, radio, television, computer, cell phone, fax machine, e-mail, internet, satellite etc have brought about a revolution in communication system.

Radio

We can listen to the news of home and abroad on the radio. Again, we can enjoy song, drama, discussion programme and advertisement of commodities. Moreover, there is use of radio in armed forces, police forces to exchange message and information within themselves. The name of G. Marconi of Itali and Sir

Figure- 13.10

Jagodish Chandra Basu of Bikrampur, Bangladesh is associated with the invention of radio.

We hear sound on the radio. How this sound is transmitted and how we can hear? A person speaks in front of the microphone in a studio of a radio transmission station. The microphone converts the sound waves delivered by the person to electrical wave. The name of this wave is audio signal. The energy of this signal is much less so it cannot go too far. So, this electrical wave is mixed with a wave named carrier-wave which is one kind of electromagnetic wave of high frequency. This mixed wave is called radio-wave. This radio wave is transmitted in the space as an electromagnetic wave with the help of the antenna of the transmitter. The radio or transistor set in our house is a receiver. The receiver receives the radio wave, converts it into electrical current (energy) and transmits it to the loud speaker. The loud speaker again converts the electric current (energy) to sound (energy). This sound we hear. Hence, you have understood that the sound is not transmitted to the radio from the transmitter. Sound wave is converted to electromagnetic wave (radio wave) then it is transmitted, receiver receives radio wave and loud speaker converts it to sound.

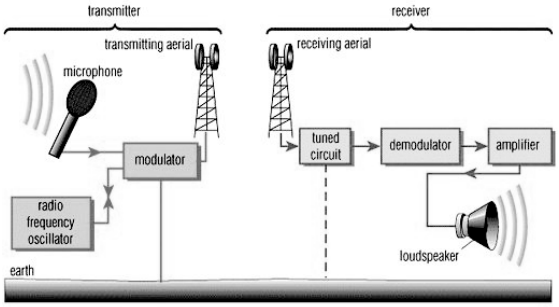


Figure- 13.11 : Radio Broadcasting and Reception System.

The Uses of Radio: Radio is used in various purposes; for example, we can listen to song, music, drama, lecture, educational programme, debate etc. on radio. We can listen to news of home and abroad in a radio. The Police and the army use radio as a medium of mass communication in defence sector. Radio is used in mobile and cellular telephone communication.

Television

The Bengali meaning of television is ‘durdarson’ (the process by which distant objects can be seen or viewed). In television both hearing and seeing can be done. The television is such an instrument by which sound coming from distant source can be heard and at the same time the picture of the speaker can be seen on the screen of the television. In 1926, Scottish inventor L. Bayard was able to transmit picture in the television. On that day, the television artist was a talking doll.

Figure- 13.12 : Television

How does a television work?

We know picture can be seen and at the same time sound can be heard in a television. To transmit an audio (sound) and video (light that is picture) signal it requires one transmission centre. There are separate transmitters to send audio and video signals in the television transmission centre. Sound is converted to electrical signal and transmitted by one transmitter. With the help of another transmitter picture (light) is converted to electric signal and it is transmitted as an electromagnetic wave.

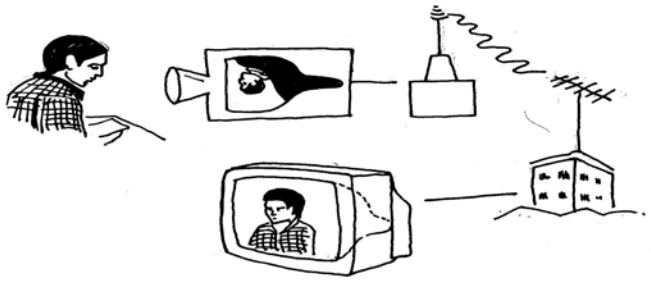


Figure- 13.13 : Transmission and Reception of Picture and Sound in Television

Transmission and Reception of Picture: The scenery that will have to transmit or broadcast the image or picture is cast on the screen of the television camera through a lens. This picture is converted to electrical signal by the television camera. This wave or signal is mixed with carrier wave of high frequency by the process of modulation. Later it is transmitted as an electromagnetic radio wave with the help of antenna. The antenna of television set receives the transmitted electromagnetic carrier wave for picture. This electric signal is amplified by the amplifier and sent it to the electron gun. Electron gun is connected at the back edge of the picture tube. After receiving the video signal the electron gun emits a needle like narrow electron beam or current. When the electron beam from the electron gun falls on the phosphorus fluorescent screen of the television, then there creates a bright and dark fringe of light. Combination of these bright and dark dots (resolution) of light expose the picture sent from the camera on the screen of the television. Roughly this is the transmission process of black and white television.

Transmission and Reception of Sound: The sound related to the picture transmitted to the television is also collected by the microphone and is transmitted. Microphone converts sound to electric signal. Its outgoing is done as alternating voltage. This alternating voltage is amplified and transmitted by the (audio) transmitter.

Our antenna of the television set catches the electromagnetic radio wave and creates electric current. This electric current goes to the receiver of the television set through the connected wire. The (audio) receiver of the television receives this electric signal and amplifies it. Loud speaker converts this electric signal to original sound. We can hear this sound.

Coloured Television

There is not much difference between black and white and coloured television in main functions. There are three separate electron tubes for three fundamental colours (red, blue, green) in the camera of coloured television. There are also three electron guns in

the receiver of coloured television. The screen of coloured television is manufactured with three kinds of phosphorus grains. Particular colour lightens only its colour of phosphorus grain. Consequently the points of red, blue and green colour simultaneously expose on the screen of the electron tube and various kinds of mixture of these colours expose different colours of the coloured picture on the television screen.

Telephone

Telephone is part and parcel of modern civilization. It is the most widely used and much popular medium in the field of conversation, sending message or fax, computer communication, exchange of e-mail with any other country. In 1875 Alexander Graham Bell invented telephone. Through many modifications the telephone invented by Graham Bell has reached at today's modern telephone. The telephones named cordless, cellular, mobile etc. have been manufactured.

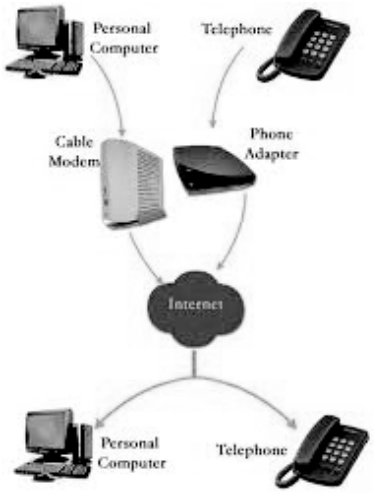


Figure- 13.14

How telephone works: In each telephone set there is signal receiving and transmitting system. The mouth piece is the microphone and ear piece is the speaker of the telephone set. These may be called transmitter and receiver. There is a ringer (which sounds cring cring when telephone comes) and a dialling system in a telephone set. When we talk on the microphone of mouth piece it converts the sound wave of the voice to electric signal. This signal is transmitted to the ear piece of the dialled telephone through wire of the telephone. The loud speaker of the ear piece converts this electric signal to sound; consequently the receiver or listener can hear the sound and can answer accordingly. This answer returns to the sender's telephone by converting it to electric signal with the help of microphone of the mouth piece of the listener's telephone set and converted to sound by the loud speaker of the ear piece of the sender, and then the sender can hear the voice of the recipient. The electric signal is transmitted so fast in the wire of the telephone that it makes no delay.

Every telephone set is connected with the regional principal office through wire. The communication with the telephone is done by the regional principal office, that is, telephone exchange office.

Cell Phone or Mobile Phone: Nowadays a type of portable telephone set in the hand or pocket of a person is seen. The name of this type of telephone is mobile phone or hand-phone.

To call over or receive the call by mobile phone : It is not connected with the principal office nor with any phone. The conversation or transmitting or receiving information by this type of telephone is done with the help of radio or wireless in place of wire.

Figure- 13.15 : Mobile Network

When you make a call over mobile phone wherever

you stay that does not matter, the call goes to any transmission-recipient tower as a radio wave. After that the call goes to the mobile switch station through wire or microwave medium. This station sends the call to the local telephone exchange. There it becomes conventional phone call and reaches to the receiver. All these are done in a moment.

Fax

All of you know about fax message. Your elder brother is going abroad for study. University asked him to send the copy of his original certificates and documents over fax. The fax is used to send any document by copying it exactly similar.

Figure- 13.16 : Fax Machine

What is fax : Facsimile or fax is an electronic system to send or receive graphical information (picture, figure, diagram or text) or any written document by copying it exactly similar, with the help of wire or radio. With the help of this instrument any figure, picture, line drawing rough sketch, written documents by scanning with the help of fax machine is despatched through telephone line.

In 1842, Alexander Bain, a scientist of Scotland invented fax. In 1850 scientist of England Frederick Blaewell and in 1907 scientist of Germany Arthur Korn developed it to the present form.

With the fax machine any document by scanning is converted to electronic signal and it is dispatched through telephone or radio. The fax system is shown below.

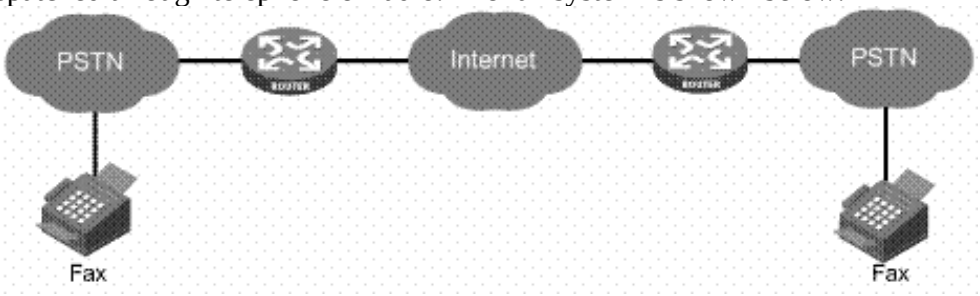


Figure- 13.17 : The Function of Fax Machine

In the modern fax machine scanning of any document is done by electronic system and the scanned signal is converted to binary signal. After that by using standard modem technique it is transmitted through telephone.

Receiver receiving the electronic signal transmitted from fax machine converts it to the original document with the help of modem. After that it is transmitted to a printer which prints out the document to an exactly similar form. The Police department helps to identify and arrest the criminals by sending the picture, finger print etc with the help of a fax machine within a short time, from one city or country to another city or country. Banks also use fax machine for their banking purposes. To preserve and to exchange the account related information and records of signature is done with the help of fax machine.

Computer


Figure- 13.18 : Computer

This generation is the generation of information and technology. The computer plays one of the main roles in communication and informational technology. Moreover, the application of computer in our every sphere of life is so wide that this generation may be called the generation of computer. The more the days are going the more the user of computer is increasing. The use of computer is increasing day by day in the field of trade commerce, administration, education, industry, medical treatment, communication, defence, recreation etc.

What is computer: The meaning of computer is counter or calculator. The computer is not only a machine for calculating but it is more than that. In fundamental meaning, the computer is such an electronic device which by processing data converts it to essential information for men.

Computer works very fast, with confidence, tirelessly, consistently and with correctness compared to man. Computer itself does not mistake. The computer can identify mistake but cannot correct it itself. This one is the main differences between the capacity of computer and that of man's brain.

Structure of a Computer

Computer is a developed electronic system. Computer collecting information processes the information according to the command and presents result according to necessity. The unit where the computer receives the information is called input or inlet. Where the information is processed that is called central processing unit (CPU), from the end from where result is obtained that is called output or outlet. The basic structure of computer is given below.

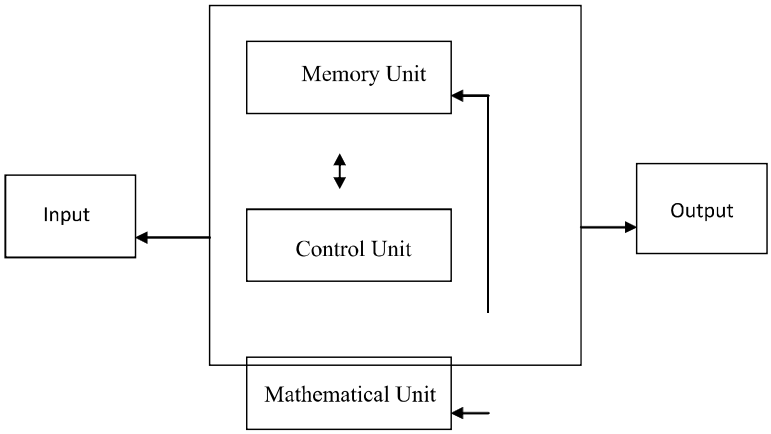


Figure- 13.19

The two main input devices remain in all computers. These are key-board and mouse. Other popular input devices are scanner, digital camera and microphone. Data is entered in the computer with the help of these devices. There are memory unit, control unit and mathematical logic unit in the central processing unit. There is mainly a monitor and a printer in the output device. We get the processed data through these devices. Besides, there may be speakers.

Moreover two objects are hardware and software in case of computer: The physical devices with which the computer is manufactured are called hardware. For example: key-board, mouse, processor, monitor, printer etc. All of these can be touched. One set of command, which tells the computer what work is to be done that is the software. There are various programmes for example, windows 98, windows 2003 and windows 2007 etc. Hardware is the body of the computer and software is the life of the computer.

Uses of Computer

In the beginning of this lesson we have told that computer is used in various spheres of our life. The different fields where computer is used are : to record the identity of the patient in case of treatment, address, symptom of disease, appointment of the patient, selection of medicine and in diagnosis. For the purpose of controlling stock of commodity in trade and commerce, commercial communication, ticket booking, banking system, salary of staff, budget of income-expenditure and for controlling accounts etc computer is used.

Traffic control of steamer, aeroplane, car, train and other transports, control of speed, ticket booking etc are done by using computer. Computer is used in automatic control of producing commodities in industries, verifying the quality of commodity, collecting information etc. In education sector for teaching in the classroom, self learning, evaluation of answer script and publication of result etc. are done by using computer.

In defence management to guide the army, to control fire-arms, communication etc. is done by using computer. Uses of computer have brought about a revolution in printing industry. Compose for printing and design etc. is done by using computer. As a result the expenditure for printing has been reduced substantially. Computer is used for designing by the architects and artists.

Internet and E-mail

Many of you have heard the name of Internet and e-mail. Those who have computer in their houses and schools they may have used internet and e-mail. Recently e-mail is widely used in postal

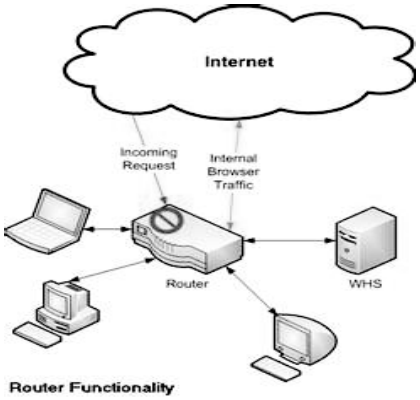


Figure- 13.20 : How Internet works

department. E-mail is transmitted through Internet.

Internet is ‘the network of the network’ or ‘mother of all networks’. It is an international network, which is connected with approximately 4,00,000 small networks of more than 200 countries.

The network of Internet is made with educational, commercial, unprofitable, governmental and military integrity. Overall there is no personal or organizational ownership of Internet. In 1969 the defence department of America started Internet. Internet is such a group of network which is made with innumerable computers, modem and telephone lines. All these components are physically connected with each other. This network is able to exchange any information and data with each other. Internet is the sum of many networks and works together like a unit of network.

You can enquire about thousands and lacs of books, journals, magazines etc from online library through Internet in any time at day or night and can study if necessary or can take print out by ‘downloading’. You can gossip with your friend or any person every now and then through Internet. If you wish you can enjoy a movie (cinema) or can listen to any radio of the world. Besides, you can book the ticket of train, bus or aeroplane through Internet. You can also do e-trade, e-business and e-banking.

E-mail

Electronic mail is in short called e-mail. E-mail is the way of communicating with friends, class-mates, relative or colleagues quickly through Internet. It does not require any stamp, postcard or envelope or postal-peon to send this e-mail or letters. The letter can be dispatched from one computer to another computer with the help of Internet, even documents, figure, pictures and any information can be exchanged. How e-mail sends messages is shown in a figure below:

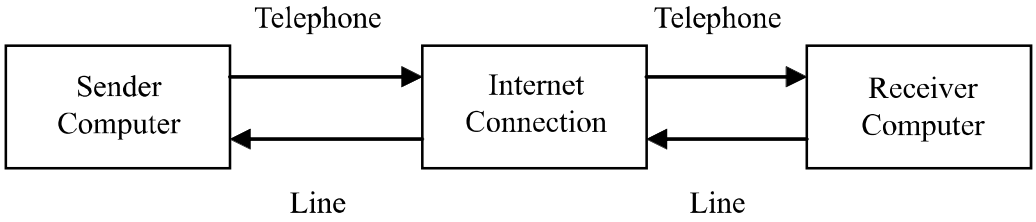


Figure- 13.21 : E-mail Receiver and Sender

Computer users can exchange messages locally or worldwide with the help of e-mail. The e-mail message can be reached within few seconds from one end of the earth to the other end and the message may also come within seconds from any end of the world.

Little time and money are required for communication by e-mail through Internet. The communication can be done quickly from one end of the earth to the other end.

Not only letters even any document can be sent through e-mail. It requires the least manpower. Shopping, idle talking, and gossiping are possible over online. Audio and

video conferencing is possible. Even e-banking and e-commerce is possible. Any radio listening and enjoying cinema is also possible.

Instruments Relating to Communication and Health Problems

Health Problems

Extensive use of information and technology creates health problem. Those who play any game in computer for a long time fall victim to health problems as they feel pain on the top of the finger like the piercing with needle there, develops a blister on the top of the finger and sometimes fingers swell up etc.

Those who work with computer for a long time as a result of using key-board and mouse for a long time and for many days there arises much stress and pressure on their veins, nerves, grips, shoulder and neck. So, if they do not take sufficient rest in between the gap of the work then there may arise many problems including pain in these organs. Among these problems there are pains in hands, arms, fingers, and swelling of fingers etc. Without taking rest in the gap of the work any person working with the computer for a long time suffer from different kinds of eye problems. This is called computer vision syndrome. In this syndrome there are burning sensations of eyes, dryness of eyes, and itching, Sometimes eye becomes red and water human of eye dries up.

The Way of Remedy

Prevention is better than the treatment for the health problem arising from using computer. We should be careful so that these health problems do not arise, For different problems created in hand, grip of hand, finger, shoulder and neck the things to do are :

1. To seat properly and to look straight forward at the time of working with computer.
2. To type in proper method. During typing hands do not remain on any things (any support) and the hand and finger remain straight.
3. To take rest for five minutes after working about half an hour and to relax shoulder and neck.

To prevent the problem of eye due to computer vision syndrome the precautions to be taken are:

1. The screen of the computer must be at a distance of 50-60 cm from your eye.
2. If any document holder is used it must be kept nearer to the screen.
3. Light of the bulb over the head and of the table lamp be-such low interesting that it does not fall on the eyes or on the screen of the computer.
4. Look at any object at far distance after every 10 minutes’; this will help eyes to feel comfortable.
5. Sometimes in between close your eye-lids.

Hence necessary precautions should be taken to avoid the problems which arise from using computer.

The problems created by radio, television and mobile phone

The health problems which arise from radio and television are mainly related with noise pollution, many of you operate radio and television in high volume. It may injure your ear, those who are residing beside you of them those who are suffering from blood pressure or heart-disease or if there is sick person they may feel more sickness and uneasy. Those who operate radio or television in high volume fall victim to the health problem of headache, short hearing, exhaustion etc.

Moreover, those who watch television more than four hours daily may suffer from many health problems like headache, disgust, sleeplessness, eye-pain and short-sight. Besides, they may suffer from abnormal exhaustion, reducing protective power of disease, and hormone related problems. These cause more harm to children. The radiation emitted from television causes much harm to them in proper development of their developing cells.

The problems arising from the use of computer are better to be prevented than to be treated. So, it is better not to play radio or television with high volume to take protection against sound pollution and not to hear or watch radio and television for a long time continuously. To take protection against the radiation emitted by the television it is better to watch television seating at a safe distance (beyond 50-75 cm) from the television. The television must be kept at eye level of you to be saved from eye-pain or excessive pressure or tension on the eyes. Instead of keeping the eye on the television continuously it is better to close eye-lids occasionally.

Now let us discuss the health problems arising from mobile phone. Mobile phone is a radio device of weak power which transmits or receives radio wave frequency radiation with the help of small antenna. At the time of using mobile phone this antenna remains nearer to the head of the user. Men are anxious that the microwave may create cancer disease. So, as a result of using mobile phone there may arise the health problems like hindrance in sleeping, memory problem, headache, vomiting tendency, grimace, high blood pressure etc. Although there is not much evidence about the creation of this problem yet it is told us to be careful to be saved from excessive radiation. Though the influence of radiation is no so much on the adults but strict advice has been given to take care of the children. Because this radiation creates problem in the development of developing brain cells of the children.

All are warned not to use mobile phone during driving a car. The chance of accident increases for using mobile phone at the time of driving. Hence we should not use mobile phone during driving.

Investigation (2 periods)

Suppose the headline of your task is: *'Health problems of the children who use computer excessively: an investigation'*. The purpose of your research may be-

1. To identify the health problems created for using computer excessively.
2. To know whether there is any difference in health problem between the professional and non-professional users of computer.
3. To know the causes of these health problems.
4. To know whether there is any relation between the health problems and age of the user.
5. To know how to prevent and solve this problem.

After that you are to select an area and then to mark the computer user. Sometimes you may not get many computer users in the same area. Then you are to search out in different area to get computer users and take sample from the users if there are many users. For this your friends can distribute the work among themselves.

Next you are to make a report of your investigation. In this report there should be?

(1) Title
(2) An introduction
(3) Purpose of investigation
(4) Sample of investigation (person or region)
(5) The process of collecting information of the enquiry
(6) The process of analyzing information.
(7) The result and comments of investigation and recommendations.

Exercise

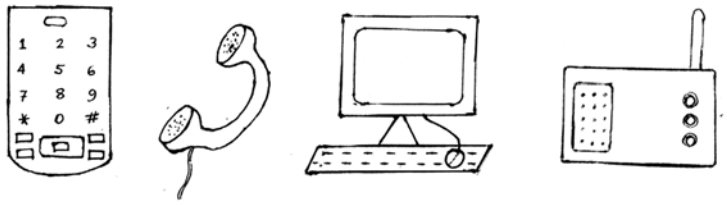
Multiple Choice Questions

1. Which one is the mother of all networks?
   a. e-mail b. internet
   c. mobile d. telephone
2. Applicable for computer?
   i. Computer cannot make mistake it identifies the mistake.
   ii. Computer can correct the mistake itself.
   iii. Computer can work tirelessly and correctly.

Which one of the followings is correct?

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

Answer question no 3 and 4 from the figure below:



P **Q** **R** **S**

3. Which one is effective to hear weather forecast?
   a. P b. Q c. R d. S
4. Excessive use of the instrument 'P'?
   i. may arise headache and vomiting tendency.
   ii. may cause convulsions and high blood pressure.
   iii. may have sound sleep.

Which of below is correct?
   a. i and ii b. i and iii
   c. ii and iii d. i, ii and iii

Creative Questions

1. Farhan and Fahad play computer game and watch television if they find time. Farhan watches television sitting near the TV. Recently Farhan feels pain in the finger and burning effect in the eyes. Mother forbids Farhan not to operate computer and not to watch television sitting very near to the television.

a. What are the fundamental colours of coloured television?
   b. What does it mean by digital signal?
   c. Describe the mechanical technique of the first instrument in the figure?
   d. Analyse the causes of the problems of Farhan mentioned in the citation above?

2. Nazrul Islam always works with internet. One day seeing an advertisement for a job abroad in the internet when he submitted an application for the post he was asked from the other end to send copies of his necessary papers and original certificates. He sent the papers within few minutes by a special process instead of scanning the papers.
   a. What is hardware?
   b. What is meant by audio signal?
   c. Explain the effectiveness of the first time communication medium used by Nazrul Islam.

d. In which special process Nazrul Islam sent the necessary papers in lieu of Internet? Analyse.

Chapter Fourteen

Science to Save Life

A healthy, strong and disease free body is necessary for us to live. We cannot live in normal state in spite of utmost effort. Sometimes we are attacked with different diseases. For diseases medical treatment is a must. For medical treatment overall diagnosis is essential. In recent times there is enough development in medical science. By applying different theories of science, new instruments have been developed to diagnose diseases. As a result, it has become easy to identify, cure and to prevent the health problems applying various techniques. The contribution of physics in diagnosis of diseases is praiseworthy.

After the lessons of this chapter we will be able to-

- describe the application of scientific theory and assumption for different instruments used to diagnose (investigate diseases) in medical science.
- describe the health problems created by the use of modern technology and instruments and the technique of prevention.
- appreciate the contribution of science in diagnosis (investigation of diseases).

X-ray

X-ray is a type of electromagnetic radiation. This radiation is not visible. In 1895, German physicist Wilhelm Roentgen invented X-ray. The photograph obtained with the help of X-ray can locate any fractured bone, injury or presence of unwanted substances in the body. Besides, X-ray can destroy the diseased cells. So, its contribution to medical science is undeniable. Besides, medical treatment and diagnosis, X-ray is used widely in security measurement and in the field of industry.

Procedure

Electrons are emitted with terrific speed from the hard tungsten coil as a result of flowing high voltage electricity through the coil. There is a metal plate (of tungsten or molybdenum) on the other side of the discharge tube. As a result of striking on the metal plate by this high speed electrons, heat is produced and some amount of unknown energy is radiated. This unknown radiated ray is the X-ray.

X-ray can penetrate through soft non-metallic substances. But the metallic substances absorb it. We know that one of the main ingredients of bone is calcium. It absorbs X-ray to some extent. So, it is easier to identify the decay or fracture of bone by X-ray.

What for X-ray is used?

X-ray is used to investigate (diagnosis) different diseases. These are the diseases of lungs like pneumonia, and the cancers of lungs; identification stone in the kidney and gallbladder, obstruction in the intestine; injury, wound and infection in the root of the teeth; displaced, and identification of fractured or broken bone. Moreover, X-ray can destroy cancer cells.

Figure- 14.1 : X-ray of hand.

Risk and side-effects of X-ray

* Excessive X-ray destroys animal cells.
* X-ray exerts harmful influence on reproductive systems of children.
* X-ray exerts harmful influence on mother and child in pregnancy stage (specially within 2-4 months).
* X-ray on the same place repeatedly increases possibility of creating tumour in that place.

Strategies to avoid risk of X-ray

* It is not wise for pregnant women to go to X-ray room without the advice of specialist doctor.
* Care must be taken while using X-ray on children .
* Those who work in the X-ray room, should stay behind a thick-layered wall of lead to avoid radiation from X-ray.

Ultrasonography

If there is any internal injury on the soft muscle or tissue in the interior of the body of a person and for that any problem arises then to identify (diagnose) it he is to go for ultrasonography. Ultrasonography is done for the heart or different important soft organs of the body, as for example : brain, liver, gallbladder, principal blood-vessels etc.

Procedure

Here echo of sound is used for the purpose. The basic principle is like that for determining the depth of sea by throwing an ultra-sonic, wave and measuring the time of reaching its echo. In ultrasonography this ultra-sonic wave (the sonic wave whose frequency is greater than 20,000 Hz) is used. Here an electrically converted narrow ultra-sonic wave ray is thrown. Some portion of this ultra-sonic wave is obstructed somewhere and return as echo and the other portion not being obstructed passes straight away. A perfect photograph is drawn (displayed) on the screen of a computer on the basis of the time taken to return and the amount of waves returned. Seeing this photograph, ultrasonists diagnose (identify) the disease.

Figure- 14.2 : Picture obtained from Ultrasonography

Risk of ultrasonography

The massive limitation of ultra-sonic wave is that it cannot penetrate hard bone. For this, sometimes the backward portion of the bone cannot be detected. Although according to the opinion of World Health Organization (WHO) ultrasonography is not harmful but they have advised that at the time of pregnancy it is best not to use the ultrasonography as far as it is possible.

The way of avoiding the risk of ultrasonography

Getting a perfect photograph of the interior of the body from ultrasonography mostly depends on the efficiency of the person (ultrasonographer) controlling the instrument. The ultrasonography should be done by an efficient operator and in the presence of a specialist doctor.

CT Scan

Suppose a person suffering from stomachache went to see a doctor. The doctor advised him to go for X-ray. The X-ray report revealed that there was a tumour in his belly. But seeing the report it is not possible to determine exactly where or how far inside the tumour exists. To solve this problem CT Scan or Computed Tomography Scan is very important. The displacement of any muscle or bone, perfect position of bone, tumour, internal bleeding and injury of the body can be detected accurately by CT scan. CT scan is the best means of detecting whether there is any secretion of blood from brain (haemorrhage) for sustaining any shock on the head.

Procedure

The two-dimensional photograph is transformed to three dimensions by geometrical calculation with the refraction of light. In X-ray one ray is thrown but in CT scan a beam of rays are thrown instead of one ray. This beam of rays thrown from different angle centring an axis takes (snap) photograph. By geometrical calculations this two dimensional photograph is transformed to three dimensional form so that the position of anybody can easily be determined perfectly.

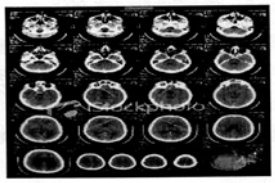


Figure-14.3:Picture obtained from CT Scan

The risk and side-effect of CT scan

The risk and side-effects of CT scan are very few. Yet there may arise the following problems in this case—

* There is radio-active radiation although it is not too much.
* Sometimes ‘dye’ is used in CT scan which can create an allergy-related problem to some people.

Strategies to avoid risk of CT scan

* Not to wear any cloth having metallic button or chain during CT scan.
* Not to keep any metallic ornaments or clock.
* Doctor should be informed regarding any type of allergy-related problems.
* If the patient is pregnant that must be informed to the specialist doctor.

M R I

Magnetic Resonance Imaging is a technique which can take clear and detailed photograph of any organ (specially soft and sensitive) of the body. Although it is used for all organs, the highest use is in identifying the case of brain, muscle, connective tissues and tumour. The intensity of back pain for injury or strike and the contortion of the ankle of leg can be determined with the help of MRI.

Procedure

The magnetic field is applied in MRI. Two main characteristics of magnetic field are that its density remains uniformly distributed in all places and the water that remains in the human body is magnetized by it by a special process. This magnetized portion of the body attains change in magnetic field and on the basis of this, three dimensional photograph is taken.

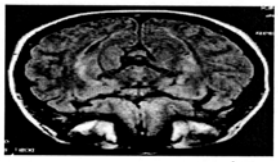


Figure-14.4 : Picture obtained from MRI

MRI— Risk and Side-effects

* Sometimes 'dye' is used here, which may cause allergy-related reaction.
* Sometimes due to continuous loud sound of MRI-machine, headache and tendency of drowsiness may arise.

MRI—prevention of its risk

* Must be sure about the elements of 'dye' by the specialist physician.
* Metallic substances must not be kept near the MRI—machine.

E C G

ECG or electrocardiography is a very simple and painless diagnosis process, through which the present or previous problems of heart can be diagnosed. Whether, the heart is performing normally, if heart beat is regular, whether the blood circulation in a particular organ is proper, all these can be identified through ECG. Moreover, it can identify whether the particular chemical elements of the body are normal. The most important thing is that it can confidently give signal of warning about possible heart-attack.

Figure-14.5 : Picture obtained from ECG

Procedure

This diagnosis is done using waves. Two metal plates are placed over the chest. It sends heart beat or the electrical waves emitted from the heart to the ECG-machine. ECG machine generally shows it in the form of graph. From this cardiograph, it is understood whether the heart is performing normally.

ECG—its risks and side-effects

According to the opinion of specialist physicians and research scholars there is no risk or side-effect of ECG.

Endoscopy

Suppose, if the different organ of the body could be seen without operating upon a man, how interesting it would have been? Keeping this in mind, scientists invented endoscopy. It is a type of bent telescope. When any problem in the interior of a body is not confirmed by X-ray or CT scan then endoscopy is used. Specialist physician advises to use endoscopy for the problems of bellyache, gastric ulcer, stomach, urethra, reproductive organs of female and so on. Endoscopy is one of the ways to diagnose the ulcer of stomach.

Procedure

Basically the total internal reflection of light is used for endoscopy. There are two or three optical wires (fibre) inside a long tube.

Figure-14.6 : Picture obtained from endoscopy

The risk or side-effect of endoscopy

* Falling ill with fever
* Feeling pain in the chest or breathing trouble.
* Blackening of the stool.
* Feeling terrific bellyache.

Strategies to avoid risk of endoscopy

Endoscopy is done only in presence of a specialist physician. So, before or after going for endoscopy, the advice of the physician must be followed exactly.

Radiotherapy

Radiotherapy is a technique to cure or control cancer. It destroys the cancer cells from the organs of the body attacked with cancer. The normal cells can recover the damage but the cells attacked with cancer are destroyed. The patients attacked with cancer are given radiotherapy for many reasons but for some patients this is the only medical treatment.

Procedure

Here the DNA of the cells attacked with cancer is destroyed by two types of energy. One is by using the photon particle of light wave and another is through radio-active particles. The portion of the cell which produces DNA is ionized by radiotherapy. Consequently by breaking DNA, the cell is destroyed.

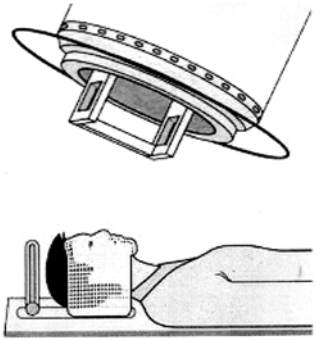


Figure-14.7 : Picture of applying radiotherapy

The risk of radiotherapy

* Fall of hair.
* Loose skin.
* Dryness inside the mouth and throat.
* Vomiting tendency, diarrhoea or indigestion or dyspepsia.
* Terrific tiredness and exhaustion.

Prevention of the risk of radiotherapy

* Radiotherapy should be given every time keeping the patient in the same place in the same position.
* During radiotherapy the advice of the physician must be followed exactly.

Chemotherapy

Chemotherapy is a kind of medical treatment where an special type of chemical medicines are used to destroy the quick divisional cells which are harmful to the human body. It is a widely used process of treatment for cancer because the rapidity of the division of the cancer cells increases abnormally.

Procedure

Every living body is formed of cells. These cells increase in size or in number by division. Chemotherapy is formed on the basis of this division of cells in the living body. The chemical medicines used in chemotherapy are applied at a definite step of cell division. The chemical medicine is selected depending on the step of cell division in which the medicine will be applied. This continues for a fixed period. For example : Once daily, once weekly or once monthly etc. Generally medicine is applied 6 times in this way.

The risk and side-effect of chemotherapy

The special medicine of chemotherapy may cause damage to other related cells besides the cells attacked by cancer. For this the following risk may arise.

* Fall of hair
* Burning of the skin of some organs like palate of hand and foot
* Problems in digestion, for this diarrhoea, dehydration, vomiting etc problems may arise
* The production of red blood cells, white blood cells and platelete is obstructed.

Strategies to avoid risk of chemotherapy

* To keep attention on the temperature of the body.
* To take liquid or soft food.
* To clear very carefully with antiseptic the wastes like stool-urine, vomit etc of the patient taking chemotherapy.
* At the time of clearing wastes, putting on hand gloves or at least covering the hand with plastic bag instead of using naked hand.
* To follow the advice of the specialist physician and to maintain contact with him for keeping the internal change of the body normal all the time.

Angiography

Angiography is a special type of diagnosis in which the snap (shot) of photograph of different blood-vein is taken by X-ray. If for any reason any blood-vein of the body is blocked or injured or any abnormal change occurred then chest pain, heart attack, stroke (brain haemorrhage) etc problem may arise. Angiography helps the doctor to be sure about the diagnosis of the particular blood-vessel responsible for these problems.

Procedure

Refraction of light is used also in angiography. Here the specialist physician at first pushes in liquid dye through a special tube in the particular blood-vessel of the patient. Generally it is pushed through the vein of the arm. When this liquid flows inside the blood-vessel then X-ray is thrown over it. X-ray cannot penetrate the liquid 'dye'; so a photograph of it is seen in the screen. At last, this liquid comes out with urine from the body. It takes about 30-60 minutes.

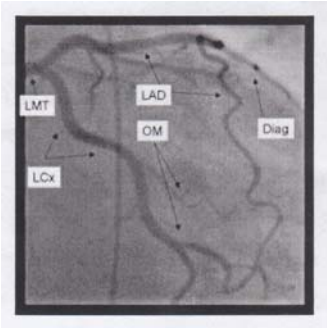


Figure- 14.6 : Picture of angiograph

The risk of angiography

Although the risk of angiography is less than the other diagnosis of heart disease yet the following risk cannot be ignored.

* Generally for this bleeding, infection or pain in the place where the injection was pushed may occur.
* The soft tube through which 'dye' was pushed may injure the blood-vessel.
* Allergy or side-effect may be created due to the 'dye' in the body of some people.
* Sometimes it damages the kidney of diabetic patient.

The way of avoiding risk of angiography

* 'Dye' should be selected depending upon the element which is allergic to the patient's body.
* For the diabetic patients and those who have kidney problem after doing angiography, the absence of 'dye' from kidney must be ensured by investigation through separate examination.

Exercise

Multiple Choice Questions

1. Which one is used for the treatment of cancer?
   a. MRI b. Chemotherapy
   c. Angiography d. Ultrasonograpy
2. Which one is applied in endoscopy—
   i. refraction of light
   ii. emits electrical wave.
   iii. total internal reflection of light.

Which one is correct?

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

Read the article below and answer question no. 3 and 4 :

Mr. Rafik felt a pain in the chest and went to investigate (diagnose) it. During this investigation (diagnosis) a special type of liquid was pushed through the blood-vessel of Mr. Rafik.

3. Which investigation (diagnosis) was done by Mr. Rafik?
   a. endoscopy b. angiography
   c. chemotheraphy d. tungsten
4. What substance was pushed through the blood-vessel of Mr. Rafik?
   a. a liquid named 'dye' b. liquid oxygen
   c. molybdenum d. tungsten

Creative Questions

1. Mr. Rahman is suffering from bellyache for a long time. He saw a doctor for this problem, the doctor advised him to go for endoscopy. On the other hand Sumon, the son of Mr. Rahman suddenly fell from the stair, sustained a blow and fractured his hand. Subsequently, he went to the doctor, the doctor advised him to go for X-ray.
   a. Write the full name of MRI?
   b. What does it mean by radiotherapy?
   c. Why the doctor advised Sumon to go for X-ray?
   d. How much effective is Endoscopy to diagnose the disease of Mr. Rahman? Give opinion.
2. Mr. Rashid was returning home from his office. Suddenly the car fell on an accident, Mr. Rashid sustained a hit on the head and became unconscious. Colleagues took him to a doctor, he was advised to go for CT scan. After few days, Mr. Rashid's brother felt terrific pain in the chest. He saw a doctor, the doctor he advised him to go for ECG.
   a. What is angiography?
   b. What does it mean by ultrasonography?
   c. Why the doctor advised Mr. Rashid to go for CT scan?
   d. Analyse the role of ECG in the medical treatment of Mr. Rashid's brother.

2013

Academic Year

9-10 Physics

দারিদ্র্যমুক্ত বাংলাদেশ গড়তে হলে শিক্ষা গ্রহণ করতে হবে

– মাননীয় প্রধানমন্ত্রী শেখ হাসিনা

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