



INTRODUCTION AND ROLE OF SCIENCE

OBJECTIVES

After completing this chapter you will be able to:

- ⊙ Understand the development of science with special reference to the Muslim and Pakistani Scientists.
- ⊙ Know the various branches of science and their interrelationship.
- ⊙ Appreciate the role played by science and technology and its impact on life.
- ⊙ Comprehend the limitations of present science and wide scope for its future developments.

Science is a Latin word which means “to know”. It is an organized form of knowledge, which is obtained by observation and experimentation. A knowledge, which is systematic, tested and brought under general principles. It helps us in understanding and describing the various processes and phenomena that take place around us. It can answer “Hows” and “Whys”.

Man has always been applying his knowledge and wisdom to make inventions and devise various processes for human security and comfort. Scientific advancements have brought great changes in human life and influenced human civilization. It has radically changed the life style particularly during the twentieth century.

Islam is a religion for all times. Its teachings are simple and natural, which create deep impact on individual and society as well. It provides the foundation of a society where peace and justice should prevail. It believes in the glory and honour of human soul and body. The “QURAN”, the holy book of Islam, contains a complete code of life in this world and thereafter. The basic subject of the holy book is “The man”.

The Quran lays great emphasis on the acquisition of knowledge. We find several verses in the Holy Quran that stimulate man to gain knowledge and ponder over the various processes and



phenomena of the universe such as the earth, skies, oceans, winds, mountains and the variety of life. The Holy Quran invites man to travel and search the hidden realities of the universe. In several verses, it has been spelled out that this universe is full of indications. The basic laws that govern the vital processes of life were explained in the Holy Quran 1400 years ago.

There is no better example of close links between Islam and acquisition of knowledge than the saying of the Prophet Muhammad (PBUH), “to acquire knowledge is the duty of every Muslim man and woman”. Following verses from The Holy Quran will reveal to you the importance Islam narrates regarding the acquisition of knowledge and research in the field of science.

- “They ponder over the creation of earth and heavens (Skies)” 3:191.
- “Indeed, the creation of earth and heaven (skies), the difference of day and night, are the indications for the wise and intelligent” 3:190.
- “Allah is the Creator Who has made every thing between the Earth and the heavens. He has made every thing subsequent to man and there is a great incentive for man to exploit these hidden treasures for the mankind” 2:163.
- “And He is the Allah, Who created every living thing from water. Out of them, some crawl, some are tetra pods, (Four legged animals) and some bipedal (Two legged animals). He is the Almighty and the Creator” 24:45.

A large number of verses from The Holy Quran and sayings of Hazrat Muhammad (ﷺ) clearly emphasize the importance of knowledge and scientific research in this mundane life. The quest for knowledge and scientific research are the two milestones of Islamic education. Every young Muslim, having faith in Almighty Allah, must seek knowledge and explore the hidden treasures of the universe for the betterment of mankind.

The history of science is as old as that of the man. The growth of science is a continuous process and it has taken a very long period of time to reach the present status. The growth of scientific process can be divided into four periods.

Classical Period

Greek period ranges from third to sixth century B.C. During this period great philosophers and scientists contributed a lot to the knowledge of science. Aristotle, Archimedes, Galen and Pythagoras are few important names of that period.

Muslim Period

It ranges from seventh to thirteenth century A.D. The Muslim thinkers and scientists made valuable and original contributions in the fields of chemistry, physics, medicine, mathematics and astronomy. They also took full benefits of the Greek philosophers. Jabar bin Hayyan, Muhammad

Bin Zikaria Razi, Ibn-ul-Haitham, Al-Beruni, Bu-Ali-Sina are few great names of this period.

Modern Period

The advancements of Muslims in the field of science and technology had deeply influenced the west with an awakening. Many books of Muslim scientists and scholars were translated into English, French and German languages. From seventeenth century to nineteenth century, most of the scientific research work was carried out by the West. This was the period of discoveries and inventions. Galileo, Issac Newton, Micheal Darwin, Maxwell Edition, Marconi were some of the few important scientists of that period. New theories had been introduced. False beliefs were rejected. New laws were discovered. New inventions had been made in almost every field of life.

In the twentieth century the growth of scientific knowledge revolutionized the human life. Electronics, Telecommunications, Computers, laser, space exploration, genetic engineering, surgery and transplantation of human organs are the major achievements of twentieth century. Nuclear energy and space invasion opened new fields of science and technology. Some of the important scientists of this period are Max Planks, Eienstein, Madame Curie, Yukawa and Dr. Abdus Salaam.

Golden Age of Islam (Seventh to Thirteenth Century)

From seventh to thirteenth century, the Muslim scientists and philosophers made valuable

He is considered as the father of chemistry. He had established his own laboratory where he worked devotedly. He invented sulphuric acid, nitric acid, hydrochloric acid and several other important compounds. His contributions to chemistry also include some important scientific techniques such as crystallization, distillation, sublimation and evaporation.



Jabar Bin Hayyan

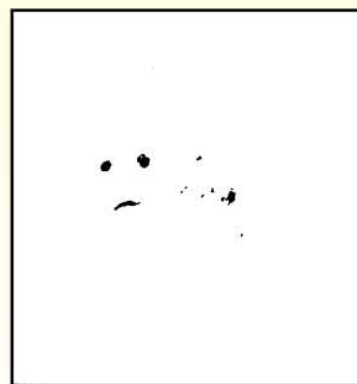
He was a great physician of his times. His great works comprise “AL-HAVI” and “AL-MANSOORI”. In these books, he wrote the history of some medical cases with symptoms and treatment. He was the first to discuss the details of small pox and measles. His books were translated into Latin, French and English languages. “AL-HAVI” was the greatest encyclopedia of tenth century. He was the first to use opium for anesthesia.



Muhammad Ibne
Zakariya Al-Razi

IBN-UL-HAITHAM (965 – 1039 A.D.)

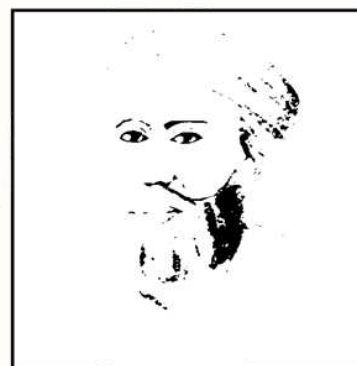
He was a renowned physicist of all times. He gave the basic principles of reflection and refraction. He worked on lenses and explained the working of eye. In Europe he is known as Al-Hazem. His famous book “Kitab Al-Manazir” was translated into Latin. He is considered the father of optics.



Ibn-ul-Haitham

AL-BHARUNI (973 – 1048 A.D.)

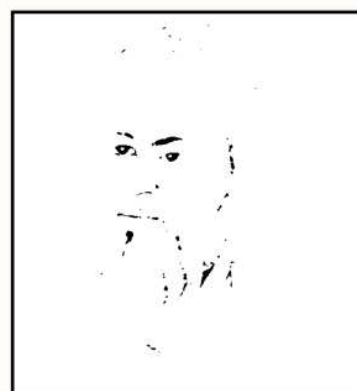
He was a great scholar of Physics, Mathematics, Geography and Astronomy. He travelled through India and recorded his observations in his famous book, “Kitab-ul-Hind”. In another famous book, “Qanoon-i-Masoodi”, he discussed Astronomy, Solar and Lunar motions. He wrote more than 150 books on varied topics.



Al-Bairuni

ABU ALI BENSINA (980 – 1037 A.D.)

He was the greatest scientist of his times. He is known as Avicenna in Europe. He wrote more than 100 books in medicines, science, philosophy and literature. His famous book on medicine, “Al-Qanun Filtib”, was prescribed as a text book in medical institutes of Europe till seventeenth century. In another famous book, “Al-Shifa”, he made useful contributions to Physics, Chemistry, Arithmetics, Biology and even Music.



Bu Ali Sina

ABU ALI BAITAR (1228 – 1308 A.D.)

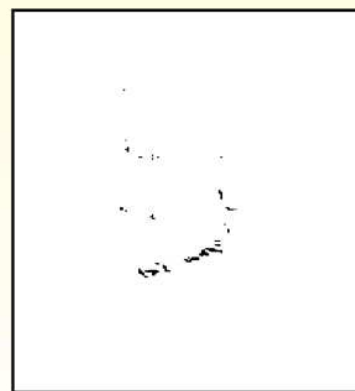
He is known for his studies in plants. He travelled a lot and collected a large number of plants. He discovered many new plants. He is also famous for the study of medicinal plants. He was a great botanist and pharmacist of his time.



Ibne Baitar

IBN-E-NAFEES (1213-1288 A.D.)

Ibn-e-Nafees was the great scientist and cardiologist of the 13th century. He was the first to describe the circulation of blood in human body. He propounded the theory of pulmonary blood circulation with correct measurement. He described that a thick wall called septum divides the heart into two sections. After a cycle of greater circulation, the blood returns to the right section of the heart from where it goes to lungs to carry oxygenation.



Ibn-e -Nafees

The land of Pakistan has also produced a galaxy of scientists, some of whom have gained international recognition for their contribution to the advancement of science. A brief contribution of Pakistani Scientists is given below:

Dr. Abdus Salaam is a world fame physicist, who proposed the Theory of Unification of two of basic four physical forces governing the universe. It was a great achievement in the world of physical science. On this contribution, he along with two other scientists was awarded the Nobel Prize. He also worked very hard for the improvement of science education in the third world countries.



Dr. Abdus Salaam

Dr. Munir Ahmad khan is a well-known scientist of Pakistan. He participated in various courses of International Institute of Nuclear Technology. He has also served the International Atomic Energy Agency in Vienna. He was the pioneer Chairman of Pakistan Atomic Energy Commission and worked very hard to establish and consolidate the Atomic Energy Commission of Pakistan.



Dr. Munir Ahmad Khan

DR. ASHFAQ AHMAD

Dr. Ashfaq Ahmad is an eminent atomic scientist of Pakistan, who remained Chairman of Pakistan Atomic Energy Commission for 10 years. He established Global Change Impact Studies Center (GCISC). In recognition to his services, he was awarded by the Govt. of Pakistan the highest civil award of Nishan-i-Imtiaz.



Dr. Ashfaq Ahmad

DR. ABDUL QADEER KHAN

Dr. Abdul Qadeer Khan is a world fame Pakistani Atomic scientist, who excelled in the field of enrichment of uranium. Dr. Qadeer brought the technology of enrichment of Uranium to Pakistan and devised new methods in this field. He established Kahuta Research Laboratories, which has now been named after him as Dr. A. Q. Khan Laboratories. He always worked for his motto, i.e. 'Atom for Peace'.



Dr. Abdul Qadeer Khan

Dr. Samar Mubarak Mand is a famous atomic scientist who joined Pakistan Atomic Energy Commission and became member technology. During his professional carrier, he earned specialization in Application of Lasers, Fiber Optics Technology, Nuclear Instrumentation, Nuclear Diagnostics & Missile Technology.

He was awarded Sitara-e-Imtiaz and Hilal-e-Imtiaz. At present, he is the Chairman of the National Engineering and Scientific Commission (NESCOM).



Dr. Samar Mubarak Mand

DR. ATA-UR-REHMAN

Dr. Ata-ur-Rehman is a famous scientist of Pakistan who Joined Hussain Ibrahim Jamal Institute of Chemistry, Karachi. He has published about 200 research papers which are part of the syllabi in various universities of the world. He was awarded Sitara-e-Imtiaz.



DR. ATA-UR-REHMAN

1.5: SCIENCE AS AN INTEGRATED DISCIPLINE

Science is an integrated and organized knowledge about problems, objects or processes of nature. In the scientific process, observation, reasoning and experimentation or physical verification are the basic tools.

It is because of scientific way of thinking that the scientists have been able to widen their knowledge and scope of their research.

Types of Science

Science is mainly divided into two main categories;

- Physical Sciences
- Biological Sciences

Physical Science

It is the main category of science that deals with earth, universe, mountains, oceans etc. Physical science is further divided into following branches such as Astronomy, Chemistry, Geology and Physics.

Astronomy

It is the one of the oldest branches of physical science that deals with the study of heavenly bodies. Chinese, Egyptians, Babylonians and Muslim astronomers made a thorough study of those heavenly bodies which could be seen with the naked eye. On the basis of these observations, they framed the calendars. The concept of year, months, weeks, and days was an major achievement of these astronomers.

Modern astronomy starts with the invention of telescope. The first telescope was made by Galileo in 1610. The telescope has made our studies about the heavenly bodies more factual and accurate. With the help of telescope, various heavenly bodies, which were not known before, have been discovered. Such as black hole, clusters of galaxies, etc. Physics and mathematics play an important role in Astronomy.

Chemistry

It is the branch of physical science that deals with the nature, composition and properties of matter. It also deals with the study of various chemical reactions taking place in the universe. Various chemical reactions taking place inside the living bodies are also considered part of chemistry and called bio-chemistry. The digestion of food, burning of candle, rusting of iron and release of oxygen from plants are the common examples of chemical reactions.

Geology

It is also known as the science of earth. It deals with the study of soil, rocks, minerals, oil and gas deposits. This branch of science is getting great importance because it is directly associated with the



exploration and excavation of fossil fuels, i.e. oil, gas and coal. Its related sub-branches are geophysics and geography. Pakistani geologists are exploring oil and gas fields in the country. Geological survey of Pakistan is an important organization, which undertakes investigation and exploration of underground resources to determine their location, nature and recoveries.

Physics

It is an important branch of physical science that deals with the physical properties of matter and energy and the interaction between them. It helps to study the basic properties of matter under different conditions. It is a vast subject that can be divided into sub-disciplines such as mechanics, heat, sound, light, electricity, magnetism and atomic structure. All the modern equipments like radio, television, telephones, tape recorders, digital watches, calculators, computers, laser machines, etc. are the products of physics. The equipments made by the physicist are used in different disciplines of science.

Life Science

This main division of science deals with the living things. It includes the study of the structure, function and development of living things. It is divided into two main branches.

Botany

It deals with the scientific study of plants.

Zoology

It deals with the scientific study of animals.

Agriculture & medicine are the integral part of biological science and both have a relationship with chemistry.

Science and Technology

Technology is the outcome of scientific knowledge, which not only helped us to understand our physical world but also gave the laws that govern the various phenomena. Application of these laws have helped in the invention of new devices for the welfare of society.

The sole of science is fundamental in the improvement of the standard of living. In the field of agriculture, industry, transport, communication, computers, television, drugs and construction, technology has brought a drastic advancement that impacted the human society.

Agriculture

The use of machines like tractors, scrapers, harvesters, thrashers and tube wells has greatly helped the man to get maximum production. The use of pesticides, insecticides and fungicides has saved the crops from conventional diseases. Fertilizers are in no way less important than other technologies. The use of fertilizers has increased the fertility of the soils which led to the production of better crops.

Medicine

Upto the 19th century, the medicines were obtained from natural sources, i.e. plants, animals or minerals. With the advancement in the field of Biochemistry, the drugs are now being synthesized in laboratories. Many antibiotics and vaccines are now being synthesized in the laboratories. These drugs are then produced at a large-scale for the prevention & treatment of various diseases. Now a days the major biological problems are cancer, AIDs, and hepatitis.

Engineering

With the awakening of society, the man has constructed and created great structures like “Pyramids of Egypt” and “Great Wall of China”. These are the symbols of advancement in the field of engineering. With the help of mechanical engineering, a great variety of machines was invented, which made the production of thousands of utility goods possible. The construction of factories, bridges, dams, along side the invention of computers and various machines has changed the human society. Modern communication has brought the whole world close to each other.

Science is the knowledge that is based on physical and chemical properties of matter. It has made great advancements in all the fields.

But, science has failed to calculate or evaluate the moral and spiritual values. Inspite of a lot of achievements in different fields of science, we are still unaware of numerous things around us. Telescope, for example, has made distant objects visible, but still numerous heavenly bodies are out of our reach. Similarly, human body itself is partly understood. Many diseases have still to be cured or even discovered. This clearly indicates that science & its products have their own limitations.

Activities

1. Students should be directed to search such verses from Holy Quran in which the emphasis has been laid on the acquisition of knowledge.
2. Students should be asked to prepare a list of Pakistani scientists with their fields of specialization.
3. Students should prepare a list of scientific organizations working in Pakistan.
4. Every student should prepare appliances of common use in his house that are the product of modern technology.



EXERCISES

1. Complete the following statements

- i) Jabber-Bin-Hayyan is the father of _____.
- ii) The theory of relativity was formulated by _____.
- iii) Astronomy is the branch of physical sciences that deals with the study of _____.
- iv) Biological sciences are divided into two branches i.e. botany and _____.
- v) The irrigation has been made more dependable and regular by the construction of canals and _____.

2. Write True/False for the following statements

- i) Ibn-Nafees was the first scientist who explain the structure of eye. True/False
- ii) Dr. Abdus Salam was a great physician. True/False
- iii) Pharmaceutical is a branch of medicines that deal with the preparation of drugs. True/False
- iv) Science has appreciated the human qualities like love justice and truth. True/False

3. Multiple choice questions on the following

- i) Greek period of scientific contribution ranges from:
(a) 300 BC – 600 BC (b) 300 BC – 800 BC
(c) 500 BC – 500 BC (d) 400 BC – 700 BC
- ii) Muslim period of scientific contribution ranges from:
(a) 700 A.D to 1000 A.D (b) 800 A.D. to 1200 A.D
(c) 700 A.D to 1300 A.D (d) 1000 A.D to 1500 A.D
- iii) Dr. Abdus Salam proposed a theory of unification for the:
(a) 3 Basic forces (b) 4 Basic forces
(c) 2 Basic forces (d) 5 Basic forces
- iv) The main categories in which science is divided are:
(a) 2 (b) 4 (c) 5 (d) 6

4. What is the role of science and technology for the betterment of human living?

5. Briefly describe the contributions of Al-Bairuni, Ibnul-Haitham and Jabir Bin Hayyan, in the field of Science.

6. What is the role of science in the fields of agriculture and medicines?



OBJECTIVES

After completing this chapter you will be able to:

- ☉ Describe the three basic elements necessary for life
- ☉ Differentiate between allotropic forms of carbon and different types of compound of carbon.
- ☉ Know the solvent properties of water and anomalous behavior of water.
- ☉ Know about the composition of air and importance of different gases in air.
- ☉ Know about the importance and applications of different elements for our health, in agriculture and daily life.

Life of all living organisms depends upon the air they breathe, water they drink, and food they eat. Air, water and food are composed of oxygen, carbon & hydrogen. These elements can combine with each other. They form thousands of compounds on which life of animals and plants depends. Other than these basic elements, other elements which are important for life will also be described in this chapter. The average percentage of basic elements present in human body is as follows:-

Oxygen 65%, Carbon 18% Hydrogen 10%.

Life depends upon two processes, i.e. respiration and photosynthesis. The detail of each is described below.

In this process, animals inhale air containing oxygen and exhale air containing carbon dioxide. The oxygen from the lungs is taken up by the blood and is transported up to cells where the oxygen reacts with the food components, e.g. carbohydrates to release energy, carbon dioxide and water. It is called the food breaking and energy releasing process. The released energy is used up by our body to keep us warm and active. The released carbon dioxide is used by plants for photosynthesis.

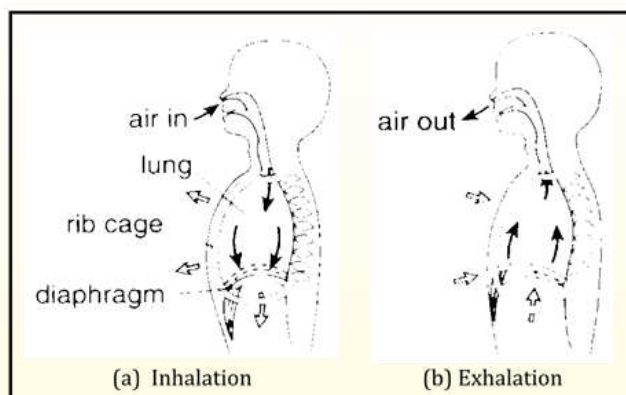


Fig. 2.1: Respiration process

Photosynthesis

Photosynthesis occurs in the green leaves of plants in the presence of sunlight. In this process, carbon dioxide and water react in the presence of light and chlorophylls to form carbohydrates (plant food) and release oxygen. The formation of carbohydrates takes place by absorption of solar energy. During this process, solar energy is converted into chemical energy. The carbohydrates formed by plants are source of food for animals; hence they depend on it for their existence. The released oxygen is used by animals. The respiration is the reverse process of photosynthesis.

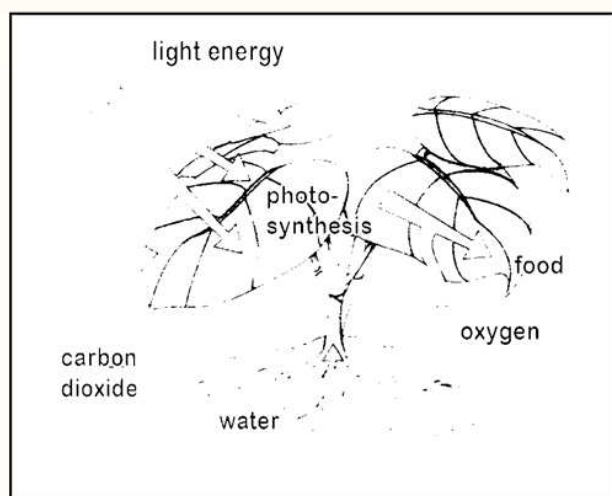


Fig. 2.2: Photosynthesis process

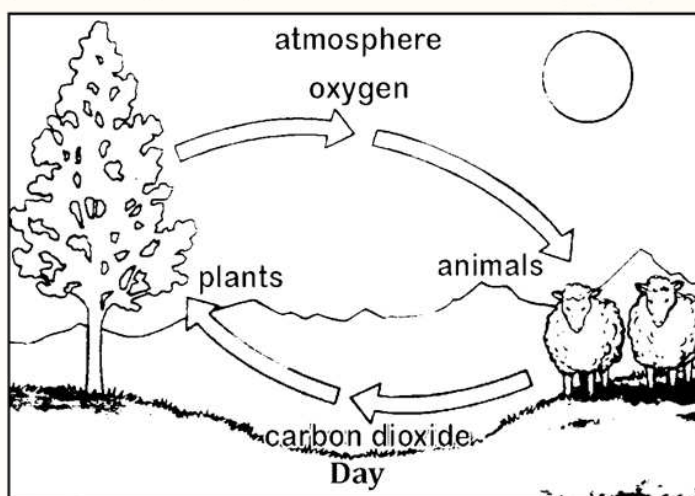


Fig.2.3: Photosynthesis and respiration

The existence of an element in different physical forms due to different arrangement of atoms in space is called allotropy. These different crystalline forms are called allotropes. The physical properties of allotropes are different but chemical properties are same. Carbon exists in nature in different allotropic forms; Diamond and Graphite are two main allotropes.

Diamond and Graphite

Diamond is the purest form of carbon. It is the hardest naturally occurred substance. It has a very high melting point of 3500°C . it is non conductor of electricity. Because of its hardness it is used in drilling tools, cutting glass and grinding other devices. The transparent diamond is used in jewelry as gem.

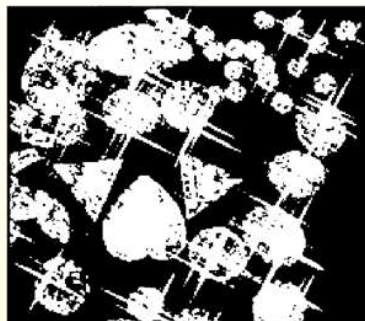


Fig. 2.4: (a) Diamond



(b) Graphite

Graphite

Graphite is soft, black and solid in nature with metallic luster. It is used in lead pencils. Graphite is a good conductor of electricity. Being soft, it can also be used as lubricant in machines. A comparison of the properties of diamond and graphite is given below.

DIAMOND	GRAPHITE
Colourless in pure state	Grayish black in colour
It is transparent and shiny.	It is opaque
It is very hard in nature.	It is soft and slippery
Bad conductor of electricity	Good conductor of electricity
At high temperature changes to graphite	At high temperature remain unchanged

Carbon atoms can combine with other elements in a variety of ways thus forming different types of compounds. In olden times, it was thought that carbon compounds are only formed inside living organisms. In 1828, Frederick Wohler prepared Urea in laboratory, since then thousands of compounds containing carbon are being prepared by mankind. These compounds are called organic compounds, which are found in:

- Living organisms
- Food we eat, and clothes we wear, e.g. carbohydrates, proteins, fats, vitamins, synthetic fiber (nylon, silk, etc)
- Drug and dyes: All type of medicine and various type of colours used to dye cloths, leather, etc.
- Paper and Ink: Every type of paper is made up of cellulose. Writing material is also composed of carbon containing compounds.
- Paints and plastic used for protection and decoration.
- Soap and detergents used for washing purposes.
- Rubber and leather used for tyres
- Polymers used for making shopping bags, household articles, casing for electronic, etc.
- Fuel for combustion, coal, petroleum and gas.

Properties of Water as Solvent

Water is the most abundant chemical compound. It has different properties. In this section, unique properties of water such as universal solvent and its density will be discussed.



Water as Universal Solvent

One of the most important properties of water is its capacity to dissolve variety of substances. Due to this unique property, it is often called “universal solvent”.

Life depends on it to the extent that we can live without food for three to four weeks but we can't exist without water for more than three to four days. Water is not only a major constituent of our food but also we take solid or liquid food dissolved and cooked in water.

- i) All aquatic life depends upon water's solvent property. Gases are soluble in water, which are used for respiration by animals.
- ii) All plants depends upon salts present in the soil, these salts in solid form can't be directly absorbed by plants. Water can dissolve mineral salts and fertilizer and make them available to be absorbed by plants. Had there been no water, plants would have not been existed.
- iii) Rainy water dissolves useful minerals salts from the earth surface of hills and mountains and carries them up to hundreds of miles to the agriculture field in plains. This process proved the required elements to the plants and plants grow and develop properly. They produce good yield.
- iv) In industry water is used to dissolve chemical compound.
- v) In laboratories water is the most important solvent to carryout chemical reactions. No other solvent can be used instead of it as it can dissolve all polar solutes.
- vi) At domestic level all sort of cooking is carried out with water as it is the cheapest and easily available item in our foods.
- vii) Water dissolves O_2 and CO_2 from air. This property of water makes the aquatic animal and plants to survive; otherwise they would die.

Water is Solid, Liquid & Gas

Water has a unique property of having maximum density at $4^\circ C$. When temperature decreases down from $4^\circ C$ water molecules begins to take crystalline structure. As a result, the large intermolecular spaces of ice increases, and its volume increases than pure water. Thus ice has lower density than water.

In winter, when temperature falls, the upper layers of water become denser and moves down ward. The lower layers which have low density moves upwards. When temperature further falls and upper layers become denser which can't go down as the lower layers have the same density. Now with the further decrease of temperature the surface of a lake freezes and converts into ice. Therefore, ice floats on water. The surface layers of ice act as an insulator and do not allow the lower layers of water to freeze. If the ice were denser than water, like other substances, the surface of a lake would freeze and sink repeatedly until the entire lake become solid. The aquatic life would not survive. Thus difference in density of water and ice is the reason for survival of aquatic life in cold regions.

2.3: COMPOSITION OF AIR

Air is a mixture of different gases. The two major constituents of air are nitrogen and oxygen.

Percent age of composition of air by volume is given below:

	DIAMOND	GRAPHITE
1	Nitrogen	78.03
2	Oxygen	20.99
3	Argon and other rare gases	0.94
4	Carbon Dioxide	0.03
5	Ammonia and Ozone	Traces
6	Water vapours	Amount varies

Role and Uses of Nitrogen

The major constituent of air is nitrogen gas. It plays an important role in the properties of air.

- It is a least reactive gas and controls the combustion process. If there had been no nitrogen, it would have been impossible to put any fire out till all the material was burnt to ashes.
- Nitrogen in air cannot be used directly by plants. The process of converting nitrogen into compounds that plants can use is called nitrogen fixation. Nitrogen in the atmosphere is converted into oxides of nitrogen which form nitric acid when react with rain water. The nitrogen thus reaches the ground and is used up by land and water plants.
- Biological fixation of nitrogen is carried out by the bacteria present in roots of legume plants. The bacteria fix nitrogen by reduction and oxidation processes into nitrate ions.
- The nitrate ions are water soluble and are used by plants to make proteins. Animals eat the plants and use the plant proteins to make their own proteins and excrete nitrogenous waste such as urea.

Role and Uses of Oxygen

Oxygen is present in air by one fifth of its volume but it plays a key role being most active. Life of animals depends upon oxygen as it is used during respiration.

- In respiration, the air is inhaled and brought in contact with blood in lungs. The oxygen present in air reacts with haemoglobin of blood to form oxy-haemoglobin in lungs. This oxy-haemoglobin blood is then transported from lungs to cells through arteries.



- ii) In the cells, oxygen is used for oxidation of food to produce energy, carbon dioxide and water, hence oxygen is the essential gas in air, used to produce energy from food. Thus energy keeps us warm and enables us to do work. If there had been no oxygen, there would have been no life.
- iii) Oxygen is responsible for burning all types of fuels, e.g. coal, petrol and gas. In burning process, oxygen in air reacts with fuel and produce energy. Burning gas liberates energy, which is used for cooking purposes and other activities.
- iv) Oxygen is also responsible for fermentation and rusting processes.

Although the percentage of carbon dioxide in air is very small but its role is very important.

- i) It is used up by plants during photosynthesis. Plants prepare food by using carbon dioxide and water vapours in the presence of sun light.
- ii) Carbon dioxide plays an important role in maintaining the temperature of the earth. It does not allow the radiations coming from the sun to leave the atmosphere. These radiations warm up the atmosphere.

It lies about 31 Km above the surface of the earth. Ozone is present in air. It acts as a shield and absorbs the ultraviolet radiations coming from the sun to earth. Ultraviolet radiations are dangerous and produce skin cancer and other diseases.

The most abundant elements found in living organisms are hydrogen, carbon, nitrogen, oxygen, phosphorus and sulphur. In addition to these are sodium, potassium, magnesium, calcium and chlorine elements. Fluorine, iodine and iron are needed in only trace amounts. Importance and application of these elements is described below:-

Our body requires sodium in large amount. Its deficiency can cause certain ailments to the body such as sun stroke and irregularity in heart beat. In daily life we take table salt in our food. It consists of sodium and chlorine elements and is called sodium chloride.

Calcium

Calcium is necessary for the formation and growth of bones and teeth in our body. Nearly 99 percent of the calcium in the body is found in our bones. The requirement of calcium is provided

through milk and milk products, vegetables, meat and fruits. In growing age it is required in large quantity. Deficiency of it causes pain in muscles and increase the porosity or softening of bones.

Phosphorous

It is an essential element like calcium for the formation and proper growth of bones and teeth. It hardens and strengthens the bones. It is necessary and controls the joints and muscles activity. Its deficiency stiffens the joints, makes the bones brittle and growth of the bones is affected adversely. It is found in fish, in dry fruits and in eggs.

Iron

Iron is an important component of hemoglobin found in blood of animals. It acts as an oxygen carrier and transport oxygen to the body cells. Deficiency of iron, reduces the formation of blood, which causes anemia. Iron is found in liver in large quantity. Iron is also found in meat and yellow of eggs.

Iodine

Iodine is required in a very small amount by our body. Thyroid gland functions in the presence of iodine, and produce thyroxine. Thyroxin plays a very important role in the proper growth of body. Deficiency of iodine hinders mental physical growth. The body dries up and skin thickens. Body gives ugly look in old age, face gets disfigured and wrinkled. Goiter disease is especially due to deficiency of iodide.

Chemical Fertilizers

Potassium

Potassium is essential for plants as sodium is for animals. It's quantity in soil is often inadequate. Therefore chemical fertilizers such as potassium chloride known as potash is often used for this purpose. The other fertilizers often used are potassium sulphate and potassium nitrate. Potassium sulphate is preferred for horticultural crops, tobacco and potatoes. Potassium nitrate is used for fruits, vegetables and tobacco.

Calcium

Calcium is the major nutrient element of the soil. Plants require calcium for their growth. In soils where calcium is required gypsum is used as fertilizer.

Phosphorus

Phosphorus is found in soil, plants and in microorganisms. It plays important role in the accumulation and release of energy during cellular metabolism. Its deficiency effects adversely the production of crop. Deficiency is makes up by using phosphorus fertilizers.

Magnesium

Magnesium element is found in chlorophyll, present in leaves of plants. Chlorophyll pigment is necessary for photosynthesis in plants. Thus deficiency of magnesium elements retards the photosynthesis process.



Iron

It is present in some vegetables and cereals. Iron is a minor nutrient in soil. In plants deficiency of iron results in yellowing of leaves that is called chlorosis.

Importance and Functions of Elements in Daily Life

Iodine

Uses of iodine in daily life are as follows:

- i) It is used in making dyes for colour photography.
- ii) It is used in pharmaceutical chemicals
- iii) Iodine tincture is used as antiseptic.
- iv) Other compounds of iodine such as sodium iodide and potassium iodide are used in medicines.

Chlorine

- i) Chlorine is mostly used for the purification of water.
- ii) It is used as germicide.
- iii) Certain compounds of chlorine are used in medicines such as sodium chloride and calcium chloride.
- iv) It is used as bleaching agent for cotton, linen and wood pulp.
- v) Organic compounds such as chloroform and carbon-tetrachloride are prepared by using chlorine.
- vi) It is used to form the manufacturing of insecticide D.D.T.
- vii) It is also used to prepare plastics such as polyvinylchloride and synthetic rubber.

Iron

In daily life iron metal has a wide range of applications. It is extracted from ore by heating to a very high temperature in a blast furnace. Depending upon its purities iron is classified into following types.

(i) Pig iron

It is the most impure form of iron and contains impurities like phosphorus, sulphur and manganese. Pig iron is hard and brittle, therefore it is usually converted to cast iron & steel.

(ii) Cast iron

It is obtained from pig iron. It is also brittle and can't be welded or forged. It has low tensile strength. It is used to prepare stoves, cooker, radiators, lamp posts and railing etc.

iii) Wrought Iron

It is the purest commercial form of iron. It is obtained by heating cast iron in a furnace. Impurities are removed. It is a soft, but very tough and malleable. It can be welded and forged. It is used to make nails, chains. Iron rods and sheets, agriculture implements.

iv) Steel

It is an alloy of iron. It is made from pig iron. Steel is hard, tough and strong. It is used to make steel wires, steel sheets and machine tools. It is used to make permanent magnets of various shapes. It is used to make stainless steel, which resists rusting. Stainless steel is used to make cutlery, scissors, saws and furniture.

Calcium

There are number of important compounds of calcium which are used in daily life.

- i) Calcium oxide (quick lime or lime) commonly called un-bujhachuna used for the preparation of bleaching powder. It is used largely for the manufacturing of cement and glass. It is used to purify sugar.
- ii) Calcium carbonate (lime stone and marble) used to prepare cement, glass, washing soda and quick lime.
- iii) Calcium sulphate (gypsum) is used to prepare Plaster of Paris and calcium super phosphate.

Magnesium

- i) Magnesium is used to prepare alloys such as magnalium and duralumin. These alloys are light in weight but strong. They are used to prepare balances, pistons of motor engines, electric equipment and aircrafts.
- ii) Magnesium powder is used in flash light, military star shells and other light signals.
- iii) The compounds of magnesium such as magnesium oxide commonly called magnesia is used to prepare fire bricks.
- iv) It is used in medicines as hyperacidity controller.
- v) Magnesium sulphate is used in medicines as purgative.
- vi) Magnesium chloride is used as filler for teeth.

Sodium

- i) Molten sodium is used as coolant in some types of reactors.
- ii) Sodium vapour lamps are used for street lighting.
- iii) It is also used to prepare different chemicals such as sodamide and sodium-cyanide, sodium.

A few important compounds of sodium and their uses.



Compound	Common name	Uses
Sodium hydroxide	Castic soda	Used in manufacturing of soap, paper and artificial silk, to purify petroleum and vegetable oil. Softening of hard water to prepare glass, paper, soaps and detergents
Sodium carbonate	Washing soda	Used to soften hard water, to prepare glass papers, soaps and detergents. Baking purposes.
Sodium bicarbonate	Baking soda	Used as fertilizer and for manufacturing of nitric acid.
Sodium nitrate	Chile salt peter	Used for developing and printing of photo graphic films.

Potassium

The important compounds of potassium and their uses in daily life.

Potassium bromide and potassium iodide	Used in medicine as sedative to remove tension and to induce sleep. It is also used in photography.
Potassium cyanide	Used for the extraction of gold.
Chrome alum	Used as mordant in dying of fibres and in chrome tanning.
Potassium dichromate	Used for the manufacturing of other important compounds which are used in tanneries.

Key Points



- ⊙ Air, water and food consist of compounds which are chiefly made of oxygen, hydrogen and carbon.
- ⊙ Life depends upon two processes respiration and photosynthesis. In respiration animals inhale air containing oxygen and exhale air containing carbon dioxide. Photosynthesis occurs in the leaves of the plants in the presence of sunlight.
- ⊙ The existence of an element in different physical forms due to different arrangement of atoms in space is called allotropy. The physical properties of allotropes are different but chemical properties may be same or different.
- ⊙ Water is a universal solvent because it has a capacity to dissolve variety of substances.
- ⊙ Water has a unique property of having maximum density at 40C. When temperature decreases down from 40C water molecules begins to take crystalline structure. As a result the large intermolecular spaces of ice increases, and its volume increases than pure water. Thus the ice has lower density than the water.
- ⊙ Air is mixture of different gases. The two major constituents of air are nitrogen and oxygen gas.
- ⊙ The six most abundant elements found in living organisms are hydrogen, carbon, nitrogen, oxygen, phosphorus and sulfur.
- ⊙ Elements important for the maintenance of our health are Sodium, Calcium, Phosphorous, Iron and Iodine.
- ⊙ Elements important for the maintenance of agriculture are Potassium, Calcium, Phosphorus, Magnesium and Iron.
- ⊙ Elements which play an important role in daily life are Iodine, Chlorine, Iron, Calcium, Magnesium and Sodium.



EXERCISE

1. Complete the following statements

- i) Percentage of oxygen element in the human body is _____.
- ii) Carbon dioxide is necessary for the life of _____.
- iii) The physical properties of allotropes are _____.
- iv) The water has maximum density at _____.
- v) Oxygen is responsible for _____ all types of fuels.



2. Tick (✓) the following statements either True or False.

- | | |
|--|------------|
| i) Diamond and Graphite are impure form of Carbon. | True/False |
| ii) All types of paper are made of cellulose. | True/False |
| iii) Nitrogen is very reactive and does not control the combustion process | True/False |
| iv) Potassium is essential for plants as sodium is for animals | True/False |
| v) Pig iron is the purest form of iron. | True/False |

i) The average percentage of carbon in human body is:

- (a) 16% (b) 18% (c) 20% (d) 22%

ii) Diamond is an allotropic form of carbon, which is:

- (a) Slightly soft (b) Softest
(c) Slightly hard (b) hardest

iii) Two major constituent of air are:

- (a) Nitrogen and carbon dioxide (b) Nitrogen and oxygen
(c) Carbon dioxide and oxygen (d) Oxygen and argon

iv) Which gas is responsible for fermentation?

- (a) Oxygen (b) nitrogen (c) Carbon dioxide (d) None of these

v) Which element is found in chlorophyll present in leaves of plants?

- (a) Sodium (b) Calcium (c) Iron (d) Magnesium

3. Write the chemical formulae of the following compounds.

4. Write the chemical formulae of the following compounds.

5. Write the chemical formulae of the following compounds.

6. Write the chemical formulae of the following compounds.

7. Explain the importance and application of carbon, iron and its compounds in daily life.

8. Describe the different forms of iron.

9. Explain the importance of iodine for our health.

10. What is importance of phosphorous for our health and in agriculture?

11. Describe the importance of chlorine in daily life.

BIOCHEMISTRY AND BIOTECHNOLOGY



OBJECTIVES

After completing this chapter you will be able to:

- ⊙ Know about the metabolism and fate of three types of food materials i.e. Carbohydrates, Proteins and Fats in human body.
- ⊙ Understand about enzymes, and their role in metabolism.
- ⊙ Know about the types, composition and functions of blood.
- ⊙ Understand DNA and its importance as hereditary material.
- ⊙ Understand Genetic Engineering and its significance.
- ⊙ Explain the antibiotics and vaccines, their importance and common uses.
- ⊙ Biochemistry is involved in different biological activities of human beings such as digestion, enzymes & their role, etc.

It is a known fact that every living cell or organism performs various vital activities for which energy is needed. This energy is obtained by the break down of energy rich compounds i.e. carbohydrates, proteins and fats. Similarly, the cell is making new organic molecules that are used in the process of repair or growth of the cell from these compounds.

The sum of all these activities, destructive and constructive, is called metabolism. It is a comprehensive term including all types of activities taking place in a cell. The human body is made of different organs like kidney, liver, lungs, stomach etc. Every organ is further made of millions of cells and every organ performs its own function. This is called division of labour. Different activities performed by different cells will be called metabolic activities.

Digestion of Food

Every living organism needs food for two purposes; to get energy for various activities and for the growth and repair of the body.

The food that we eat contains carbohydrates, proteins and fats. These food substances are in the form of large molecules (made of smaller units) and can not enter (diffuse) into a cell. It is therefore essential that the food we eat must be broken down into smaller units, otherwise it will go waste. This is achieved by the process of digestion. The food is broken down into smaller units which are of small size (diffusible) by the action of enzymes. The nature and role of enzymes will be discussed in this chapter later.

Let us first identify the smaller units that make these large molecules of food.

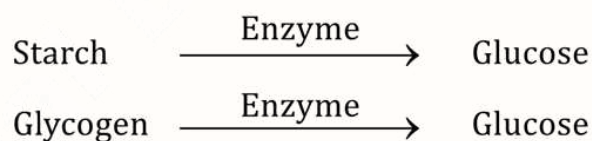
- | | | |
|------------------|--------|------------------------|
| a. Carbohydrates | —————→ | Glucose Molecules |
| b. Proteins | —————→ | Amino Acids |
| c. Fats | —————→ | Fatty Acids & Glycerol |

Carbohydrates

They are energy rich compounds of C, H and O₂. They are available in the form of sugars, starch and glycogen. Sugars (mostly cane sugar) is digested and changed into glucose, which is highly diffusible and absorbs into the blood and supplied to all the cells of the body.

Starch is available in the form of wheat, rice, potato, sweet potato, etc.

Glycogen is also called animal starch and is found in liver and meat. Starch and glycogen are higher carbohydrates. They have large molecules and are non diffusible. They are digested in the alimentary canal, in the presence of Enzymes and converted into glucose.



Glucose diffuses into blood and supplied to all the living cells of the body. Once inside a cell, it is broken down to give energy during respiration.

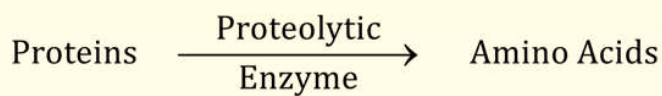


Symbolically it can be written as follows:



Proteins

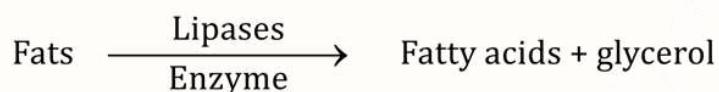
They are energy rich complex molecules made of C, H, O₂ and N₂. Proteins are present in meat, egg, chicken, fish and pluses. They provide energy as well as raw material for repair and growth. Proteins have large molecules and non diffusible. Proteins are broken down into amino acid during digestion.



Amino acids are small molecules that diffuse into blood and supplied to various cells of the body. Some amino acids are used to make various proteins needed by the cells and rests of the amino acids are further broken down to release energy.

Fats

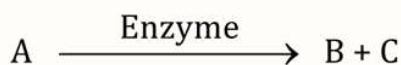
They are energy rich compounds made of C, H and O₂. They have double amount of energy as compared to carbohydrates and proteins. Fats are available in the form of ghee, butter and oils. Fats have large molecules and are non diffusible. During digestion fats are broken down into glycerol and fatty acids.



Fatty acids and glycerols are small molecules that diffuse into blood and taken to all parts of the body. They are either used to make structures of the cell or broken down to give energy.

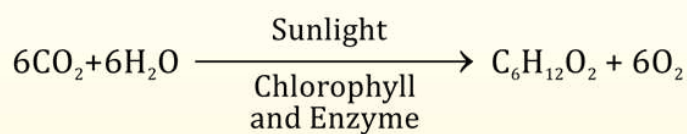
It is important to note that amino acids, fatty acids and glycerols are also used to make various structures of the cell. This phenomenon is called assimilation. The growth of the cell and of the body is the result of assimilation.

We have seen that most of the metabolic activities and reactions are facilitated by the enzymes present inside a cell. Enzymes are organic catalysts and essential for the processes of life. Suppose that a compound called A is to be broken into B and C. In the presence of Enzyme it may be carried out in the fraction of a second and on the other hand it may take six months.



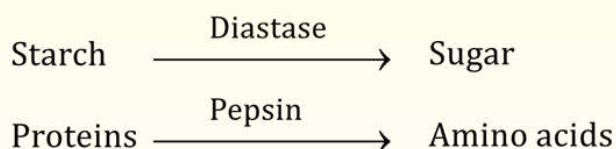
The process of digestion, respiration and assimilation are all facilitated by these enzymes. The whole process of life is at the mercy of enzymes and without these enzymes, life can not exist.

These enzymes are equally important in plants and plant processes. The most important activity carried out by plants is photosynthesis during which plants produce food from raw materials.



Enzymes are therefore the bases of life and have following some important characters.

- i. Enzymes are made of proteins.
- ii. Enzymes are specific in their activity i.e. they can catalyse only a particular reaction e.g.



- iii. Enzymes are killed at high temperature.
- iv. Enzymes are very fast in their action.
- v. Enzymes are not used in the reaction.



- vi. They can be isolated in the form of crystals.

Blood is the main transporting fluid of the human body. It supplies all the essential substances to every cell of the body and collects wastes from every cell and transports them to those parts from where these wastes are to be excreted. A continuous and perpetual flow of blood is the sign of life. Blood also helps to keep our body cells wet or moist. Every living cell must be kept wet for its normal working. The blood has two main parts.

- i) Plasma (liquid part) 55% by volume
- ii) Cells (different types of cells) 45% by volume

It is the liquid part of the blood and constitutes 55% of the blood by volume. It's composition is as under.

Water 90%	Other organic	} 2% - 3%
Proteins 7% - 8%	And inorganic	
	Substances	

Plasma proteins which are 7%–8% perform some important functions such as

- a. Transport of inorganic iron
- b. Help in blood clotting
- c. Anti bodies save us from diseases.

- d. Supply of digestion products i.e. glucose, amino acids, fatty acids and glycerol to all the cells of the body.
- e. Transport of hormones to the place of their activity.
- f. Transport of urea, uric acid and carbon oxide to kidneys and lungs for excretion.

Myeloid Cells

Following three types of cells are floating in the plasma which perform some very important functions. These cells are 45% of the blood by volume.

- i. Red blood cells (Erythrocytes)
- ii. White Blood cells (Leukocytes)
- iii. Platelets (Thromobocytes)

Red Blood Cells

They are the most numerous in the blood. Each cubic millimeter of blood contains about five million Red Blood Cells. RBC contains a protein called haemoglobin which carries oxygen to all cells of the body. Haemoglobin gives red colour to the blood. It has a remarkable property of attaching dissolved oxygen to itself and giving it up again. This oxygen is very essential for every living cell because it is used in respiration and provides energy to the cells.



The average life of a red blood cells is 120 days i.e. they are continuously destroyed after completing their age of 120 days. They are reformed in the red bone marrows, ribs and breast bones.

White Blood Cells

They are colourless and irregular in shape and have a prominent nucleus in them. One cubic millimeter has 7000 - 8000 WBC. They are important in combating the diseases and giving immunity against the diseases. They save us from diseases in two ways.

- i. They engulf and digest the bacteria and viruses and destroy them.
- ii. They produce antibodies that kill and destroy bacteria and viruses.

Platelets

They are much smaller than RBC and WBC. They are fragments of bone marrow cells and without

nucleus. They help in the clotting of blood and stop blood from flowing out of damaged vessels.

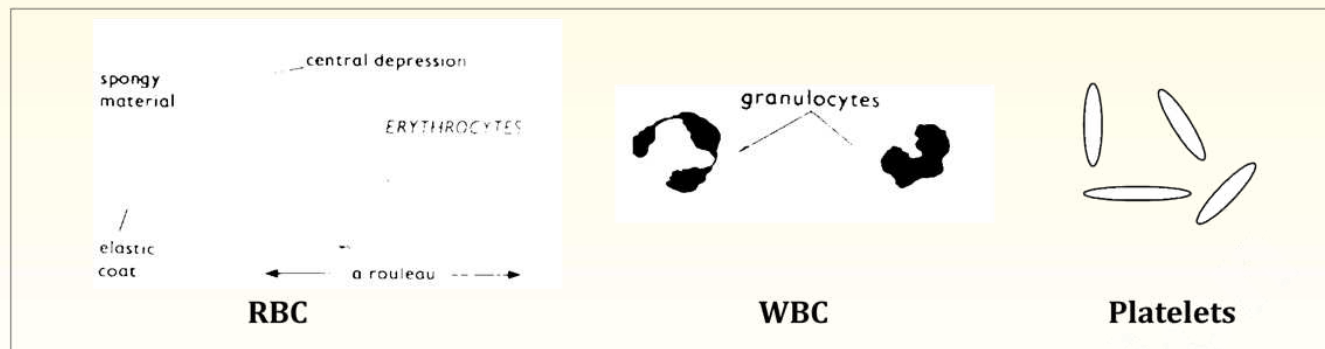


Figure 3.1: Blood Cells

Blood groups

Human blood is divided into four main groups on the basis of different types of antigens present on the RBC. Antigens are special proteins which have a particular shape and are genetically controlled.

Blood Group	Antigen	Antibodies
A	A	B
B	B	A
AB	A and B	None
O	None	A and B

Table 3.1: Blood groups and their antigens and antibodies.

Antibodies

Antibodies are also proteins and are produced against their respective antigens. Antibodies A will destroy Antigen A and Antibodies B will destroy Antigen B. During blood transfusion, particular care is taken in providing matching blood group otherwise the death can take place.

Blood type

Another factor is also used to determine the blood type and it is called Rh factor. It is due to the presence or absence of Rh antigens. If Rh antigens are present in the blood of a person, it is said to be Rh +ve and if absent, it is Rh -I've.

Rh + ive Rh antigens present

Rh -ive Rh antigens absent

Blood group and blood type of a person cannot be changed as they are genetically controlled.

3.4: CHROMOSOMES DNA AND GENES

Every cell has a nucleus in the centre which is the most vital organ of a cell. It contains special thread like structures called **CHROMOSOMES** that are present in the form of a network before the start of cell division, called chromatin network.

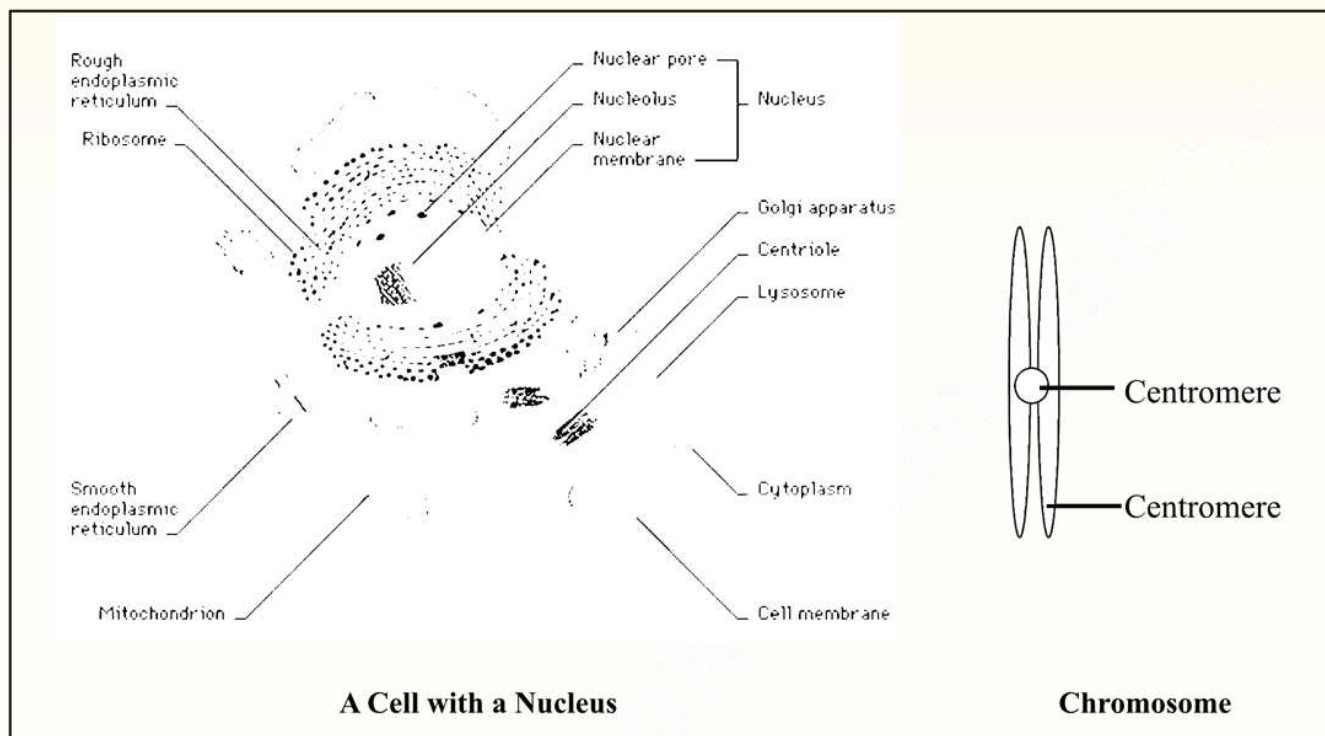


Figure 3.2: A cell showing nucleus and chromosomes.

Chromosomes can be observed as independent structures at the time of cell division. Each chromosome is made of DNA and proteins. DNA is Deoxyribonucleic acid.

DNA is found in the form of a double Stranded Helix. It is the hereditary material of the organism. This DNA has particular areas that act as genes. Gene is therefore the basic unit of inheritance. These genes control various traits of the body such as eye colour, skin colour and blood groups in man. It also control the complete development of the organism and all of its vital activities.

The number of chromosomes in an individual of a species is always constant and therefore the number of genes is also constant.

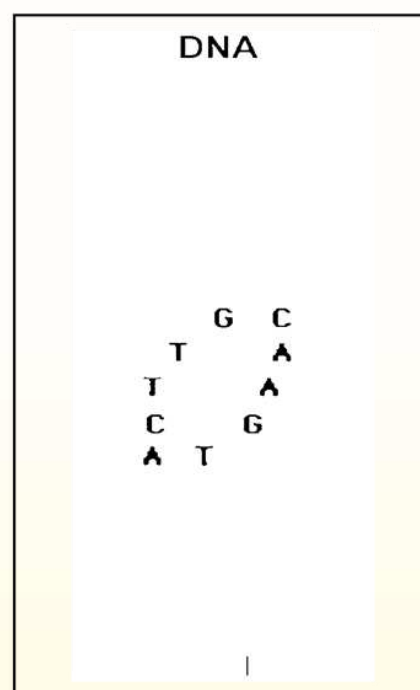


Figure 3.3: Double helix DNA

ORGANISM	NUMBER OF CHROMOSOMES
Drosophila	8 (4 pairs)
Man	46 (23 pairs)
Monkey	48 (24 pairs)
Cat	30 (15 pairs)
Earth Worm	32 (16 pairs)
Onion	16 (8 pairs)
Pea	14 (7 pairs)
Wheat	42 (21 pairs)

A change in the number of chromosome or the composition of DNA is called Mutation. These mutations may lead to fatal results. Many human diseases are the result of abnormalities of chromosomes and genes. Such diseases are called inherited diseases, e.g. haemophilia and colour blindness.

The branch of biology that deals with the study of genes and inheritance is called **genetics**. Genetics has made great advances in several fields of human interest, i.e. agriculture and medicines. It is believed that the 21st century will be the century of biotechnology. The most important fields are genetic engineering and biotechnology.

It is the manipulation of genes in which the undesirable genes are removed and certain desirable genes are introduced. With the help of this method, desired characters can be introduced in crops and live stock.

With the help of genetic engineering, such varieties of crops are being produced that give better yield and are resistant to diseases. Similarly, the live stock gives more milk and flesh.

Crops provide food to the humans as well as animals which indirectly provide milk and flesh to humans. A better agricultural produce in the form of crops is the sign of prosperity. Being an agricultural country Pakistan has always given due importance to agriculture particularly crops. Main achievements are in the fields of

- i) High yield varieties
- ii) Control of plant diseases

High Yield Varieties

With the help of genetic engineering and cross breeding, high yield varieties have been prepared which give much more productivity per acre. It has brought prosperity to both the grower and the country.

Better yield in wheat rice, cotton and sugar cane has made Pakistan self-sufficient in these crops and has also earned foreign exchange for the country. The use of machines like tractors, scrapers, harvesters and thrashers have greatly helped the man for better production.

Control of Plant Diseases

Another important factor that has facilitated the better productivity is the control of crop diseases. In Pakistan, crop diseases destroy 10% - 30% of our produce which is a great national loss. An equally important requirement was to control the crop diseases and reduce the losses. Plant diseases have been controlled by two methods

- i. Production of Resistant Varieties.
- ii. By the use of insecticides and fungicides.

Efforts are continuously being made to produce such varieties of crops that can resist the attack of plant pathogens, i.e. Fungi and insects. It is being achieved with the help of genetic engineering, biotechnology (tissue culture) and cross breeding. These resistant varieties have created more confidence in the growers and have reduced the crop losses.

Two types of organisms are a threat to crops. These are insects and fungi. To save the crops from the attack of insects, special chemical compounds are used that kill the insects. They are called insecticides. Their proper spray has greatly helped to save the crops especially cotton crop.

Fungicide are those chemicals that kill the fungal pathogens. Rusts and smuts are the common fungal diseases of cereal crops which have now been greatly reduced by the use of fungicides.

We are living in the ocean of Bacteria and viruses. A lot of micro-organisms are surrounding us all the times. Many of them are pathogenic, i.e. disease causing. The effort of the biologists always have been to control and treat the diseases.

Two important discoveries, i.e. Antibiotics and Vaccines have saved the humanity from several fatal diseases.

Any substance that is produced by an organism that inhibits or kills a microorganism is called antibiotics. Many of you have been given an antibiotic by a physician to help you to combat certain diseases such as sore throat, pneumonia, typhoid and other bacterial diseases. Antibiotic have become part of our life and we must know what they are and how they act.

It was in 1929 that a British microbiologist Alexander Flemming reported antibiotic activity from a blue green mold. Blue green mold is a common fungus growing on stale citrus fruit, milk or bread. Its



biological name is *Penicillium*. During his experiments on bacteria, he found that the bacteria failed to grow in the presence of *Penicillium*. It was a great discovery. He isolated a substance from this fungus and called it Penicillin. It was the first antibiotic which was discovered accidentally. Further tests showed that penicillin was harmless to man.

In 1938 penicillin was commercially produced and used in many bacterial infections. Several other antibiotics were obtained from various different organisms and used to control and combat the diseases. Now there are several synthetic varieties of antibiotics used all over the world. These antibiotics have saved the life of millions of people and many fatal diseases are now controlled and cured very safely. The use of antibiotics should be made under the proper guidance of physician because haphazard and excessive use of antibiotics may be injurious to health.

Another important discovery to control the diseases was that of vaccines. Whenever a disease producing organism, say bacteria or virus enters our body, the blood produces antibodies against these microorganisms and kill them or inhibit their growth. The person thus becomes immune to that disease. This is called active immunity.

If we inject weakened germs of a disease into the body of a person, he will start producing antibodies without getting the disease. He has now become immune against that disease. These weakened germs are called vaccines.

The discovery of vaccines was the result of a daring experiment of English Physician Edward Jenner (1749 – 1823). He was able to prepare the first vaccine against a dreadful disease i.e. smallpox. In his time the cause of this disease, a virus, had not yet been discovered (virus was discovered in 1892).

Jenner made two observations regarding cowpox and smallpox, both viral diseases. Firstly he noticed that milkmaids often contracted a mild case of cowpox from the cows infected with cowpox which is a mild disease for both cows and milkmaids.

Secondly, he observed that milkmaids, who had contracted cowpox, did not contract the dreadful disease smallpox. He could believe that if a person contracted cowpox he became immune to smallpox. In spite of his limited information Jenner performed a bold experiment.

He vaccinated (vacca-latin for cow) a young boy with pus from a cowpox blister. The boy contracted a mild case of the disease and soon recovered. Was the boy immunized against smallpox? It could only be tested by contracting the boy with smallpox disease. The results could be otherwise but Jenner continued his experiments and inoculated the boy with pus from active case of smallpox – the boy did not contract smallpox. The boy had indeed become immune against smallpox. It was a great achievement. A vaccine had been discovered.

When the boy was inoculated with pus from cowpox, the boy produced antibodies against the cowpox virus. Fortunately the cowpox virus resembles the smallpox virus and antibodies produced against cowpox virus were also effective against smallpox virus. The boy became immune to smallpox also. The method of vaccination was used all over the world and the number of people thus benefited is incalculable.

Now a days vaccines have been prepared for several diseases such as TB, Cholera, Polio,

Measles, Hepatitis and many others. A comprehensive campaign has been lodged against polio in Pakistan. It is a viral disease of infants. Its vaccine is consisted of weak viruses of polio. The vaccine is given to children upto the age of five years, produces antibodies against polio virus and the children become immune against polio.



Figure 3.4: An average city dweller may produce a ton of refuse in a year, a volume that rapidly overflows local dumps.

Recycling is the collection, processing and reuse of materials that would otherwise be thrown away. Materials ranging from precious metals to broken glass, from newspaper to plastic spoons can be recycled. The recycling process reclaims the original materials and uses it in new objects.

Generally recycling of materials to make new products costs less and require less energy and labour than using new materials. Recycling also reduces pollution by reducing the pollution produced during the manufacturing process. Recycling decreases the amount of land needed for dumps by reducing the volume of discarded wastes.

Once glass, plastics and metals are removed from the domestic wastes what remains is essentially organic wastes. These organic wastes can be biologically decomposed and converted into humus which is a good fertilizer. This is called bioconversion. Kitchen wastes when decomposed with leaves and grasses make useful fertilizers. It reduces the amount of wastes and improves soil fertility. If the wastes are properly segregated their recycling become easy and purpose ful.



Figure 3.5: Many products may be made using recycled materials at less cost and with less pollution.

Paper products can be recycled to make card board, wrapping paper and even newspaper which is the most proper use of waste papers. Papers and paper products are about 20 to 30 % of wastes. In developed countries it is even more. The recycling of paper wastes has been of great advantage. It has also greatly help to check pollution.

They are also a major part of the wastes now a days. Recycling of plastic is relatively difficult because of the mixing of different types of plastics. During plastic recycling, the plastic wastes are cut into pieces,

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melted and converted into small pellets. These pellets can be remolded into sheets and desired shapes.

Recycling is now a profitable industry. It reduces the garbage and pollution and produces useful products.



EXERCISE

- i) Carbohydrate is broken down by the enzyme into _____.
- ii) During digestion fats are broken down into fatty acids and _____.
- iii) Enzymes are made of _____.
- iv) The percentage of plasma by volume in the blood is about _____.
- v) A person with blood group A has _____ on his RBC.

- i) Genes are present in the cytoplasm of the cell. True/False
- ii) The number of chromosomes in pea plant is 32. True/False
- iii) Vaccines are active germs of the diseases. True/False
- iv) The first antibiotic was discovered by Jenner. True/False
- v) Virus was discovered in 1792. True/False

- i) During digestion protein are broken down into:
(a) Glucose (b) Sucrose (c) Glycrole (d) Aminoacid
- ii) The number of chromosomes in a cat is:
(a) 15 pairs (b) 16 pairs (c) 8 pairs (d) 7 pairs
- iii) A person with blood group B has following antigens:
(a) Antigen A (b) Antigen B (c) Antigen A & B (d) None
- iv) The shape of W.B.C. is:
(a) Circular (b) Oblong (c) Rod like (d) Irregular
- v) Special chemical compounds that kill the insects are called:
(a) Fungicides (b) Insecticides (c) Pesticides (d) All

(a) Genetic Engineering (b) Control of Plant diseases (c) Recycling



MAN AND HEALTH

OBJECTIVES

After completing this chapter you will be able to:

- ⊙ Know about the major components of food and their sources
- ⊙ Learn about the energy values of nutrition
- ⊙ Know about balanced diet
- ⊙ Understand the functions of glands
- ⊙ Get awareness about importance of First Aid

Human body is a machine that needs fuel for its normal working. We perform a variety of functions in our daily life such as walking, moving, talking, etc; all of these activities need energy. Moreover several functions are automatically going on in our body, i.e. beating of heart, formation of urine, etc. They also need energy. Energy is also needed to keep our body warm. Our food is the source of energy to carry out all these functions. The food acts as fuel for the human body.

In human body, food is broken down or burnt in a highly controlled and organized manner inside a cell with the help of an enzyme system. The energy released during break down is taken up by special energy transferring compounds called ATP (Adenosine Triphosphate) and then used by the cell.

The food we take should provide us enough energy as well as other materials needed for the growth and repair of our body. The main components of the human food are:-

i.	Carbohydrates	iv.	Minerals
ii.	Proteins	v.	Vitamins
iii.	Fats	vi.	Water



The role and importance of food in which these components are present can be summarized as follows:-

- i. Food is the basic source of energy for all the activities of the body.
- ii. Food provides materials for the growth and repair of the body.
- iii. Food also contains certain minerals and vitamins that regulate various functions of the body.

Carbohydrates

They are the organic molecules made of carbon, hydrogen and oxygen. The most common carbohydrates are sugar, flour, rice, potato etc. are the rich source of energy. The simplest carbohydrate is the Glucose ($C_6H_{12}O_6$). During respiration glucose burns to release energy. The basic unit of all other forms of carbohydrates is the glucose. The other forms are;

Sucrose	—————→	cane sugar
Starch	—————→	potato, flour, rice, sweet potato
Glycogen	—————→	liver, muscles
Cellulose	—————→	cotton fibers (it makes the wall of plant cell)

Our food mainly contains starch i.e. flour, rice and potatoes. During digestion the starch is converted into its basic unit glucose. This glucose then diffuses into the blood and the blood during its circulation supplies this glucose to every living cell. Once inside a living cell the glucose is burnt or respired to release energy.

Proteins

They are also important organic compounds made of carbon, hydrogen, oxygen and nitrogen. Protein molecules are of much larger size and made up of small basic units called **Amino acids**. The number of amino acids range from 30 to 3000. Proteins are the most abundant organic compounds in the human body. Proteins are mainly present in muscles, liver, brain and blood.

The best sources of proteins are meat, egg, milk, yogurt, liver, beans, peas and pulses. During digestion large molecules of proteins are broken down into amino acids. Amino acids are diffused into blood and transported to different cells of the body. Inside a cell, these amino acids may form desired proteins or used to provide energy. Proteins also play some other important roles in the body such as:-

- i. They make bulk of the human body
- ii. They provide energy to the body
- iii. They make various structures of the cell.

- iv. Enzymes are also proteins.
- v. Hemoglobin of red blood cells is also proteins.
- vi. Insulin is also a protein. Its shortage causes the common disease called diabetes.

Fats

They are also important organic compounds. All types of fats i.e. ghee, oil, butter etc are collectively called **Lipids**. Fats have large molecules and contain double amount of energy as compared to carbohydrates and proteins. Fats are therefore rich source of energy. During digestion fats are broken into **glycerol** and **fatty acids**, which are diffused into blood and are then supplied to all the cells of the body.

Minerals

In addition to energy our body also needs some elements which are made available in the form of mineral salts. Some of the important elements are **calcium, iron, phosphorus, magnesium, iodine, copper, chlorine, sodium, potassium, sulphur and cobalt**. These elements are required in very small quantities but they are essential for the normal working of our body.

Vitamins

Human body also needs another important group of compounds called vitamins. Vitamins are also essential for the normal working and growth of the body. The most common vitamins are vitamin A, B, C, D, E and K. Vitamins are divided into two main groups on the basis of their solubility.

Some of the vitamins are soluble in fats and are mostly found in fats. They are vitamin A, D, E and K.

Vitamin A

This vitamin is essential for the growth of the body, particularly in the children. Its deficiency may cause night blindness. It is found in milk, butter, fish, yellow of egg, liver, maize, carrot, mustard, turnip, beet and fruits.

Vitamin D

This vitamin helps the body in consuming calcium and phosphorus. Its deficiency may cause weakness of the bones. It is found in cod-liver oil, milk, butter and eggs. Our skin synthesizes vitamin D, in the sunlight.

Vitamin E

It is important for the normal working of the nervous system. In the absence of this vitamin, the



vitamin A and C cannot work properly. It is found in eggs, milk, groundnut, butter and liver. It is also available in salad, cabbage, carrot, beans and beet.

Vitamin K

This vitamin helps in the coagulation of the blood in case of an injury. It helps in the proper working of the liver. In its absence the blood fails to clot properly. Its shortage may cause the malfunctioning of the liver. It is found in cabbage, egg, tomato, spinach and soybean.

Some of the vitamins are water soluble. They are Vitamin B and C.

Vitamin B

A number of vitamins constitute vitamin B complex. This complex includes about 10 vitamins. Vitamins B1, B2 and B12 are the most common members of this complex.

Vitamin B1

This vitamin is also called Thiamin. It helps in the digestion of carbohydrates and also helps in the proper growth of the body. It is found in wheat, rice-busk, maize, beans, pulses, almond and nuts. Its deficiency may cause a disease called Beri Beri.

Vitamin B2

It is also called Riboflavin. It helps in the process of digestion and assimilation of proteins. In its absence the digested food does not become the part of the body. Its deficiency in children keeps them weak and stunted. It is found in the heart, kidneys and liver. It is also available in eggs, meat, milk, wheat, prawn, mint, spinach, groundnuts and pulses.

Vitamin B12

It is also called Cyanocobalamine. It is mostly found in dividing cells specially in the blood forming tissues. Its deficiency may cause pernicious anemia. It is found in liver, chicken and fish.

Vitamin C

It is also called ascorbic acid. It is an important vitamin that helps in several metabolic activities. It keeps the gums and the teeth healthy. It helps in the formation of blood and healing of wounds. Its deficiency may cause several related problems. Bleeding start from the gums and even from other parts of the body. Healing of wound is delayed. It is found in oranges, grapefruits, peaches, guava, lemons and green chilies.

Water

It is the most abundant content of the human body which may be upto 70%. Water has certain peculiar qualities that make it a vital constituent of human body. Body cells cannot live without water.

- i) It is a good solvent. Most of the objects are first dissolved in water and then diffused into

the body cell.

- ii) It helps in the excretion of urea in the form of urine.
- iii) It is a major component of the blood and keeps it circulating.
- iv) It makes the food soft to be digested properly.
- v) The sweating water keeps our body cold during hot summers.

The major part of food contains carbohydrates, proteins and fats. Their energy contents have been calculated as under.

One gram of Carbohydrate is equivalent to:	4.1 calories of energy
One gram of Protein is equivalent to:	4.1 calories of energy
One gram of Fats is equivalent to:	8.3 calories of energy

If we eat more, the excessive food is converted and stored as fats in our body. The following table will give some idea about the energy contents of few common foods:

100 gms of food	Calories
Wheat	348
Egg	180
Rice	348
Meat	194
Potatoes	100
Barley	355
Banana	155
Cucumber	014
Milk (Cow)	070
Dry fruits	500
Milk (Buffalo)	120
Brinjal	005



Energy Requirements of the Body

The energy requirements vary from individual to individual. It depends on the age of the individual, the sex and the occupation. A young male needs more energy than female. The following table may give some idea about the energy requirements of various age groups:

Group	Age in years	Calories/day
Children	1 - 3	1200
	4 - 6	1600
	7 - 10	2000
	11 - 12	2500
Girls	12 - 13	2600
	14 - 20	2800
Women	Doing no work	2200
	Doing light work	2500
	Doing hard work	3000
Men	Doing no work	2500
	Doing light work	3000
	Doing hard work	4200

Energy requirements of children are more than the adults. This is because the growing bodies need greater amount of energy. The pregnant mothers also need additional energy for developing baby.

People doing greater physical labour need more energy. Such persons should take enough food otherwise they will lose weight. Similarly, persons having comfortable life need less energy. Such persons should take less food otherwise their body weight will increase which is not a healthy sign.

People living in colder regions need more energy to combat low temperature outside the body. People living in warmer zones need relatively less energy. It is a common observation that in winter we take rich diet and in summer we take light diet and excessive water. We must take care of our body requirements and should take food energy accordingly.

4.3: BALANCED DIET

A diet that contains all components of food in proper ratio for the proper growth and maintenance of health of the body is called balanced diet. The balance diet needed for babies, young & old people and feeding mothers is described below.

Babies

In the new born babies, milk is the only proper diet. It contains all the contents required to a baby. Mothers milk is the blessing of God for the new born babies. In the first three months, the baby should be fed on mother's milk. It is from the human body and for the human body. A baby needs 600 to 700 c.c of milk per day. The stomach of the baby has a small capacity and can take a small amount of milk at a time. The baby should be fed as many times as she or he feels hungry. Efforts should be made to provide mother's milk to the babies. The second choice is the buffaloes milk.

At the age of four months, depending upon the overall health of the baby, semi solid food should be started, e.g. egg, sago, kheer, soup or mashed bananas. At the age of one year, suitable diet prepared with milk, fruit, cereals, eggs and porridge should be given.

Young People

The diet of the young people should contain high energy value as they are undergoing growth and need energy for playing and running. Their diet should have more fats, carbohydrates and proteins. Proteins should be given in higher proportion for the growing body. They also need more minerals and vitamins. The growth rate is faster between the age of 12 and 16 years. Many body changes also take place in this age. Special care is therefore needed during this critical growing age. Milk, yogurt, fruits and minerals should be part of the food.

Old People

The food requirements of the old people are different from the young ones. In the old age, the working capacity of the body decreases. The food should be less in fats and carbohydrates. Milk, fruits, vegetables and such light foods be given to old people that can be digested easily.

Pregnant Women

The pregnant mother provides nourishment to the developing baby and therefore it must contain more proteins, vitamins and minerals. In case of deficiency of these food components any mishap may take place. Pregnant mothers need more energy. Their diet should also be rich in carbohydrates.

Breast feeding mothers should particularly include at least one liter milk daily alongwith proteins, calcium and phosphorous. A healthy mother will bear a healthy child. The common diet for pregnant and breast feeding mothers should contains cereals, bread, sugar, fats, vegetables, fruits, eggs, milk and meat in proper ratios.

4. COORDINATION

The human body is composed of various organs such as heart, lungs, kidneys, stomach, etc. which work simultaneously in an organized and integrated manner that the human body looks like a unit. For such an integration and organization there is a separate system called Coordination system. It coordinates between different organs. Coordination is carried out by two distinct systems i.e.

- i. Nervous System
- ii. Endocrine System



Nervous System

Nervous system is composed of nerve cells called Neurons. It performs the function of transmission of message (impulses) from one part of the body to the other. This transmission is immediate and direct. The nervous system can be divided into two sub systems, i.e.

- i. Central Nervous System
- ii. Peripheral Nervous System

Central Nervous System

Brain and **spinal cord** form the central nervous system (CNS). Brain and spinal cord are made of a very large number of neurons. Every message is first taken to CNS and then to other parts. Brain is present in the skull and spinal cord is located in a canal like structure in the vertebral column or back bone.

Peripheral Nervous System

The nerves that originate from brain or spinal cord constitute the peripheral nervous system. These nerves are of two types. Sensory nerves that bring messages from receptors to CNS and motor nerves that carry away the message from CNS. The receptors are the organs which receive the stimuli from the surrounding environment.

Stimuli are received by the receptors in the sense organs i.e., eyes, nose, ears, skin and tongue from where the stimulus is transmitted to the CNS through the sensory nerves. In the CNS the stimulus is processed and sent immediately through the motor nerves to the effectors e.g. muscles and glands.

Pain, heat, cold, odour etc. are felt with the help of receptors. Whenever the body receives an injury the message is immediately sent to the brain and spinal cord through the neurons. The brain and spinal cord immediately send message to the muscles of that point and we feel pain.

Endocrine System

There are several **endocrine glands** in the human body which secrete certain chemicals called **hormones**. These endocrine glands are also called ductless glands because they do not have any duct or vessel for the release of their hormones but they are passed directly into the blood.

The endocrine system is also called Hormonal System. The affect of these hormones is indirect and relatively slow as compared to nerve transmission. The main Endocrine Glands of man and their functions are given below:

Thyroid Gland

It is located on either side of the middle of the neck. Our food must contain some iodine otherwise these glands become large and cause a disease called “Goiter”. This disease is common in the Northern areas of Pakistan. Hormonal recreation of thyroid gland regulates the rate of growth of the body and rate of metabolism.

Parathyroid Gland

These are four small glands embedded in the thyroid gland. They secrete hormone that controls the amount of calcium in blood and bones. Its shortage reduces the level of calcium in the blood and

causes tension in muscles.

Adrenal Gland

They are located on the kidneys. They produce several hormones. They prepare the body to meet any shock or emergency condition. Adrenal gland accelerates the heart beat and general rate of body metabolism with the result the body becomes more active and can face the emergency condition. Its shortage leads to laziness.

Pituitary Gland

This is the most important gland which is situated in the lower part of the brain. This gland secretes several hormones. Some hormones regulate the secretions of other and some regulate the growth and other functions of the body. The pituitary gland is therefore called "**Master Gland**" of the body.

Islets of Langerhans

It is present near the small intestine. Small areas of pancreas act as endocrine glands. These areas produce two hormones "**Insulin**" and "**Glucagon**". Insulin lowers the sugar level in the blood and the glucagon raises it. The two hormones collectively keep the sugar level in the blood at a constant level. The shortage of insulin causes a dangerous disease called **Diabetes**.

Sexual Glands

Ovaries in human female and testes in male also act as endocrine glands. In addition to the formation of female and male gametes, they also produce sex hormones. These hormones regulate the sex functions of the body and give secondary sexual characters to the body.

Stages of Human Development

A human being passes through various stages during its life time. The first stage is the **infant stage** in which the child is fed by the mother and the growth rate is maximum. His/her cells are young, most active and reproduce at a fast rate. The second stage is the **child stage** in which the young ones are again at a fast growing rate. The body metabolism is at its peak. When a child enters into the **adolescence stage**, there are various hormonal changes in the body the metabolic rate and growth rate are still at a high rate. In the **young stage** one is having a constant rate of metabolism. The growth rate is approximately stopped and the cells start degenerating. It is believed that the process of degeneration starts at the age of 30. In the **old stage** the rate of metabolism is slowed down, the degeneration process is enhanced and one becomes aged.

Aging And Degradation

The cells of the body do not remain young and active throughout life. With the passage of time they are deteriorated and become less active. This process of deterioration, with time, is called Aging. It is a natural phenomena. Every cell has its age after which it starts deteriorating. There are basic physiological reasons for such a deterioration. The accumulation and deposition of wastes and other products make the cell less efficient and sluggish.



Aging is a slow and gradual process; various organs become aged at different time. Thymus gland is completed by the age of 10 or 12, after which it starts shrinking and at age of 20 it is reduced to half. The reproductive organs start growing at the age of 14 and above. The muscles are fully developed by the age of 30. After which they start degenerating. The aging of the bones starts very late, i.e. after the age of sixty. The nervous system usually remains active till the last moments of life.

The blood vessels play a very important role in the aging of other cells. Deposition of calcium in the heart muscles and blood vessels, make them inelastic and hard and increases the blood pressure. The load on the heart is increased and the heart may become enlarged. It results in many related problems.

These physiological changes within our body lead to general weakness and decrease body's ability to cope with stress and to resist the attack of diseases as well as seasonal hazards. As these negative changes continue, a stage is reached when our body system cease, to function and death occurs. It is now believed that the process of aging is programmed in the DNA of the individual.

Aging basically starts at molecular level and cellular level then organ level and finally organismal level.

Molecules —————> Cells —————> Organs —————> Body

As mentioned earlier several biochemical activities are taking place inside a cell all the time. With the passage of time the cells and other organs become tired, fatigued and weak and their efficiency is decreased. Under such conditions, the nature discards these old cells and new ones are formed, which are more efficient and energetic.

A red blood cell becomes fatigued after four months and fails to perform its functions properly. Such RBCs are decomposed and new RBCs take their place. In the human body, a balance is maintained between the destructive and constructive processes.

In the old age, the constructive processes are slowed down and destructive processes are accelerated. The overall body strength is decreased and the capacity to resist the attack of diseases is reduced. One becomes the victim of the process of aging and decay as well as of diseases. Vital organs like heart, kidney and liver are effected and they ultimately stop working which leads to the death of the organisms. At the time of death all biochemical activities cease to work, the energy is not produced and the nervous system becomes functionless.



11 EXERCISE AND HEALTHY LIVING

A healthy body has a healthy mind and a healthy mind has a positive thinking which leads to a healthy society.

Life and health are two marvelous gifts of God. We must try our best to maintain a good health. We generally, due to our carelessness, lose these gifts. We can maintain a good health by observing a few minor activities and precautions. By observing these precautions, we can save ourselves from diseases and slow down the process of aging.

Hygienic Conditions

We must adapt the basic principles of day to day hygiene. We should keep our environments clean. We must wash our hands before every meal, after using toilet, and clean teeth twice a day i.e. morning and before going to bed. Our nails should properly be trimmed and we must take bath regularly. We should avoid eating rotten fruits and food stuff. It may be toxic for us. Iron your clothes because ironing kills the germs.

Fresh Air

Our houses should be properly lighted and ventilated because all members of the family may breathe in fresh air which is the source of oxygen. Sunlight is also essential for the killing of germs & disinfections.

Clean Food

Water and food are good carriers of germs and microorganisms. Many diseases are caused due to contaminated water. If possible, the drinking water should be boiled to decontaminate (to kill germs) it. The food should also be properly cooked and preserved. Any food giving bad smell or having small bubbles in it should not be taken. Do not keep the cooked food in the refrigerator for a long time. Try to use fresh food as much as possible.

Proper Disposal of Garbage

The garbage and wastes of house should be disposed of properly. Do keep a covered basket for this purpose. Put all the wastes in the basket and dispose it of at the proper garbage center.

Regular Exercise

A regular exercise is a key to good health. We must spare some time especially in the morning for light exercise. Even a light exercise for 15 minutes will give you marvelous results. The exercise may be brisk walking or light jogging. It should be a regular feature of your daily routine. A regular exercise brings you many benefits some of which are: -

- It regulates the blood circulation.
- It keeps the heart healthy and active.
- It gives better supply of oxygen to the body and every cell of the body is refreshed by the supply of oxygen.
- It improves the working of all the muscles of the body.
- It improves the working of kidneys.
- After exercise the appetite is improved and digestive system works better.
- A little perspiration keeps skin healthy and fresh.

Note: *Heavy exercise or hard physical work should be avoided after major meals.*

During exercise, much calories are consumed and obesity is checked. It will not be irrelevant to say that over eating and much intake of heavy food leads to become fat and bulky. This obesity makes

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us inactive and lethargic which itself is dangerous to health. A regular exercise will consume extra body fats, reduce obesity and keep fit and active. It also saves us from diseases such as heart attack, paralysis and diabetes.

Rest and Sleep

We must provide proper rest and sleep to our bodies. A regular and proper sleep keeps us vigorous. It also keeps us physically and mentally fit.

Regular Prayer

To say regular prayer five times a day is essential. It keeps us clean, healthy and contented; all of which are of vital importance for a happy life. Some of the features of regular prayers are: -

- We wash our hands, face and feet five times a day.
- We wear clean clothes.
- It gives physical exercise.
- We submit ourselves to Almighty Allah. This act makes us contented.
- A fear of God keeps us away from bad and undesirable activities.

Accidents or mishaps or emergencies are the part of life. In such situations, one should not panic and provide immediate help to injured persons. While dealing with an injured person the first aider must call for specialist's help or shift the person to a medical center.

Basic principles of first aid are: -

- i. Restoration of Airway
- ii. Restoration of Breathing
- iii. Restoration of Circulation

In some particular cases immediate steps can be taken as first aid to save lives as given below: -

In case of an accident, following steps are of immediate importance

- i. Remove the patient to a safe area preferably under shade.
- ii. Make rapid assessment of the condition of the patient.
- iii. Airway, Breathing and Circulation of first aid must be taken care of.
- iv. Bleeding must be stopped by applying pressure.
- v. If there is a fracture of any limb bone, stabilize it with a splint.
- vi. Manage to transport the patient to the nearest medical center.

Snake Bite

All snake bites are not fatal. The venom released during bite can cause considerable pain, illness or death. Following treatment is immediately needed to the victim of a snake bite.

- i. Identify the snake if possible or kill the snake and carry it to the medical staff. This will enable them to prepare the appropriate anti-venom.
- ii. Wash the wound with soap and water and cover it with a clean cloth or dressing if available. Place a broad bandage or cloth strip just above the site of the wound and fix it firmly but not too tight.
- iii. Immobilize the affected limb to reduce circulation.
- iv. Arrange persons for immediate shifting of the victim to the nearest hospital. A delay may be dangerous.

Bites which have been caused by an animal, say dog, cat and mice should always be referred for medical examination because there is a risk that bacteria on teeth or in saliva may lead to infection.

Bleeding can be severe depending upon the nature of bite. The first aider's aim should be to stop bleeding immediately.

- i. Control serious bleeding by applying direct pressure.
- ii. Cover the wound with a sterile dressing or a pad of clean cloth.
- iii. Observe carefully that the patient does not undergo a shock.
- iv. Arrange for immediate transfer of the patient to the hospital.

Heart attack is a dangerous situation that can lead to death. An immediate help can save the life. In case of heart attack the most important activity of a first aider is to restore respiration.

- i. Remove any visible obstruction from the mouth.
- ii. Place two fingers under the patients chin and gently raise the jaw and tilt the head well back by applying pressure on the forehead with your other hand.
- iii. Place your face close to the patients mouth and feel the breathing along with observing the movements of chest and abdomen.
- iv. Feel the pulse in the neck when the main arteries of blood pass on the brain.

If breathing and pulse are present then shift the patient to some hospital otherwise manage artificial respiration and chest compression commonly known as CPR which stands for **Cardio-Pulmonary Resuscitation**.

- i. Lie the patient flat on the back on a firm surface and feel for the point at which the lower ribs meet in the center, it is the lower part of the breast bone or sternum.
- ii. Place your left hand on the top of your right hand interlocking the fingers, on the indicated part of breast bone. Pull the fingers up so that the palm of your right hand is the only part in direct contact with the breast bone.
- iii. Keeping your arms straight, lean over the patient and apply pressure to the breast bone about 4–5 cm approximately 80 times per minute, never bending the arms at elbow.
- iv. The most effective sequence of CPR, which can be performed easily by one person, is 15 chest compressions followed by 2 breaths of artificial respiration through the mouth.
- v. Continue the process of CPR till the patient starts breathing or the doctor arrives.



EXERCISE

1. Complete the following statements.

- i) Plants manufacture their foods by the process of _____.
- ii) Cotton fibers are actually a carbohydrate called _____.
- iii) Vitamin A is essential for health and _____.
- iv) Vitamin C is also known as _____.
- v) The number of calories in 100 grams of potatoes is _____.

i) One gram each of carbohydrates and fats will release the same amount of energy.

True/False

ii) Vitamin B1 is also known as riboflavin.

True/False

iii) Thyroid glands are present near the kidneys.

True/False

iv) Pancreas produces enzymes as well as hormones.

True/False

v) Vitamin D is water soluble.

True/False

i) Out of the following Vitamins which is associated with the clotting of blood.

- (a) Vitamin A (b) Vitamin B (c) Vitamin E (d) Vitamin K

ii) How much energy will be released from one gram of proteins?

- (a) 3.1 Calories (b) 4.1 Calories (c) 6.1 Calories (d) 8.1 Calories

iii) How much calories are present in 100 grams of potatoes?

- (a) 50 Calories (b) 70 Calories (c) 80 Calories (d) Calories

iv) All the following types of foods provide energy except:

- (a) Potato (b) Milk (c) Egg (d) Water

v) Semi solid food should be started to the babies after the age of:

- (a) 3 months (b) 4 months (c) 5 months (d) 6 months

4. What are the main components of human foods? Explain with appropriate examples.

5. Explain water soluble vitamins (i.e. B and C).

6. Write a note on balanced diet.

7. Explain the endocrine glands of man and their functions.

8. What are the basic principles of First Aid?



MICROORGANISMS AND DISEASES

OBJECTIVES

After completing this chapter you will be able to:

- ⊙ Know about the diseases and their causes.
- ⊙ Understand the spread of germs.
- ⊙ Explain how to protect against germs.
- ⊙ Know that smoking is injurious to health.
- ⊙ Understand mental illness.
- ⊙ Understand the difference between drugs, medicines and narcotics.

Human diseases are caused by different organisms. These are micro-organism, fungi, malarial parasite, ascarises and thread worms. Microorganisms are very minute organisms, which can be seen only with the help of a microscope. Microorganisms include bacteria, viruses, malarial parasite, etc.

Some diseases and their causes are given below:

Several harmful human diseases are caused by bacteria. Some of the common bacterial diseases are mentioned below.

This disease is caused by bacterium called Mycobacterium. It is a wide spread and long lasting disease. The main symptoms of the disease are,

- Chest Pain
- Blood in sputum
- Prolonged coughing



- Constant fever and
- Loss of body weight

The disease is common in those people who live under unhygienic conditions, take poor food and breathe polluted air. The disease spreads by coughing, sneezing and spitting of T.B patient. Un-boiled milk also carries the T.B bacteria. In this disease mostly the lungs are affected. In severe cases the patient may spit blood along with sputum during coughing. The disease can be controlled by improving living conditions of the people specially the patient and by adopting and providing the following facilities:

- a. Proper food, fresh air and proper rest can improve the recovery of the patient.
- b. The victims of this disease should be kept in isolation or sanatoria to control further spreading of disease.
- c. The disease is curable but prolonged and persistent treatment is necessary.
- d. Infants must be immunized with BCG against T.B.

It is a disease of the infants. The symptoms of the disease are

- a. The infant coughs actually for a minute after which air rushes into the lungs producing a whistling sound called “whoop”.
- b. Due to acute coughing, delicate linings of the lungs and capillaries are damaged.
- c. The infant gradually gets weaker and reduced to skeleton.

The disease can only be controlled by immunizing the infants by the DPT injections. The injections are administered in a typical method.

Ist dose - 6 Weeks

IIInd dose - 10 Weeks

IIIrd dose - 14 Weeks

Booster dose - 18 months

DPT contains three vaccines

D for diphtheria

P for Pertussis (whooping cough)

T for Tetanus

Diphtheria

It is also a disease of the infants. The bacterium attacks the epithelial cells of the nose, throat and

larynx and produces boils. These bacteria produce toxic substances which kill the neighboring cells. The trachea and larynx of the patient become non functional. The heart muscles get weak which may lead to death. Infants should be immunized against this disease by vaccination.

Tetanus

It is a rare but dangerous disease. The disease causing bacteria are found on the animal dung, where they reproduce rapidly.

They enter the human body through the wounds or cuts. Once enter inside the body they reproduce rapidly and produce a toxic substance that affects the nervous system of the patient. In the early stage of disease, the patient feels headache and becomes lazy. Later on, the patient feels difficulty in the opening of mouth; his neck becomes stiff and feels difficulty even in urination. There is no remedy of the disease and the patient faces death. The disease can be avoided by administering the injections of ATS, i.e. Anti tetanus serum at the time of getting any injury. Artificial immunity can be achieved by periodic use of vaccines.

Typhoid

It is a common disease. Nowadays the use of antibiotics has helped to control the disease. A vaccine is also available which gives artificial immunity against typhoid.

Shigellosis

It is an infectious disease of digestive tract. The bacterium is transmitted through the contaminated food and water. House flies play an important role in the spread of these bacteria.

The main symptoms are vomiting and diarrhea. It causes dehydration and loss of salts from the body. Severe attack may cause the death of the patient. The attack of the disease can be avoided by the vaccine. In case of attack, the use of ORS (oral rehydration salt) and antidiarrheal drugs is most important.

Viruses

They are ultra microscopic organisms and much smaller than bacteria. They are measured in millimicrons ($1 \text{ millimicron} = 1/1000 \text{ micron}$) and can not be seen under compound microscope. They can be seen under electron microscope only.

They are not composed of cell but their body has outer coat of proteins and inner part of nucleic acid, i.e. DNA or RNA. Ordinarily they are found in the form of crystals. They become active and reproduce inside a living cell only. Some biologists do not consider them even living organisms because of their crystalline nature. They are of various shapes and sizes.

Viral Diseases

Several harmful diseases are caused by viruses; some of them are mentioned below:



Small Pox

It is a fatal disease but fortunately it has now been eliminated from the world including Pakistan.

During this disease, small boils appear on the whole body of the patient and each boil is filled with pus cells.

The patient must be isolated from rest of the family members. The only remedy or control is the use of vaccine. The vaccine against small pox was the first to be discovered.

Polio

This is a disease of the infants in which the lower limbs are damaged making them disable. Main symptoms are fever, headache and stiffness in the neck. Under severe attack the legs are paralyzed.

The polio virus spreads through air and water and the infants below the age of five are the victims. The only treatment is the use of polio vaccine at regular intervals up to the age of five years. Its vaccine is available in the form of oral drops.

A campaign has been lodged by the government of Pakistan with the collaboration of UNICEF to vaccinate as many infants as possible against polio.

It is a common disease of the humans. It is not a dangerous disease. It is caused by the influenza virus. The virus spreads through the air and by the sneezing of the influenza patient.

The symptoms are mild fever, redness of the eyes, irritation in the nasals and flow of nose. The disease automatically diminishes after 4-5 days. Complete rest and use of drugs reduce the intensity of the attack.

Measles

It is also a common disease of infants. The patient suffers from cough and fever but afterwards small boils appear on the body i.e. face and chest. These boils are light gray in colour with red circles around them. The disease gradually diminishes within 10 days. After the disease is over the patient becomes immune to this disease for the rest of his life. The infants are now immunized by the use of vaccines which has greatly reduced the rate of occurrence of this disease.

AIDS

This is a fatal viral disease which has threatened the mankind. AIDS stands for Acquired Immunity Deficiency Syndrome.

It is caused by a virus called HIV (Human Immunodeficient Virus). This virus kills/destroys the white blood cells of the patient with the result the immune system of the patient is destroyed. The patient becomes the victim of various other diseases such as T.B, Pneumonia, Typhoid etc. because of the loss of natural resistance. This multiple attack proves fatal.

The disease spreads mostly through the blood transfusion, contaminated syringes and direct contact with the patient. A vaccine against this disease is in the experimental stage.



It is a disease of liver caused by a virus. It is mainly of 3 types, i.e. Hepatitis A, Hepatitis B and Hepatitis C. The virus invades the liver cells and destroys them at a very fast rate.

If the immune system of the patient becomes active, the disease can be controlled otherwise it proves fatal. It is characterized by Jaundice, abdominal pain, liver enlargement, fatigue, loss of appetite and sometimes fever.

The disease is spread through blood, saliva and mothers milk. Hepatitis A can also spread through the contact of faces from the infected person. Vaccines are now available for Hepatitis A and B and not for C.

Some other important diseases

There are several other important diseases which are not caused by bacteria or viruses, but some other organisms. Some of them are as under.

	Disease	Causative organism
I.	Cancer	Not clearly known
ii.	Malaria	Plasmodium (a unicellular organism)
iii.	Ring worm	A fungus
iv.	Ascariasis	Intestinal worm (Ascaris)
v.	Thread worm	Intestinal worm (Enterobios)

It is a strange disease that can trap persons of any age group. Cancer is the uncontrolled growth of cells which form a cyst or a tumor. These cancerous cells may stay at one place of the body or they may spread in the whole body through the blood and may cause tumors in other parts of the body. If the cancerous cells are restricted to one particular area of the body, they can be removed with the help of surgery and if these cells spread in the whole body, it becomes dangerous and causes the death of the patient. Cancer can occur in any part of the body but lungs, mouth, skin, intestine and breasts are the common targets.

Cancer can be caused by many factors that may be physical, chemical or biological. Any factor that can stimulate the unwanted growth in the cells can cause cancer, e.g.

- Sunrays may cause skin cancer.



- ii. Certain drugs may cause cancer.
- iii. Viruses have also been found to cause cancer.
- iv. Smoking can cause the cancer of mouth and lungs.
- v. Certain chemicals have been found to cause cancer.
- vi. Tin packed food materials are also considered to cause cancer.

Symptoms of Cancer

Following symptoms can help to identify the disease.

- (i) A persistent open wound
- (ii) A cyst or tumor under the skin
- (iii) Constant headache with vomiting
- (iv) Prolonged indigestion with the loss of weight
- (v) Persistent cough and swelling in the throat.

We should confirm the disease with the help of clinical tests which include blood test, biopsy analysis and sonography.

Treatment of Cancer

With the passage of time the treatment of this disease is possible but quite difficult. It can be treated at its early stage but later it becomes rather impossible. Much work is being done, all over the world, to cure the disease. At present there are three methods to control/cure the disease.

- i) **Chemotherapy:** Several medicines have been devised and discovered to treat the cancer.
- ii) **Surgery:** A tumor can be removed, with the help of surgery, at its early stage.
- iii) **Radio Therapy:** Special radiations are used to kill the cancerous cells or tumors.

Symptoms of Malaria

It is common disease of the third world i.e. Asia and Africa where the living conditions are not up to the mark.

The disease is caused by a unicellular microorganism called Plasmodium. It belongs to the animal kingdom and phylum Protozoa. It is transmitted through the mosquito called Anopheles. The female mosquito carries the germs in its saliva and when bites a person to suck the blood, some saliva is left at the wound. The plasmodia (plural of plasmodium) in the saliva enter the human body through the cut surface. Once in the blood stream it enters the red blood cells and destroys them at a very fast rate.

If the drug (quinine) is not administered, the patient becomes weak and pale in a few days. The disease can be controlled by following precautions.

- i. Remove standing water ponds or ditches or fill them completely, removing the breeding places of mosquitoes.
- ii. Regular spraying of DDT in the houses and drains to kill the mosquitoes.
- iii. Taking anti malarial drugs immediately in case of attack. Now a days very safe and effective drugs are available in the market.
- iv. Getting the houses screened.

It is a skin disease caused by a fungus. The fungal hyphae penetrate into the skin, generally in the legs and form ring like structures on the skin. It causes itching and uncomfot to the body. The disease can be avoided by

- i. Keeping your environments clean.
- ii. Don't move bare footed in the fields.
- iii. Have regular bath.

The disease is cureable by the use of proper anti-fungal skin creams and ointments.

Ascariasis is a universal disease of human intestine found in dirty and unhygienic areas. It is more common in children under the age of 8 years. It is caused by a round worm called *Ascaris lumbricoides* and therefore the disease is called Ascariasis. The worm is long and cylindrical with pointed ends.

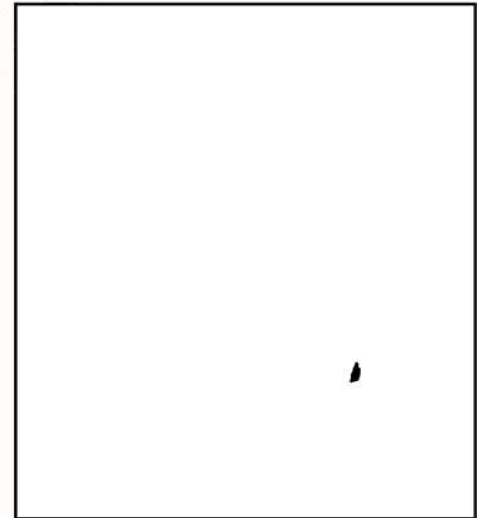


Figure 5.1: A Roundworm

The infection is caused by the ingestion of small eggs along with the food, water or dirty and dusty hands. The children with this disease become weak and pale. They also undergo the shortage of vitamin A which may be a problem for the eyes and affect the vision.

These worms keep on moving in the body from one part to the other and may cause Jaundice, Pneumonia and Appendicitis. Following precautions can save our children from this disease.

- i. To wash the hands before every meal.
- ii. To use boiled water for drinking purpose.
- iii. Proper disposal of the faeces and sewage.
- iv. Overall cleanliness in the house and surrounding areas.

In case of attack of the disease the patient may be taken to the doctor.

THREAD WORM

Thread worm causes disease mostly in children.

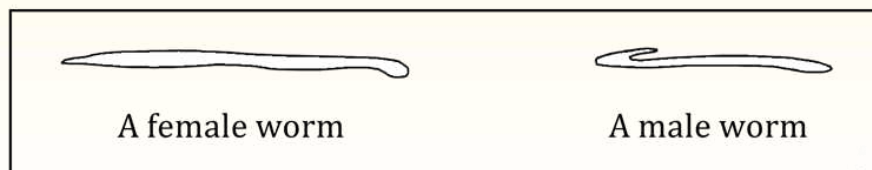


Figure 5.2: Enterobios vermicularis

The thread worm lays eggs around the anus, the last part of alimentary canal where the female thread worm is resting. This condition causes itching and the patient can not live without scratching the affected area. The eggs get attached to the fingers of the infected child and may cause re-infection in the child. The best indication is the scratching habit of a child in the anal part of the body. Following precautions may help to reduce the occurrence of disease.

- i. To wash the hands before every meal.
- ii. Immediate treatment of the infected child.
- iii. The bed and clothes of the infected child be washed with antiseptic drugs.
- iv. Nails be trimmed properly.
- v. Faeces and sewage be disposed off properly.

The germs or disease producing microorganisms are spread in various ways. The main agencies involved in the spreading of germs are

- | | |
|-----------------------------|-------------------------|
| i. Air | v. Faeces |
| ii. Water | vi. Animals |
| iii. Food | vii. Cuts and wounds |
| iv. Touch or direct contact | viii. Blood transfusion |

Most of the germs are present in the form of spores in the air. They can enter the human body during breathing or through the mouth. Air is a very good medium for the dispersal of germs. The dust in the air contains a large number of spores of germs. T.B is mainly caused by the germs that travel through the air. Fresh and dust free air is essential for good health.

Water is also a good source for the spread of germs. Germs can easily live and grow in water. The germs of cholera and diarrhea may spread through the water. It is advisable that the drinking water may be boiled. In villages, where hand pumps and proper water supply is not available, water must be boiled for drinking purpose.

Food

Rotten fruits, vegetables and spoilt and contaminated food are a source of spreading of germs. Never keep your edibles uncovered. Such spoilt food is toxic or poisonous and cause great trouble in the alimentary canal.

Water, Air and Touch

Several diseases spread due to direct contact with the patient e.g. AIDS, T.B and plague. The direct contact with such patients should be avoided.

Faeces

Many germs spread through the faeces of the patient. If the faeces are not properly disposed off, they after getting dry, spread in the air and transmitted to other healthy persons. The faeces should be buried properly in the soil.

Pet Animals

The pet animals and cattle are also the source of germs. Various germs get attached to the animal's body and reach you. The pet animals be given regular bath with anti-septics. The cattle should also be washed regularly to avoid such contamination.

Cuts and Wounds

Cuts or wounds should never be left open. They are the gates of germs. Every cut or wound should immediately be washed with some antiseptic material and covered properly with bandage.

Blood Transfusion and AIDS

The germs of AIDS and Hepatitis are transferred through the blood. The blood must be checked for its germs from some recognized laboratory before transfusion, when needed.

5.3 PROTECTION FROM GERMS AND DISEASES

Microorganisms or germs are present all around us in the air, water and soil. We can save ourselves from these germs by observing following precautions.

Sterilization

Most of the germs are killed by boiling water. Our surgical instruments must be sterilized otherwise



there is a chance of infection. We must use disposable syringes. Unboiled milk should not be used at all as it contains the germs of several diseases. The milk must be boiled before use

Pet Animals

Animals carry the germs of various diseases. Such animals must be washed regularly. Animals carrying diseases must be killed and buried in the soil. Now a days the pet animals are also vaccinated for various diseases so that they become immune to various diseases.

Isolation

The patients suffering from infectious diseases should be isolated from rest of the family members. Their clothes and utensils should also be isolated. It will help to save the life and health of rest of the family members.

Cleanliness

A very effective and simple way to have a healthy life is to keep yourself clean. Have bath regularly, wash your hands before every meal, clean your teeth regularly and above all keep your surrounding clean. Germs always grow on the dirty places.

Water Supply

Water is one of the major source for the spreading of germs. If the drinking water is boiled, all of its germs are killed and it becomes suitable for drinking.

Proper Disposal of Sewage

Proper disposal of sewage is essential to keep the area clean. If not properly disposed of, it mixes with our drinking water and food, which is very dangerous for our health.

Vaccines and Antibiotics

Proper use of vaccines especially at the infant stage make the bodies immune against many fatal diseases.

Antibiotics

It is a type of medicine that kills or stops the growth of the germs. Antibiotics have saved the man from various fatal diseases. The use of antibiotics should be under the medical advice.

5.4 SMOKING: A BAD HABIT

Smoking is injurious to health. It has now been realized all over the world that smoking causes several fatal diseases and must be discouraged at all levels. During smoking we inhale toxic gases in our lungs which then diffuse into the blood and taken to all parts of the body. Smoking can cause following fatal diseases.

Respiratory Diseases

The diseases of the throat, wind pipe and lungs are called respiratory diseases which are caused by smoke & smoking. It may cause the cancer of lungs.

Heart Diseases

The rate of occurrence of heart attack and other cardiac disorders is much more in people with the habit of smoking.

Cancer, blood pressure and skin diseases are also caused by smoke and smoking.

It is a condition in which the behaviour of a person is considered abnormal as it deviates from the general norm of the society. Such persons are called mentally ill or abnormal. Mental illness is basically of two types.

- i. Neuroses
- ii. Psychoses

Neuroses

It is a mild disorder in which the person is not functionless in the society. The patient never loses sense of responsibility in his environments. His behaviour is not injurious to himself or society. Simple psychotherapy can cure the patient and he does not need hospitalization.

Psychosis

It is a severe disorder in which the patient becomes functionless to some extent in the society. The patient loses his sense of responsibility. His behaviour may become injurious for himself or the society. Such patients must be hospitalized for the use of drugs or shocks. There are several factors for such mental disorders, only a few are mentioned here.

i) Biological factors

Such as secretions of certain hormones or neurotransmitters.

ii) Inherited factors

They are due to a change in the gene or part of the chromosome.

iii) Social factors

Economic stresses and social stresses. It also includes depersonalization.

iv) Physiological factors

Prolonged illness, some medical disorder, Toxic and drugs can affect the brain. Brain injury may also cause mental illness.

5.6 DRUG AND DRUG ABUSE

Every drug has its effects on the person's mind, body, life and those around him. It is important for us to know what a drug is, what are its uses, how are they used and when the same drug becomes harmful to the person using it.

A drug can be defined as “any substance which, when taken in the body, changes the functioning of the body. It is a substance that can lead to addiction, if a drug is used to get relief. It is the proper “use” of the drug, and when the same drug becomes part of our daily routine and one becomes uncomfortable without using it, it becomes the “abuses” of the same drug. It can be understood by the following example.

To relieve the severe pain, a doctor will give us an injection of Morphine. Morphine is manufactured from OPIUM. If this injections is used during normal days just to get a state of extra comfort, a stage will come when we will be addicted to the drug and a state of discomfort will have to be faced without using it. This is what we call “addiction” or abuse of drug.

Addiction is a condition in which a person desires or need to continue taking the drug and to obtain it by any means. It is actually a dependence on the drug. This condition is dangerous for the person, his family and the society. The most common drugs are Heroin, Bhang and Hashish. The injections of Morphine and Pethidine are also used by a particular segment of the society. Alcohol is also a common drug used by a large number of people.

Heroin

White or brown powder with a bitter taste. It is diluted by adding powder milk, sugar, sleeping pills and such other substances. It can be smoked or injected.

The main effects on the body are

- i. Breathing and heart rate slows down.
- ii. Blood pressure becomes low.
- iii. Eye pupils become small.
- iv. The person goes to sleep.
- v. Health gradually declines.
- vi. Ultimately one may die.

Charas/Cannabis/Hashish

These are the forms of hemp or Bhang plant (*Cannabis sativa*) commonly found as a wild plant

on the waste lands. Charas includes the green leaves of the plant and Hashish (Marijuana) includes the flower tops of the plant. Hashish also comes from the plant juice. Different forms of this drug are used through smoke or in the form of a drink.

The effects on the body are

- i) It reduces the body coordination.
- ii) It reduces the ability to make decisions.
- iii) One becomes dizzy, hungry and sleepy.
- iv) Eyes become red and the throat becomes dry.
- v) Above all one becomes a useless member of the society and loses interest in all social activities.
- vi) There is a risk of damage to the mouth, throat and lungs.
- vii) It may cause loss of fertility.

It is produced by fermentation of fruits, vegetables or grains. It is present in some tonics and cough syrups. The common effects are

- i) It causes drowsiness and dizziness.
- ii) It causes staggering and loss of balanced movements and concentrations.
- iii) A continuous consumption may cause headache, nausea vomiting.
- iv) It may damage the liver or brain.
- v) It leads to heart diseases and cancer.

The term is applied to all such compounds that produced insensibility to external stimuli as well as internal pains and unrests. They may be obtained from opium or Charas or Bhang. It is the official and moral duty of the state as well as members of the society to check this drug movement. The Government of Pakistan has established a comprehensive organization called ANF (Antinarcotics Force) which has its offices all over the country.



EXERCISE

1. Complete the following statements

- i) One meter is equal to _____ millimeters.
- ii) The tetanus causing bacteria are found on _____.
- iii) A virus can be seen under an _____ microscope.
- iv) Measles is a _____ disease.
- v) Malaria is caused by a unicellular organism called _____.

2. Tick (✓) or cross (✗) the following statements

- | | |
|---|------------|
| i) Most of the germs are killed in the boiling water. | True/False |
| ii) Measles is common diseases of old people. | True/False |
| iii) ATS is administered against cholera. | True/False |
| iv) Polio virus can also cause disease to adults. | True/False |
| v) Smoking can cause the cancer of mouth and lungs. | True/False |

3. Write the correct answer in the space provided

- ii) All the following diseases are caused by Bacteria except:
(a) Whooping Cough (b) Tetanus (c) Diphtheria (d) Hepatitis
- ii) Ring worm is caused by:
(a) Bacteria (b) Virus (c) Amoeba (d) Fungus
- iii) It is a type of medicine that can killed the germs:
(a) Antigen (b) Anti body (c) Anti biotics (d) Anti coagulant
- iv) Which is following is the disease of digestive tract
(a) Cholera (b) Tetanus (c) Small pox (d) Diphtheria
- v) All the following methods are used to cure cancer except:
(a) Chemo therapy (b) Surgery (c) Radio Therapy (d) Hydro therapy

4. Explain the useful activities of bacteria.

5. Write note on diphtheria, tetanus and measles.

6. Write a comprehensive note on cancer, its symptoms and treatments.

7. How can we protect ourselves from germs?



ENVIRONMENT AND NATURAL RESOURCES

OBJECTIVES

After completing this chapter you will be able to:

- ⊙ Know the atmosphere and different layers of atmosphere.
- ⊙ Know about ozone and its importance.
- ⊙ Know about green house effect and its importance in the climate.
- ⊙ Know about the different forms of radiations coming from sun and their absorption.
- ⊙ Know about the effect of human activities on climate.
- ⊙ Know about the different forms of pollution and their effect on daily life.
- ⊙ Know about the fossil fuels and their uses.
- ⊙ Know about the mineral and natural resources of Pakistan and methods to conserve them.
- ⊙ Differentiate between the different crops of Pakistan and mechanization of agriculture.
- ⊙ Know about the importance of wild life and conservation of endangered species.
- ⊙ Know about the effects of rising population on environment poverty and quality of life.

Environment has become very important topic in the world. In this chapter, we will learn about the atmosphere and how it is being polluted by human activities. Natural and mineral resources of Pakistan will be discussed. Production trends of main crops and mechanisation of agriculture sector will be mentioned. Importance of wildlife and how they can be conserved will also be discussed. Population and its effects on environment and quality of life will also be touched upon.

6.1: ATMOSPHERE

Our earth is surrounded by an envelope of gases, which is called earth's atmosphere. The envelope of gases extends upwards. It can be stated that just as certain sea creatures live at the bottom of the oceans, humans live at the bottom of atmospheric sea of gases.

Composition of Atmosphere

Atmosphere consists of many gases. Air consist of 78% nitrogen and 21% oxygen which form 99% of the volume of air near earth. The other gases are argon (0.9%) and carbon dioxide 0.03%.

In addition to these gases there are suspended liquid droplets and solid particles in the air.

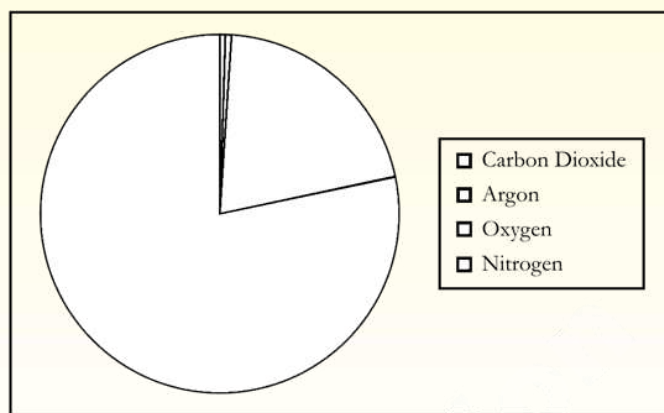


Figure 6.1: Percentage of different gases in the atmosphere

Atmosphere is divided into different layers.

Troposphere

It extends from surface of earth up to around 12 kilo metre. It consists of about 80% of the mass of atmosphere. It contains all the clouds and water vapours. All our weather exists in this region. Weather is the atmospheric conditions of a particular area. Variations of atmospheric conditions near earth's surface indicates the change of weather.

Stratosphere

It lies above the troposphere and extends up to 50 km. 99.9% of the mass of atmosphere exist in troposphere and stratosphere.

It extends up to 80 km.

Thermosphere

It is a region that extends up to 500 km. The sun's rays heat up this region. Temperature rises from 500°C to 2000°C. Rise in temperature depends upon solar activity.

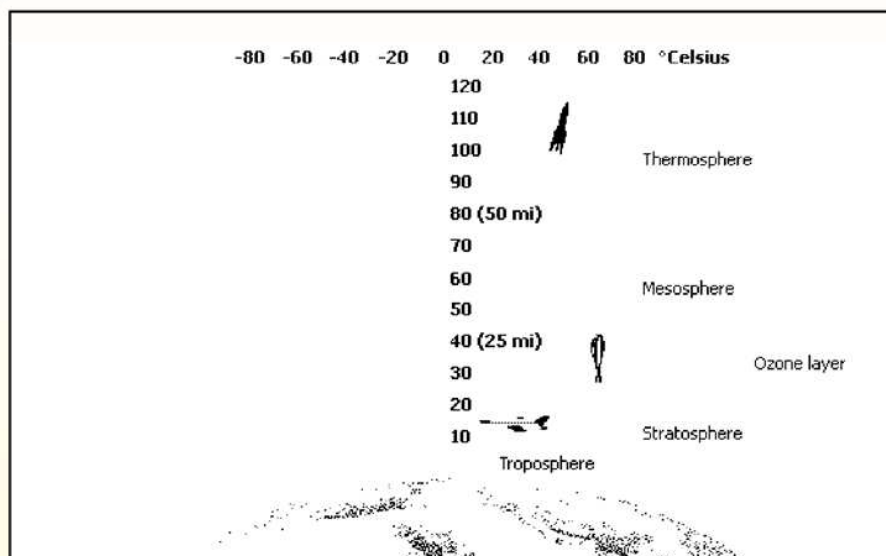


Figure 6.2 : Showing the height of various layers of Atmosphere

6.3: OZONE

Ozone layer exists about 30 km above the earth. Ozone has pungent smell. The ozone layer acts as an umbrella. It shields and protects life on earth against harmful ultraviolet radiations. It absorbs some radiations. Ultraviolet radiations burn skins, damage vegetables and many other materials like rubber and textile.

Depletion of Ozone

Chlorofluorocarbons compounds were considered responsible for the depletion of ozone. CFCs are used in spray cans, refrigerators and air conditioners. They release out in atmosphere due to leakage, and go up in the atmosphere where they destroy the ozone layer.

Effect

Depletion of ozone will cause increase in skin cancer cases. Crops and climate will be affected. Sea level will rise about 1 to 4 metre. Global warming and melting of polar ice caps will take place.

Importance of Ozone Layer

Ozone is beneficial for us. Protection of ozone is necessary otherwise ultraviolet radiation would cause a great damage on earth.

Earth has suitable temperature for living things to survive. This temperature is kept controlled and favourable by the atmospheric gases like carbon dioxide, water vapours, and ozone. These gases behave like a glass or plastic of a greenhouse. These gases allow more energetic sunlight to pass through it and prevent a part of less energetic radiated heat radiations to escape back into space. This phenomenon helps to maintain the temperature of the earth and warm it. This warming effect of atmospheric gases is called green house effect.

Greenhouse effect has many advantages. It maintains the temperature of the earth favourable. Otherwise days would have been very hot and nights very cold.

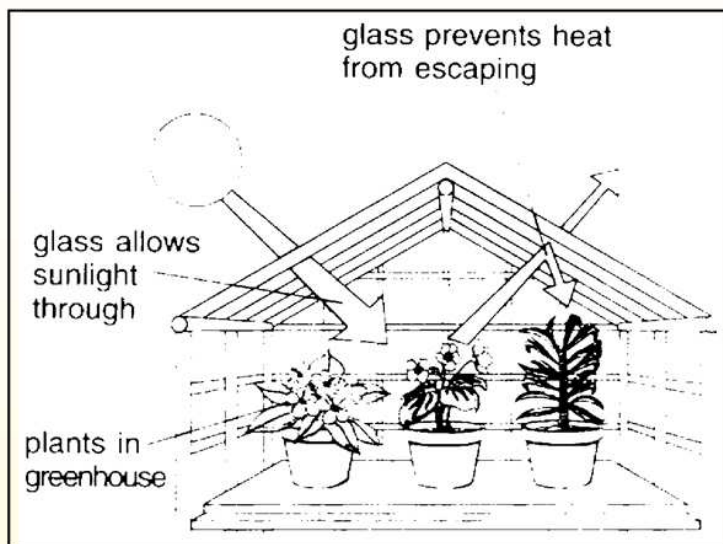


Figure 6.3: Green house effect

Sunlight warms the ^earth during the ^day and earth reradiate heat energy at night. If there had been no atmosphere, there had been no trapping of heat and temperature would fall down at night.

It is due to greenhouse effect that average temperature of earth is 15°C otherwise it would have been -20°C and earth would have been uninhabitable. But human activities are upsetting the balance of these gases in the atmosphere. The main gas of greenhouse is carbon dioxide. Humans, land and water animals, motor vehicles and industries are producing it at a faster rate than used by plants during photosynthesis. As a result, the percentage of carbon dioxide gas in the atmosphere is steadily increasing. This is raising the average temperature of the earth due to greenhouse effect. This phenomenon is called global warming.

The sun (a ball of hot gases whose surface temperature is about 5500°C) gives off energy as radiations. These are radio, infra red, visible, ultraviolet, X-rays and gamma rays. The part of these radiations is visible light which is commonly called sunlight.

When sun's radiations approach the earth, part of it is absorbed in the atmosphere and a part is reflected by atmosphere. The radiations which reach the earth are also reflected and absorbed by earth.

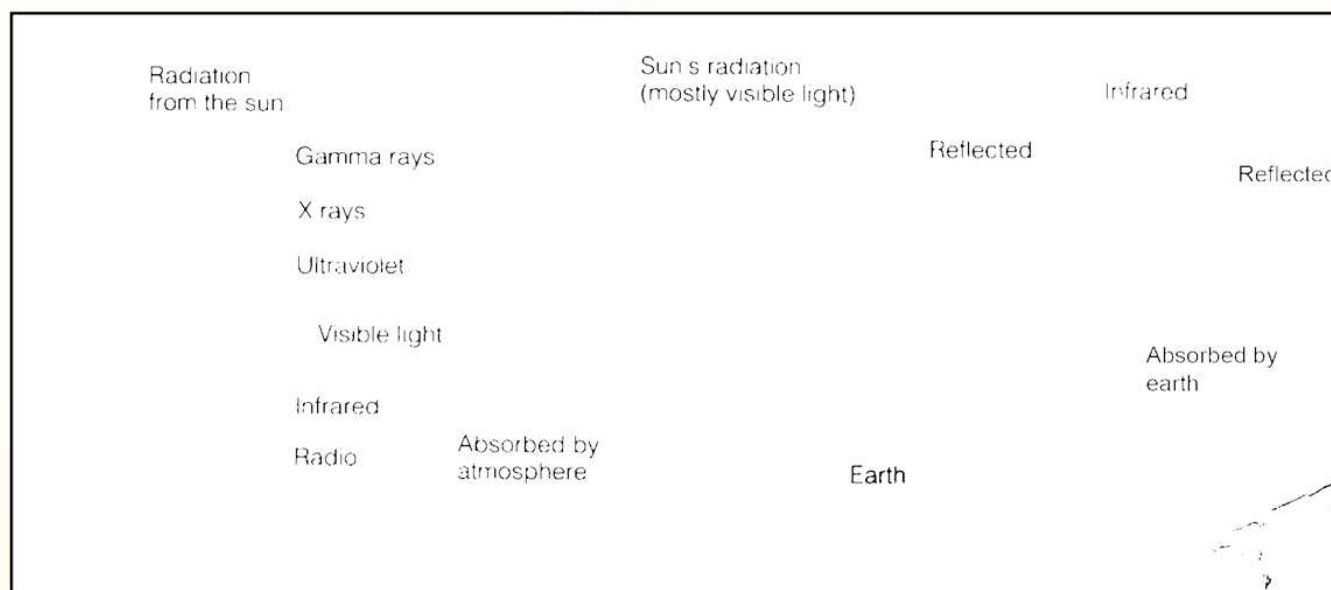


Figure 6.4: Absorption of energy radiation in the Atmosphere

- About one fifth of the energy is absorbed by the atmosphere. Ozone and oxygen molecules absorb almost all of the harmful ultraviolet radiations. It prevents harmful radiations to reach the earth, that save the life on earth.

- About one fourth of the sunlight is reflected by clouds. This reflection depends upon the density of clouds. Thicker the clouds, more is reflection and less light passes through.
- Less than half of the sun's energy coming to the earth actually reaches the surface. Most of the radiations reaching the surface are absorbed by the earth. The earth re-radiates a part of this absorbed energy.

The atmosphere and the earth together reflect about one-third of the sun's radiation back into space. It is due to the scattering of visible light by gas molecules and dust particles in the atmosphere due to which sky looks blue in colour.

Climate is the average weather conditions of a region over a longer period of time. Climate of a region remains almost the same for years. It may be warm, cold or dry. Nature preserves and keeps a balance between different factors that control climate of a region. But human activities are disturbing climate. The concentration of CO_2 in the atmosphere is increasing day by day. This is due to more and more combustion of fossil fuel by automobiles. It is expected that CO_2 level will rise to double from its present level in the coming years. It will increase the global temperature, which will cause melting of icebergs and glacier etc. Another important gas, sulphur dioxide is also being put into the atmosphere by human activities which affect ozone layer. The gas react with oxygen and water vapour in air to form tiny droplets of sulphuric acid. These droplets stay in atmosphere and fall on earth with the rain. It is called acid rain. It affects buildings and acidify soil, in which plants can't grow properly. When it reaches lakes, it becomes dangerous for the fishes and other aquatic life present there.

Human is also manufacturing refrigerators, air conditioners to facilitate his living. The CFCs gases are used in these machines for cooling. The CFCs rise to the atmosphere. They destroy the protective layer of ozone. As a result ozone layer is getting thinner. Ultraviolet rays from the sun are able to cross thin ozone layer and reach the earth. These rays affect life on earth. It also damage crops, plants and trees which form the basis of food chains that support life on earth.

6.3 POLLUTION

Pollution is a harmful or unpleasant change in the standard quality of environment. It may also be the addition of harmful or unpleasant material to the air, water or land. There are three types of pollution.

Air Pollution

Air is not always as clean as it should be. The cause of air pollution is combustion of fossil fuel by

automobiles and other machines and accumulation of waste gases in the atmosphere. The increase in the concentration of different gases in air causes serious problems.



Figure 6.5: Air pollution by vehicles and a Factory

Most common pollutants in air are

- i) Smoke and soot produced from burning of fossil fuel.
- ii) Gases such as carbon mono oxide, carbon dioxide, nitrogen oxides, sulphur dioxide and Lead particles are present in the combustion of fossil fuel.

Effects of Pollutants on the Human Body and Environment

Presence of pollutants in air causes headache, irritation of eyes, badly affect lungs and nervous system, create anxiety and tension. Therefore suitable measure should be taken to control the emission of polluted gases.

- i) It is necessary to purify the fuel from impurities before it is burnt.
- ii) Combustion of fuel should be complete and efficient. So that it should not form smoke, soot or carbon monoxide.
- iii) Concentration of carbon dioxide in atmosphere should be controlled. Either increase of automobiles be checked or there must be more and more plantation.

Water Pollution

Water is an excelled solvent. It dissolves many substances, like minerals and salts. It is called polluted water which contains substances which are harmful and injurious for living things including human beings. The major sources of water pollution are discussed below.

i. **Micro organism** Micro organism like virus and bacteria present in polluted water cause diseases like typhoid, cholera and dysentery. The source of pollution is mixing of sewage waste with clean water supplies.

ii. **Agricultural water pollution** The pesticides, fertilizers and animal wastes used in fields are poisonous to human beings and other living things. They accumulate in the environment and pollute water. It causes toxic to human beings and other animals.

Animal waste is another important source of water pollution. It is often thrown in water supplies like canals, rivers.

iii. **Industrial water pollution** Industries produce a lot of waste. This waste is often discharged or thrown into streams, canals, rivers or open fields. This waste contains compounds of mercury, cadmium, lead, Chromium, arsenic, copper and other metals. These metals along with water

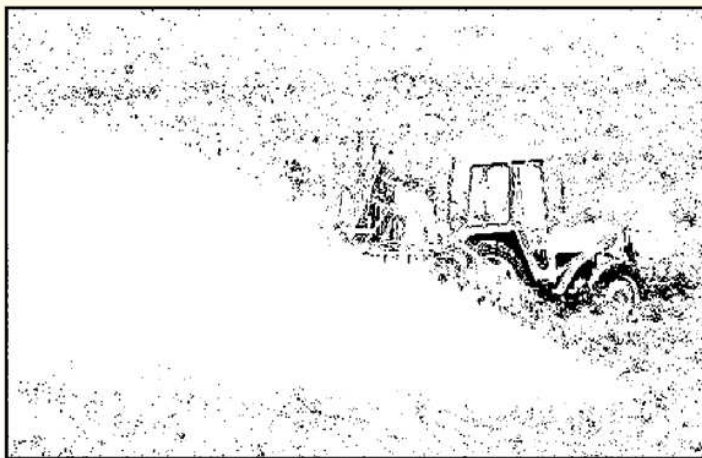


Figure 6.6: Pesticides is being sprayed



Figure 6.7: Industrial waste polluting the water

passes down and mix up with ground water and pollute it. This has created serious problem to industrial cities like Lahore, Faisalabad, Gujranwala, Kasur, Karachi and other parts of Pakistan.

iv. **Domestic water pollution** The two major sources of domestic water pollution are detergents and human organic waste. Detergents cause a rapid growth of algae in water. When this algae die and decay, it reduces the oxygen content of the water. Thus it affects the aquatic life of the lake. The human organic waste thrown or flushed in streams and rivers can be a source of water borne diseases such as cholera, typhoid and dysentery.

Methods to Reduce Water Pollution

- i) Drinking water supplies must be protected and safeguarded from contamination and pollution.

- ii) Unnecessary use of pesticide and fertilizers must be avoided.
- iii) Industrial waste should not be discharged in water supplies directly.

Land Pollution or Solid Waste

Solid waste term is applied to any useless material produced by human or animal activities. It includes

- i) Garbage or food waste. It is animal or plant residue
- ii) Rubbish is combustible and non combustible portion of solid waste, excluding food waste e.g. papers, tyres, tins, rags, car boards. Plastic items etc.

The disposal of solid waste is a serious problem in big cities which is the main source of pollution.

Waste Management and Disposal

- i) Disposal of solid waste must be carried out properly.
- ii) Plastic materials should be recycled to produce useful material again.
- iii) Polythene bags either should be banned or disposed off carefully.
- iv) Waste materials should collect and dispose off at proper places.

Effects of Pollution on Environment

Every type of pollution affects individuals and community in a number of ways. Its collective effect on climate also affects living things.

Air pollutants are main source of diseases. The effects of different gases are summarized in table 6.1

Table 6.1 showing air pollutants and their harmful effect

Air pollutant	Sources	Harmful Effects
Carbon dioxide	Industries and Vehicles' Exhaust	Breathing difficulties Greenhouse effect leading to global warming
Carbon monoxide	Cigarette smoke, Incomplete combustion of fuel and vehicles' exhaust	Headache, brain damage, death.
Sulphur dioxide	Power station, industries and vehicles' exhaust	Eye and nasal irritation, breathing difficulties, bronchitis, lung cancer, acid rain.
Oxides of nitrogen	Burning of coal and oil, industries and vehicles' exhaust	Coughs, headaches, lung diseases, acid rain, green house effect.
Lead Compounds	Vehicles' exhaust	Lead poisoning, sleepiness, brain damage, deforestation.
Chlorofluoro Carbons	Air conditioner and refrigerators, foams aerosol sprays	Thinning of ozone layer, green house effect
Ozone	Vehicles' exhaust	Respiratory disease, deforestation.

6.8: OCCURRENCE OF FOSSIL AND THEIR USES

Fossils are formed naturally over millions of years from the remains of buried plants and animals. Coal, petroleum and gas are commonly known fossil fuels. The process of formation is much slower than the rate of consumption. With the advent of industrial era, it was estimated that known oil reserves could be 90% depleted by the year 2020.

COAL

Coal is a black colour mineral. It is found in different depths under the surface of earth. It exists in solid form. Coal began to form millions of years ago, dead and decaying plants buried under the earth crust formed a soft and brownish material called peat, with the passage of time sediments buried the peat and under the influence of pressure and heat it first changed into a soft coal called lignite. Lignite is brown colour low quality coal and is used to prepare fire bricks. Then with continued pressure and heat lignite is changed into bituminous coal. Bituminous coal is harder and brownish black in colour. Mostly it is used to produce coke and coal tar. It is also used in power generating stations to produce thermal electricity. Bituminous under more pressure turned into a hard and black form called anthracite. Anthracite consist of highest percentage of carbon. It is the top quality coal and is used for domestic needs. It is efficient in burring

PETROLEUM

It is a mixture of gaseous, liquid and solid hydrocarbons. It is brownish to greenish black in colour. The petroleum mineral today began to form millions of years ago. Remains of dead plants and animals sank to the bottom of the sea and were buried deeper and deeper under mud and sand. The influence of heat and high pressure slowly changed them into a thick black liquid called crude oil. Crude oil can't be used unless refined. Therefore crude oil is heated up to about 400oC in an electric furnace to form different fractions. These fractions are collected separately. This process is called fractional distillation. The principal products formed during this process are follows.

- i. **Refinery Gases:** Used for domestic and industrial purposes.
- ii. **Petrol:** Used for light vehicles fuel such as cars, motorcycle
- iii. **Kerosene Oil:** Used for domestic purposes and air crafts fuel.
- iv. **Diesel Oil:** Used for heavy vehicles fuel such as Buses, Truck.
- v. **Waxes:** Used as lubricants and candle making.
- vi. **Residue:** Used for carpeting roads etc.

6.11: NATURAL GAS

It is mixture of gaseous hydro carbons. It consists of chiefly methane along with ethane, propane and butane. In addition to these gases, it contains impurities of toxic compounds such a compounds of sulphur and nitrogen. These toxic impurities are removed before gas is supplied to consumers. It is usually found along with coal and petroleum deposits. Sometimes it seeps out of the oil and coal to form a gas cap.

But it may be present as a separate gas field, such as at Sui in Baluchistan. It has advantages over the other fuel being cheap clean, smokeless and handy. Natural gas is used as a source of energy and chemical products. It is used heating and cooking purposes both at domestic and commercial level. Its use in industries as fuel to produce heat needed in various industrial plants and to run thermal power plants. It is also used as an ingredient in manufacturing fertilizers.

Mineral is a naturally occurring element or compound in soil or rocks. For example silver, Gold, chromite, gypsum etc. Minerals are useful substances and they can be extracted from earth. Pakistan has valuable resources of minerals. But extraction process is slow more than 370 minerals have been discovered up till now. A few very important are natural and mineral resources are discussed here.

Pakistan has large deposits of nearly 500 million tones of coal deposits. The coal fond in pakistan is not of good quality. It has large quantity of moisture and low percentage of carbon in it. It is mostly used in brick kilns. It is also used in thermal power stations to produce electricity.

In Baluchistan the deposits of coal are found at Sharg, Khost, Harran, Bolan, Mulch, Degar, Sour. In Sindh, it is found at Lakhra, Thamphir and Thar etc. In Punjab, it is found at kalabagh, Makarwal, calakhe, warcha, dandot.

Petroleum is a chief source of energy. Pakistan has large deposits of it, but still we are not self sufficient in the production of petroleum. Only 30% needs of the country are met locally. Petroleum deposits are found in Khorr, Dholion, ChakNarrang, Tut KotSarang, Meyal, Dhormond, Dhudak, Balkasar, Joyanir, Karsal and AdhI. These sites lie near Rawalpindi. The crude oil from these sites is refined in Attock oil refinery situated in Rawalpindi.

In Sindh petroleum is found in Khaskhaeli, Badin, Tandoalam and Tandoadam. To refine imported crude oil, two refineries are working in Karachi. Pakistan is in search of petroleum reserves

with the help of foreign internal organizations. For this purpose oil and gas development organization has been working with the cooperation of foreign companies.

Natural Gas

Pakistan has large reserves of natural gas. It is the main source of energy. Nearly 35 percent needs of energy are met by natural gas. The largest deposits are found at Sui (Baluchistan). Other deposits are found in Uch, Sari, ChakSarang, Dhudak, Dholion, Khairpur, KandKot, Pirkoh and Mial.

Chromite

It is a brown or dark black mineral. Pakistan has largest deposits of chromite in the world and it is exported. It is found in Muslim Bagh, Chagha Kharan, Pashin, Khanazai, Waziristan, Malakand.

This ore is used to make special type of steel. Chromium metal is extracted from this ore. Chromium metal is a precious metal. It has wide application for it's white and shining luster, resistance to rusting and corrosion. It is used to make a protective layer for door knobs, car parts and other items of iron. Compounds of chromium like alums are used in photography, paints and tanneries. It is also used to make alloys like Nichrome.

Gypsum

Gypsum is a soft, shining white or yellowish mineral. It is found in Dhundot, Mianwali, DeraGhaziKhan, Quetta, Sibbi, Kohat, Daudkhel, Chakwal, Dadu and Sanghar. It is used for the manufacturing of cement, glass, plaster of paris. Gypsum is applied to control salinity in the water logged areas.

Quartz

It is a mineral of mostly inorganic compound of aluminum, beryllium and silicon. This mineral is famous for it's shine and beauty. It resist to scratches wear and tear. It has extraordinary property of reflection of light, which gives it shine and brilliance. This property is further enhanced by stylish cutting and polishing. It is used in jewellery. It is found in Swat, Chitral, Kaghan and Hunza Valleies.

Mica

A group of minerals of aluminum, potassium and silicon compounds are called mica. It is found in Hazara, Swat and Chitral areas.

It has unique property of non conductor of electricity. It can be easily split into very thin sheets. Due to these properties it is used as insulator in electronic and electrical devices such as transistor, dynamos, fans, heaters and irons.

Iron

It is a blackish brown mineral. The development of a country depends upon this mineral. The largest deposits of iron are found in Kala bagh. Other deperots lies in Chitral, Khuzdar, Muslim Bagh, Nakhuandi. It only covers 16% needs of the country therefore it is imported. Pakistan has largest steel mills in Karachi. It is used to make steel and a number of other alloys.

Salt

Pakistan has largest deposits of salt in Khewra (Jhelum). It is considered the biggest source of salt in world. In addition it is also found in Warcha, KalaBagh, Bhadar Khel.

It is commonly used as table salt. It is also used to manufacture caustic soda, washing soda and Baking sod.

Copper

This metal is second in elements to iron. Pakistan has vast deposits of copper in Sandak and Chaghi in Baluchistan. The ore has other valuable metals with it like, silver, gold and molybdenum. These metals can also be recovered along with copper metal. Copper metal is highly conductor of electricity and heat. It is used to prepare electrical cables and wires and other telecommunication devices.

Conservation means using only according to requirement as efficiently as possible. A few methods of conservation are discussed here.

Resources that can not be replaced in nature are called non renewable resources, e.g. coal, oil and gas.

i) Efficient and careful use

Efficient and careful use of non-renewable resources like coal, gas and Petroleum is necessary. Non renewable resources can be conserved by getting maximum output by minimum input.

(ii) Construction of Building

A lot of natural gas is used for home heating in winter and electricity for cooling in summer. Buildings should be constructed with proper ventilation and layout so that these can be liveable without expending energy resources.

(iii) Use of renewable resources

We should not rely only on natural resources for energy requirements. Other resources such as solar energy, nuclear energy, hydel energy must be used in daily life.

(iv) Use of Modern Techniques

Petroleum resources of the world have been doubled by applying new techniques of cracking and reforming.

The resources which are replaceable in nature and never run out are called renewable resources. Such as sunlight, wind plants, crops and many minerals.

(i) Efficient and Careful Use

Efficient and careful use of renewable resources also plays a very important role in the conservation. They must be used, to get more and more benefits from them.

(ii) Recycling

Most of the mineral once used do not destroy. They can be recycled to form other items. For example iron metal can be reused for making low quality items. Iron scrap is collected and it is used over and over again. Steel in Pakistan is mostly made by re-melting the iron scrap.

(iii) Application of artificial materials

Most of minerals can be conserved by using plastics and polymers. For example plastic is used instead of iron in the manufacturing of house hold items like chair, table, baskets, dinner sets.

Pakistan is an agricultural country. Presently, agriculture contributes 25 percent to GDP, two third of total population of the country directly or indirectly depends on agriculture. 47 percent of labour force is employed in agriculture sector. About 60 percent of total export earnings come from agriculture based commodities. Agriculture is divided into following four sub sectors.

- i) Crops
- ii) Live stock
- iii) Fisheries
- iv) Forestry



Production Trends in Main Crops

Research organization introduced new fast growing and high yield varieties. The use of these new varieties by farmers has enhanced the over all production of country. For instance, traditional seeds of wheat could only yield four quintals of wheat per acre, while the new variety Maxi Pak has enhanced the yield to more than 30 quintiles. Similarly new varieties in other crops have also been tested. The crops grown in Pakistan are divided into two groups.

Kharif crops

The sowing season of these crops begins in April June and harvesting during October – December e.g. rice, sugar cane, cotton, maize, bajra, and jowar.

Rabi crops

The sowing season of these crops begins in October- December and harvesting in April- May e.g. wheat gram, tobacco, barely, mustard.

Wheat

It is the single largest grain crop of country. It provides the staple food to people. Every Pakistani use wheat product items daily. The annual production of wheat is more than 18 thousand million tons. It is grown all over the country but main areas are interior and Southern districts of the Punjab, and upper area of Sind.



Figure 6.10: Wheat Crops

Rice is an important food as well as commercial crop. Nearly two-third of the production is used locally while on an average one third of its production is exported to earn foreign exchange. It is grown in vast area and occupies about 10 percent of the total cropped area. The rice of Gujranwala division is famous for its taste and flavor.

It requires plenty of water for growth. The seed is sown in small area, to prepare sapling. When saplings, are about 1 feet, they are transferred to main field where enough water is available. Through out the crop growing period, water must be remained standing in the field. The best variety of rice is Basmati variety.

Cotton

Cotton is the important non-food crop. It is called silver fibre of Pakistan. It provides raw material for the local textile industry. Cotton crop is very sensitive to weather variation and attack of pests. Government has taken measure to control the pest's problem. A research institute has been established at Multan. It has discovered new varieties of cotton that have long and fine fibre with high yields. Southern Punjab and Sindh has the



Figure 6.11: Cotton Crops

favourable weather conditions for cotton.

Sugar Cane

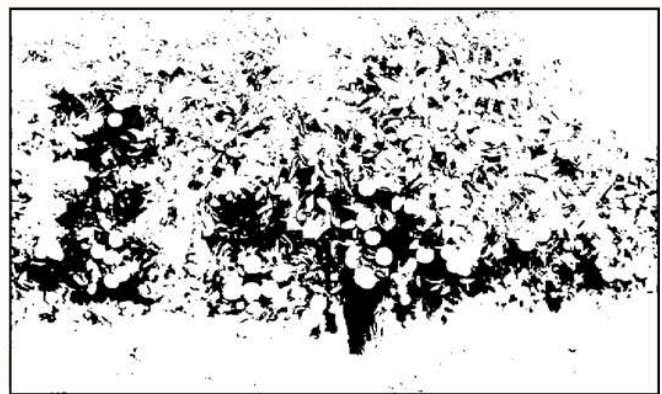
It is industrial crop of Pakistan. Bumper crop of sugar cane in recent years has made the country almost self sufficient in sugar. It covers about 5 percent of the total cropped area. It is grown in central Punjab, Sindh Mardan and Dera Ismail Khan (NWFP).

Fruits of Pakistan

Our country is famous for producing fresh and dry fruits. The most important fresh fruits are Apples, Mangoes, Bananas, Grapes, Guava, Oranges, Melon, Lemons, Dates, Raspberry. The dry fruits are Almonds, Walnut, Pine, Nuts and Peanuts, Coconut.



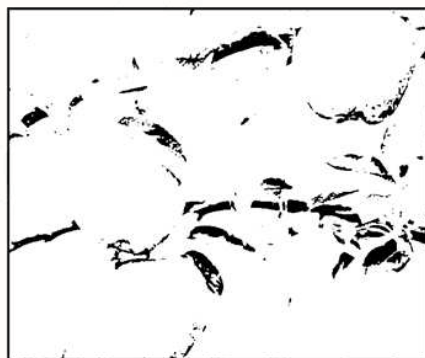
Mango



Oranges



Raspberry



Apples



Almonds

Figure 6.12: Different fruits of Pakistan

Mechanization

Mechanization means adoption of modern farming methods, in agriculture for increasing productivity. It includes the use of new techniques and implements, better quality seeds, fertilizer and plant protection etc.

Mechanization of agriculture sector is necessary for the enhancement of production and development of country. It is crucial for achieving self sufficiency in food production. It can increase productivity and decrease pre and post harvest losses. Our country is making efforts to modernize its

agriculture. It includes the following steps.

i) **Tractors and different implements.**

Farm-machinery concept is changing day by day. The old techniques are being discarded. Use of tractor and other different implements for ploughing and harvesting are commonly used by the farmers. To facilitate the farmers Agriculture Development Bank of Pakistan provides loans for the purchase of tractors and other allied implements.



Figure 6.13: A Tractor with implements.

ii) **Tube Wells**

Pakistan has a vast irrigation system. But due to shortage of rainfall there is acute problem of water for irrigation. To overcome this issue tube wells are commonly used in all over the Pakistan.

ii) **Plant protection**

It is an important factor for the enhancement of yield of the crops. It provides effective protection against the attack of pests and diseases. To help the farmers, government and private sector provide facilities such as pest scouting, advisory services, and aerial spray.

iii) **Agricultural Credit**

Agricultural credit means to provide financial resources to the farmers. It facilitates the former community to purchase basic inputs such as, seed fertilizer, pesticide and tractors etc. It plays a very important role in increasing the production of the very important role in increasing the production of the agriculture sector.

Dairy Farming and its Importance

Dairy farming is a sub sector of live stock sector of agriculture. It is keeping and caring of milk cattle. Milk cattle are buffaloes, cows, sheep and goats. The purpose of dairy farming is to produce and develop milk and milk products like cream, butter, yogurt, purified butter oil and ice cream.

Government has established different dairy forms. The most important are at Islamabad, Lahore, Faisalabad, Sargodha, Okara, Sheikhupura and Karachi etc.

The importance of dairy farming in rural economy may be realized from the fact that majority of population is engaged in live stock raising. Every family is having 2-3 cows/buffalo and 5-6 sheep/goat and is earning 30-40 percent of their income from it. The trend of dairy farming is developing in rural areas. Especially near the big cities, people have established dairy farms. They market milk in the cities and earn their livelihood. The most suitable regions for dairy farming are central and Southern Punjab and lower Sindh.

Dairy farms are the most important source of milk production in Pakistan. There has been a gradual increase in milk production in the country. Milk and its products are the essential items of human diet.

In recent years average production of milk has increased. The consumption was more than production, therefore dry milk powder had to be imported in early nineties. But with the help of Asian Development Bank, government launched a comprehensive live stock development project all over the country to increase milk production. It provided technical assistance and awakening to the people. Various organizations have been established. They collect milk from villages and then refrigerate it to prohibit the growth of bacteria. The items obtained from milk are called milk products. These include cream, butter, ghee, yogurt, cheese and ice cream.

Fishery plays an important role in Pakistan's economy. It is considered main economic activity on the central belt of Sindh and Baluchistan. Apart from marine fisheries, inland fishery is also practiced in rivers, lakes, dams and ponds. Fish farming is now very popular activity in rural areas. Fish is a very important source of white meat. It not only fulfils the needs of country, it is also exported to earn a substantial amount of foreign exchange. Fishery products are exported to Japan, USA, UK, Germany and Middle East countries.

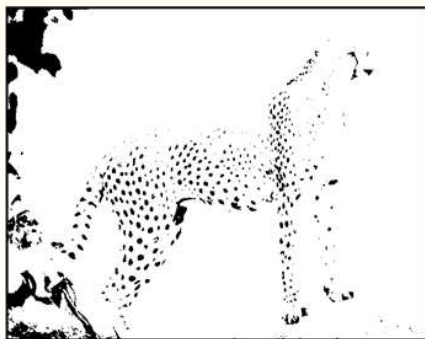
Measure has been taken in order to improve this sector such as the establishment of fisheries, training centre, fisheries harbour at Karachi and Peshawar. Hatchery complex for production of fish/shrimp seeds.

6.15: WILD LIFE

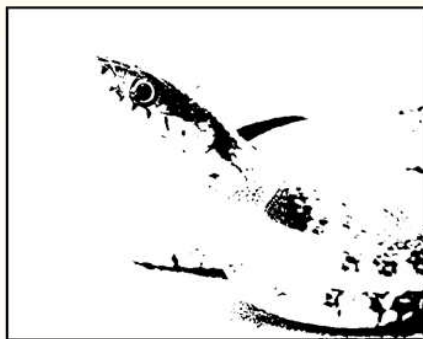
Wild life of an area consists of non domestic animals and uncultivated plants. Wild life in Pakistan is not same throughout. It varies from place to place due t different habitats in different parts of the country. Habitat of an area depends upon climate conditions of the area.

Wild Animals and Birds

Wild animals are different in different areas. In northern mountainous area there are long spiral horned white markhor, white gorial and urials. In the upper regions snow leopard, tigers are also found, which are often seen in winter season. In the hilly plains, many types of wild cats, rats, rabbits, reptiles, snakes, foxes and hyena are found. In southern parts, peacocks, hugh deer and gazelle are found.



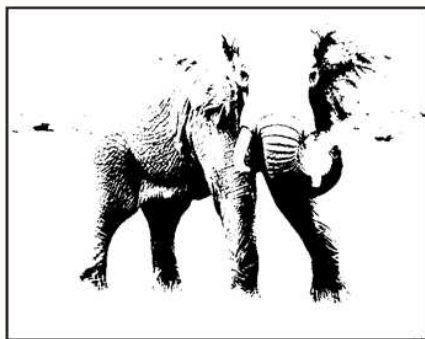
Cheetah



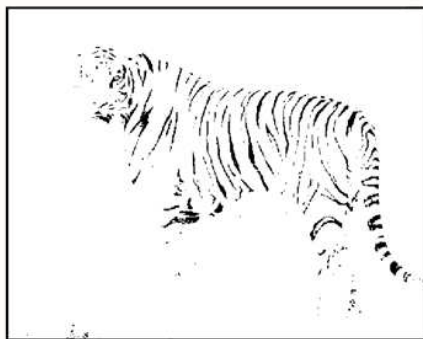
Snake



Hyena



Elephant



Tiger



Fox

Fig. 6.14: Wild Animals

A large variety of birds are also found. In upper regions black crow is available. In central regions crow, dove, a number of sparrows, pigeons are found. In winter season pelican, ibises, storks, cranes and duckling migrate from upper area to the central Punjab. The aquatic birds like ducks, ostriches, swans and storks are also found in central Punjab and southern areas.



Peacock



Pelican



Ibises

Fig. 6.15: Wild Birds

Endangered Species and Their Conservation

The development and progress of human activities has affected traditional feeding grounds and shelter places for wild animals and birds. Many local and migratory birds have become extinct. For instance, Hog deer, Musk deer, Snow Leopard, similarly black bird (Koel).

A few water fowl have also reduced. Whales and other sea animals are also disappearing. To protect the extinct species, government has established wild life department all over the country. The department takes care of the animals and birds. The shooting, hunting or trapping extinct species of animals and birds is legally banned. For safety and security, natural parks has been established in different parts of the country. These parks provide sanctuary and undisturbed breeding environment to a large number of endangered species.

Keerther National Park covers over 3,000 square miles and used to rear sindi goats and black birds Khunjrab National Park covering Khurjrab, Gojarab and Shamshal valley, provides shelter to marcopolo sheep, blue sheep, snow leopards and libices. Lal Suhrara Park, covering a vast area near Bahawalpur is meant for blue cows, black deer and muskdeer. It is famous for having aquatic land and plant environment. National Hazara Gangi Park in Baluchistan is famous for its favourable environment to wild life.

Pakistan has a vast coastal area about 700 km in length. The Arabian Sea is considered a warm water channel. It links up Pakistan through, marine trade routs with international sea parts. The Sea is valuable source of food, minerals, ornamental items, medicinal plants.

The sea along coastal areas are a great source of food. About 400 varieties including famous varieties like huron, tuna, sardine, shrimp and salmon are found in this area. The fish and fish products like cod-liver oil are used locally and a part is exported to earn foreign exchange. To improve the fisheries activities government is taking a number of measures, including establishment of training centre, hatchery complex. It is upgrading socio -economic conditions of the fishermen's community. A large number of sea plants and algae is also obtained from the sea.

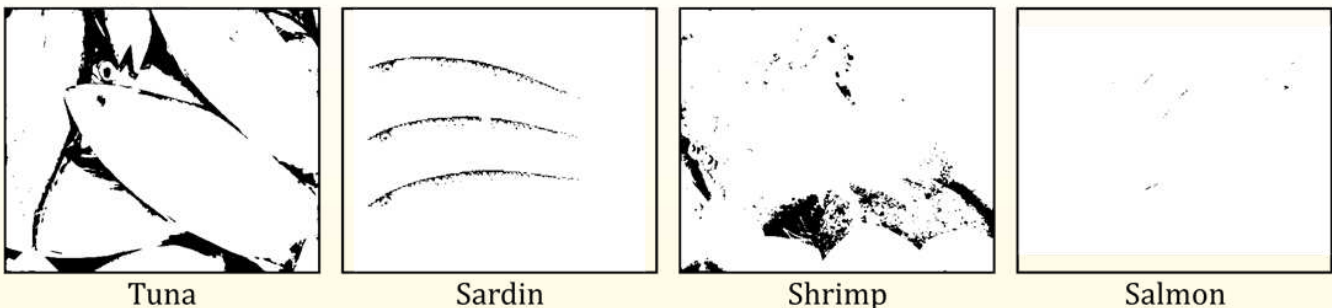


Fig. 6.16: Different fish present in sea water of pakistan

Sea Minerals

Sea water is a great source of minerals. It is evaporated to obtain table salt. It also consists of different other salts like magnesium sulphate, Potassium sulphate, sodium sulphate etc. These salts can easily be recovered from seawater. A very important metal magnesium is commercially obtained from sea water. Bromine and iodine are also obtained from seawater. It is estimated that one cubic km of sea water consist of twelve tons of mixture of salts.

Ornamental Items

Sea is also a source of ornamental items. Different types of corals, animals and plants are used by people for ornaments. Corals are famous for multi coloration. Multicoloured plants are used for interior decoration, skin of several sea animals are used for making female purses, coats, shawls, garments and other ornamental products.

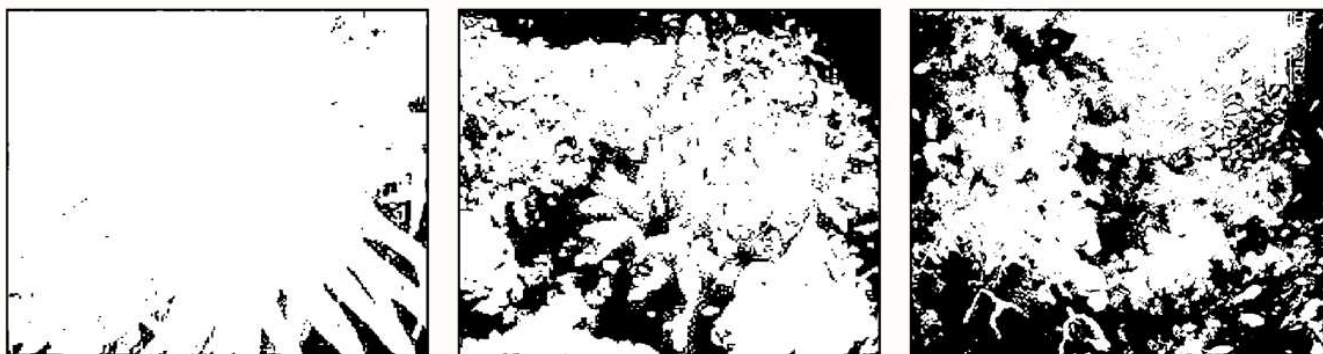


Fig. 6.17: Corals of various colours

Medicines

Plants and animals found in sea are used as medicines from a long time. The very dangerous diseases like cancer, AIDS are being cured by medicines derived from marine life.

6.18 POPULATION AND ENVIRONMENT

Pakistan is a populous country, its population is about 140 millions. Annual rate of population increase is 3 percent which is very high. Given this rate of growth population would be doubled in next twenty five years. The rising trend of population has created a lot of problems. Its effects on environment, poverty and quality of life will be discussed here.

6.18 EFFECTS OF RISING POPULATION ON ENVIRONMENT

Rising population has affected the environment badly. Man is polluting air, water, land, hence environment. It is disturbing our ecosystem.

Ecosystem

In eco-system, plants, animals and human beings exist together. They depend upon each other for their survival. Plants produce oxygen, foods and medicine and compounds, which are vital for

animals. Without oxygen, animals and human beings would die. Plants also provide shelter and hide to animals against their natural enemies. Dead plants are great source of fossil fuels.

On the other hand, animals give out carbon dioxide which is used by plants for photosynthesis. It is a process carried out by green plants to synthesize foods and fruits. Animal excreta are used as manure for plants. Dead animals decompose to provide basic nutrients in soil. In fact all living things live together like a community.

A vital balance is required for the survival of each member of the community in an ecosystem. Malfunctioning of any member of community can disturb the living of other members. For example, if there is over population, there will be shortage of foods, and ecosystem will be disturbed.

Deforestation means reduction in the forest areas. Pakistan has only 5% land covered with forests which is less than the required percentage, i.e. 15% and being reduced by human activities. They are being cut by people to meet the requirements and needs of rising population. But, there is no proper arrangement for the plantation of new forests. Deforestation is badly affecting environment. Some of its effects are discussed here.

- i) Forests are main source of earning for a country. Deforestation has proven a great national loss.
- ii) Deforestation has badly affected the climate due to which annual rainfall has decreased.
- iii) Deforestation and rising population are becoming a cause of global warming.
- iv) Plants are main source of soil fertility. Deforestation has decreased the soil fertility.
- v) Forests control the flood and storm by decreasing the speed of water and air.
- vi) Forest control land erosion.

The migration of rural people to cities is called urbanization. In Pakistan, urbanization has been increasing day by day. Consequently, cities are expanding without any planning. There are many reasons behind migration of people to big cities. Some of which are:-

- o Reduction in the area of fertile land
- o Reduction in the productivity of the land
- o Non-availability of jobs
- o Non-availability of proper health facilities
- o Non-availability of proper educational and vocational facilities
- o Attraction of amenities of city life
- o Freedom from the mastery attitude of feudal lords in rural areas.
- o Prosperity of rural population by earning foreign exchange from abroad.

All these factors encouraged rural population to migrate to big cities. This has increased the population pressure in big cities

Effects and Problems

The urbanization movement has resulted in the sudden increase of population of cities. Table 6.2 shows that the rate of urbanization has increased from 9.8% to 31.5% in almost a century. It has created a lot of social and economical problems.

YEAR	% OF URBAN POPULATION	% OF RURAL POPULATION
1901	9.8	90.2
1951	17.8	82.2
1972	25.4	74.6
1981	28.3	71.7
1995	31.5	68.5

The rising trend of population has badly disturbed the quality of life of individuals and community as well. People want the basic civic facilities. The basic demands of food, clothing and housing are not properly fulfilled. Masses are deprived of necessities of life due to over population. Per capita income of a common man is very low. In most of the families only a single earning member has to support a big family.

The increased population in cities has resulted in acute shortage of accommodation.. People are bound to live in slums and katchi abadis. People are forced to live in unhygienic and unhealthy environment where they face congestion and sanitation problems.

Rising trend of population has affected the income of the people. Income of majority of the people is not sufficient to fulfil their basic needs. No doubt production in every sector is going well but demand is increasing fastly. It has resulted to expensive ness. People work day and night to meet their expenses. But over population has created a consumers market under items are less and demand is high. People are forced to purchase items at high prices.

Job opportunities are not available with respect to rising population. As a result the youth is out of job. One or two persons are earning while a family depending on them.

Key Points

- ⊙ Our earth is surrounded by an envelope of gases called atmosphere.
- ⊙ Air consists of 78% of nitrogen and 21% of oxygen.
- ⊙ Atmosphere is divided into different layers. These are Troposphere, Stratosphere, Mesosphere and Thermosphere.
- ⊙ Ozone shields and protects life on earth against harmful ultraviolet radiations.
- ⊙ The warming effect of atmospheric gases is called green house effect.
- ⊙ It is due to green house effect that average temperature of earth is 15°C.
- ⊙ Pollution is a harmful or unpleasant change in standard quality of the environment. There are three types of pollution Air Pollution, Water Pollution and Land Pollution or Solid Waste.
- ⊙ Fossils are formed naturally over millions of years from the remains of buried plants and animals.
- ⊙ PETROLEUM is a mixture of gaseous, liquid and solid hydrocarbons.
- ⊙ Natural and mineral resources are coal, petroleum, natural gas, chromite, gypsum, gemstone, mica, iron, salt and copper.
- ⊙ Agriculture is divided into following four sub sectors i.e. Crops, Live Stock, Fisheries, and Forestry.
- ⊙ Rising population has affected the environment badly. and ecosystem will be disturbed. In eco-system plants, animal and human beings exist together.
- ⊙ Deforestation means reduction in the forests areas.
- ⊙ The migration of rural people to cities is called urbanization.



EXERCISES

- i) Nitrogen and Oxygen form _____ of the volume of air near earth.
- ii) Troposphere extends from surface of earth upto _____ kilometres.
- iii) Ozone is _____ for us.
- iv) About 1/5th of the energy is _____ by the atmosphere.
- v) Lignite is and contains _____.

2. Tick (✓) the following statements either True or False.

- | | |
|--|------------|
| i) All our weather exists in the stratosphere. | True/False |
| ii) Carbon Monoxide is produced due to complete combustion of fuel. | True/False |
| iii) Fertilizers cause water pollution by releasing phosphates and nitrates. | True/False |

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- iv) Deforestation and rising population are becoming a cause of global warming. True/False
- v) Kharif crops are sown during April – June and harvested during October – December. True/False

3. Encircle one choice a, b, c or d in each case:

- i) Which sphere or layer consists of about 80% of the mass of atmosphere?
 - (a) Troposphere
 - (b) Stratosphere
 - (c) Mesosphere
 - (d) Thermosphere
- ii) Ozone layer exist above the earth about:
 - (a) 25km
 - (b) 30km
 - (c) 35km
 - (d) 40km
- iii) Coal that contains the highest percentage of coal is:-
 - (a) Lignite
 - (b) Bituminous
 - (c) Sub bituminous
 - (d) Anthracite
- iv) Which fraction or product of petroleum is used in cars as fuel?
 - (a) Petrol
 - (b) Kerosene oil
 - (c) Diesel oil
 - (d) Lubricating oil
- v) Land covered with forest in Pakistan is only.
 - (a) 3%
 - (b) 5%
 - (c) 7%
 - (d) 9%

- 4. Write a short note on the following:
 - a) Deforestation
 - b) Desertification
 - c) Global warming
 - d) Ozone layer depletion
 - e) Acid rain
 - f) Air pollution
 - g) Water pollution
 - h) Soil pollution
 - i) Noise pollution
 - j) Light pollution
 - k) Thermal pollution
 - l) Radioactive pollution
 - m) Land use change
 - n) Urbanization
 - o) Industrialization
 - p) Agricultural intensification
 - q) Overfishing
 - r) Overhunting
 - s) Invasive species
 - t) Alien species
 - u) Endemic species
 - v) Extinct species
 - w) Threatened species
 - x) Conservation
 - y) Sustainable development
 - z) Environmental impact assessment
- 5. Explain the following:
 - a) The greenhouse effect
 - b) The ozone hole
 - c) The acid rain
 - d) The air pollution
 - e) The water pollution
 - f) The soil pollution
 - g) The noise pollution
 - h) The light pollution
 - i) The thermal pollution
 - j) The radioactive pollution
 - k) The land use change
 - l) The urbanization
 - m) The industrialization
 - n) The agricultural intensification
 - o) The overfishing
 - p) The overhunting
 - q) The invasive species
 - r) The alien species
 - s) The endemic species
 - t) The extinct species
 - u) The threatened species
 - v) The conservation
 - w) The sustainable development
 - x) The environmental impact assessment
- 6. Explain the production trends of the principal crops of Pakistan.
- 7. Explain the mechanization in agriculture sector of Pakistan.
- 8. What is ecosystem?
- 9. Explain the effects of deforestation on environment.
- 10. Explain the effects of urbanization.



ENERGY

OBJECTIVES

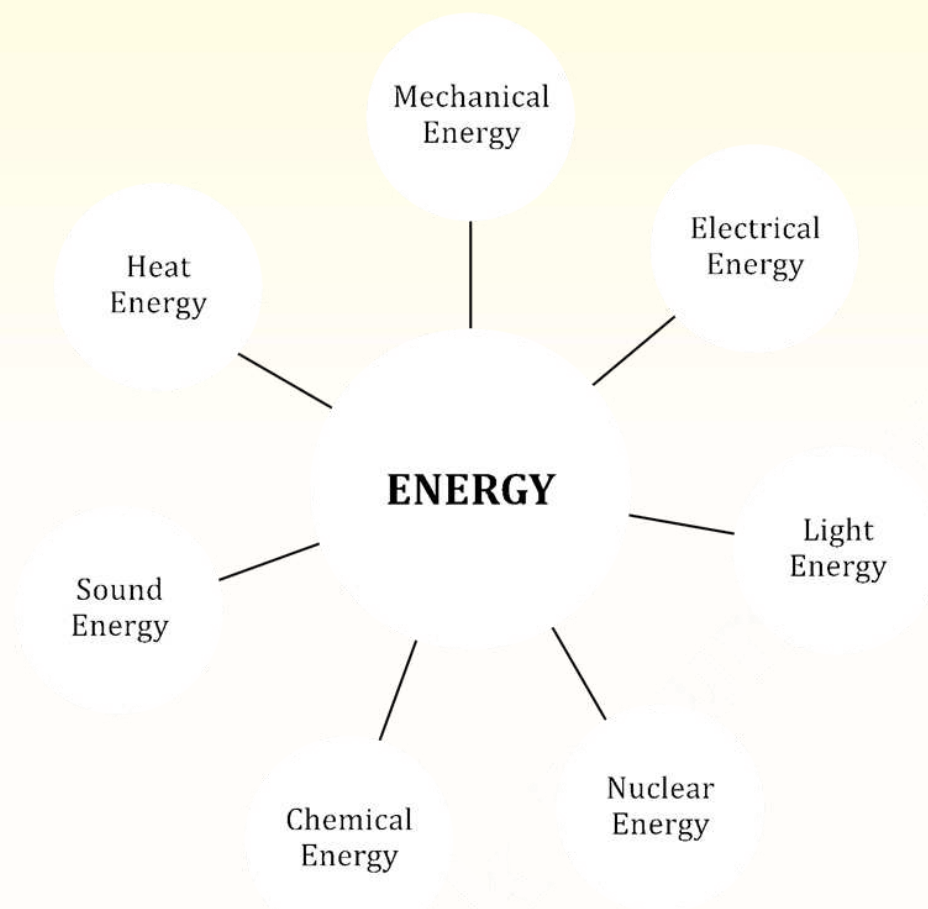
After completing this chapter you will be able to:

- ⊙ Define energy and its two kinds
- ⊙ Explain the need of energy
- ⊙ Identify several forms of energy
- ⊙ Describe the Inter-conversion of energy from one form to another
- ⊙ Understand the increasing demand of energy
- ⊙ Know various methods of getting energy
- ⊙ Explain different energy sources (renewable and non-renewable)
- ⊙ Describe the methods of measuring energy and its units
- ⊙ Understand the pollution caused by the use of energy
- ⊙ Know various measures to minimize pollution
- ⊙ Understand and appreciate energy conservation

Sometimes you feel that you do not have enough energy to continue whatever you are doing. Energy in a body is its ability to perform some activity. Without energy there would be no motion and no change. A car or a motorcycle needs energy to move. This energy comes from fuel. We need food, which provides us energy to carry out various activities such as to play, to run, to speak, to read, to see etc. Even when we are sleeping, various parts of our body need energy to keep on doing their work. Plants also take food to meet their energy requirement.

7.1 ENERGY

Energy is an important and fundamental concept in science. When we say that a body has energy, we mean that it has the ability to do work. Water running down the stream has the ability to do work, so it possesses energy. The energy of running water can be used to run water mills or water turbines. Running water gets this ability due to its height where it is stored. Energy exists in different forms. Some of the main forms of energy are given in the chart.



Mechanical Energy

The energy possessed by a body both due to its motion or position is called mechanical energy. Water running down a stream, wind, moving car, lifted hammer, stretched bow or a catapult or a compressed spring etc. possesses mechanical energy. Any form of energy that a body possesses is of two kinds. These are kinetic energy or potential energy.

Kinetic Energy

The energy that a body possesses due to its motion is called kinetic energy. The faster a body moves, the more kinetic energy it has. Running water, wind and a falling stone have kinetic energy because they are capable to do work due to their motion.



Fig. 7.1: A water mill

The energy that a body possesses due to its position is called potential energy. Stored water before it runs down possesses potential energy. A hammer, raised to some height, possesses potential energy. A stretched bow has potential energy due to its position. When released, the stored energy of the bow pushes out the arrow in it.

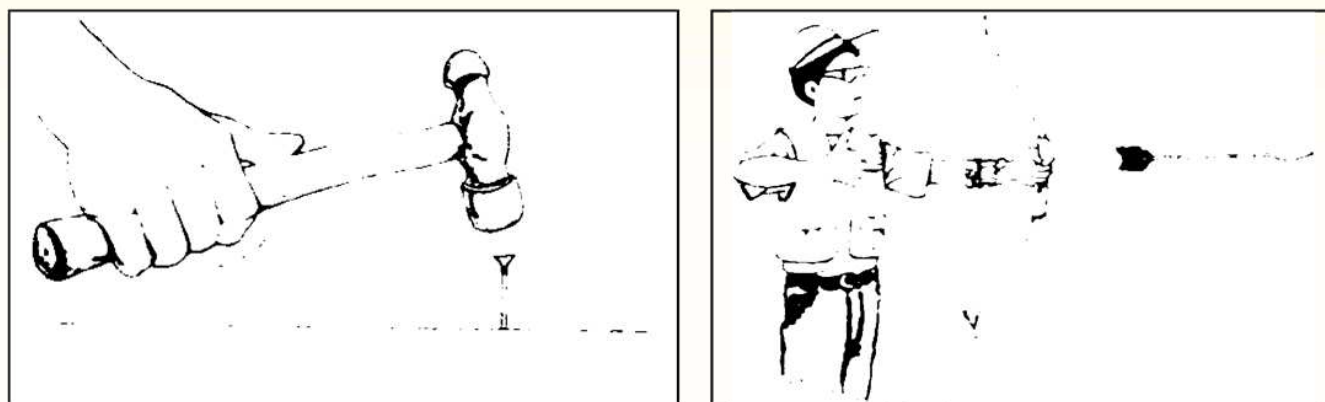


Figure 7.2: (a) A raised hammer possesses P.E. (b) Stretched bow also possesses P.E.

Heat is a form of energy given out by hot bodies in the form of radiations. Large amount of heat is obtained by burning fuel. Heat is also produced when motion is opposed by frictional forces. The foods we take provide us heat energy. The sun is the main source of heat energy.

Electricity is one of the widely used pollution free form of energy. Electric energy can be sent through wires easily to any desired place. We get electrical energy from batteries and electric generators. Most of the electric generators are run by thermal or hydro power.

Sound is produced when a body vibrates; such as vibrating diaphragm of a drum, vibrating strings of a sitar or guitar and vibrating air column of wind instruments such as flute pipe, etc.



Figure 7.3: Some sound producing instruments

Light Energy

Light is an important form of energy. Plants produce food in the presence of sunlight. We also need light to see things. We get light from candles, electric bulbs, fluorescent tubes and also by burning fuel. However most of the light comes from the sun.

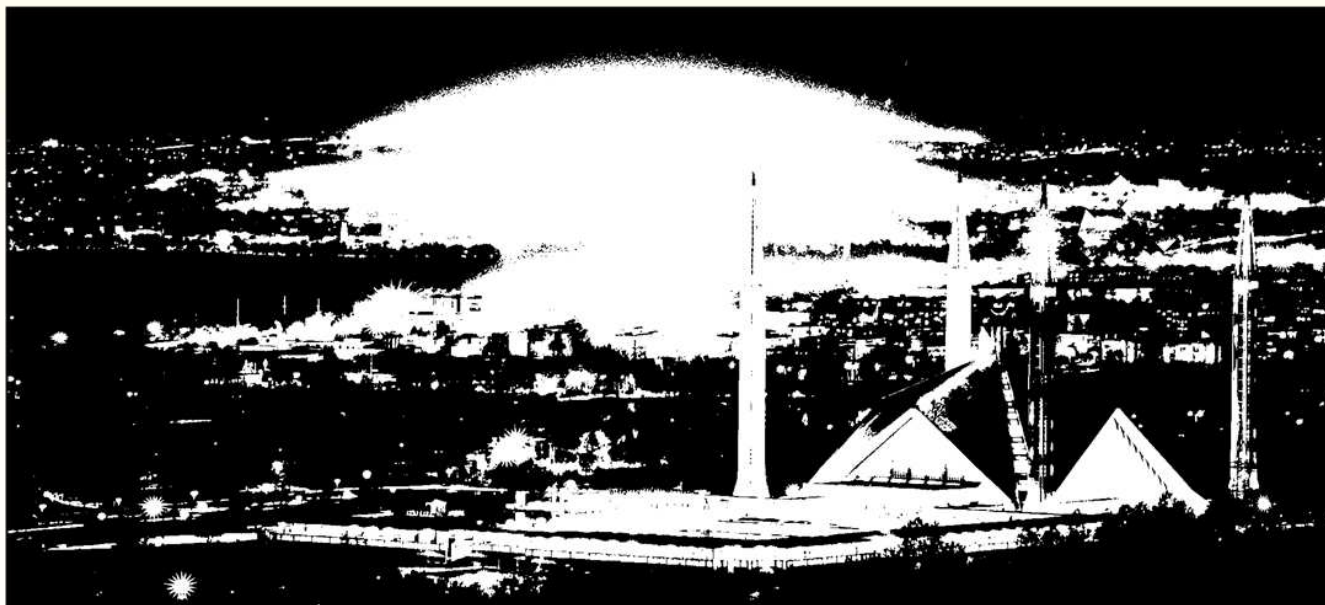


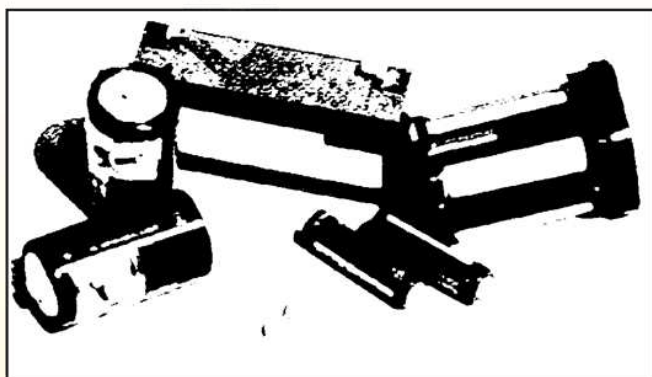
Figure 7.4: Light is needed during night also

Chemical Energy

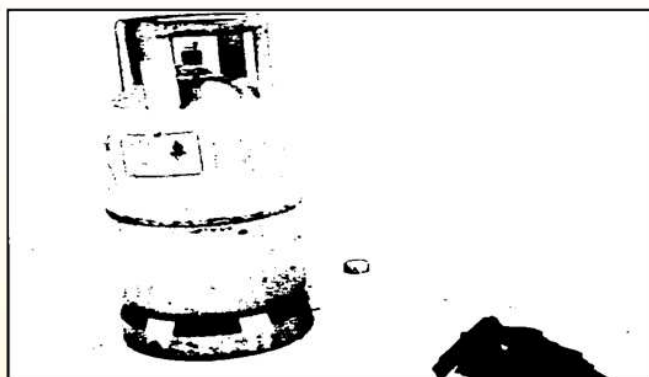
Chemical energy is present in food, fuels and some other substances. Energy is released from these substances during chemical reactions. The burning of wood, coal or natural gas in air causes a chemical reaction which releases energy in the form of heat and light.



Fig. 7.5: Food as a source of energy



(a) Cell and Batteries



(b) Fuel

Fig. 7.6: Few more energy sources

Nuclear energy is the energy released in the form of nuclear radiations in addition to heat, light and sound during nuclear reactions such as fission and fusion reactions. Heat energy released from nuclear reactors is changed into electrical energy. Energy coming from the sun for the last billions of years is the result of nuclear reactions taking place on the sun.

7.2: INTER CONVERSION OF ENERGY

We cannot create or destroy energy, but energy can be converted from one form to another form. For example, rub your hands together quickly. You will feel them warm. You have used your muscular energy in rubbing as a result heat is produced by rubbing hands which makes hands warm. In this process, the kinetic energy of hands was converted into heat energy.

Processes in nature are the result of energy changes. For example, some of the heat energy from the sun is absorbed by water in the oceans. This increases the thermal energy. Thermal energy causes water to evaporate from the surface to form water vapour. These vapours rise up and form clouds. As they cool down, they form water drops. These water drops fall down as rain. Potential energy

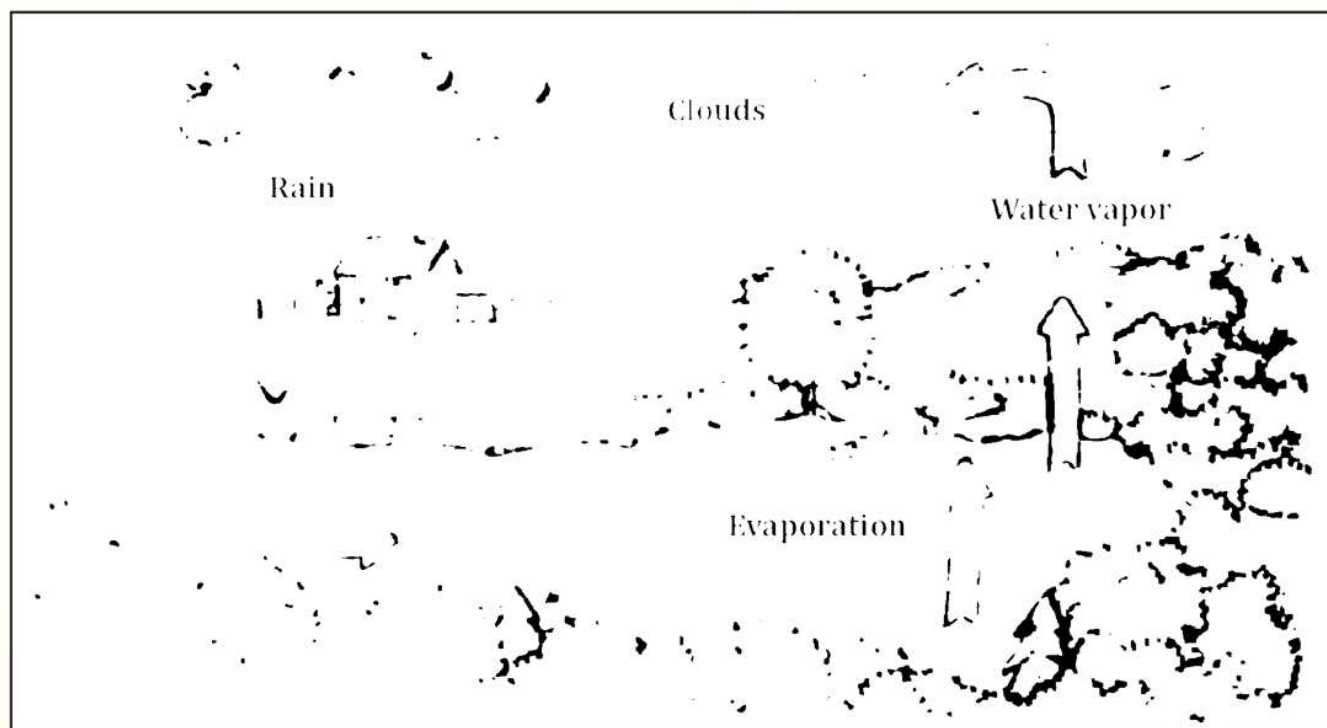


Fig. 7.7: Interconversion of Energy

changes to kinetic energy as the rain falls. If the rain water flows down, its kinetic energy changes into thermal energy while parts of the kinetic energy of flowing water is used to wash away soil particles of rocks that changes the landscape.

Energy of flowing water can also be used to run water mills or turbines. Turbines move

generators which produce electrical energy. Rainwater stored in dams has potential energy. Water stored in dams is allowed to pass through tunnels to run the turbines. These turbines then run electric generator to produce electricity. The electrical energy can be converted into light, heat or mechanical energy.

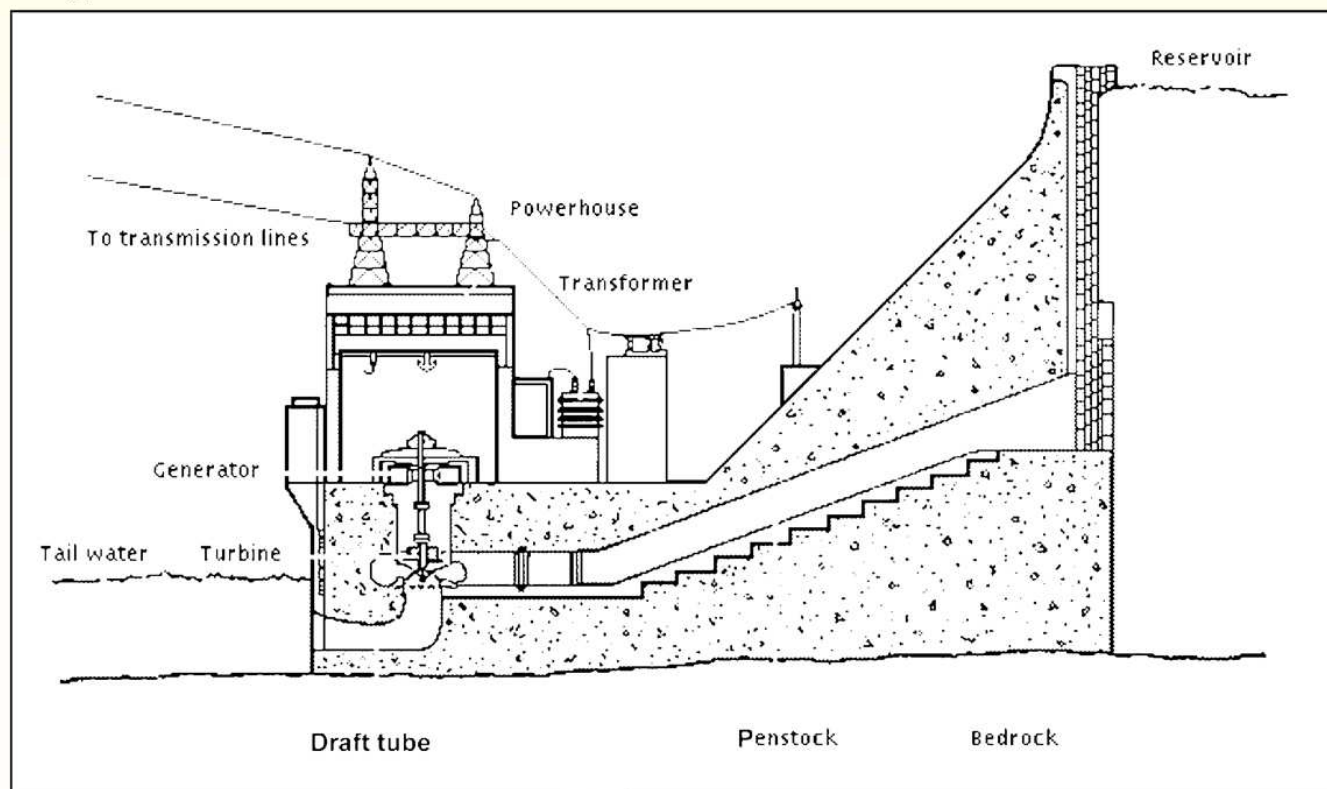


Figure 7.8: An electric generator run by a turbine changes mechanical energy into electrical energy

During the inter-conversion of energy from one form to another the total energy at any time remains constant.

Life on earth needs energy for its survival. Nature has blessed us with plenty of energy sources such as wind, flowing water, coal, fire wood, petroleum, natural gas and the sun — the major source of energy. For thousands of years heat was the only form of energy used by man. After the invention of steam engine, the use of mechanical energy increased gradually in transport and in industry. The discovery of petroleum is accompanied by the invention of internal combustion engines driven by petroleum products. These engines are used for transportation and generation of electricity.

Today people need unlimited supply of energy. We need energy in our homes to run appliances such as lamps, fans, gas/electric ovens, heaters, air-conditioner refrigerators, telephone, radio, television, etc. In schools and offices, we use electrical energy that runs many electric appliances such as tube lights, telephones, computers, etc. In hospitals, we also need electrical energy to operate medical equipments. We need energy to run our factories. We also need energy in agriculture for tube-



wells, tractors etc.

We need energy in every field of life in trade, in transportation, Telecommunication, research, and even for entertainment. The use of energy is increasing day by day due to an increase in population and also due to the increase in energy need of every individual. Energy is needed at national level to meet the requirements of industry and agriculture.

THE METHOD OF SCOURING ENERGY

Industrial, agricultural and scientific development of a country depends upon higher rate of the use of energy in the most economical way. The progress and prosperity of a country depends upon the exploitation of its energy resources.

Energy exists in various forms. Heat is a form of energy. Most of the heat energy we use comes directly from the sun. Heat can also be produced by burning wood, coal, natural gas or petroleum products. Electricity is a familiar form of energy. It is produced by generators run by thermal, hydro or nuclear power. Electrical energy is the back bone of industry.

Mechanical energy is also an important form of energy that runs industry, transport and agriculture. Mechanical energy is obtained using fossil fuels in combustion engines. Mechanical energy is also obtained by using electric motors that convert electric energy into mechanical energy. Energy of flowing water and wind is first converted into mechanical energy by turbines or wind mills. The mechanical energy of water or wind can also be used directly or converted into electrical energy.

The energy we use comes from the sun, wind and water power, etc. Actually all of the energy we use today comes either directly or indirectly from the sun. We use fossil fuels such as coal, oil and gas to heat our houses and run industry and transport. The fossil fuels are formed due to the conversion of plants and animals' remains that died millions of years ago. We are using fossil fuels at a very fast rate. Their use is increasing day by day to meet our energy needs. If we continue to use them at present rate, then they will be exhausted soon.

Fossil fuels are known as non-renewable resources because it took millions of years for them to attain the present form. Moreover, they also release harmful waste products. These wastes include carbon mono-oxide, carbon dioxide, etc., which pollute the environment and causes health problems.

Using fossil fuels cause serious problem. Once their supply is exhausted, the world will face energy crisis. Thus non-renewable fossil fuels will not meet our future energy needs. We must use them wisely and at the same time develop new energy sources necessary for our survival.



Nuclear Fuels

In nuclear power plants, we get energy using uranium. The process taking place in nuclear reactors is known as nuclear fission. During fission reaction the nucleus of an atom splits up into smaller parts releasing a large amount of energy. Some uranium atoms and atoms of few other materials are used in fission because they split up easily. Nuclear fuel has dangerous waste. No complete safe method has so far been discovered for their disposal. Nuclear power plants give off a lot of waste heat, which can be harmful to the environment.

Water evaporates from lakes, seas and oceans to form clouds from which we get rain and snow. Rainwater and water formed by melting of ice runs down through streams from hills and mountains.

Sunlight and water power are the renewable sources of energy. They will not run out like coal, oil and gas.

Water Power

Water power is becoming more popular. Dams are being constructed at suitable locations in different parts of the world. Dams serve many purposes. They help to control floods by storing water. The water stored in dams is used for irrigation and also to generate electric energy without creating much environmental problems.

Energy from the Sun

Solar energy is the energy coming from the sun. Sunlight does not pollute the environment in any way. The energy coming up from the sun is used directly and indirectly.

The sun rays are the ultimate source of life on earth. We are dependent on the sun for all our food and fuels. Solar energy reaching earth is thousand times more than the energy consumption of mankind.

Solar House Heating

The use of solar energy is not new. However its use in houses and offices as well as for commercial industrial purposes is quite recent. Complete solar house heating systems are successfully used in areas with a minimum amount of sunshine in winter. A heating system consists of:-

- A collector
- A storage device
- A distribution system.

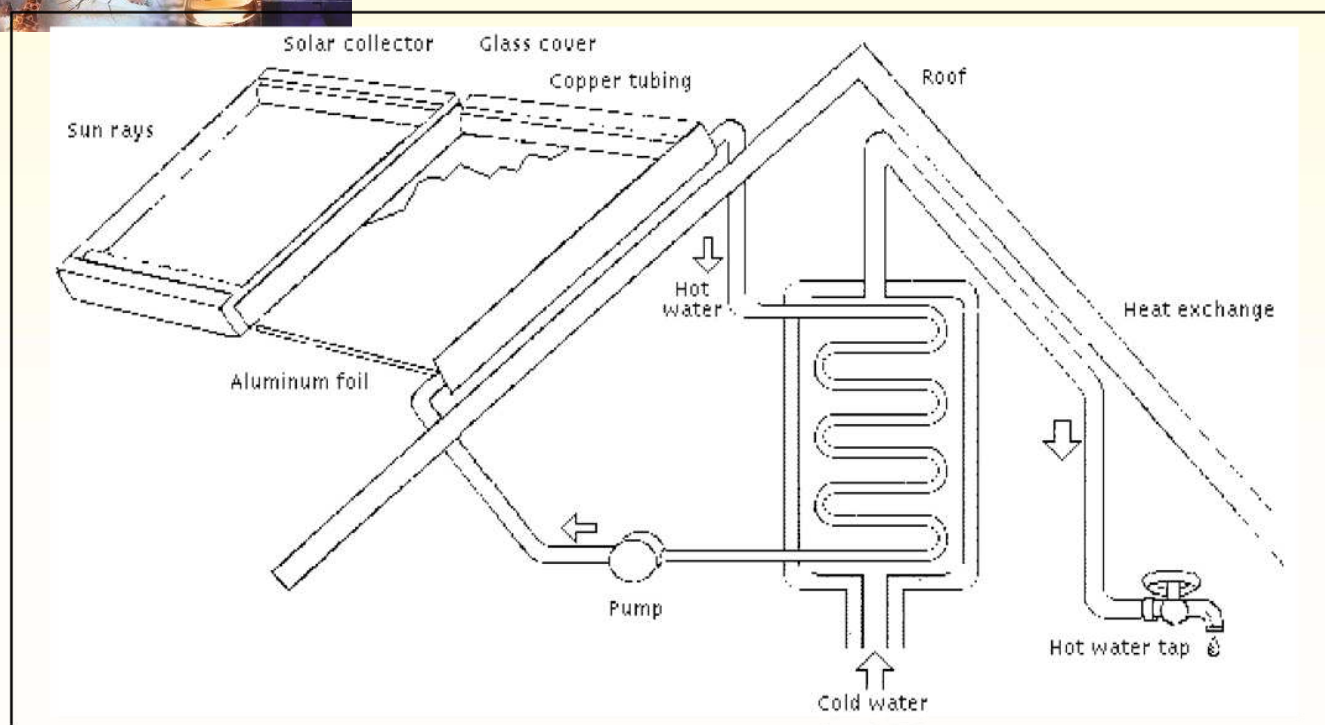


Fig. 7.9: A Solar house heating system

The figure 7.9 shows a solar collector made up of glass panels over blank metal plates. The plates absorb the sun's energy which heats a liquid flowing in the pipes at the back of the collector. The hot water can be used for cooking, washing and for heating the building.

Solar energy is used in solar cookers, solar distillation plants, solar power plant, etc.

Solar energy can also be converted directly into electricity by solar cells. A solar cell is made from silicon wafers. When sunlight falls on a solar cell, it converts the light directly into electrical energy. Solar cells are used in calculators, watches and toys. A large number of solar cells are wired together to form solar panels. Solar panels can provide power to telephone booths, light houses and scientific research centres. Solar panels are also used to power satellites.

Several other methods to trap sunrays are under way. If scientists could find an efficient and inexpensive method to use solar energy, people will have clean, limitless energy as long as the sun continue to shine.

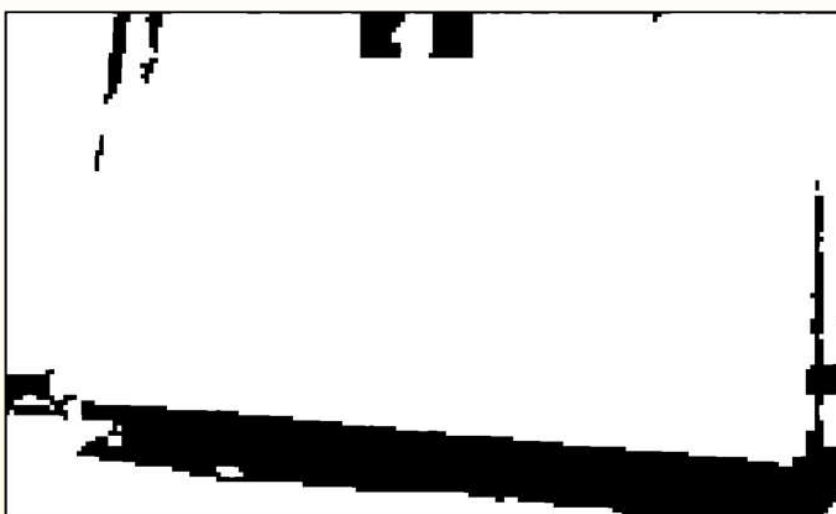


Fig. 7.10: A solar panel

Wind Energy

Wind has been used as a source of energy for centuries. It has powered sailing ships across the oceans. It has been used by wind mills (figure 7.11) to grind grain and pump water. More recently wind power is used to turn wind turbines. When many wind machines are grouped together on wind “farms”, they can generate enough power to operate a power plant. In the United States, some wind farms generate more than thirteen hundred megawatts of electricity a day. In Europe, many wind farms routinely generate one hundred or more megawatts of electricity a day.

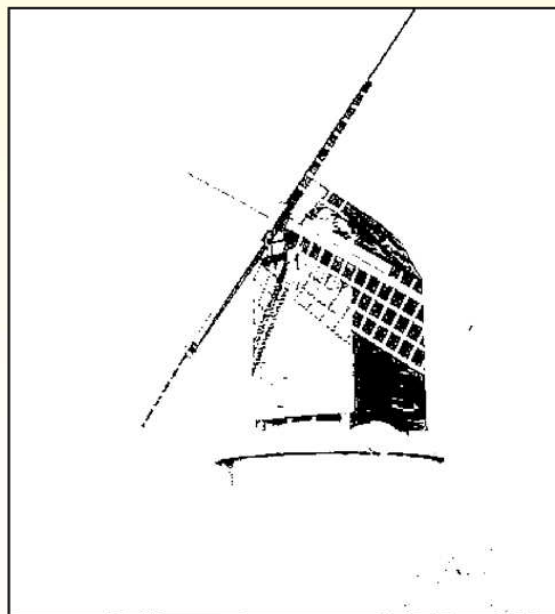


Fig. 7.11: A windmill

Tides are the rise and fall in the level of sea water. People living in coastal areas are familiar with tides occurring twice during twenty four hours. A huge amount of water is pushed towards land with the incoming high tide and set toward sea during low tide. If water is stored in a basin at high tide then its energy can be used to drive turbines when released. Electricity can be produced from the generator coupled with these turbines.

Geothermal Energy

The earth provides us with hot water from geysers and hot springs. There is a hot molten part, deep in the earth called magma. High temperature of magma turns the water found around the magma into steam. This energy is called geo-thermal energy. It can be used only at few places where geysers and hot springs occur.

Geothermal well can be created by drilling deep into the earth near hot rocks in case pockets of heated water are not available then. Water is then pushed

down into the well. The rocks quickly heat the water and turn it into steam that expands and moves up to the surface. The steam can be piped directly into houses and offices for heating purposes or it can be used to generate electricity. Such wells can produce steam for twenty to thirty years making them very cost effective.



Fig. 7.12: A Geothermal Power Station

Energy From Biomass

Biomass is plant or animal materials that can be burnt as fuel. Wood is probably the best known and most widely used form of biomass. Other forms of biomass are garbage, farm wastes, sugarcane and other plants. Sugarcane wastes and other plants wastes are burned to make electricity. Many industries that use forest products get half of their electricity by burning bark and other wood wastes.

Biomass can serve as another energy source, but problems are there in its use. Using biomass produces pollutants similar to those that fossil fuels produce. Cutting trees can speed the erosion of our land. Also wood-burning, power plants would require much land to supply enough wood.

When animal dung, dead plants and dead animals decompose, they give off a mixture of methane and carbon dioxide. Once collected, methane can be burned to produce electricity. In experimental plants fifty megawatts of electricity per day have been obtained.

Alcohol Fuels

Some liquid by products of living things are promising alternative fuels. These are the alcohols which are derived from wood and other plant products. These alcohols are methanol and ethanol. They make excellent fuels for power plants that produce electricity.

The most important use of these alcohols is as fuel for cars, trucks and other vehicles. Both alcohols can be used as substitutes for gasoline or such diesel fuel. In addition to utilizing plants from its rain forests, Brazil grows thousand of acres of crops especially for the production of alcohol fuel. In United States, a mixture of ethanol and gasoline called gasohol can be used in cars, and trucks.

Hydrogen is another promising alternative fuel. Hydrogen is the most abundant element in nature. Hydrogen gas makes up 99% of the mass of the universe. Every molecule of water contains two atoms of hydrogen. The hydrogen can be separated from water by electrolysis and then collected and stored. The hydrogen can be burned as fuel.

Measuring Energy

The food we take provides us energy to carry out different activities. A conventional unit to measure energy is calorie. It is the unit in which we generally measure heat energy.

CALORIE

It is the quantity of heat required to raise the temperature of one gram of water through 1°C .

Another unit used to measure energy is joule. After adapting international system of unit, various forms of energies are now measured in joule.

Joule: One joule is the amount of work by a force of 1 Newton which acts on a body and moves it through a distance of 1 metre.

Joule and calories are related as:-

$$4.2 \text{ Joule} = 1 \text{ calorie}$$

$$1000 \text{ calories} = 1 \text{ k cal.}$$

$$1000 \text{ joules} = 1 \text{ k joule.}$$

Our body needs energy that is supplied in the form of chemical energy stored in food. One glass of milk contains nearly 150 kcal or 630 kJ of energy. An egg provides nearly 160 kcal or 670 kJ of energy. Similarly an average size apple (200g) provides 170 kcal or 710 kJ of energy.

Another unit in which electrical energy is measured is kilo watt- hour (KWh)

$$1 \text{ kWh} = 1000 \text{ Watt-hour} \quad \text{or } 1000 \text{ Wh}$$

1 Watt is the power at which energy is used or produced at the rate of 1 joule/second.

Thus 1 watt-hour (1Wh) is the energy used or produced in one hour at the rate of 1 joule/second (1 Watt).

$$\begin{aligned} \text{Or } 1 \text{ Watt hour} &= 1 \text{ Watt } 1 \text{ h} \\ &= 1 (\text{J/s}) \times 3600 (\text{s}) = 3600 \text{ joule} \end{aligned}$$

$$\begin{aligned} \text{Or } 1 \text{ Watt .hour} &= 3600 \text{ J} \\ &= 3.6 \text{ kJ} \end{aligned}$$

$$\begin{aligned} 1 \text{ kWh} &= 1000 (3.6 \text{ kJ}) \\ &= 3600 \text{ kJ} \end{aligned}$$

Energy is obtained from different sources such as coal, wood, petroleum, natural gas, the sun, wind, geothermal etc.

It is necessary to use a common unit to know the energy contained in a fuel instead of measuring its quantity. The common unit used to measure any form of energy is joule or kilo joule kJ.

Measurement of Electricity

The energy unit for measuring electricity is kilowatt-hour (kWh) or simply called “UNIT”.

One unit of electrical energy (= 1 kWh) is consumed by



Fig. 7.13: Electricity meter

any device of 1 kilowatt in one hour. Similarly one unit of electrical energy is also consumed by an electric lamp of 100 watt in 10 hours. The same amount of energy may be consumed by 10 electric lamps each of 100 watt when used for 1 hour.

$$\text{Thus} \quad 1\text{kW} \times 1 \text{ hour} = 1 \text{ kWh}$$

$$\begin{aligned} \text{Or } 1 (\text{lamp}) \times 100 \text{ watt} \times 10 \text{ hour} &= 1000 \text{ Watt-hour} \\ &= 1 \text{ kWh} \end{aligned}$$

$$\begin{aligned} \text{Or } 10 (\text{lamps}) \times 100 \text{ watts} \times 1 \text{ hour} &= 1000 \text{ Watt-hour} \\ &= 1 \text{ kWh} \end{aligned}$$

Consumers obtain electric supply through energy meter. The energy or electricity metre measures electrical energy in electrical units or KWh. An electric current is produced as soon as an electrical appliance such as electric lamp, fan, electric iron or T.V is turned on. This current moves a disc in the electricity metre. After certain number of revolutions a digit moves at the unit place in the display window. The display window in the electricity metre displays the metre reading in Kwh.

Environmental problems such as polluting emission consisting of noise, air pollution and water pollution may arise by using different sources of energy such as fossil fuels, nuclear energy. Pollution is the change in the quality of environment that can be harmful and unpleasant for living things. A temperature rise in the environment that disturbs life is called thermal pollution. Thermal pollution upsets the balance of life and endangers the life.

Air pollutants are unwanted and harmful. Natural processes such as volcanic eruptions, forest fires and dust storms add pollutant to the air. These pollutant, rarely build up to harmful levels. On the other hand, the burning of fuel and solid wastes in homes, cars and factories releases harmful amount of air pollutants.

All power plants produce waste heat, but fission plants produce the most. The heat released into a lake, a river or an ocean upsets the balance of life in them. Unlike other power plants, nuclear power plants do not produce carbon dioxide. But they do produce dangerous radioactive wastes. Storing the radioactive wastes is a technical problem.

All power plants produce waste heat, but fission plants produce the most. The heat released into a lake, a river or an ocean upsets the balance of life in them. Unlike other power plants, nuclear power plants do not produce carbon dioxide. But they do produce dangerous radioactive wastes. Storing the radioactive wastes is a technical problem.

In many countries, governments have passed laws to control air pollution. Some of these laws limit the amount of pollution that power plants, factories and automobiles are allowed to give off. To meet these conditions for automobiles, new cars have catalytic converters. These devices convert



some polluting gases. The use of lead free petrol has greatly reduced the amount of lead in the air. Engineers have succeeded to make new kinds of car engines that use electricity or energy sources other than diesel and petrol.

Many individual communities have laws which protect their areas from pollution. Individuals can help to control air pollution simply by reducing the use of cars and other machines that burn fuel. Sharing rides and using public transportation are the ways to reduce the number of automobiles in use.

Indoor pollutants include tobacco smoke, raw materials, for building, car exhaust, chemicals used for cleaning etc. All indoor air pollution can be reduced by allowing fresh air into it.

Nature has blessed us with energy resources both non-renewable and renewable resources. But resources of fossil fuels are limited and will exhaust some day due to the increased rate of consumption and also due to the growing population. If we want to preserve our civilization under the fast growing world population, we must find ways of tapping other energy resources.

There is another alternative that produces no pollution, no radiation and saves money. It is energy conservation, which is the use of energy in the most economical and efficient way. Conserving energy avoids waste and pollution. It requires:

- i. An understanding of the importance of energy.
- ii. Knowledge of avoiding unnecessary use of energy.
- iii. Making maximum use of solar energy.

We can conserve energy by taking suitable steps at our homes, schools, offices, in factories, in transportation etc as described below: -

We need energy in our homes for lighting, heating and for our comfort. We have to take all possible measures to save as much energy as possible so that it might be available for agriculture and industrial units. This is possible if we.

- i. Close all unnecessary electrical appliances when not in use, such as electric lights, fans, air conditioners, electric heaters, TVs, electric irons, etc.
- ii. Use electric appliances that uses electricity most economically, such as tube lights and energy saver bulbs etc.
- iii. Have cross ventilation system in our homes, white washed room walls so as to make maximum utilization of daylight.
- iv. Design our homes so as to take maximum benefit of solar energy.

- v. Close gas-taps in the kitchen when not in use.
- vi. Avoid unnecessary lighting during functions and other gatherings.

Energy Conservation in Schools

Normally school functions during day time. Generally very small amount of energy is required for lighting, mostly it is required for comfort and to run lab equipments in Physics, Chemistry and Computer labs and to operate audio and visual aids. Although in schools energy is generally used most economically, however further steps can minimize the unnecessary use of energy. These are:-

- i. Turning off all the unnecessary electric appliances when not in use.
- ii. Turning off all the unnecessary lights fans refrigerators or heaters.
- iii. Design of the school building should be such that the solar energy could be utilized as much as possible.

Industries are vital for the development and prosperity of a country. Energy in all its forms is needed to run industry. However suitable method can be adapted to conserve energy in the industry.

- i. All the machines and plants should be turned off when idle.
- ii. All the equipment used in the industry should be properly maintained so that they work efficiently avoiding energy losses.
- iii. Energy can be conserved by employing better machines of high efficiency and improved technology.
- iv. The industry should run at its full capacity at times when electric energy would be surplus.
- v. Alternate energy sources should also be used like solar energy, sugarcane wastes and other wastes products wherever available.

Energy is required to transport people and goods from one place to another. Although modes of transport have been changed over the years from muscular energy to fossil fuels and electricity yet some of them are still in use. Motorcycles, cars, motor boats tractors buses, ships and trains, aero planes use petroleum products. Increased number of vehicles not only consume large quantity of liquid fossil fuels but also has endangered the life on earth by polluting the environments. It has becomes very important to take necessary measures to conserve energy in transportation. This can be done by

- i. Using smaller and low consumption vehicles



- ii. Sharing transportation
- iii. Travelling through public transport as much as possible preferably through railway.
- iv. Shut down the engine when stopping for a longer period.
- v. Keep the engine properly tuned. This helps to achieve greater efficiencies and causes less pollution. In addition keeping the tyres inflated saves fuel.
- vi. Drive at moderate speed at which fuel consumption is most economical.

Energy Conservation in Agriculture

We need water for irrigation and energy for mechanised farming, processing and transporting the crops. Our country is an agricultural country and our socio-economic development is based on better farming, higher yield and to make more and more area worth for cultivation. Agriculture sector is one of a major consumer of energy. It is important to conserve energy that could be made available for expansion projects. In agriculture energy can be conserved by following steps

- i. Storing excess rain water in rainy areas
- ii. Selecting suitable crops according to the nature of land and climatic condition for better yield.
- iii. Selecting crops that are best suited in dry areas and require less water by constructing concrete.
- iv. To reduce water seepage irrigation tunnels.
- v. By promoting corporate farming
- vi. Avoiding the use of tractors for transporting goods and crops between towns.
- vii. Using tube wells at times other than peak hours of electricity consumption.
- viii. Promoting the use of bio-mass to produce bio gas and using the remaining waste materials as manure in the fields.
- ix. Keeping the tractors and agricultural tools properly maintained and aligned and using the agricultural tools efficiently.
- x. Tube well systems should also be properly maintained greasing and oiling should be done regularly.
- xi. Planting trees at suitable places and constructing small dams and fish farms where possible.

Key Points

- ⊙ Energy possessed by a body means that it has the ability to do work
- ⊙ Energy it possesses due to its motion is called its kinetic energy.
- ⊙ The energy that a body possesses due to its position is called the potential energy
- ⊙ Some of the Main forms of energy are; Mechanical Energy, Heat Energy, Electrical Energy, Sound Energy, Light Energy, Chemical Energy, Nuclear Energy.
- ⊙ Actually all of the energy we use, comes either directly or indirectly from the sun.
- ⊙ Some energy sources are renewable. Solar energy is the energy of sunlight. Sunlight is a renewable energy resource that will exist for as long as the sun itself exists.
- ⊙ Wind has been used as a source of energy for centuries.
- ⊙ The earth provides us with hot water from geysers and hot springs. This energy is called geo-thermal energy.
- ⊙ Biomass is plant or animal materials that can be used as fuel. Wood is probably the best known and most widely used form of biomass.
- ⊙ A conventional unit to measure energy is calorie. Another unit used to measure energy is joule. The energy unit for measuring electricity is kilowatt-hour (kWh) which is simply called the “UNIT”.
- ⊙ We cannot purify polluted air however air pollution can be controlled by people. If we want to preserve our civilization under the fast growing world population, we must find ways of tapping other energy resources.
- ⊙ Conserving energy avoids waste and pollution. We can conserve energy by taking suitable steps at our homes, schools, offices, in factories and in transportation etc.



EXERCISES

Complete the following statements

- i) The energy of a body due to its _____ is called kinetic energy.
- ii) _____ is the major source of energy.
- iii) _____ is one of the widely used pollution free energy.
- iv) In nuclear power plants _____ is used to get energy.
- v) Polluted air contains _____ that causes headaches and even death if taken in large quantities.



2. Tick (✓) the following statements either True or False.

- | | |
|--|------------|
| i) Fossil fuels are known as non-renewable resources. | True/False |
| ii) A compressed spring possesses kinetic energy. | True/False |
| iii) The energy coming from the sun as heat and light is expected to exhaust within the next 1000 years. | True/False |
| iv) Most of the energy is obtained from natural gas (sui gas) | True/False |
| v) The unit of electrical energy is kWh. | True/False |

3. Multiple choice questions (Choose the correct answer)

- i) Which is the main source of energy on earth?
(a) hydroelectric power (b) sun (c) fossil fuel (d) nuclear energy
- ii) Which one is the odd thing?
(a) heat (b) electricity (c) light (d) sound
- iii) Which types of power provides pollution free form of energy?
(a) Thermal power plants (b) Hydroelectric power plants
(c) Nuclear power plants (d) None of these
- iv) Which one is not the renewable energy sources?
(a) Solar energy (b) Oil and gas (c) Nuclear fuel (d) Wind energy
- v) Which one is not the unit of energy?
(a) Calorie (b) Joules (c) Watt (d) Kilowatt hour

4. Write short answers (Answer in 20-30 words)

1. What is the difference between renewable and non-renewable energy?

2. What is the difference between potential and kinetic energy?

3. How does the energy supplied to a house reach the various parts of the house?

4. How is the energy supplied to a house converted to electricity?

5. How is the energy supplied to a house converted to heat?

6. How is the energy supplied to a house converted to light?

7. Explain the working of a solar home heating system.

8. Describe how geothermal energy can be used to generate electricity.

9. How energy obtained by fossil fuels affect the environment?

10. Name some of the pollutants produced by burning fuel.

11. Define the unit Calorie.

12. Give ways to control pollution.

13. Write a short note on energy conservation in transport.