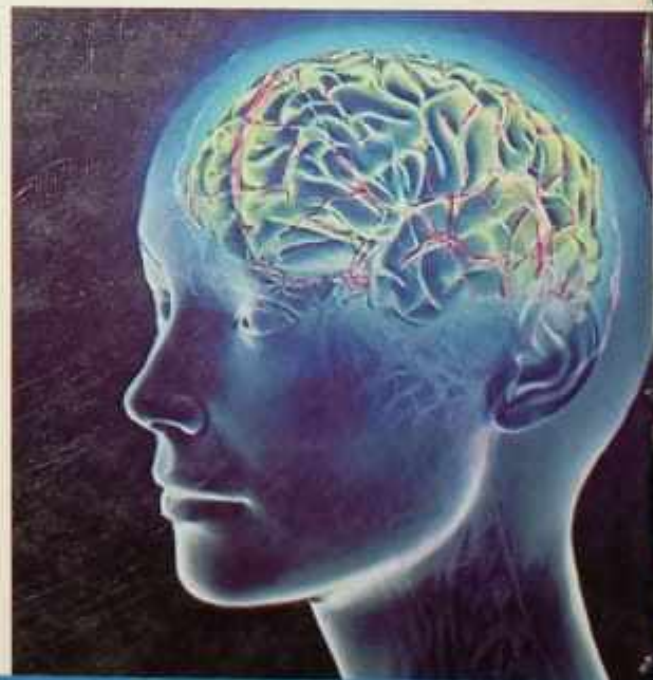
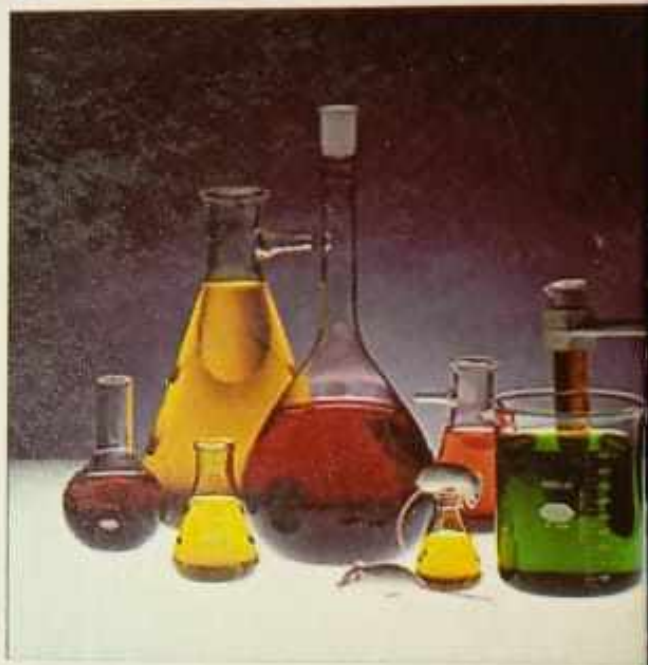
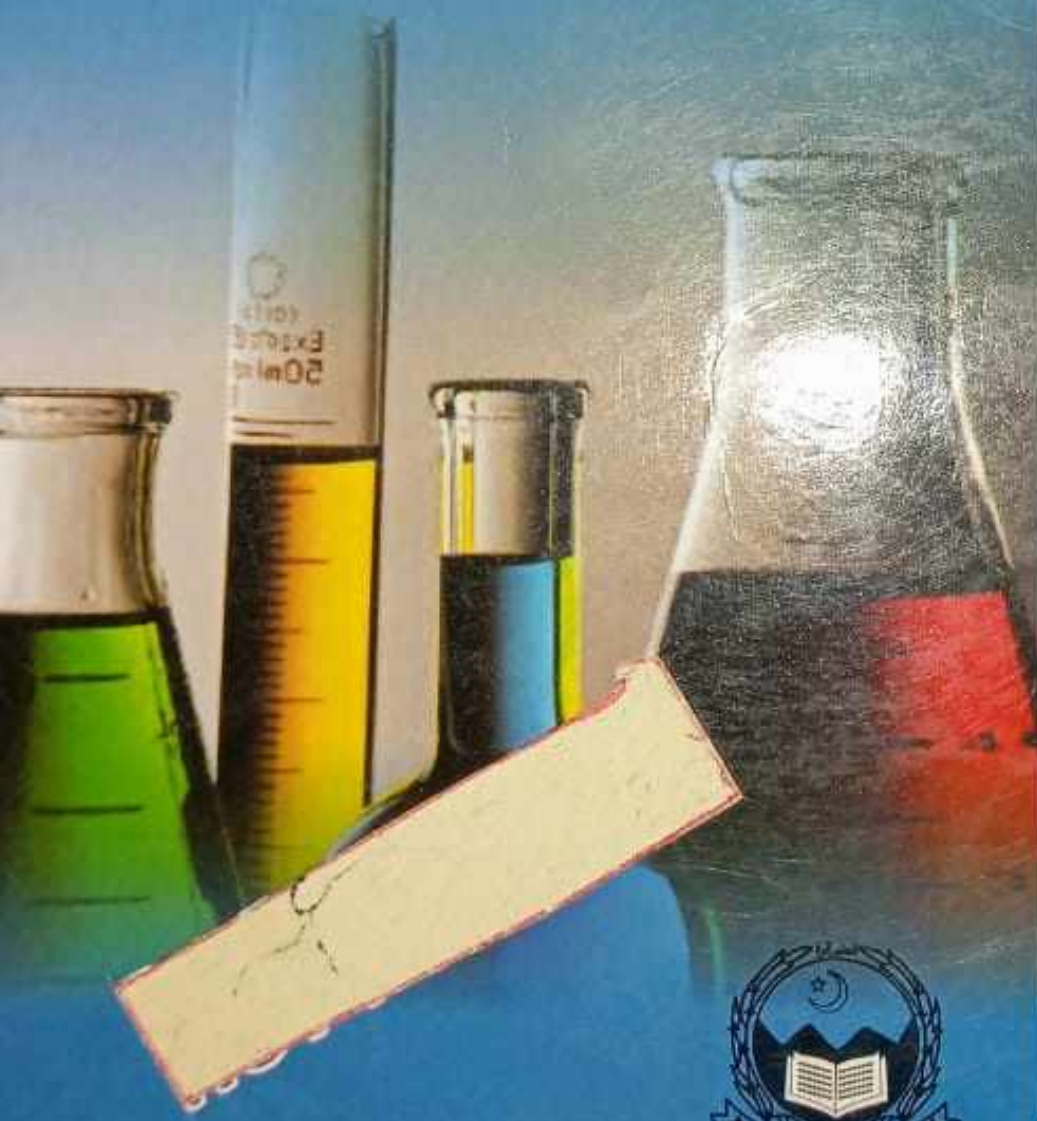


General Science 9



**Khyber Pakhtunkhwa Textbook Board
Peshawar**



In the name of Allah, the most beneficent, the most merciful

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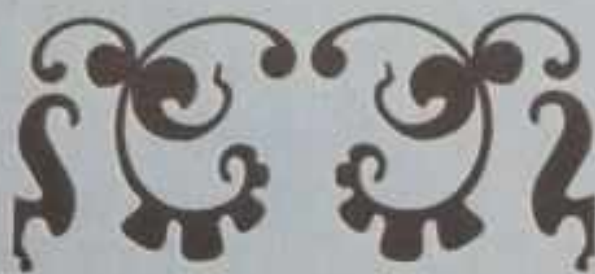
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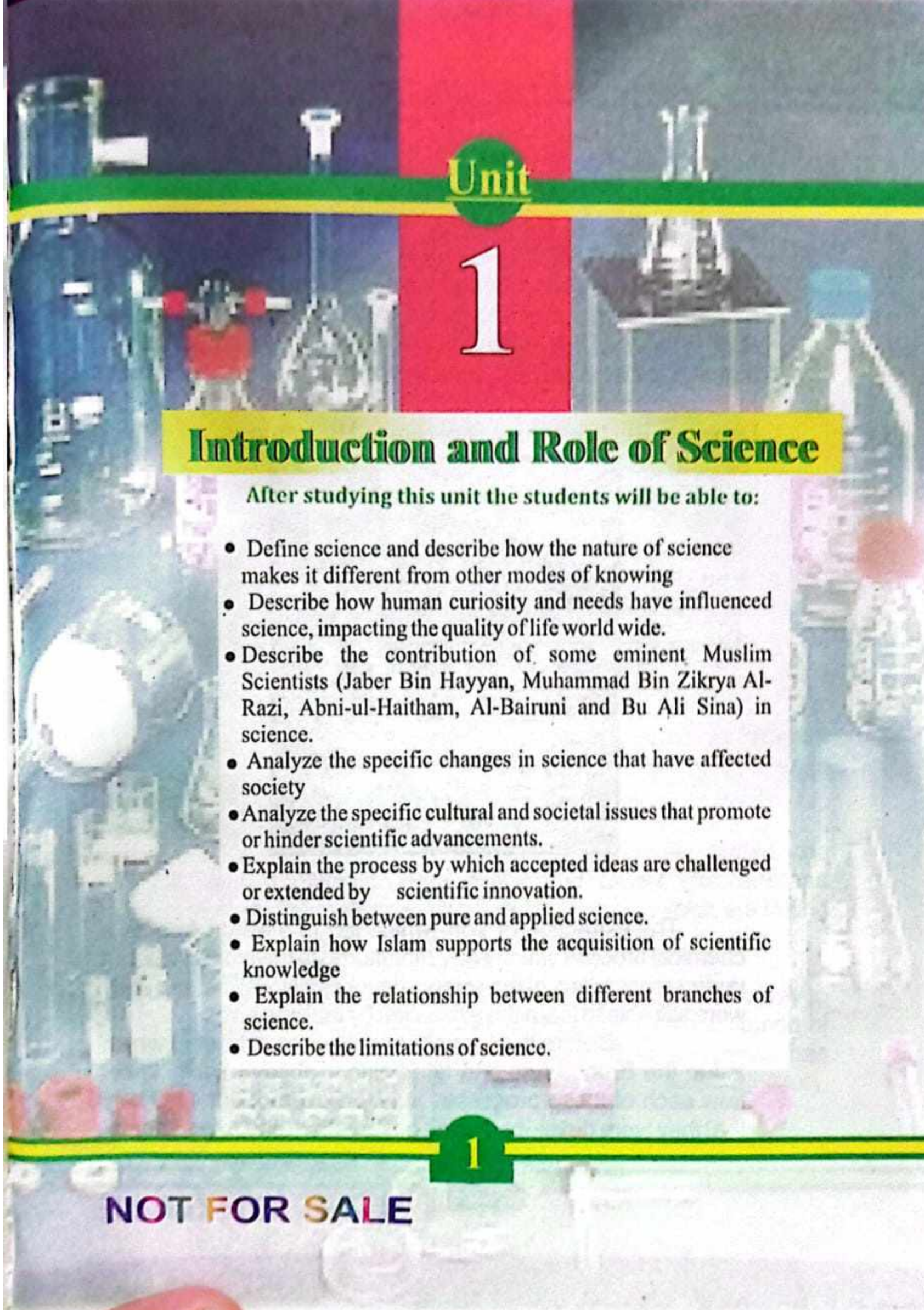
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Unit

1

Introduction and Role of Science

After studying this unit the students will be able to:

- Define science and describe how the nature of science makes it different from other modes of knowing
- Describe how human curiosity and needs have influenced science, impacting the quality of life world wide.
- Describe the contribution of some eminent Muslim Scientists (Jaber Bin Hayyan, Muhammad Bin Zikrya Al-Razi, Abni-ul-Haitham, Al-Bairuni and Bu Ali Sina) in science.
- Analyze the specific changes in science that have affected society
- Analyze the specific cultural and societal issues that promote or hinder scientific advancements.
- Explain the process by which accepted ideas are challenged or extended by scientific innovation.
- Distinguish between pure and applied science.
- Explain how Islam supports the acquisition of scientific knowledge
- Explain the relationship between different branches of science.
- Describe the limitations of science.

1.1 Science and its Nature

Humankind has always been inquisitive, needing to understand why things behave in a certain way, and trying to link observation with prediction. In about 4000 BC, the Mesopotamians tried to explain their observations by suggesting that the Earth was the center of the Universe, and that the other heavenly bodies moved around it. Humans have always been interested in the nature and origins of this Universe. But they weren't only limited to astronomy.



Fig: 1.1 Iron Age tools used for daily life activities

The extraction of iron, which led to the Iron Age, is a chemical process which early metallurgists developed without understanding any of the science involved. Nevertheless, they were still able to learn the extraction by trial and error.

Before this, copper and tin were extracted which led to the Bronze Age and later, zinc. Nobody exactly know how each of these processes was discovered, but it is likely that they were developed using observation and experiments

in a similar way to that used by today's scientists. These early developments are clear evidences that Science and Scientific Attitude is something which is part of human nature.



Fig: 1.2 Neander Age tools

The word science is originated from Latin word "scientia" which means, "to know". It is an organized form of knowledge obtained by observation and experimentation.

It is the knowledge, which is systematic, tested and brought under general principles. It helps to understand and describe various processes and phenomena, which are taking place around us.

For every branch of knowledge there is a specific way to study it. In order to study Science we use scientific method of study. This systematic approach to the study of science has made it different to other branches of knowledge like history, literature etc.

Over the last few hundred years we have seen that the use of the scientific method as a way of learning about the natural world has yielded useful technologies and discoveries.

Scientific method involves collecting data, developing hypotheses about that data, and then testing those hypotheses with experimentation. This practical approach in science to issues related to our day to day problems has made it unique from other branches of knowledge.

1.2

Human Curiosity and Social Development

Human beings have innumerable range of characteristics. Some are innate, some are formed through experiences and some are developed through wisdom and understanding.

One of the most fundamental of these human features is that of curiosity. It is the curious nature of man that has led him to wonder, ponder and then learn.

It is curiosity in man's nature which drives him to understand different phenomena in life identify his problems and work to find their solutions, build communities and develop societies.

Though modern science is of relatively recent origin, it has made very rapid progress and completely transformed our lives in the past one hundred years than it did in thousands of years earlier.

Scientific knowledge has been accumulated over the last three centuries and its practical application in the form of technology has made a great impact on our lives. For example, rise in population has created a demand for higher yield and pest resistant crops.

Progress in the field of agriculture addressed these problems and now we see that quality of food has been improved and quantity of food has been increased.



Fig:1.3 Use of modern technology has revolutionized the agriculture sector.

The modern technology has made the agriculture a profitable business. The use of modern machines like tractors, scrapers, harvesters and tube wells have greatly helped the man to get maximum production.

With the help of modern technology to a certain extent we have been able to overcome the deadly menace of water logging and salinity. By doing so, a vast land has been reclaimed and used for agriculture.

Tissue culture and genetic engineering techniques are playing prominent roles in increasing the yield by producing disease and drought resistance varieties. Modern technology has also played an important role in the field of medicine.

For Your Information

In 1967 the World Health Organization (WHO) started a worldwide campaign to eradicate smallpox. This goal was accomplished in 10 years due to massive vaccination efforts.

The last case of smallpox occurred in Somalia in 1977. On May 8, 1980, the World Health Assembly declared the world free of smallpox.

Many epidemic diseases such as, Plague, Cholera, Typhoid, Polio and Pneumonia, which were known as killer diseases, have now been controlled with the help of vaccines and drugs. In the near past these diseases played havoc with the human society.

The diagnosis of diseases is very important for its proper treatment. The modern scientific studies have analyzed and discovered each and every part of human body and its working. Many instruments have been devised for the proper diagnosis of the diseases. X-rays, sonography, biopsy etc which help in the diagnosis of diseases.



Fig: 1.4 Sonography or ultrasound is being used as an effective way of monitoring the development of fetus in the mother body.

The Laser technology is used to kill the cancer cells and also has its applications in the field of microsurgery.

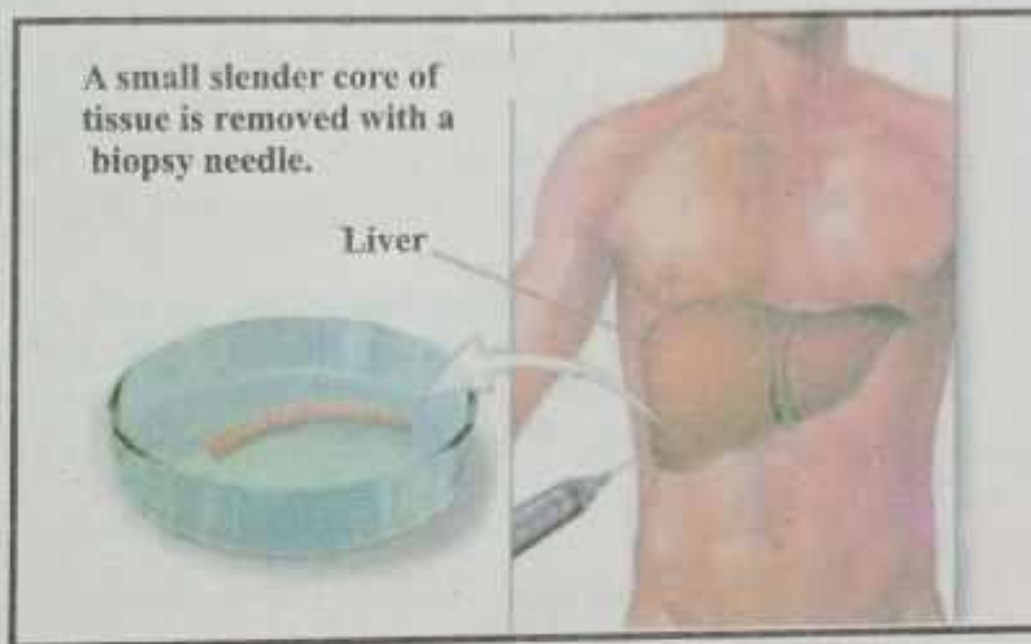


Fig: 1.5 A biopsy is a medical test involving the removal of cells or tissues for examination.

Treatment of retina with the help of laser is an example of microsurgery. The repair of the heart valves, the bypass grafting and the use of pace maker is very helpful to heart patients.

The field of transplant of organs has also gained great importance. Transplant of eye, heart, kidneys and lungs is now a common feature.

Although at present we have not been able to find cure for a number of diseases, yet it was the scientific attitude of the scientists which made possible the control and cure of several fatal diseases. Vaccination against various diseases is considered as a major step towards the development of healthy future.

Same is the case with communication technology. People are in touch with each other even if they are separated by thousands of kilometers. Telecommunication has been greatly facilitated by the use of inter-continental satellite system.

Internet has revolutionized our life. Rapid land and air traveling has become possible. Energy has been vital for human activities. New energy resources have been discovered. Alternate form of energy resources have been identified keeping in view the limitation posed by the fossil fuels.

In this short account we saw how human curiosity lead to the identification of problems and their possible solutions which has ultimately made our life comfortable, healthy and more secure and our living standards have risen with the passage of time.

1.3 Contributions of Muslim Scientists

Muslim scientists and scholars have contributed immensely to human knowledge especially in the period between 7th and 13th century. A brief contributions of a few Muslim Scientists are given below briefly;

a. Jaber bin Hayyan (722 – 817 A.D)

Jaber bin Hayyan is considered to be the father of chemistry. He had established his own laboratory.

He invented sulfuric acid, nitric acid, hydrochloric acid and several other important compounds.



Fig: 1.6 Jaber bin Hayyan

Jaber bin Hayyan defined chemical reactions as union of the elements together in small particles too small for the naked eyes to see without loss of their character, as John Dalton (1766-1844), the English chemist and physicist discovered this reality ten centuries later.

His contribution to chemistry also includes some important scientific techniques such as crystallization, distillation, sublimation and evaporation.

b. Muhammad bin Zakriya Al- Razi (865 – 930 A.D)

Muhammad bin Zakriya Al –Razi was a great physician of his time. Before learning medicine, he studied philosophy, alchemy and music. At an early age he gained eminence as an expert in medicine and alchemy. Patients and students flocked to him from distant parts of Asia.



Fig:1.7 Muhammad bin Zakriya Al- Razi

One of his landmark contribution is Al-Hawi. It was the largest medical encyclopaedia ever composed till that time, containing all important information that was available from Greek and Arab sources.

Another major contribution is Kitab al-Mansuri fil-tibb. In this books he has written about the diseases, their 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. Al- Razi was the first man who used opium for anesthesia.

c. Ibn-ul-Haitham (965 – 1039 A.D)

Ibn-ul-Haitham is a renowned physicist of all times. He gave the basic principles of reflection and refraction of light. He worked on lenses and explained the working of eye. His famousbook "Kitab-Al-Manazir" was translated into Latin. He is considered the father of optics.



Fig.1.8 Ibn-ul-Haitham

d. Al- Bairuni (973 – 1048 A.D)

Al-Bairuni was a great scholar of physics, mathematics, geography and astronomy. He travelled through subcontinent and recorded his observations in his famous book "Kitab-ul-Hind".

In another famous book, "Qanoon-al-Masoodi Fil Hayat wan-Najoom" he has discussed astronomy, solar and lunar motions. He has written more than 150 books on various topics.



Fig: L.9 Al- Bairuni

His major contribution was to determine the diameter of Earth. His observatory was located in district Jehlum of Pakistan

e. Bu- Ali- Sina (980 – 1037 A.D)

Bu-Ali-Sina was the greatest scientist of his time. He wrote more than 100 books about medicine, science, philosophy and literature. His famous book about medicine, "Al- Qanoon Fil-Tib" was prescribed as a text book in medical institutes of Europe till 17th century.



Fig: L.10 Bu- Ali- Sina

In another famous book "Al- Shifa" he made useful contributions to physics, chemistry, arithmetic, biology and even music.

Ibn Sina was also the first physician to describe meningitis (Meningitis is a bacterial infection of the membranes (meninges) covering the brain and spinal cord), parts of the eye, and the heart valves, and he found that nerves were responsible for perceived muscle pain.

1.4 Important Contributions of Peoples and Cultures to Scientific Innovations

The history of science is as old as human. The growth of science is a gradual process and it has taken a very long period of time to achieve the present status. The growth of scientific processes can be divided into four periods.

a. Greek Period (300-600 BC)

During this period great philosophers and scientists contributed a lot to the knowledge of science. Aristotle, Archimedes, Galen and Pythagoras are a few important names of this period. Greeks were the first to try and develop the theory on the basis of their observations. Pythagoras concentrated on a mathematical view of the world. Aristotle and Plato developed logical methods for examining the world around them. Similarly, it was the Greeks who first suggested that matter was made up of atoms — fundamental particles that could not be broken down further.

b. Muslim period (700-1300 AD)

The Muslim thinkers and scientists made valuable contributions to the field of chemistry, physics, medicine, mathematics and astronomy. They took full benefits of the Greek contributions and added their own research and observations to make it more logical. Jaber bin Hayyan, Muhammad bin Zakriya Al-Razi, Ibn-ul-Haitham, Al-Bairuni and Bu-Ali-Sina are a few great names of the Muslim period. Their contributions to Science have been already discussed.

The most important contribution of Muslim Scientists was their practical and experimental approach to solve scientific problems.

c. European Period (1700-1900 AD)

During 17th to 19th century scientific studies and research was conducted in European countries. The European scientists took great advantage of Muslim work. Many books of Muslim scientists and scholars were translated into English, French and German languages. These books are still available in the libraries of these countries.

It was in the 17th century that modern science was really born, and the world began to be examined more closely, using instruments such as the telescope, microscope, clock and barometer. It was also at this time that scientific laws started to be put forward for such phenomena as gravity, motion and the relation of volume, pressure and temperature of a gas. Much of basic biology and chemistry was developed in this period which is called as the Age of Enlightenment.

The 19th century saw some of the great names of science: people like John Dalton, who developed the atomic theory of matter, Michael Faraday and James Maxwell who both put forward theories concerning electricity and magnetism, and Charles Darwin, who proposed the (still) controversial theory of evolution.

d. Recent Period

In the 20th century the growth of scientific knowledge has been marvelous. It has revolutionized the human life. Super computers, genetic engineering, laser surgery and transplantation of human organs are the major achievements of 20th century. Nuclear energy and space invasion has opened new dimensions of scientific achievements

SOME EMINENT PAKISTANI SCIENTISTS

Dr. Abdus -Salam was born in 1926. He was a world fame physicist and was awarded Nobel Prize. His contribution was the presentation of theory of unification of two of four basic forces governing the universe. It was the great achievement in the discipline of physical sciences.



Dr. Abdul Qadeer Khan was born in 1936. He is the world fame Pakistani nuclear scientist, who excelled in the field of enrichment of uranium. Along with other scientists he successfully tested the nuclear devices at Chaghi in Balochistan on May 28, 1998. He established Kahuta Research Laboratories (KRL).



Dr. Ashfaq Ahmad Khan was born in 1930. He is an eminent nuclear scientist of Pakistan and remained chairman of Pakistan Atomic Energy Commission for 10 years. He established Global Change Impact Studies Center (GCISC). In recognition of his services, he was awarded the highest civil award of Nishan-i-Imtiaz by the Government of Pakistan.



Dr. Munir Ahmad Khan was born in 1926. He participated in various courses of International Institute of Nuclear Technology. He also served the International Atomic Energy Agency (IAEA) in Vienna. He contributed in the development of Science and Technology by the way of associating himself in the establishment of various research and teaching organizations including PINSTECH and Centre for Nuclear Studies.



Dr. Samar Mubarak Mand was born in 1942 in Rawalpindi. He joined Pakistan Atomic Energy Commission in 1962. During his professional carrier, he earned specialization in Application of Lasers, Fiber Optics Technology, Nuclear Instrumentation, Nuclear Diagnostics and Missile Technology.



1.5 Islam and Science

The Islamic world was in the midst of its "Golden Age," between 7th to 13th centuries paving the way for the growth of modern sciences. Rather than stifling science, the religion of Islam encourages its study.

In Islamic era scientific inquiry was widespread, and some of the greatest scholars and scientists of the world made unprecedented discoveries and inventions. Muslims led the world in the study of medicine, astronomy, mathematics, geography, chemistry, botany, and physics. They transmitted their studies to the West, where their work was built upon and further disseminated.

Islamic teachings are of universal and everlasting values. In the Holy book "Quran" great emphasis has been laid on the acquisition of knowledge. We find several verses in Quran that stimulate the man to seek knowledge and to ponder over the various processes and phenomena occurring in the universe and also exploring oceans, space, heavenly bodies etc.

The Holy Quran invites the man to travel and search the hidden realities of universe. The basic laws that govern the vital processes of life were explained in the Holy Quran.

There is no better example of close link between Islam and acquisition of knowledge than the saying of Prophet Muhammad (PBUH), "to acquire the knowledge is the duty of every Muslim man and woman".

Following are a few verses from Holy Quran that stress the acquisition of knowledge and search.

The Qur'an calls upon Muslims to look around them and study the physical world, so that they might appreciate the majesty of Allah's creation:

"Behold! in the creation of the heavens and the earth; in the alternation of the night and the day; in the sailing of the ships through the ocean for the benefit of mankind; in the rain which Allah Sends down from the skies, and the life which He gives therewith to an earth that is dead; in the beasts of all kinds that He scatters through the earth; in the change of the winds, and the clouds which they trail like their slaves between the sky and the earth -- (Here) indeed are Signs for a people that are wise.

"(Surah Al-Baqarah 2:164

"They ponder over the creation of earth and heavens (skies)"

(Sura Al -Imran, Ayah: 191).

"Indeed, the Creation of earth and heavens (skies), the difference of day and night, are the indications for the wise and intelligent"

(Sura Al -Imran, Ayah: 190).

"And He is the Allah, who created every living thing from water, out of them, some crawl, some are tetra-pods (four legged) and some are bipedal (two legged). Allah creates what he pleases. He the almighty and creator"

(Sura Nur, Ayah: 45).

Science is studied keeping in view the principles of scientific method. Scientific method is limited to a process which is measurable and repeatable. By definition, it cannot speak to issues of ultimate origin or morality. For such answers, science is dependent on the values and personal beliefs of those who use it. Science, therefore, has great potential for both good and evil. It can be used to make vaccines or poisons, nuclear power plants or nuclear weapons. It can be used to clean up the environment or to pollute it.

Science by itself offers no moral guidance or values to govern our lives. All science can do, is to show how natural law works, while telling us nothing about its origins.

Mankind has never devised a better tool for solving the mysteries of the universe than science. However, there are some kinds of questions for which scientific problem solving is not suitable. In other words, **science has limitations**.

There are three primary areas for which science can't help us answer our questions. All of these have the same problem: The questions they present don't have testable answers. Since testability is so vital to the scientific process, these questions simply fall outside the venue of science.

The three areas of limitation are;

1. Science can't answer questions about value. For example, there is no scientific answer to the questions, "Which of these flowers is prettier?" or "which smells worse, "Which is more valuable, one ounce of gold or one ounce of steel?" Our culture places value on the element gold, but if what you need build a skyscraper with then off course gold, a very soft metal, is pretty useless. So there's no way to scientifically determine value.

2. Science can't answer questions of morality. The problem of deciding good and bad, right and wrong, is outside the determination of science.

3. Finally, science can't help us with questions about the supernatural. The prefix "super" means "above." So supernatural means "above (or beyond) the natural world phenomenon."

The toolbox of a scientist contains only the natural laws of the universe; supernatural questions are outside their reach.

1.7 Process by which accepted ideas are challenged or extended by Scientific Innovation

Science is more than a body of knowledge and way of developing and validating that knowledge. It is also a social activity that reflects human values, including curiosity, creativity, and skepticism.

Scientific inquiry as both content and as a process for learning provides opportunities for students to develop critical thinking, and deepen their understanding of science contents.

Science is continually changing, though, and some innovative science ideas can challenge and even unseat widely accepted historic ones.

Scientific knowledge is based upon observations of the natural world. While some scientific ideas are theoretical and are derived from logic and reasoning, all scientific ideas must ultimately conform to observational or experimental data. Quantitative and qualitative data, forms foundation for scientific knowledge.

Scientific knowledge is both reliable and tentative. It should not be viewed as absolute, but tentative and revisionary. For example, many scientific ideas have remained largely unchanged over long periods of time; however, scientific knowledge can change in light of new evidence and new ways of thinking. New scientific ideas are subject to skepticism, especially if they challenge well-established scientific ideas. Once generally accepted by the scientific community, scientific knowledge is durable. Therefore, it is reasonable to have confidence in scientific knowledge.

Scientific knowledge is the product of creative thinking. Scientists do not solely rely on logic and rationality. In fact, creativity is a major source of inspiration and innovation in science. Scientists often use creative methods and procedures throughout investigations. Scientists use many methods to develop scientific knowledge. There exists no single "scientific method" used by all scientists. Rather, scientists use a variety of approaches to develop and test ideas and to answer research questions.

Principal strength of scientific knowledge is that it can change as needed and required to better fit existing data. However, it is important to realize that change in science is not arbitrary. Scientific knowledge changes only as a result of further inquiry, debate, collaboration, and evidence. Thus, changes in science move our understandings toward important "truths" about the natural world.

Although these truths should not be viewed as absolute or final, they are among the most reliable that we have at any given point in time. No other means of inquiry has proven more successful or trustworthy. One need only consider the advances in science-related fields such as medicine, agriculture, and engineering, for verification that science works.

1.8 Relationship between Different Branches of Science

Science is referred to as a system of objective knowledge obtained through deep researches done by the human being. In the scientific process observations, reasoning and experimentation are the basic tools. With the help of scientific methodology, the scientists have described many objects and solved many problems. Science is applied in every field and every aspect of life.

With the help of scientific inventions and techniques, we have got all the latest facilities and high living standards. To make the scientific knowledge more systematic, it has been divided into several branches and sub-branches.

1.9 Pure and Applied Sciences

The sciences that describe the physical universe are categorized in different ways. The largest distinction in science is whether a science is pure or theoretical or whether it is applied or practical. Pure science explains a phenomenon, while applied science determines how a particular phenomenon may be put to use. In general, pure science is divided into the following categories:

- Physical sciences, which deal with matter and energy and allow us to describe the material universe in terms of weight, mass, volume and other standard objective measures.
- Earth sciences, which explain the phenomena of Earth, its atmosphere, and the solar system to which it belongs.
- Life sciences, which describe living organisms, their internal processes and their relationship to each other and the environment

The physical science is associated with the nature and behavior of energy and matter. Physics includes the study of time, light and gravity. Chemistry deals with the properties, composition, structure and reactions of the matter. Astronomy involves the study of the universe beyond the earth. The earth science that involves the study of structure and composition of the earth includes different branches such as geology, oceanography, meteorology, paleontology, etc. Life science is also known as biology, which deals with the study of evolution, development, distribution, origin, structure and function of the living things. It is categorized into different branches such as botany, genetics, zoology, medicine, etc. The mathematical science involves different branches such as arithmetic, algebra, geometry and calculus.

However, these three categories of pure science have areas of overlap, where one type of phenomenon may be associated with another. For example, light (studied in physics) is the energy source behind the (chemical) process of photosynthesis, or food production, in plants (studied in biology). For this reason, distinctions between pure sciences, and even between pure and applied sciences, can blur, and a new compound science can develop. An example of this is biochemistry, in which the chemical processes of living things (such as photosynthesis, blood chemistry etc.) are observed and explained. Other examples are biophysics, biostatistics and environmental chemistry.

Science and technology (S&T) influence society as never before. Scientific achievements continue to push back the frontier of knowledge and increasingly contribute to the technological progress that affects how we live and work. New technologies help to protect the environment, to build safer homes, schools and factories, and to develop energy-saving transport systems. Advances in genetics save lives and improve health standards throughout the world.

Information and communications technologies (ICT) have enhanced productivity in the advanced economies and made it possible for a greater number of individuals, firms and countries to take part in the knowledge-based economy.

Continuing progress in biotechnology, nanotechnology and Information Technology, including broadband technologies, promises further improvements in living standards and economic field.

For Your Information

Nanotechnology is the study of manipulating matter on an atomic and molecular scale. It deals with developing materials, devices, or other structures possessing at least one dimension sized from 1 to 100 nanometres.

KEY

POINTS

- Science is an organized form of knowledge obtained by observation and experimentation. It is the knowledge, which is systematic, tested and brought under general principle.
- Curious nature of man has led him to wonder, ponder and then learn. It is curiosity in man's nature which drives him to understand different phenomena in life.
- The word science is originated from Latin word "Scientia", which means to know.
- Science can help us in predicting various phenomena and facts
- The Holy Quran lays emphasis on acquisition of knowledge.
- Muslims scientists and philosophers have made many contributions in various fields of science.
- All the branches of science are inter related to each other.
- Science is playing an important role in improving our living standards.
- Although science is successful in achieving certain goals but it has certain limitation also.

KEY POINTS

- The sciences that describe the physical universe are categorized in different ways. The largest distinction in science is whether a science is pure or theoretical or whether it is applied or practical.
- Science and technology (S&T) influence society as never before. Scientific achievements continue to push back the frontier of knowledge and increasingly contribute to the technological progress that affects how we live and work.
- Information and communications technologies (ICT) have enhanced productivity in the advanced economies and made it possible for a greater number of individuals, firms and countries to take part in the knowledge-based economy.

A. Select the best answers for the following questions.

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- a. Life Science
- b. Earth Sciences
- c. Physical sciences
- d. None of these

B. Answer the following questions in detail.

1. Define science? Describe how the nature of science makes it different from other modes of knowing?
2. Write the contribution of three famous scientists of Pakistan.
3. Muslims scientists made significant contributions in the field of Science. Write some of the prominent contributions of Jaber bin Hayyan, Bu-Ali-Sina and Ibn-ul-Haitham in the field of Science.
4. Do you think The Holy Quran give due importance to the acquisition of knowledge and it compels its reader to ponder over the various processes and phenomena occurring in the universe. Support your answer by quoting some verses of The Holy Quran.
5. Give detail account of different branches of science and their interrelationship with each other.
6. List down some of the important developments in the medical field which have provided relief to humanity.
7. What is the contribution of developments taken place in the field of agriculture and medicines for the welfare of mankind.
8. Write some important contributions of Greek in the field of science.

Unit 2

Chemistry and Life

After studying this chapter the students will be able to:

- Identify the chemical composition of common materials such as plastic, polyester, nylon, polythene, rubber, glass, sugar, table salt, washing powder.
- Compare the physical and chemical properties of element and compounds to assess their potential uses and associated risks (e.g., hydrogen versus helium in balloons, copper versus aluminum in wiring, copper versus lead in plumbing, water and alcohol in thermometers, petrol and diesel in automobiles).
- Describe the recycling of elements and compounds (Cu, Fe, Al, plastic, glass and rubber) and its benefits.
- Investigate how the chemical products (aerosol, CFCs, fertilizers, pesticides) has an impact on our lives and environment.
- Find examples of chemical changes in the events that we encounter daily (burning, rusting, fermentation, respiration and decaying).

Everything around us is composed of chemical elements. Elements are the basic building blocks of our lives. As you know that an element is a pure substance that cannot be decomposed (broken down) into simpler substances. There are about 92 naturally occurring elements. Elements combine with one another in different proportions to form compounds which are everything from the air that we breathe, to the wood that we use to build our homes. Compounds are pure substances made up of 2 or more elements. Compound can be decomposed into simpler pure substances. For example, an electric current can be passed through water to form the elements hydrogen and oxygen.

In our daily life we use variety of products made up of elements and compounds which have made our lives comfortable and enjoyable. At the same we see that due to their frequent use and applications in different activities of life has resulted in the generation wastes of different nature. In this chapter we will study about chemical composition of some common materials along with physical and chemical properties of some commonly used elements and compounds.

2.1 Common Elements and Compounds and their Physical and Chemical Properties

Most of the substances you see in your daily life are the result of chemistry. There are few things in the world on which chemistry has made no impact. If there had been no chemistry, we wouldn't have any plastic, any pharmaceuticals, gasoline, paint, synthetic fertilizer, cleaning products, or synthetic fabrics to name a few. Chemistry has also greatly impacted the fields of genetics, automobiles, information technology, nuclear

energy, medicine, advanced materials, and many more. In this section we will study some common elements and compounds and their physical and chemical properties.

a. Plastic

The word plastic is derived from Greek "plastikos" meaning to mold or form) has become a part of our life, and it is present all around us. It forms much of the packaging for our daily use items like foods, drinks etc.

Plastic is versatile, lightweight, flexible, moisture resistant, durable, strong and relatively inexpensive material. It can be clear or opaque. Due to these wonderful and useful qualities, plastic plays many important roles in life on Earth.

For Your Information

The first man-made plastic was created by Alexander Parkes who publicly demonstrated it at the 1862 Great International exhibition in London. The material called Parkesine was an organic material derived from cellulose that once heated could be molded, and retained its shape when cooled.



However, widespread use of plastic is also causing unprecedented environmental problems, and is causing serious health risks – especially for children.

b. Polyester

Polyester is a manufactured product made from synthesized polymers. It is made from polyethylene terephthalate (PET).

Polyethylene is a type of polymer which is chemically synthesized from molecules that contain long chains of ethylene, a monomer that provides the ability to double bond with other carbon-based monomers to form polymers.

Polyester is mainly used in textile manufacturing. Polyester tends to be very resilient i.e returning to the original form or position after being bent, compressed, or stretched. It dries quickly and is resistant to biological damage such as mold and mildew attacks. polyester is easy to wash, and able to hold forms well.



Fig: 2.2 Textile products made up of polyester catch fire quickly.

Polyester is highly flammable, so care should be taken when wearing it. Most synthetic fabrics are subject to flammability by nature, because they are made from polymers. Polyester is not just a textile. The same material used to make plastic drink bottles.

Many drink bottles are recycled by being reheated and turned into polyester fibers, which in addition to being an efficient use, also helps keep polymers out of landfills.

c. Nylon

Nylon belongs to a family of synthetic polymers known as polyamides. They can occur both naturally and artificially, examples being proteins, such as wool and silk. Nylon can be lustrous, semilustrous or dull. It has an excellent abrasion resistance (The ability of a material to withstand mechanical action such as rubbing, scraping, or erosion that tends progressively to remove material from its surface.) and is highly resilient. Nylon is highly resistance to insects, fungi, animals, as well as molds, mildew and many chemicals.

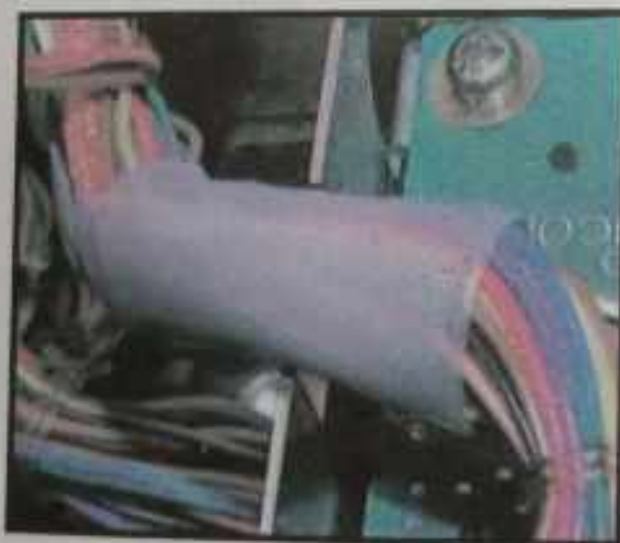


Fig: 2.3 Nylon used in electric cables

Nylon melts instead of burning. Nylon is widely used in daily use products like electrical connectors, gear, bearings, fishing nets, brush bristles, fabric, carpeting, sportswear etc.

d. Polythene

Polythene is formed when polymers of ethene combined together. It is a tough, white, translucent, and waxy thermoplastic. Thermoplastics can be softened by heating. Polythene is produced in two forms: low-density polythene, made by high-pressure polymerization of ethene gas (the monomer), and high-density polythene, which is made at lower pressure by using catalysts.



Fig: 2.4 Polythene Packaging is common nowadays.

Polythene is used in the manufacturing of packaging, bottles, toys, milk containers and the common plastic bag (shopping bag).

The purified form of natural rubber is the chemical polyisoprene, which can also be produced synthetically. Natural rubber is used extensively in many applications and products, as is synthetic rubber. It is normally very stretchy and flexible and extremely waterproof.

Synthetic rubber is an artificial elastomer which can undergo much more elastic deformation under stress than most materials and still return to its previous size without permanent deformation.

Synthetic rubber serves as a substitute for natural rubber in many cases, especially when improved material properties are required.

Rubber is water repellent and resistant to alkalies and weak acids. Rubber's elasticity, toughness, impermeability, adhesiveness, and electrical resistance make it useful as an adhesive, a coating composition, a fiber, a molding compound, and an electrical insulator.

f. Glass

Glass is an amorphous solid (non-crystalline) solid material. Glasses are typically brittle and optically transparent. Glass has been around in various forms for thousands of years and has been manufactured for human use.

Glass occurs naturally when rocks high in silicates melt at high temperatures and cool before they can form a crystalline structure. When manufactured by humans, glass is a mixture of silica (SiO_2), soda, lime and minor additives to add colour.

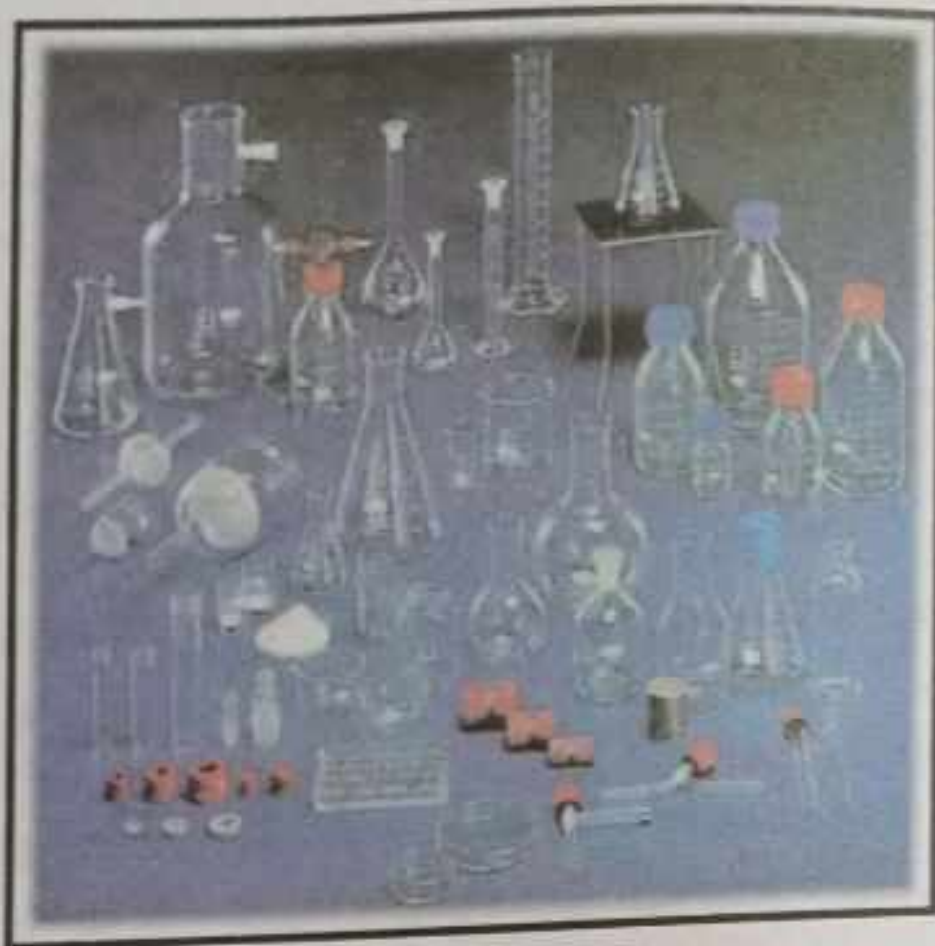


Fig: 2.6 Glass apparatus are common feature in a laboratory.

The elements of glass are heated to 1800° Fahrenheit (982° Celsius). The resulting fused liquid can be poured into molds or blown into various shapes, and when cooled, glass is a strong, minimally conducting substance that will not interact with materials stored inside. As a result, glass is frequently used in scientific laboratories.

Silica is found in a wide variety of natural sources, including, most commonly, sand. Sodium carbonate, or soda, is added to lower the fusion point of silica, making glass light and workable.

Do You Know?

Glass is a strange substance. It is not a solid, not a gas, and not quite a liquid either. Generally, it is classified as a rigid liquid, maintaining liquid properties while acting like a solid. Heat can return the glass to a liquid and workable form, making it easy to reuse and recycle.

.g. Sugar

Sucrose is the organic compound commonly known as table sugar. A white, odourless, crystalline powder with a sweet taste, it is best known for its role in human nutrition.

The molecule is a disaccharide derived from glucose and fructose with the molecular formula $C_{12}H_{22}O_{11}$. Sugar forms a major element in confectionery and desserts. It can also act as a food preservative when used in sufficient concentrations.



Fig: 2.7 Sugar is a common household item of kitchen.

. h. Table Salt

Salt, also known as table salt, or rock salt, is a mineral that is composed primarily of sodium chloride. The taste of salt (saltiness) is one of the basic human tastes. Salt for human consumption is produced in different forms: unrefined salt (such as sea salt), refined salt (table salt), and iodized salt. It is a crystalline solid, white, pale pink or light gray in color, normally obtained from sea water or rock deposits. Edible rock salts may be slightly grayish in colour because of mineral content.



Fig: 2.8 Think for a moment food without table salt?

i. Washing Powder

Washing powders are a combination of soaps, detergents and other chemicals. Sodium sulphate and sodium silicate are added to keep the powder dry. Sodium triphosphate or sodium carbonate is added to make the solution alkaline. This helps to remove dirt and also soften water. Carboxy methyl cellulose is added so that the dirt particles removed are kept suspended in the solution. For obtaining sparkling white clothes, a bleaching agent is added. The bleaching agent is in the form of sodium perborate.

2.2 Physical and chemical properties of elements and compounds

Elements in their individual capacity possess certain properties which play an important role in our daily life activities. When elements combine they form compounds which exhibit their own unique properties. For instance carbon in combination with hydrogen forms hydrocarbons, fuels which burn and steer our life engine. However, when carbon combines with oxygen it forms carbon dioxide, a gas which extinguishes fire.

These and some other unique examples have given elements and compounds a special place in our life. Now when we have enough knowledge about the physical and chemical nature of elements and compounds we have the liberty to pick and choose what suits us most.

In the following section let's study a comparative account of some of the elements in relation to their uses.

a. Hydrogen

Hydrogen is the most abundant element in the universe. Hydrogen is a colourless, highly flammable and light in weight. Pure hydrogen is a gas under normal conditions.

Hydrogen is diatomic i.e. exists as pairs of atoms. It has such a small mass that it can escape earth's gravitational pull and fly off into space. The gas mixes well with air, explosive mixtures are easily formed.

Hydrogen is slightly more soluble in organic solvents than in water. It does not usually react with other chemicals at room temperature.

b. Helium

Helium is a member of the noble gas family. The noble gases are also called the inert gases. Inert means that an element is not very active. It will not combine with other elements or compounds. In fact, no compounds of helium have ever been made.

Helium is the second most abundant element in the universe. Only hydrogen occurs more often than helium. Helium is also the second simplest of the chemical elements.

Its atoms consist of two protons, two neutrons, and two electrons. Only the hydrogen atom is simpler than a helium atom. The hydrogen atom has one proton, one electron, and no neutrons.

For Your Information

Helium has some interesting and unusual physical properties. For example, at very low temperatures it can become superfluid.

A superfluid material behaves very strangely. It can flow upwards out of a container, against the force of gravity. It can also squeeze through very small holes that should be able to keep it out. The Nobel Prize in physics for 1996 was awarded to three Americans who discovered superfluidity. They were David M. Lee, Douglas D. Osheroff, and Robert C. Richardson.

Hydrogen versus Helium in balloons

Although not used much anymore, hydrogen balloons were once quite popular. However, it is highly flammable, so the slightest spark can cause a huge explosion. Hydrogen is explosive and helium is inert. Helium is less dense. Because helium is lighter than air, a helium balloon rises. Hydrogen is another gas lighter than air; it is even lighter than helium.

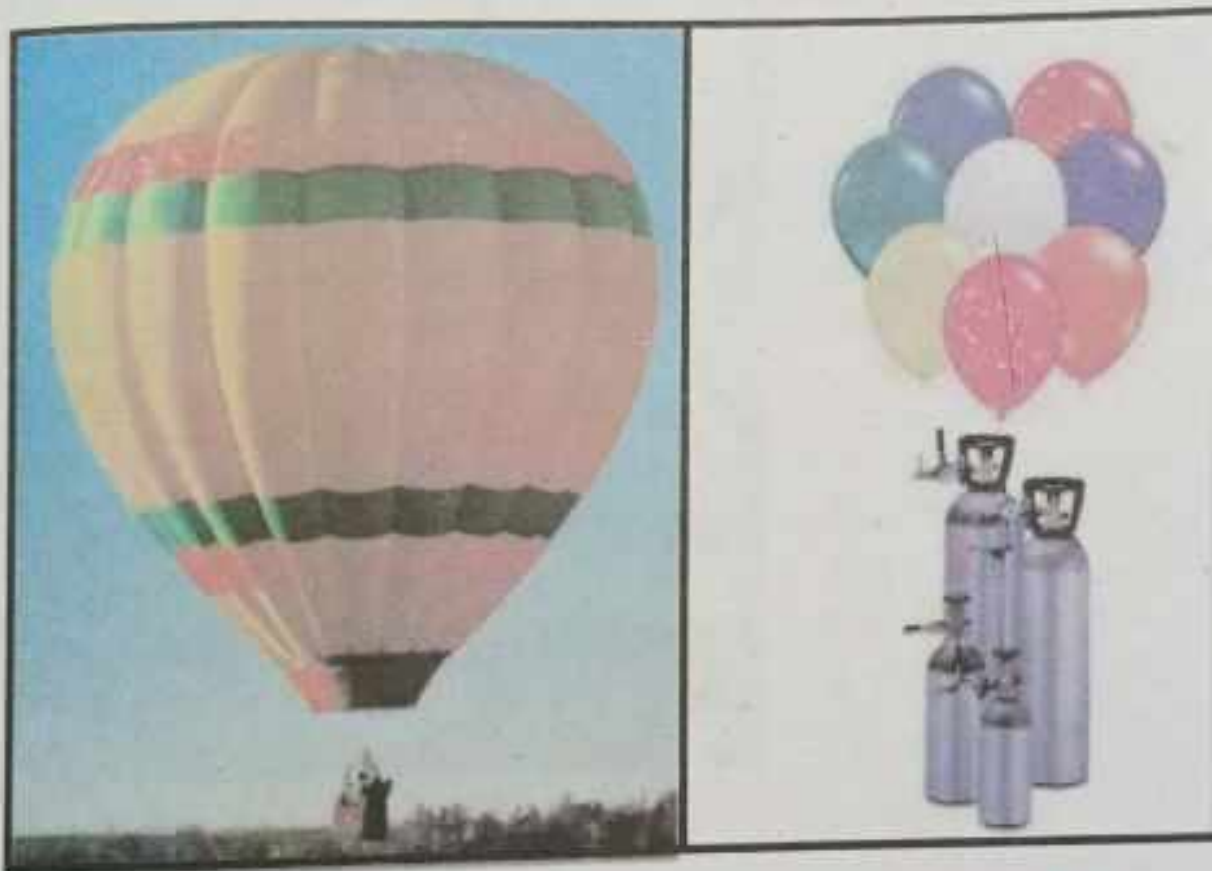


Fig: 2.9 Hydrogen and helium both are lighter than air which makes the balloons to rise in the air.

c. Copper

Copper is **malleable** that is, it can be bent and shaped without cracking, when either hot or cold. It can be rolled into sheets as thin as $\frac{1}{500}$ of an inch.

Copper is ductile, that is, it can be drawn out into thin wire. Copper is second only to silver in its ability to conduct electricity. Besides electricity, copper also is an excellent conductor of heat, making it an important metal in cookware, refrigerators, and radiators.



Fig: 2. 19 Copper is used in the production of various useful products.

Copper is resistant to corrosion, that is, it will not rust. Copper is a moderately active metal. It dissolves in alkalis e.g. Sodium hydroxide. An important chemical property of copper is the way it reacts with oxygen. In moist air, it combines with water and carbon dioxide. The product of this reaction is called hydrated copper carbonate ($\text{Cu}_2(\text{OH})_2\text{CO}_3$).

d. Aluminum

Aluminum is a shiny, silvery white colored metal that is light in weight and strong. The surface of aluminum metal is covered with a thin layer of oxide that helps to protect the metal from attack by air. So, normally, aluminum metal does not react with air. If the oxide layer is damaged, the aluminum metal is exposed to attack. Aluminum will burn in oxygen with a brilliant white flame to form the aluminum oxide, Al_2O_3 .

Copper versus Aluminum in wiring

Copper is the most efficient and reliable electrical conductor for commercial and industrial wire and cable. When compared to aluminum, copper has a significant (1.6 times) ampacity advantage (current carrying capacity). It is easier to install, and is resistant to corrosion.

The true cost of a cable, often referred to as its "life cycle cost," includes the preliminary cost of the cable, as well as the cost of installation, maintenance, repairs, and replacement. While aluminum cable wire is sometimes less expensive to buy than copper, aluminum cable is more difficult to install and is more prone to failure. Therefore, the full life cycle cost of copper cable is lower than aluminum cable.

e. Lead

Lead is one of only a few elements known to ancient peoples. Although lead is a known poison, the mechanical and chemical characteristics of the metal continue to keep lead as an important component in society. Lead is a heavy, soft, gray solid poor electrical conductor, resistant to corrosion. It is both ductile and malleable. It has a shiny surface when first cut, but it slowly tarnishes (rusts) and becomes dull. Lead can be easily bend, cut, shaped, pull and otherwise change shape of the metal.

Copper versus Lead in plumbing

Copper pipes are the standard plumbing material for potable water and heating systems in most of the developed countries of the world. Copper has been used to make drinking vessels, water pipes and containers for thousands of years. Copper is durable. It is strong and resists damage, so copper tube and fittings can be relied on for decades. Due to bacteriostatic quality it inhibits the growth of bacterial and viral organisms in water systems.

Copper tube and fittings can be used in every part of plumbing and heating systems. Copper is strong, it can easily be formed into bends and systems can be assembled. It is capable of withstanding extremes of heat without suffering any degradation. It is resistant to corrosion and high water-pressure. It doesn't burn, it keeps its shape and strength in high temperature environments. In addition, copper piping gives excellent protection against contaminants to the domestic water supply. Copper is completely recyclable without loss of quality, which benefits the environment. However, copper is a considerably more expensive material. Another disadvantage of copper pipe plumbing deals with water acidity. This type of plumbing is only suitable for water that has a pH between 6.5 and 8.5.

Lead comes from many sources, such as car exhausts and old paint work. It may be naturally present in air, food, soil and in water. Lead can be harmful to health, especially for young children and unborn babies. The water from our treatment works supplied through our mains to the boundary of properties contains virtually no lead. But the water can dissolve tiny amounts of lead from the inside of lead supply pipes and internal plumbing. As a result, the water coming out of your pipe may contain more lead than the drinking water standards allow.

f. Water

Water is unique in that it is the only natural substance that is found in all three states - liquid, solid (ice), and gas (steam). Pure water is colourless and has no taste or smell. A molecule of water (H_2O) is composed of one atom of oxygen bound to two atoms of hydrogen. The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water molecule having a positive charge on that side where the hydrogen atoms are present and a negative charge on the other side, where the oxygen atom is present. Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky".

Tidbit

At 0° Celsius water freezes and at 100° Celsius water boils. Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.

Water is called the "universal solvent" because it dissolves more substances than any other liquid. Pure water has a pH of 7 which is regarded as neutral neither acidic nor basic. Water can absorb a lot of heat before it begins to get hot. This is why water is valuable to industries and in car's radiator as a coolant.

g. Alcohol

Most of the common alcohols are colourless liquids at room temperature. Methyl alcohol, ethyl alcohol, and isopropyl alcohol are free-flowing liquids.

Alcohols have an odour that is often described as "biting" and as "hanging" in the nasal passages. Alcohols have applications in industry and science as reagents or solvents. Because of its low toxicity and ability to dissolve non-polar substances, ethanol can be used as a solvent in medical drugs, perfumes, and vegetable essences such as vanilla. Ethanol can be used as an antiseptic to disinfect the skin before injections are given, often along with iodine. Alcohol is also used as a preservative for specimens.

Tidbit

Some alcohols, mainly ethanol and methanol are now being used as fuel.

Alcohol and Water in Thermometers

Most often thermometers use mercury, but alcohol could be used as well since it has a freezing point below 100 degrees celsius.

Water cannot be used in a thermometer because it will freeze at 0°C which will make the use of a thermometer impossible when freezing outside. That's why liquids like alcohol or mercury are used in the thermometers which have a very low freezing point so the liquid thermometer stays a liquid and doesn't start to harden.

The bulb thermometer is the common glass thermometer you probably have used since your childhood. Bulb thermometers rely on the simple principle that a liquid changes its volume relative to its temperature.

Liquids take up less space when they are cold and more space when they are warm. All bulb thermometers use a fairly large bulb and a narrow tube to accommodate the change in volume. The main reason that mercury or alcohol is used in thermometers instead of water is due to the fluctuations that are seen in the boiling and freezing points of water which vary with pressure.

Water is also used as a standard by which the thermometer is calibrated by. Alcohol's low freezing point makes it perfect for measuring low temperatures, but its low boiling point means that high temperatures are hard to measure. Plus, it expands very nicely within the capillary tubes in which it is held. Mercury's low freezing point and high boiling point make it ideal for measuring most temperatures. However, mercury is also very expensive and dangerous.

2.3 Recycling of material

Recycling is reusing materials in original or changed forms rather than discarding them as wastes. In today's world the importance of recycling is of great concern both for the general public and in terms of economy.

The earth's natural resources are being consumed at an alarming rate. Recycling has become a major issue as scientific research has been suggesting for years that the earth is being depleted too fast to sustain a healthy balance. Recycling along with reducing consumption is our best means to counter the damage we have been doing to the earth for centuries.

Let's see how can we recycle some of our daily use products and what benefits we can achieve in this process.

a. Recycling of Glass

It is important to recycle glass because it is 100 percent recyclable. Glass can be recycled endlessly without any loss in purity or quality. Recycling glass lowers manufacturing costs and benefits the environment. Raw materials are conserved, and less energy demand reduces CO₂ emissions.

Recycling of glass is a simple process. Used glass in various forms are collected from consumers. Glass is then taken to a glass treatment plant. The glass is sorted by colour and washed to remove any impurities. It is then crushed and melted, then moulded into new products such as bottles and jars. Or it may be used for alternative purposes such as decorative uses.



Fig: 2:11 Glass bottles are used as container for variety of materials.

The glass is then sent back to be used for a variety of purposes again. Glass does not degrade through the recycling process, so it can be recycled again and again.

b. **Recycling of Copper**

Copper is a ductile metal with very high thermal and electrical conductivity. Pure copper is soft and malleable. It is used as a conductor of heat and electricity, a building material, and a constituent of various metal alloys. Copper is mined to be used for various purposes. It is cheaper to recycle copper than to mine and extract new copper.

Recycled copper is worth up to 90% of the cost of the original copper. Recycling helps to keep the cost of copper products down. Recycling a tone of copper uses 15% of the energy that would be used to mine and extract the same copper. So, recycling helps to conserve fossil fuels and reduce carbon dioxide emissions.

The process of transforming copper scrap into new copper products begins with copper scrap. There are two types of copper scrap: Old scrap comes from the public. It is collected from discarded, dismantled or obsolete products.

For example: copper pipes from old buildings, old taps from a bathroom renovation, old hot water cylinders or disused electrical cable.



Fig: 2.12 Copper scrap ready to be recycled.

New scrap comes from factories which make articles from copper, brass or bronze. Their machines will produce off cuts and shavings that can be collected and returned for recycling.

Activity

Write an article to motivate people to recycle things to avoid production of unnecessary waste produced in daily life.

When copper scrap is received for recycling it is visually inspected and graded, and analyzed chemically if necessary. Scrap material is directly melted and in some cases brought to higher purity while molten (fire refined). Chemical analysis checks the purity level of the copper when the charge is fully melted, and the molten copper is deoxidized and cast into an intermediate shape (billets, cakes, ingots) for further processing.

c. Recycling of Aluminium

Aluminium is the most abundant metal in the Earth's crust, and the third most abundant element, after oxygen and silicon. Aluminium is a soft, durable, lightweight, ductile and malleable metal. It has opened up new dimensions in the last decades. Countless objects that simplify as well as increase the quality of our daily life are partly made of aluminum, for example, CDs, cars, refrigerators, kitchenware, electric power lines, packaging for food and medicine, computers, furniture and aircrafts.

Recycling aluminum saves precious natural resources, energy, time and money. Aluminum cans are unique in that in about 60 days a can is recycled, turned into a new can and is back on store shelves. Aluminum is a sustainable metal and can be recycled over and over again.



Fig: 2.13 Aluminum cans are being collected and large blocks are ready to be recycled as new cans.

The consumer throws aluminium cans and foil which are collected and taken to a treatment plant. In the treatment plant the aluminium is sorted and cleaned and is ready for reprocessing. It then goes through a re-melt process and turns into molten aluminium. This removes the coatings and inks that may be present on the aluminium.

The aluminium is then made into large blocks called ingots. The ingots are sent to mills where they are rolled out, this gives the aluminium greater flexibility and strength. This is then made into aluminium products such as cans, chocolate wrapping and ready meal packaging. In as little as 6 weeks, the recycled aluminium products are then sent back to the shops ready to be used again.

d. Recycling of Plastic

All plastic can be recycled. However, it is difficult to separate (by hand), and different plastics use different amounts of energy to get them back to their original condition.

If there is a mixture of different kinds of plastics in the melt they can separate and degrade the final product. With extra effort and energy, plastic can be re-made into the same quality as the original.

Some plastics can be "upcycled", that is, made into plastic of higher quality than the original. However, much plastic recycling is "downcycling", that is, it is made into materials of lesser quality than the original (garden furniture, garbage bins etc).



Fig: 2.14 Used plastic bottles are being collected for recycling.

During the recycling process the plastic recyclables are sorted at the recycling center and baled. At the mill they are chopped into little bits and cleaned. They are further washed and purified. They are then melted, extruded and chopped into tiny pellets from these pellets various things like plastic bottles are formed.

e. **Recycling of Rubber**

Rubber recovery can be a difficult process. There are many reasons, however why rubber should be reclaimed or recovered. Recovered rubber can cost half that of natural or synthetic rubber. Recovered rubber has some properties that are better than those of virgin rubber.



Fig: 2.15 Imagine what would have happen if rubber could not be recycled?

Activity

Survey your surrounding to find out where your local recycling sites are present.

Producing rubber from reclaim requires less energy in the total production process than does virgin material. It is an excellent way to dispose off unwanted rubber products, which is often difficult. It conserves non-renewable petroleum products, which are used to produce synthetic rubbers.

f. Recycling of Iron

Iron is an important metal used in a variety of ways for different purposes. Scrap iron is an important source for recycling of iron.

The scrap metals is collected and then melted at high temperature. Any of the impurities if present is scraped off from the top of the container of molten metal. The pure molten iron is then poured into casts and cooled.

The blocks of iron can now be used again. It is cheaper and less environmentally damaging to recycle iron rather than to extract it from its ores, in the ground.



Fig: 2.16 Iron scrap being collected for recycling.

2.4 Impact of Chemical Products on our Lives and Environment

In the pervious chapter you have studied how scientific development has made its impact on our lives. Some of the prominent development has been in the field of agriculture, medicine and communication technology. Modern day electronics devices and equipments have raised the standard of living. Now we need not to worry if it is hot and humid summer one can enjoy the coolness and fresh atmosphere created by an air conditioner.

We can now enjoy the freshness of vegetables and fruits for weeks without compromising taste and nutrients. In the agricultural field farmers are using fertilizers, pesticides, high quality seeds for increasing the overall yield of the crops. Fertilizers reenergizes soil by adding necessary nutrients to the soil.

Pesticides and insecticides kills pests and insects which otherwise have a devastating potential to wipe out the whole field in days. All these and other facilities which we have today are not free from harmful side effects.

a. Impact of Fertilizers

The toxic chemicals found in fertilizers can be absorbed into the plants and enter the food chain via vegetables and cereals, although the biggest health risk is when the chemicals seep into the ground water which is then extracted for drinking water.



Fig: 2.17 Adding fertilizers do increase the over all yield but it also have negative impacts on the environment.

This water can contain high levels of nitrates and nitrites which can cause blue-baby syndrome (methemoglobinemia). women.

Mercury, lead, cadmium and uranium are some of the toxic heavy metals that have been found in fertilizers and can cause disturbances of the kidneys, lungs and liver.

b. Impact of Pesticides

Pesticides are designed to kill pests. Many pesticides can also pose risks to people. Health effects of pesticides depend on the type of pesticide. Some, such as the organophosphates and carbamates, affect the nervous system.



Fig: 2.48 Pesticides are used to kill insects damaging the crops.

Others may irritate the skin or eyes. Some pesticides may be carcinogens. Others may affect the hormone or endocrine system in the body.

c. Impact of CFCs

The invention of chlorofluorocarbons (CFCs) in the late 1920s and early 1930s was regarded as safe alternatives to the sulfur dioxide and ammonia refrigerants used at the time. Chlorofluorocarbons were chosen for their safety and for their advantageous chemical properties.

These compounds are low in toxicity, nonflammable, noncorrosive, and nonreactive with other chemical species, and have desirable thermal-conductivity and boiling-point characteristics. These features led to increased demand as more applications arose for CFC use.

Appliances such as refrigerators, freezers, air conditioners and dehumidifiers started using chlorofluorocarbons (CFCs).

However, it is now being proved that these CFCs when released, reacts with ozone in the upper atmosphere, reducing this layers protective properties against ultraviolet radiation.

Scientists have found that overexposure to UV radiation can cause skin cancers and it may suppress proper functioning of the body's immune system and the skin's natural defenses.

d. Impact of Aerosols

Aerosol Spray product are a popular and convenient way to dispense a wide variety of products used in industry today and is one of the most effective and practical packaging methods available.



Fig: 2.19 Aerosol sprays are commonly used in daily life activities.

Aerosol Spray Cans have a sealed container that is made from more than 25 percent recycled metals and is designed for easy recycling when the Aerosol Spray product is empty. Aerosol Products and Aerosol Sprays are easy to use and provide a targeted stream that reduces waste, saves money and are able to reach both large and small spaces very effectively.

Activity

Make a list of aerosol spray generally used in your daily life and list down its contents.

However, use of aerosols products such as air fresheners, polish, deodorants and hair sprays increase the risk of diarrhoea, earache and other symptoms in infants as well as headaches and depression in adults. High levels of Volatile organic compounds (VOCs) may contribute to asthma in toddlers. Air fresheners combined with other aerosol and household products contribute to a complex mixture of chemicals and a build-up of VOCs in the home environment.

2.5 Chemical Change and its Common Examples

Chemical changes take place at the molecular level. A chemical change produces a new substance that wasn't there before. In our daily life we frequently encounter various situations where we experience various examples of chemical changes.

Some of the more prominent among those are discussed below.

a. Burning

Burning or combustion reactions are example of chemical change. These always involve molecular oxygen O_2 . Anytime anything burns (in the usual sense), it is a combustion reaction. Combustion reactions are almost always exothermic (i.e., they give off heat). For example when wood burns, it must do so in the presence of O_2 and a lot of heat is produced. Wood as well as many common items that combust are organic (i.e., they are made up of carbon, hydrogen and oxygen). When organic molecules combust the reaction products are carbon dioxide and water (as well as heat).

b. Rusting

Rusting of iron is an example of chemical change. During rusting the iron (Fe) combines with oxygen (O_2) in the atmosphere and produce iron oxide. In iron, the iron atoms are arranged in a metallic crystalline matrix. When rust occurs, oxygen bonds to the iron atoms (which were not chemically bonded to anything before) to create an oxide of iron.

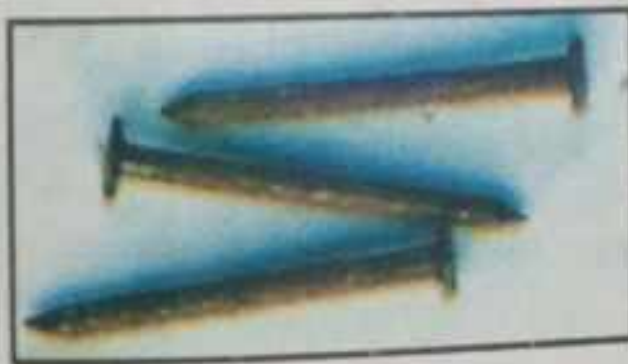


Fig: 2.28 Rust formed on iron nails exposed to air.

c. Respiration

Respiration can be divided into two steps:

1. One of the step in respiration is breathing process during which the body draws fresh air into the lungs. However, this leads to chemical changes - oxygen diffuses out of the air in the lungs into the blood, and carbon dioxide diffuses out of the blood into the air in the lungs.
2. The second step is cellular respiration, in which every cell in the body "burns" sugar (in which energy is stored) in the presence of oxygen to make adenosine triphosphate (ATP), the form of energy storing molecules in the cell. Carbon dioxide and water are the by-products.

d. Fermentation

Fermentation is yet another example of chemical change. It occurs naturally in some foods, such as dough and curds.

It is the process of using yeast or bacteria to convert sugar or other carbohydrates into either an acid or alcohol.

Fermentation only happens in oxygen-free or anaerobic conditions



Fig: 2.21 In industries large scale fermenters are used for the production of various fermentation products.

e. Decomposition

You have studied in your previous classes that in an ecosystem bacteria are acting as decomposers of dead bodies of plants and animals. Decomposition is the break down of complex bodies into their simpler components.

As the bodies of animals and plants are made up of complex chemical compounds and these by the action of bacteria are broken down into simple compounds which are used in the recycling of various elements in nature.

KEY POINTS

- An element is a pure substance that cannot be decomposed (broken down) into simpler substances.
- We use variety of products made up of elements and compounds which have made our lives comfortable and enjoyable.
- Plastic is versatile, lightweight, flexible, moisture resistant, durable, strong and relatively inexpensive material. It can be clear or opaque. Chemically plastic refers to a synthetic high molecular weight chain molecule, or polymer.
- Polyethylene is a type of polymer which is chemically synthesized from molecules that contain long chains of ethylene.
- Nylon belongs to a family of synthetic polymers known as polyamides.
- Polythene is formed when polymers of ethene combined together.
- Natural rubber is an elastomer (high molecular weight compounds consisting of long chains of hydrogen and carbon molecules) that was originally derived from latex, a milky colloid produced by some plants.
- Glass is a mixture of silica (SiO_2), soda, lime and minor additives to add color.
- Hydrogen is a colourless, highly flammable and light in weight.
- Helium is the second most abundant element in the universe.

KEY POINTS

- Copper is second only to silver in its ability to conduct electricity.
- Water is the only natural substance that is found in all three states - liquid, solid (ice), and gas (steam).
- Alcohol is used as a preservative for specimens.
- Recycling is reusing materials in original or changed forms rather than discarding them as wastes.
- Glass is 100 percent recyclable.



EXERCISE

A. Select the correct answers for the following questions.

1. Plastic chemically refers to as
 - a. synthetic high molecular weight chain molecule
 - b. natural high molecular weight chain molecule
 - c. synthetic low molecular weight chain molecule
 - d. natural low molecular weight chain molecule
2. Polyethylene is chemically synthesized from
 - a. long chains of ethylene
 - b. short chains of ethylene
 - c. some are long and some are short chains of ethylene
 - d. long chains of ethane
3. Why it is not desirable to wear clothes made up of polyester?
 - a. it does not clean easily
 - b. it is out of fashion
 - c. it is highly flammable
 - d. it fibres thread apart easily
4. The polymers from which the nylon is made up of are:
 - a. polyethylene
 - b. polyether
 - c. polyesters
 - d. polyamides
5. One of the following is a product of polymerization of ethane gas.
 - a. polyethylene
 - b. polythene
 - c. polyesters
 - d. polyamides
6. Latex is a natural source of :
 - a. rubber
 - b. plastics
 - c. nylon
 - d. polythene

7. Polyisoprene is a purified form of
- rubber
 - plastics
 - nylon
 - polythene
8. A perfect storage container material of chemicals is:
- plastic
 - polythene
 - rubber
 - glass
9. Sand acts as a natural source for the production of which of the following product?
- plastic
 - polythene
 - rubber
 - glass
10. Which of the following chemicals make the washing powder dry?
- sodium triphosphate or sodium carbonate
 - sodium triphosphate or sodium bicarbonate
 - sodium biphosphate or sodium tricarbonat
 - sodium sulphate and sodium silicate
11. Identify the correct statement in the following:
- hydrogen is inert and helium is explosive
 - hydrogen is explosive and helium is inert
 - hydrogen is light and helium is explosive
 - hydrogen is gas and helium is solid at room temperature
12. If copper, aluminum, iron and lead are left in open air which one will rust?
- copper
 - aluminum
 - lead
 - iron
13. Which one of the following will have lower life cycle cost if used as electrical cables?
- copper
 - aluminum
 - lead
 - iron

14. One of the limitations for copper plumbing is
- it leaks easily
 - it is capable of carrying water with a specific pH
 - it is not easy to bend and cut
 - it works only in cold environment

15. Pure water has a pH of :

- 8
- 7
- 6
- 5

16. Thermometer is filled with material which should have:

- high freezing point
- moderate freezing point
- low freezing point
- no fixed freezing point

17. Which one of the following ideal to be used in thermometers:

- water
- alcohol
- benzene
- mercury

B. Write answers for the following questions.

1. Write in detail the chemical composition and some of the prominent chemical and physical properties of the following material.

a. Plastic

b. Polythene

c. Glass

2. Compare hydrogen with helium. Which element is better to be used in balloons?

3. Write the chemical and physical properties of copper and compare it with aluminum. Justify which element is better suited to be used in wiring.
 4. Give a brief description about different materials which can be used in thermometers. Based on their nature justify which is the most suited material for thermometer.
 5. Write three examples of chemical changes which we encounter in our daily life.
 6. Describe the harmful impacts of CFCs, pesticides and fertilizers.
 7. Recycling is the need of the day. Different types of waste material like plastic, glass, rubber etc if not recycled can pose serious threats to environment. Elaborate the statement.
-

Unit 3

Health, Diseases and Prevention

After studying this chapter the students will be able to:

- Explain the relationship among dietary intake eating behaviours, physical activity and emotional health.
- Explain the cleanliness and its importance for health.
- Briefly describe the composition of blood and mention the causes and effects of important blood diseases like leukemia, hemophilia and anemia.
- Describe the viral, bacterial and fungal infection and parasitic diseases in terms of their causes, signs and symptoms, prevention and treatments.
- Relate HIV with the human immune system and describe the ways to cope with the spread of this disease.
- Research the relationship of strokes to the following risk factors: obesity, high-fat diets and smoking.
- Collect and interpret local, national and international statistics on a specific disease spread by germs.
- Design and evaluate a personal action plan for good health and nutrition.
- Analyze ways in which research and medical advance have changed the process which help to prevent, diagnose, monitor and to treat the specific diseases and their spread.
- Describe the first aid of dog bites, snake bites, insect bites and artificial respiration and role play the same situation for the first aid.

Introduction

We all need food for our survival but at the same time merely eating food cannot guarantee us healthy life. The health of an individual and communities are affected by a wide range of contributory factors. People's good or bad health is determined by their environment and situations. Dietary intakes, eating habits, physical activities and emotional health all in one way or the other way affects our health. Health is metabolic efficiency and disease is metabolic inefficiency an abnormal condition of an organism produced as a result of infection, inherent weakness or environmental stress that impairs normal physiological functioning. Being healthy is important because it makes you feel good and live longer. Getting healthy depends on eating the right food, doing the right exercise and knowing what to do if you have an illness or disability. Good health is much more than merely the absence of disease. People generally do not go from a healthy condition to a sick condition overnight – although we feel the problem when the symptoms of illness appear. Our body is extremely effective at achieving and maintaining good health, if it is given what it needs.

3.1 Health and Food

Your food choices play a vital role in how you look and feel. Eating a nutritious and balanced diet is best way to protect and promote good health. We consume a variety of food e.g our dietary intakes may include natural food products, processed food, fast food or junk food.

a. Natural and organic food diet

Natural and organic food diet is a key factor in any nutrition program. By eating natural and organic foods and consuming lots of fruits and vegetables one can ensure good health as one can avoid the use of foods that contain artificial sweeteners and other additives.

It causes the body to build up toxins and generally leads to bad health. Similarly, use of unnaturally occurring fats and oils can also lead to disease.

b. Processed Food

Processed foods have been altered from their natural state for safety reasons and for convenience. The methods used for processing foods include canning, freezing, refrigeration, dehydration and aseptic processing.

We generally think that processed foods are not good for health, but some processed foods are not bad for your health at all. For example, milk would be considered a processed food because it is pasteurized to kill bacteria and homogenized to keep fats from separating.

Another example of good food processing is frozen vegetables. Freezing vegetables preserve vitamins and minerals and makes them convenient to cook and eat all year around. Fruit and vegetable juice is also an example of a healthy processed food. In fact, some orange juice is fortified with calcium to make it even more nutritious.

Of course, there are a lot of processed foods that aren't good for you. Many processed foods are made with fats, and large amounts of sodium and sugar e.g chips, candies etc. These types of foods should be avoided, or at least eaten not frequently.

c. Fast and Junk food

Junk food, also called as fast food, is defined as any food packed with "full of calories", which contains abundance of fat, sugar, sodium, and other chemicals, which has less nutritional value.

v

People especially in big cities take junk food in addition to their routine lunch, dinner e.g burgers, chips, pizza etc.



Fig. 3.1 Fast food items are attractive but these are with less nutritional value.

Fast food nutrition should make up a minimal part of a healthy diet. High fat, sodium and sugar, can lead to obesity and a range of attendant health problems, including diabetes, heart disease and arthritis. Here are the facts about how excessive junk food consumption affects your body.

3.2 Malnutrition, under nutrition, overeating and obesity

Nutrition and physical activity are the two most important factors which influence our health. The balance of nutrients we consume and burn impacts our health. Nutritional imbalances like overnutrition and undernutrition may lead to severe health difficulties.

Overnutrition is frequent or habitual overconsumption of nutrients by eating too much food to the point that it becomes dangerous to your health. Nutrients are all compounds necessary for bodily function, including minerals, vitamins, fats, carbohydrates and proteins.

Although most nutrients can be harmful in excess, the danger of overnutrition relates mostly to carbohydrates and fats.

Undernutrition is the opposite of overnutrition, meaning that it is a nutrient deficiency from not eating enough food. Undernutrition usually affects the balance of all the nutrients in the body. Nonetheless, problems relating to a deficiency in carbohydrates and fats will manifest first.

If a person is undernourished then initially, the body starts using its glycogen or sugar reserves, stored water and body protein. Then, your body consumes stored fatty acids and lean muscle. These two effects of undernutrition result in a dramatic decrease in body weight.

Malnutrition is a condition resulting from not consuming enough nutrients. However, it is not synonymous with undereating – it can occur despite overeating.

This is because proper nutrition requires a balance of all nutrients not present in all foods; this means that your body requires a balance of many different foods.

Tips for Healthy Eating

Eat a variety of fresh and green vegetables. Drink at least 3 cups of milk daily to fulfill your calcium requirements. Make half your grains whole. Take a balanced amount of cereals, breads, rice and protein like meat, fish, beans etc. Eat at least 3 ounces of whole-grain cereals, breads, rice, or pasta each day. Use of saturated fats like banaspati ghee, butter should be limited to 10 percent of your calories used. Unsaturated fats like vegetable oils, fish and nuts should be preferred. Excessive use of salt should be avoided to reduce the risk of heart diseases. Use of less than 1 teaspoon of salt each day is generally recommended.

Even in the case of overnutrition, when you may be eating too much food, you can still develop a deficiency in certain nutrients if you fail to consume the proper variety foods.

Other causes of malnutrition unrelated to the amount of food you eat include digestion or absorption problems and certain medical conditions e.g. if a person takes rice only in his diet, he may suffer from protein deficiency.

Activity

Visit a super market , select a few bottled, canned, or packet foods. fpr each item look carefully at its labels and record the amount of carbohydrate, fats and protein it contain. Organize your data and work out the total amount of energy each item can supply. 1gram of carbohydrates gives 16Kj of energy, 1gram of proteins gives 16Kj of energy, 1gram of fats gives 16Kj of energy.

3.3 Physical Activity and Health

People of all ages, both male and female, benefit from regular physical activity. Significant health benefits can be obtained by doing a moderate exercise e.g., 30 minutes of brisk walking, 15 minutes of running, or 45 minutes of playing volleyball daily. Physical activity reduces the risk of premature death in general, and of coronary heart disease, hypertension, colon cancer, and diabetes mellitus in particular.



Fig: 3.2 Physical activities are vital for healthy growth in children.

Physical activity also improves mental health and is important for the health of muscles, bones, and joints.

14 Rest and Sleep

Humans are not created to work indefinitely. Keeping yourself working is great, but there has to be some limits. There should be some balance between times when you are being productive and times when you are resting.

Health really does depend on our ability to get enough rest and sleep. If we try to keep going without any breaks, we may start feeling exhausted, tired, and worn out. Rest can take different shapes and forms. It can be a relaxing sleep at night.

Getting enough sleep is important for adults as well. That is the time when your brain grows intellectually. How much sleep you need depends on your age and health status. Infants, children, and even teenagers need more sleep than full grown adults because growth happens at night while they are sleeping.

Processes active in the body during sleep

While you rest and sleep your body cleanses, repairs, heals, renew itself. Your body gets revived, the tissues of your brain get restored, new information and memories are stored, and your nerves get recharged.



If you are not getting enough sleep, your body will not be able to rebuild itself and recharge itself properly. Your body will begin to suffer.

Modern research has proved that insufficient rest and sleep can even shorten life of an individual. Lack of sleep can also put people at higher risk for accidents.

-3.5 Abuse of Drugs and Smoking

People use and experiment with drugs for many different reasons. Generally people try drugs out of curiosity, to have a pleasurable time. They may start using drugs just because their friends are doing it, or in an effort to improve athletic performance or ease problems, such as stress, anxiety, or depression.

If your drug use is causing problems in your life you likely have a drug abuse or addiction problem.



Fig: 3.3 Drug addicts unfortunately a common sight in every city of Pakistan.

Taking a recreational drug causes an increase in levels of dopamine in the brain, which trigger feelings of pleasure.

Brain remembers these feelings and wants them repeated. It makes a person to use these drugs again and again and become addicted.

Drug abuse interfere with the ability to think clearly, exercise good judgment, controlling behavior, and feel normal.

Common signs and symptoms of drug abuse

Although different drugs have different effects, the symptoms of addiction are similar. Some of the common signs and symptoms of drug abuse are:

- Neglecting responsibilities
- problems in relationships, such as fights with family members etc.
- Nausea, restlessness, insomnia, depression, sweating, shaking, and anxiety.
- Avoiding activities such as hobbies, sports, and socializing
- Red eyes, pupils larger or smaller than usual.
- Changes in appetite and sudden weight loss or weight gain.
- Unusual smells on breath or from body or clothes.
- Drop in attendance and performance at work or school.
- Sudden change in friends and hobbies.
- Frequently getting into trouble (fights, accidents, illegal activities).

a. Why quit smoking?

Smoking is regarded as a first step before someone gets into some serious drug addiction. Although the harms related to smoking are not seriously considered and very easily ignored especially among the teenagers who considered it be one of the fashionable things to be proud of, but infact it is the first step towards self destruction.

The damage caused by smoking is influenced by the number of cigarettes smoked and whether the cigarette has a filter or not.

Tidbit

On average, each cigarette shortens a smoker's life by around 11 minutes, and reduces life expectancy by seven to eight years.



Cigarettes contain more than 4000 chemical compounds and at least 400 toxic substances. When you inhale, a cigarette burns and breaks down the tobacco to produce various toxins. The products that are most damaging are:

- tar, a carcinogen (substance that causes cancer)
- nicotine is addictive and increases cholesterol levels in your body
- carbon monoxide reduces oxygen in the body

Major diseases caused by smoking

a. Cardiovascular disease

Cardiovascular disease (diseases related to heart and vessels) is the main cause of death due to smoking.

Hardening of the arteries is a process that develops over years, when cholesterol and other fats deposit in the arteries makes it narrow, blocked or rigid.

When the arteries narrow (atherosclerosis), blood clots are likely to form. Smoking accelerates the hardening and narrowing in arteries. Blood clots in the heart and brain are the most common causes of sudden death.

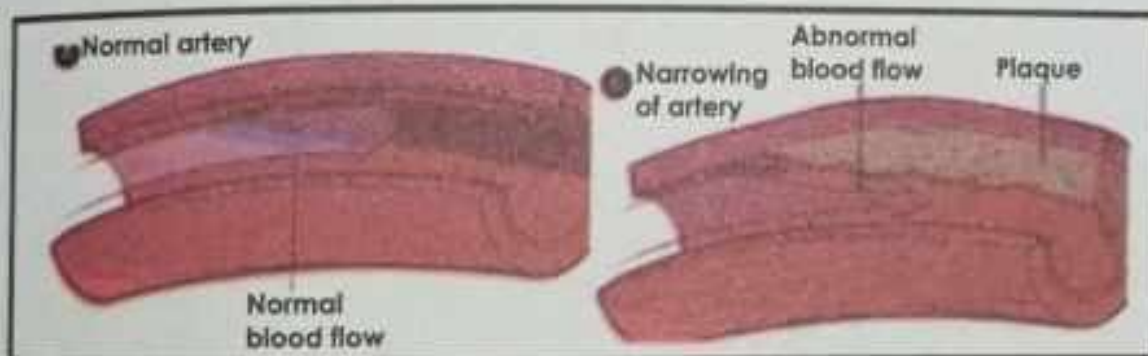


Fig: 3.4 Smoking accelerates the hardening and narrowing in arteries causing atherosclerosis as is seen in fig B where plaque has narrowed the path of blood.

b. Cancer

Smokers are more likely to get cancer than non-smokers. This is particularly true of lung cancer, throat cancer and mouth cancer, which hardly ever affect non-smokers.

WARNING
SMOKING DAMAGES
YOUR TEETH

Smoking stains your teeth and gums. Smoking increases your risk of periodontal disease, which causes swollen gums, bad breath and teeth to fall out.

**Passive Smoking**

There are many health-related reasons to give up smoking—not just for smokers, but to protect those people who are around. Children who grow up in a home where their parents and relatives smoke have twice the risk of getting asthma and asthmatic bronchitis. They also have a higher risk of developing allergies. For adults, passive smoking seems to increase the risk of lung cancer.



Cleanliness and Importance for Health

In the Holy Quran, there are a number of verses which throw light at the importance of cleanliness:

"Truly, Allah loves those who turn to Him constantly and He loves those who keep themselves pure and clean."

(Al Baqarah 2:222)

At another place Allah says:

"In it (mosque) are men who love to clean and to purify themselves. And Allah loves those who make themselves clean and pure."

Surah-e-Taubah (9:106)

Cleanliness and purity has been also emphasized in Hadith of the Prophet (peace be upon him). In a Hadith he said:

Cleanliness is half of faith.

(Sahih Muslim Book 2, Number 0432).

Cleanliness, is the most essential practice for good health. The widely accepted definition of health is that given by the World Health Organization (1948).

According to this definition "Health is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity". This definition covers three specific aspects-the physical, the mental and the social.

Islam is a religion of purity and it emphasizes purity of all sorts. The noble soul can reside only in a clean body. Only by maintaining the outer cleanliness, one can obtain inner purity. As for as personal hygiene The Holy Qur'an teaches great importance to personal and environmental cleanliness.

Think for a moment do you know what dirt holds for you? It is the source of different microorganisms like parasites, bacteria, fungi and viruses which cause diseases. Will you permit these microscopic organisms ruin your health?

Eating clean food is very important. We shall take care of all the utensils and the raw ingredients of our food as being clean. Cleanliness in our toilets should also be maintained. A daily bath prevents skin infection and a habit of hand washing, especially after using the toilet and, before eating should be implemented.

3.7 Blood and Its Composition

Blood is a body fluid that delivers essential substances like nutrients and oxygen to the cells of the body. Blood also transports carbon dioxide and other waste products for removal from the body. In addition, the blood also helps fight infection.

Our body has billions of cells that need regular supply of fuel and oxygen to function. Blood meets these requirements and ensures proper functioning of cells, thus, also making sure that our body keeps in good health.

An average adult human body has about five liters of blood. Blood in our bodies is pumped by the heart through a network of arteries and veins. It is interesting to note that even the heart cannot survive without blood flowing through the vessels that bring nourishment to its muscular walls.

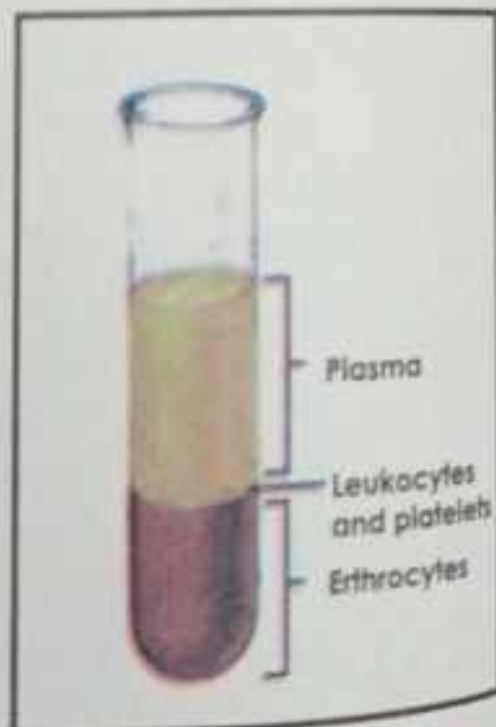


Fig: 3.5 Blood and its components

Blood is composed of a large variety of dissolved and suspended materials. The blood contains nutrients (digested substances), protein, gases, hormones, water, etc. If some human blood is collected from a person and placed in a test tube after adding some anti-coagulants to prevent it from clotting, you will notice that it quickly separates into two layers. The upper layer is yellowish and semi transparent (plasma) while lower layer is thick and reddish in colour (blood cells).

Blood is made of three specialized elements called erythrocytes (red blood cells), leukocytes (white blood cells) and platelets that are suspended in a complex liquid called plasma. The constant flow of blood keeps the cells evenly distributed in the plasma.

(a) Plasma

It is the liquid part of the blood which is about 55% by volume of the blood. The main component of plasma is its water part which is about 90% by weight of the plasma. The other components are different types of about 7-8% proteins, e.g. fibrinogen, antibodies etc, about 0.9% salts e.g. sodium chloride, calcium ions etc and about 0.1% glucose. The other components are the products of digestion e.g. amino acid, fatty acids etc, which are about 2-3%.

(b) Blood Cells

It is the part that is about 45 percent by volume of blood. Besides platelets there are two types of cells present in this part Fig3.2.

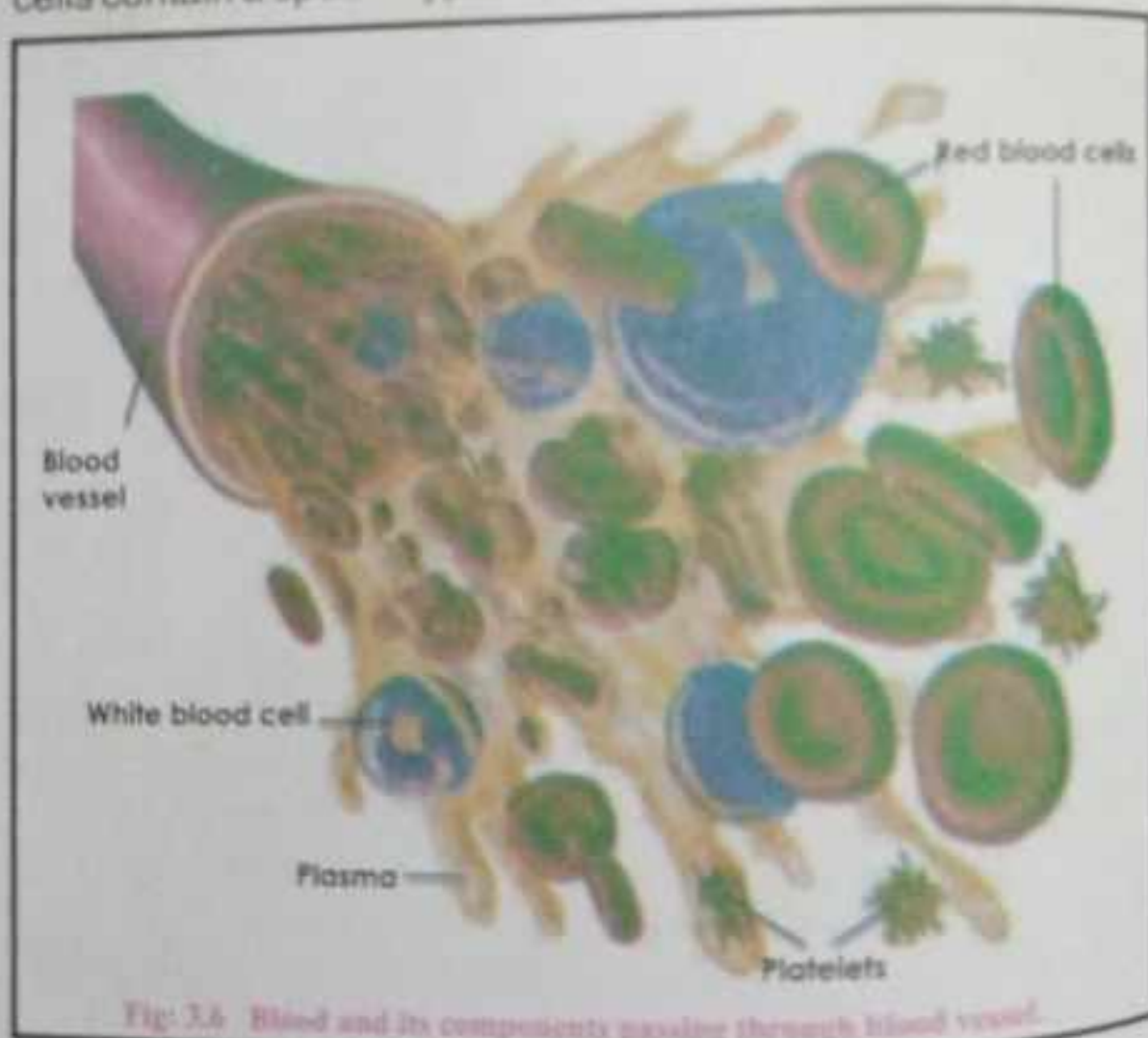
- i. Red blood cells (RBCs)
- ii. White blood cells (WBCs)
- iii. Blood platelets

Tidbit

Blood cells are mostly manufactured in the bone marrow, especially in the bone marrow of bones that make up the spine (vertebrae), ribs, pelvis, skull, and breast bone (sternum).

1. Red Blood Cells (RBCs)

Red blood cells are also called erythrocytes. They are the most numerous cells in the blood. Each cubic millimeter of blood contains about five million red blood cells in man. Red blood cell is biconcave in shape and is without a nucleus. These cells contain a special type of protein called haemoglobin.



The haemoglobin has the capability to carry oxygen to all cells and tissues of the body. The red colour of the blood is because of haemoglobin which is an iron containing pigment compound. The average life of a red blood cell is about 120 days

ii. White Blood Cells (WBCs)

White blood cells are also called leucocytes. These cells are colourless, larger than red blood cells and with a nucleus in each cell. They are of many types because of their different shapes and functions. Their number is less in blood than that of RBCs. One cubic millimeter of blood contains about 7000 to 8000 WBCs.

Most of them have a short life span of only three to four days. They are also formed in red bone marrow. Their main function is to protect the body against attacking microorganisms and diseases.

For Your Information

Blood clotting – An important mechanism to heal wounds

Blood, in addition to platelets, also contains important proteins called clotting factors. These clotting factors are vital for the process of blood clotting. Although platelets alone can plug leaks in small blood vessels and even temporarily stop/slow down bleeding, the action of clotting factors is needed to produce a strong, stable clot.

iii. Blood Platelets

They are much smaller than red blood cells and white blood cells. They are oval in shape and without a nucleus. One cubic millimeter of blood contains about 250,000 - 500,000 blood platelets. They play an important role in clotting of blood during bleeding.

3.8 Blood diseases

a. Leukemia

In Greek the meaning of Leukemia is "white blood". Leukemia is a cancer of blood-forming cells in the bone marrow. These abnormal white cells accumulate the bone marrow and flood the bloodstream, but they cannot perform their proper role of protecting the body against disease because they are defective. As leukemia progresses, the cancer interferes with the body's production of other types of blood cells, including red blood cells and platelets.

Studies have found the following risk factors for leukemia:

- People exposed to very high levels of radiation.
- Exposure to high levels of chemicals like benzene.
- Cancer patients treated with certain cancer-fighting drugs sometimes later develop leukemia.

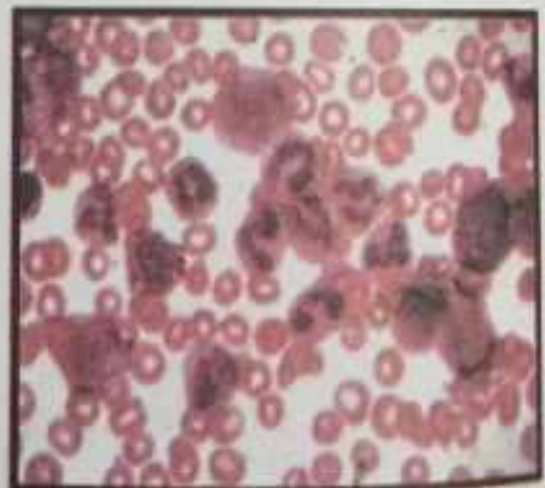


Fig: 3.7 Uncontrolled growth of defective WBCs results in leukemia.

The symptoms of leukemia are numerous but it may not be available in all the persons. It varies in many cases. Commonly seen symptoms are: weakness or chronic fatigue, headaches, skin rash, non specific bone pain, fever of unknown origin, frequent bacterial or viral infections, weight loss, easy bruising, bleeding from gums or nose. Many cases of leukemia can be effectively treated, and some can be cured.

b. Anemia

Anemia is a common blood disorder that is caused by an acquired or inherited abnormality of red blood cells to provide adequate oxygen supplies to body tissues. The causes of anemia are numerous, but most can be grouped within three major mechanisms that produce anemia:

- Blood loss (excessive bleeding)
- Inadequate production of red blood cells
- Excessive destruction of red blood cells

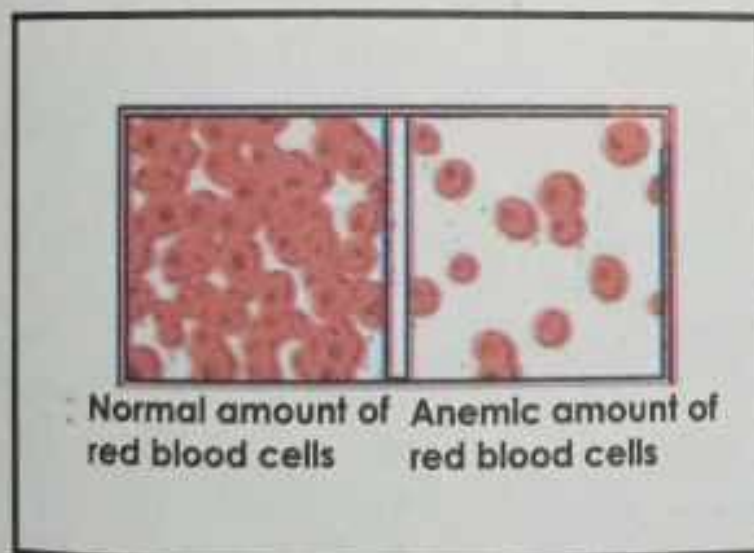


Fig: 3.8 Comparative account of the number of RBCs in normal and anemic blood.

Mild anemia often causes fatigue, weakness, and paleness. In addition to these symptoms, more severe anemia may produce faintness, dizziness, increased thirst, sweating, a weak and rapid pulse, and rapid breathing. Severe anemia may produce painful lower leg cramps during exercise, shortness of breath, and chest pain.

c. Haemophilia

Haemophilia is a rare bleeding disorder in which the blood doesn't clot normally. The major signs and symptoms of haemophilia are excessive bleeding and easy bruising. Bleeding can occur on the body's surface (external bleeding) or inside the body (internal bleeding).

Signs of external bleeding may include:

- Bleeding in the mouth from a cut or bite or from cutting or losing a tooth
- Nosebleeds for no obvious reason
- Heavy bleeding from a minor cut

Signs of internal bleeding may include:

- Blood in the urine (from bleeding in the kidneys or bladder)
- Blood in the stool (from bleeding in the intestines or stomach)
- Large bruises (from bleeding into the large muscles of the body)
- Bleeding in the Joints

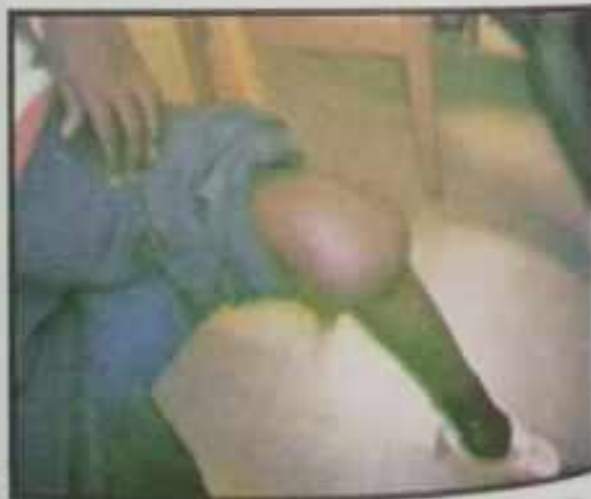


Fig: 3.8 Internal bleeding in haemophilia patient can occur in muscles and joints especially the knees, elbow and ankle.

Haemophilia usually is inherited. "Inherited" means that the disorder is passed from parents to children through genes. People born with hemophilia have little or no clotting factor.

Clotting factor is a protein needed for normal blood clotting. There are several types of clotting factors. These proteins work with platelets to help the blood clot.

3.9 Disorders and Diseases

Stability of the body results from normal metabolic activities. But this normalcy is often disturbed when body suffers from certain disease. In daily life we encounter various circumstances which expose us to various diseases.

Agents of diseases are present every where from home to school and from play ground to bookshop, we are never sure of our total safety.

Microorganisms like bacteria and viruses are the major source of many diseases. Apart from them, certain fungi and parasites play significant role in causing various common diseases.

a. Bacterial Diseases

Bacterial diseases include any type of illness caused by bacteria. Bacteria are a type of microorganism that can only be seen with a microscope.

Other types of microorganisms include viruses, some fungi, and some parasites. Millions of bacteria normally live on the skin, in the intestines, and in the mouth.

The vast majority of bacteria do not cause disease, and many bacteria are actually helpful and even necessary for good health. These bacteria are sometimes referred to as "good bacteria" or "healthy bacteria." Harmful bacteria that cause bacterial infections and disease are called pathogenic bacteria.

Bacterial diseases occur when pathogenic bacteria get into the body and begin to reproduce and crowd out healthy bacteria, or to grow in tissues that are normally sterile.

Harmful bacteria may also emit toxins that damage the body. Bacteria are cause of many diseases such as tuberculosis, whooping cough, diphtheria, tetanus, typhoid and cholera.

1. Tuberculosis

Tuberculosis (TB) is a bacterial infection caused by a germ called *Mycobacterium tuberculosis*. The bacteria usually attack the lungs, but they can also damage other parts of the body, like bones, brain, liver, spleen and intestine. TB spreads through the air.



Fig: 3.10 *Mycobacterium tuberculosis* usually attack the lungs, but it can attack any part of the body such as the kidney, spine, and brain.

The major route of spread of the disease is through infective respiratory droplets. The droplets are formed when a patient coughs or sneezes. A healthy person may get the disease by inhaling these droplets. Intestine may become infected by drinking unpasteurized or unboiled milk. If you have been exposed, you should go to your doctor for tests. You are more likely to get TB if you have a weak immune system.

Signs and Symptoms

Symptoms of TB in the lungs may include;

- A bad cough that lasts 3 weeks or longer
- Weight loss
- Coughing up blood or mucus
- Weakness or fatigue
- Fever and chills

If not treated properly, TB can be deadly. You can usually cure active TB by taking several medicines for a specific period of time. Unhygienic conditions, over crowding and dark, damp houses with poor aeration expose a person to contracting tuberculosis.

Prevention and Treatment

The disease can be prevented by:

- 1) Vaccinating infants with BCG vaccine.
- 2) Isolating infectious patients.
- 3) Improving hygienic condition and housing.
- 4) Using pasteurized and properly boiled milk.

Tuberculosis can be cured by a course of antibiotics taken

For Your Information

TB can remain in an inactive (dormant) state for years without causing symptoms or spreading to other people. When the immune system of a patient with dormant TB is weakened, the TB can become active (reactivate) and cause infection in the lungs or other parts of the body. Drug-resistant TB is a serious, as yet unsolved, public-health problem, especially in Southeast Asia, the countries of the former Soviet Union, Africa, and in prison populations.

Unhygienic conditions, over crowding and dark, damp houses with poor aeration expose a person to contracting tuberculosis.

Prevention and Treatment

The disease can be prevented by:

- 1) Vaccinating infants with BCG vaccine.
- 2) Isolating infectious patients.
- 3) Improving hygienic condition and housing.
- 4) Using pasteurized and properly boiled milk.

Tuberculosis can be cured by a course of antibiotics taken over several months.

ii. Pertussis (Whooping Cough)

Whooping cough or pertussis is an infection of the respiratory system caused by the bacterium *Bordetella pertussis*.

The bacteria thrive in the respiratory passages. Here it produce toxins that damage the tiny hairs (cilia) these cilia helps to remove particulate matter and cellular debris that are normally introduced into the airways with each breath. This results in an increased inflammation of the respiratory passages and the typical dry cough characterized by severe coughing spells that end in a "whooping" sound when the person breathes in.

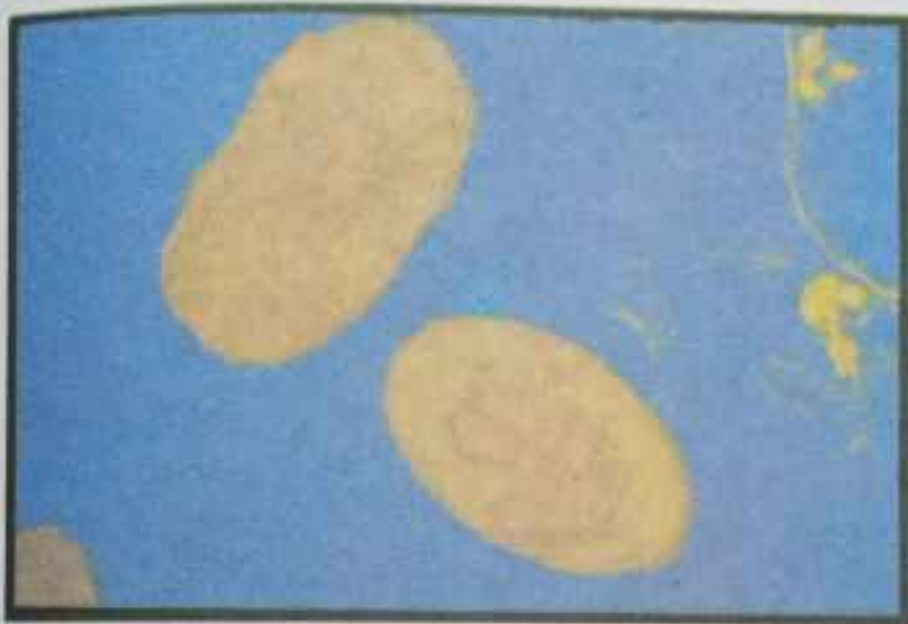


Fig: 3.11 *Bordetella pertussis*.

Tidbit

The incubation period (the time between infection and the onset of symptoms) for whooping cough is usually 7 to 10 days, but can be as long as 21 days.

It mainly affect infants younger than 6 months old before they're adequately protected by immunizations and young people between 11 to 18 years old whose immunity has faded with the passage of time.

Signs and Symptoms

The first symptom of whooping cough are similar to those of a common cold: runny nose, sneezing, mild cough, low-grade fever. After about 1 to 2 weeks, the dry, irritating cough evolves into coughing spells which can last for more than a minute.

Between spells, the child usually feels well. Adults and adolescents with whooping cough may have milder or a typical symptom, such as a prolonged cough without the coughing spells or the whoop.

Whooping cough is highly contagious i.e spread from person to person. Tiny drops of fluid from an infected person's nose or mouth may infect a healthy person. Sneezes, coughs, or laughs are the cause of air borne droplets. Others then can become infected by inhaling the drops or getting the drops on their hands and then touching their mouths or noses.

Prevention and treatment

Whooping cough can be prevented with the pertussis vaccine, which is part of the DTaP (diphtheria, tetanus, acellular pertussis) immunization. DTaP immunizations are routinely given in five doses before a child's sixth birthday. Once a disease occurs it can be effectively treated with antibiotics like erythromycin.

Anyone with whooping cough should be isolated for five days after starting antibiotics or until three weeks after the onset of the coughing spasms if the person has not received antibiotic treatment.

iii. Tetanus

Tetanus, also known as lockjaw, is a serious but preventable disease that affects the body's muscles and nerves. It is caused by a spore forming bacteria called *Clostridium tetani*. The bacteria live in soil, saliva, dust and manure..

Signs and Symptoms

The bacteria usually enter the body through a deep cut, like those you might get from cutting yourself with a knife or stepping on a nail. Spores are dormant form of the bacterium. Once inside the body they germinate into multiplicative form called vegetative bacteria.



Fig. 3.12 a. *Clostridium tetani* b. Tetanus is characterized by muscle spasms as is seen in this child suffering from

These vegetative bacteria increase in number by repeated divisions and produce a harmful substance called toxin.

The tetanus toxin causes strong and continuous muscle contraction. When muscles of chest wall undergo such prolonged contraction, the victim is unable to move the air in and out of the lungs, and without breathing the patient soon dies.

A special form of tetanus occurs in newborn babies if they are born in dirty environment and if unsterilized instruments are used during deliveries.

Prevention and treatment

Every person should be immunized against tetanus by giving vaccine against harmful toxin. If a patient is suspected to have tetanus he is given antitoxin to neutralize the toxin and antibiotics to kill the bacteria.

iv. Diphtheria

Diphtheria is an acute infectious disease caused by the bacteria *Corynebacterium diphtheriae*. It spreads from person to person by respiratory droplets through coughing and sneezing. Diphtheria can also be spread by contaminated objects or foods (such as contaminated milk).

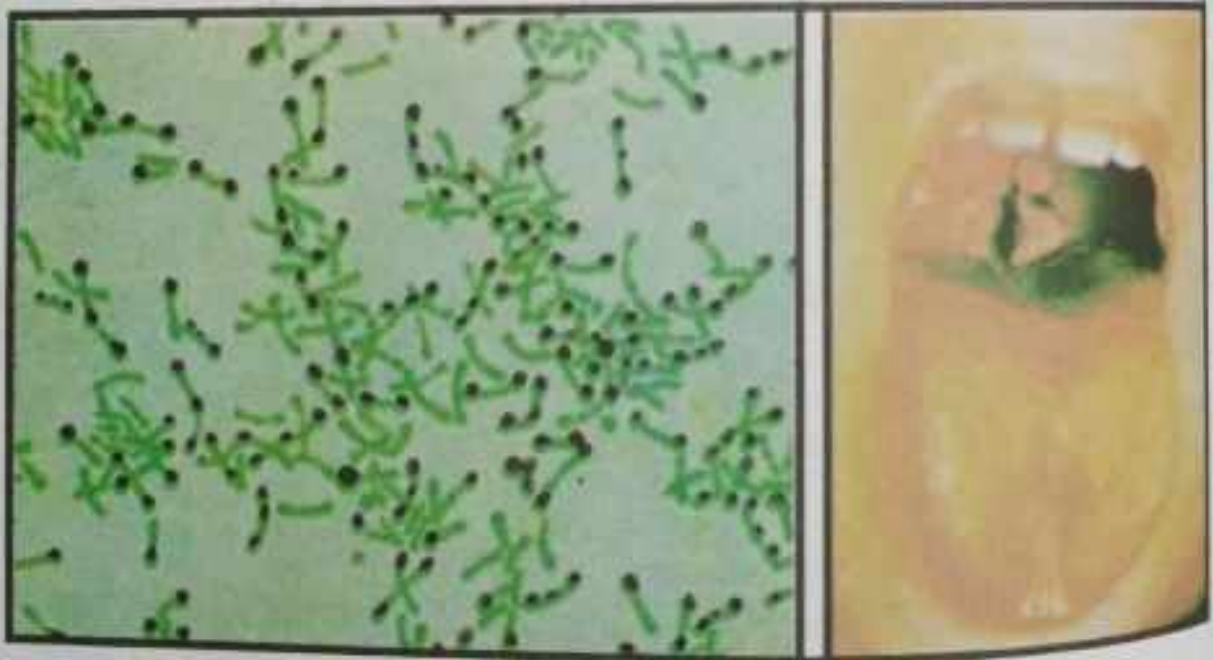


Fig: 3.13 a. *Corynebacterium diphtheriae*.

b. Affected tonsils can make the swallowing process painful in diphtheria patients.

Signs and Symptoms

Diphtheria usually affects the tonsils, pharynx, larynx and occasionally the skin. Symptoms range from a moderately sore throat to toxic life-threatening diphtheria of the larynx or of the lower and upper respiratory tracts. Symptoms usually occur 2 to 5 days after the patient has come in contact with the bacteria. Some of the significant symptoms are bluish coloration of the skin, bloody and watery drainage from nose, breathing problems, chills, cough and painful swallowing.

Prevention and treatment

The disease can be prevented by immunization with DPT. If the disease has occurred it is treated with antibiotics such as Penicillin and erythromycin to kill the bacteria and antitoxin to neutralize the toxin. Diphtheria antitoxin is given as a shot into a muscle or through an IV (intravenous line).

v. Typhoid

Typhoid is a severe bacterial infection affecting several organs of the body. The causative agent is *Salmonella typhi*. Diagnosis of typhoid fever is made when the *Salmonella* bacteria is detected with a stool culture. This disease is very common in areas with poor sanitary conditions. It affects the people of all ages and both the sexes.



Fig: 3.14 *Salmonella typhi*.

Signs and Symptoms

The bacteria enter the body through contaminated food or water. The bacteria cross the wall of small intestine and enter the blood to reach other organs like liver, spleen, brain, and bones. Some of the bacteria also multiply within the wall of intestine causing localized destruction leading to formation of an ulcer. Such ulcers may bleed. The disease manifests itself by high fever, headache and diarrhoea or constipation. People with typhoid fever usually have a sustained fever as high as 103 °F. 104 °F.

Prevention and treatment

The disease can be prevented by improving the sanitary conditions and by providing immunization of susceptible person. Antibiotics provides effective cure for typhoid fever.

vi. Cholera

Cholera is an infection of the small intestine that causes a large amount of watery diarrhea. Cholera is an acute diarrheal disease caused by *Vibrio cholerae*. The bacteria releases a toxin that causes increased release of water in the intestines. It is transmitted through contaminated food or water. Houseflies play an important role in the spreading of germs. The flies carry the germs from faeces to the uncovered food.



Fig: 3.18 *Vibrio cholerae*.

Signs and Symptoms

The bacteria are ingested with food. Inside the intestine they multiply and produce a toxin. This toxin acts on intestine itself and causes severe diarrhea which leads to dehydration. Cholera generally erupts in the form of an epidemic during rainy season or after floods. A patient with cholera has severe and painless watery diarrhea and vomiting. Fever is usually absent.

Tidbit

It takes about 100 million cholera bacteria to infect a healthy adult so significant contamination of food or water is required to transmit the disease and person-to-person transmission is uncommon.

Prevention and treatment

The disease can be prevented by "improving hygiene". Food and water should be properly covered. Hands should always be washed properly before eating and after going to toilet. A patient of cholera requires plenty of fluids e.g. ORS (Oral rehydrate salt).

Antibiotics are used to kill the bacteria. Travelers should always take precautions with food and drinking water, even if vaccinated. When outbreaks of cholera occur, efforts should be directed toward establishing clean water, food, and sanitation, because vaccination is not very effective in managing outbreaks.

b. Viral Diseases

In 1898, Friedrich Loeffler and Paul Frosch found evidence that the cause of foot-and-mouth disease in livestock was an infectious particle smaller than any bacteria. This was the first clue to the nature of viruses and their ability to cause diseases.

Viruses are capable of infecting animals, plants and even bacteria. Even with present development in medical science viral diseases are still a major concern for humanity. Some of the common human viral diseases are discussed below.

1. Small Pox

Smallpox is caused by variola which is a member of the genus orthopoxvirus. Smallpox is the only disease that has been completely wiped out throughout the world. Smallpox is also potentially one of the most devastating biological weapons ever conceived. Due to the success of an intense worldwide public health initiative, not one documented naturally occurring case of this highly infectious, deadly disease has occurred since October 26, 1977. The World Health Organization (WHO) officially declared smallpox eradicated in 1980.



Fig: 3.16 a. Variola (Genus orthopoxvirus)

b. Virus Filled sores are present all over the body of this small pox affected child.

Signs and Symptoms

After infection, symptoms may take from 7-17 days to appear for major types of smallpox. The virus begins growing in the bloodstream 72-96 hours after infection, but no obvious symptoms appear immediately.

People who have contracted smallpox initially develop such symptoms as fever, body aches, headache, chills, and, particularly, backache. Over half of people with smallpox experience chills and vomiting.

A rash appears 48-72 hours after the initial symptoms and turns into virus-filled sores, which later scab over. The process can take up to 2 weeks.

Just after the rash appears, the virus is highly contagious as it moves into the mucous membranes. The body sheds the cells, and virus particles are released, coughed, or sneezed into the environment.

The infected person can be infectious for up to 3 weeks (until the scabs fall off the rash). After the scabs or crusts fall off (in 2-4 weeks), a depression or light-skinned scar remains.

Prevention and treatment

Symptoms of smallpox stops when the disease is medically treated. This includes replacing fluid lost from fever and skin breakdown. Antibiotics may be needed for secondary skin infections.

The infected person is kept in isolation for 17 days or until the scabs fall off. Vaccinations and post exposure interventions is the main treatment. Vaccination is the most effective means of preventing smallpox infection.

Vaccination can even be administered up to 4 or 5 days after a person is exposed to the virus. This practice may not completely prevent disease, but probably it will result in a significantly less severe case of the illness.

II. Polio

Polio (also called poliomyelitis) is a contagious, historically devastating disease that was almost eliminated from the Western hemisphere in the second half of the 20th century. Polio is an acute viral infection caused by polio virus. The disease occurs among young children especially under 5 years of age.

The virus enters the body through the mouth. When it reaches the intestine it crosses the wall of the gut and enters blood stream thus it spreads to various organs of the body specially nervous system. It damages motor neurons (neurons attached to the muscles) due to which the patient loses power in limbs leading to paralysis.

Tidbit

Although polio has plagued humans since ancient times, its most extensive outbreak occurred in the first half of the 1900s before the vaccination created by Jonas Salk became widely available in 1955.



Signs and Symptoms

Initial symptoms are fever, fatigue, headache, vomiting, stiffness in the neck and pain in the limbs. One in 200 infections leads to irreversible paralysis (usually in the legs). Among those paralysed, 5% to 10% die when their breathing muscles become immobilized.

Polio Eradication Programme

The World Health Organization (WHO) is working toward eradicating polio throughout the world. Significant success has already been achieved. In 2010, only four countries (Afghanistan, India, Nigeria and Pakistan) in the world remain polio-endemic, down from more than 125 in 1988 when this programme was launched.



Prevention and treatment

Immunization against the disease through oral vaccine (polio drops) is highly effective. It should be given to all children under the age of 5 years. Once polio occurs and damages neurons its effects can not be reversed thus immunization is very important.

Measles

Measles is a highly contagious viral disease of the children caused by the measles virus (a paramyxovirus) which spreads through respiratory droplets.

Signs and Symptoms

Initially the symptoms are mild but as the disease progresses patient runs high fever and rash all over his body. The fever that occurs with measles is called a stepwise fever. The patient starts with a mild fever that progressively gets higher. Fevers often reach temperatures greater than 103 °F (39.4 °C).

Left untreated, the disease settles by itself in about 2 weeks but complications may occur.

Prevention and treatment

The disease can be prevented by immunization with vaccine. Drugs are used to prevent fever and secondary bacterial infections.



Fig: 3.17 Rash all over the body is one of the sign of measles.

Activity

Dengue fever has been responsible for a number of deaths in different parts of Pakistan. From different sources collect data regarding the number of deaths in various parts of Pakistan. Analyze major factors which contributed in the spread of this disease. List down some precautionary measures against this disease.

IV. Hepatitis

It is a viral disease which damages the liver and its functioning. There are different agents, which can cause hepatitis. These include hepatitis A, B and C viruses. The less dangerous of these is hepatitis A virus. Hepatitis B and C are more dangerous infections.

The virus enters the body through contaminated air, water, food, blood products, razors, needles and close personal contact.

Signs and Symptoms

The patient of hepatitis loses appetite and has jaundice, dark urine and pale stools.

Prevention and treatment

Vaccines are available against hepatitis A and B. There is no vaccine for hepatitis C. Use of screened blood products, disposable syringes and avoiding dangerous sexual practices are the mainstay of prevention against hepatitis B and C.

v. AIDS

Acquired immunodeficiency syndrome (AIDS) is fatal disease caused by a virus called Human immunodeficiency virus (HIV). AIDS was first described in 1981 and HIV was identified as causative agent in 1983. The virus enters the body through the blood products, shared needles and razors and sexual relationship with a patient or carrier of AIDS.

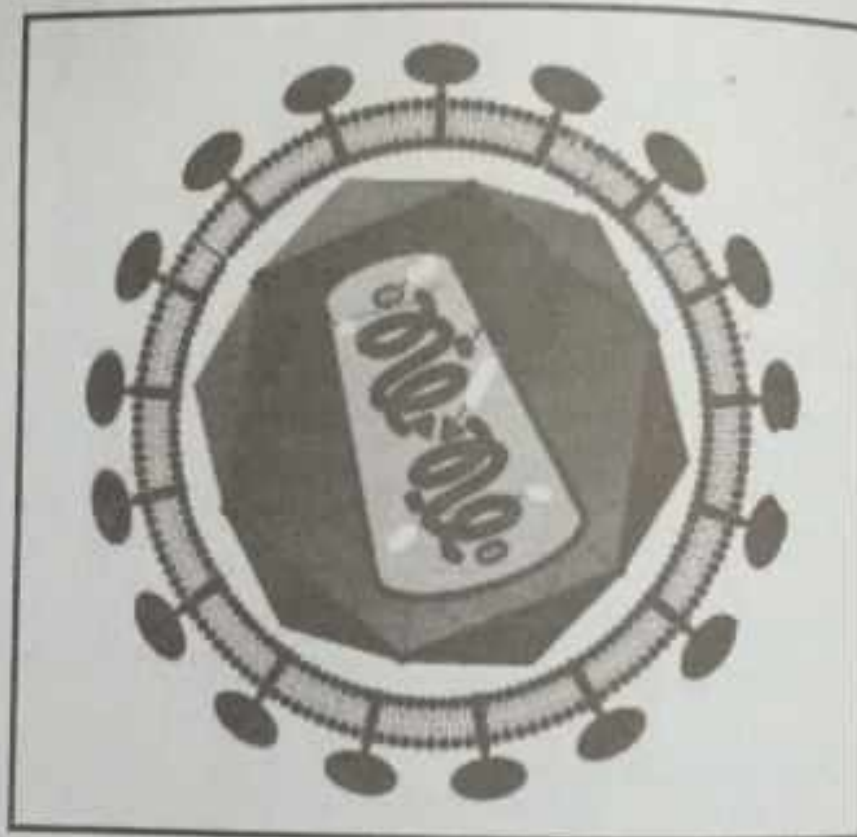


Fig:3.17 Structure of HIV

Signs and Symptoms

The virus destroys the defense system of the body by damaging the white blood cells. The immune system i.e. body defense system is weakened so much that even a mild infection can cause death.

Prevention and treatment

There is no cure for AIDS as yet. Disease can however be prevented by use of disposable syringes, new razors, use of blood which has been tested for HIV.

c. Fungal Diseases

Kingdom Fungi (singular: fungus) includes organisms which are usually regarded as saprophytes. Such organisms break down the complex organic matter and convert it into simple organic materials.

During this process they extract their nutrition from the decaying organic matter. You might be familiar with some common fungi like the mushrooms which grow on heaps of dung and debris.

Fungi are special organisms because as they play an important role in our environment. Along with bacteria they are regarded as decomposers.

Some fungi are edibles e.g. mushrooms, some are a great source for the production of antibiotics and still many fungi are causing many serious diseases and thus have pathogenic nature.

Some of the common fungal diseases in humans are ringworm, Athlete's foot, histoplasmosis etc.

Ringworm

The causative agents of ringworm are collectively known as dermatophytes. They may infect skin, hair and nails. If the fungi invade the skin they produce a circular white area, which grows in all directions. Nail destruction and hair loss may occur.

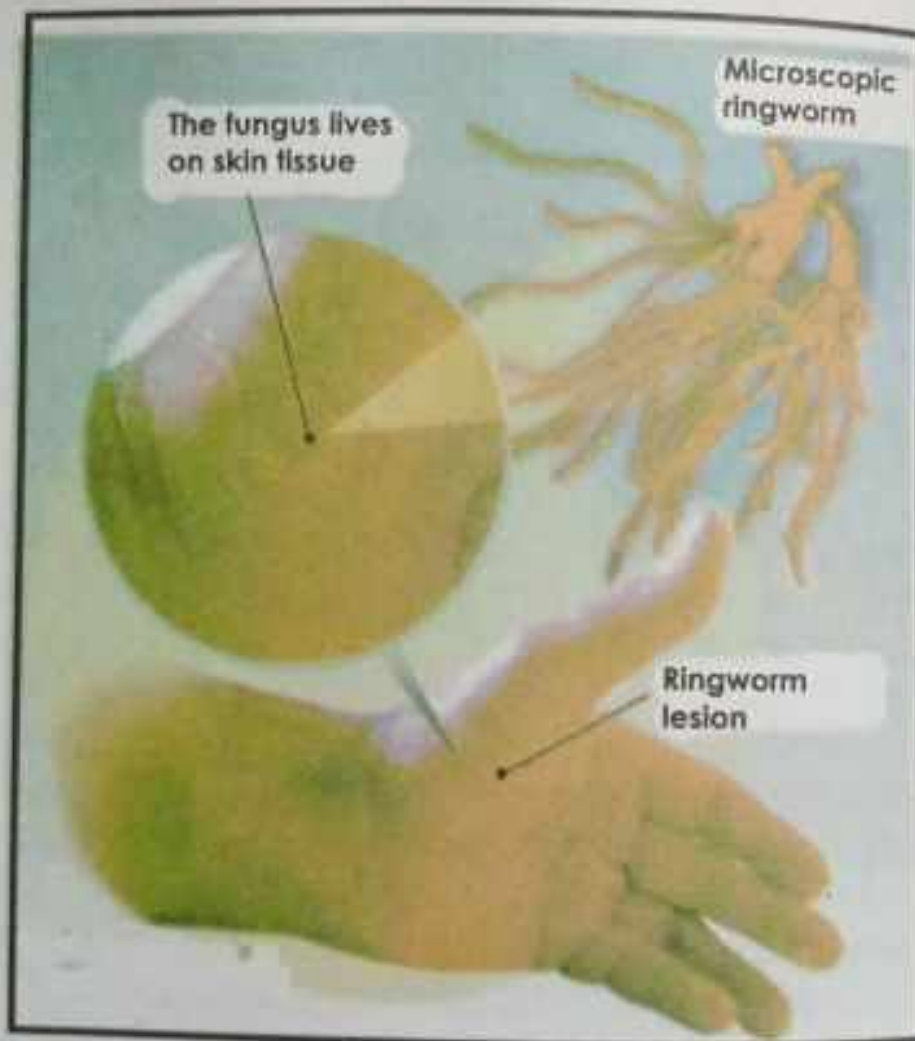


Fig: 3.19 Attack of ringworm

Ringworm spreads in the community by direct contact with the patient or infected animals. Use of common showers and swimming pools or sharing of towels and sports wear are the cause of transmission.

Prevention and treatment

Disease can be prevented by:

- 1) Avoiding common baths and poorly managed swimming pools.
- 2) Using the personal towels and sports wear only.

Ringworm can be treated by antifungal tablets and ointments.

d. Parasitic diseases

Parasites are living things that use other living things - like your body - for food and a place to live. You can get them from contaminated food or water and bug bite. Parasitic diseases can cause mild discomfort or be deadly. Parasites range in size from tiny, one-celled organisms called protozoa to worms that can be seen with the naked eye.

Lets study some of the common parasitic diseases.

1. Malaria

Malaria is a particular problem and a major one in areas of Asia, Africa, and Central and South America. Malaria occurs in about 100 countries; approximately 40% of the world population is at risk for contracting malaria.

Malaria is an infectious disease caused by a parasite, Plasmodium, which infects red blood cells. Malaria is characterized by cycles of chills, fever, pain, and sweating.

Signs and Symptoms

The symptoms characteristic of malaria include flulike illness with fever, chills, muscle aches, and headache. Some patients develop nausea, vomiting, cough, and diarrhea. Cycles of chills, fever, and sweating that repeat every one, two, or three days are typical.

Prevention and treatment

Mild malaria can be treated with oral medication. Drug treatment of malaria is not always easy. Chloroquine phosphate (Aralen) is the drug of choice for all malarial parasites except for chloroquine-resistant *Plasmodium* strains.

Malaria in History

Historical records suggest malaria has infected humans since the beginning of mankind. The name "mal aria" (meaning "bad air" in Italian) was first used in English in 1740 by H. Walpole when describing the disease. The term was shortened to "malaria" in the 20th century. C. Laveran in 1880 was the first to identify the parasites in human blood. In 1889, R. Ross discovered that mosquitoes transmitted malaria.

If people must travel to an area known to have malaria, they need to find out which medications to take, and take them as prescribed. Currently, there is no vaccine available for malaria, but researchers are trying to develop one.

To reduce the chance of getting malaria, people should avoid malaria-endemic areas of the world, use mosquito repellents, cover exposed skin, and use mosquito nets while sleeping.

How is malaria transmitted?



The life cycle of the malaria parasite (*Plasmodium*) is complicated and involves two hosts, humans and *Anopheles* mosquitoes. The disease is transmitted to humans when an infected *Anopheles* mosquito bites a person and injects the malaria parasites into the blood.

ii. Threadworm

There are a number of types of worm (helminth) infestations that humans are susceptible to. Of these, the most common is the *Enterobius vermicularis*, also known as the threadworm, pinworm or seatworm.

Threadworms derive their name from their appearance, with the adult worms resembling fine pieces of white cotton. The adult female threadworm is larger than its male counterpart and can grow up to 1.5cm in length.

Threadworms are the most commonly encountered human host specific nematode.



Fig.3.20 *Enterobius vermicularis*

Signs and Symptoms

There may not be many external symptoms to indicate that you have a threadworm infestation so it may go undetected.

Common signs include an intense itchy feeling around the anus, usually at night or early in the morning. Other symptoms include restless sleep, irritability, grinding teeth during sleep, or a loss of appetite. In rare cases slight stomach pains associated with gastrointestinal upsets may be experienced.

Prevention and treatment

The common treatment is to take a medicine to kill the worms. Mebendazole is the usual treatment for people aged over six months. Just one dose kills the worms. A second dose two weeks after the first is sometimes needed if the infection has not cleared (which may occur if you swallow some eggs after taking the medication).

Piperazine is an alternative medicine. It can be used by anyone aged over three months. Medication will kill the worms in the gut, but not the eggs that have been laid around the anus. These can survive for up to two weeks outside the body on underwear, bedding, in the dust, etc (as described above). So, hygiene measures aim to clear any eggs from the body and the home, and to prevent any eggs from being swallowed. This will then break the cycle of re-infection. However, it may not be your home which is a main source of threadworm eggs.

Children may come into contact with eggs in schools particularly in the toilets if they are not cleaned properly. This is why child may have recurring threadworms, even if home and personal hygiene is of a very high standard.

III. Ascariasis

Ascariasis is an intestinal infection caused by a parasitic roundworm. It is the most common human infection caused by worms in the world.

Ascariasis occurs when worm eggs of the parasite *Ascaris lumbricoides* commonly found in soil and human feces are ingested.

The eggs can be transmitted from contaminated food, drink, or soil. Ascariasis is frequently found in developing countries where sanitary conditions are poor.

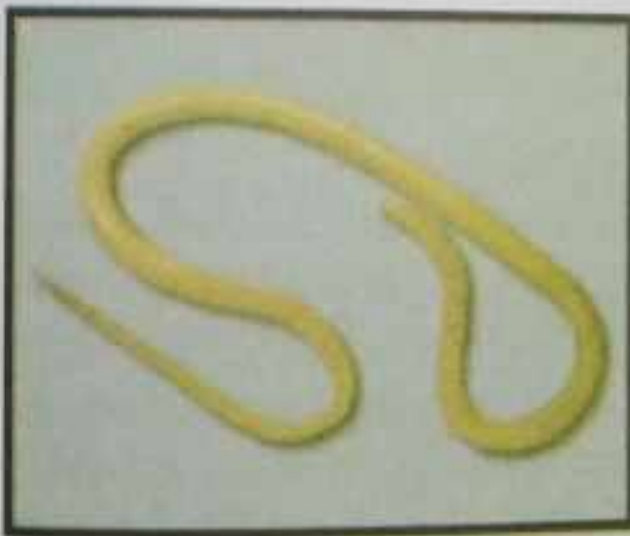


Fig: 3.21 *Ascaris lumbricoides*

Signs and Symptoms

Although no symptoms may occur, the greater the number of worms involved in the infestation, the more severe a child's symptoms are likely to be. Kids are more likely than adults to develop gastrointestinal symptoms because they have smaller intestines and are at greater risk of developing intestinal obstruction.

Symptoms seen with mild infestation include: worms in stool, coughing up worms, loss of appetite, fever, wheezing. More severe infestations can result in more serious signs and symptoms, including: vomiting, shortness of breath, swelling of the abdomen, severe stomach or abdominal pain etc.

Prevention and treatment

Antiparasitic medication to be taken orally to kill the intestinal roundworms. Sometimes the stool will be re-examined about three weeks after treatment to check for eggs and worms. Symptoms usually disappear within one week of starting treatment.

The most important measure of protection against ascariasis is the safe and sanitary disposal of human waste, which can transmit eggs.

Areas of the world that use human faeces as fertilizer must thoroughly cook all foods or clean them with a proper iodine solution (particularly fruits and vegetables).

Children may be prescribed a preventive deworming medication. Teach children to wash hands thoroughly and frequently, especially after using the bathroom and before eating.

3.10 First Aid and its administration.

First aid is an immediate help given at the place of accident, till the patient is taken to the hospital. It is usually performed by non-expert, but trained personnel to a sick or injured person until definitive medical treatment can be accessed.

In certain circumstances illnesses or minor injuries are self-limiting and these may not require further medical care treatment once the first aid intervention has been successfully done.

It generally consists of a series of simple and in some cases, potentially life-saving techniques that an individual can be trained to perform with minimal equipments

In the following text you will study how first aid administration can become a life saving activity.

a. Dog Bite

If a dog bites or scratches the body of a person, it may be dangerous. The wound may become infected with viruses of rabies present in dog's saliva.

In case of bleeding, pressure bandage should be administered until bleeding stops. The damaged area should be covered with clean cotton or piece of cloth.

b. Burn

If some part of the body is burnt the cloths from the burnt part should be immediately removed. Run off the tap water on burnt area. In case of severe injury the patient should be rushed to the nearest hospital.

c. Artificial Respiration

Due to suffocation a person may become breathless. If the patient is breathless lift the chest of the patient slightly upward so that the respiratory tract may become straight. Open the mouth of the patient and remove any blood, vomiting or secretion accumulated in the mouth.

Clean the mouth with some clean piece of cloth. The clearance of respiratory pathway may help the patient to breathe. If the patient is still breathless, try to help him breathe artificially. If breathing starts take the patient to the hospital immediately.



1. Clear victim's mouth quickly. Tilt head back.



2. Cover victim's mouth with your mouth. Pinch nostrils shut and blow hard. For child, place your mouth over his mouth and blow gently.



3. Remove your mouth, allowing air to come out. Repeat every 5 seconds for adults, every 3 seconds for children.

4. If unable to get air into victim's lungs retilt head into proper position. If you suspect foreign matter in airway, place victim on back, straddle the victim's thighs, perform 6-10 abdominal thrusts, clear matter from mouth, resume artificial respiration.

Fig: 3.22 Steps to be followed for providing artificial respiration

Snake Bite

In case of snake bite take the following measures.

- (i) First tie up the bitten arm or leg tightly with cloth so that poison may not move further.
- (ii) Wash the wound with water and lay down the patient and restricts its movement.
- (iii) Avoid sucking the patients blood from injury because it may be fatal for you.
- (iv) Let the wound bleed.
- (v) Take the patient to hospital as soon as possible for medical help.

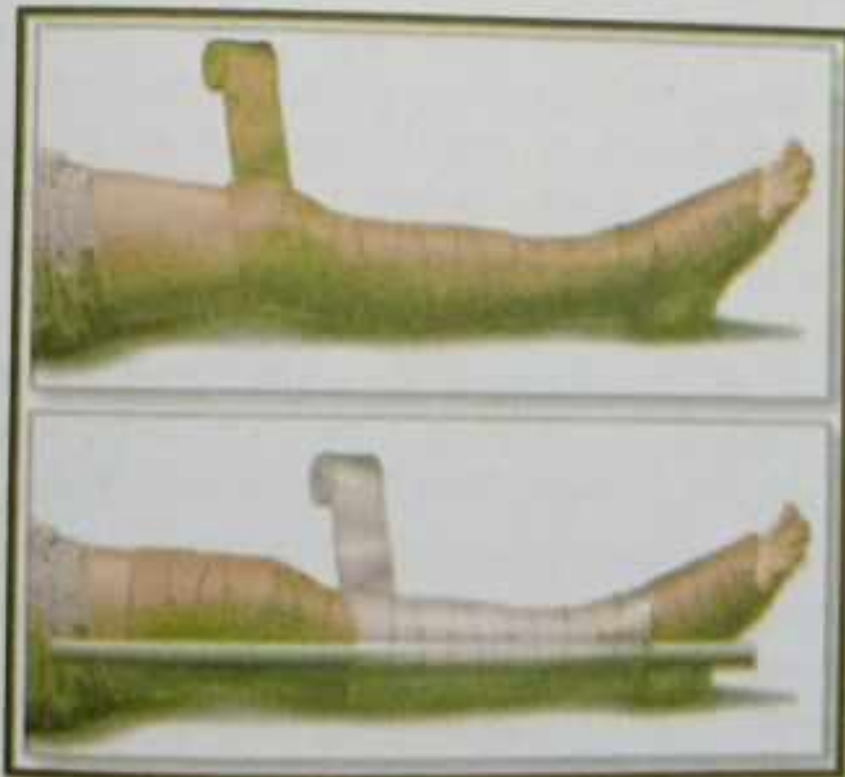


Fig: 3.23 Snake bite first aid.

3.11 Research and medical advances in Disease control

Health and disease have been part and parcel of human life since its existence. Human being employed different methods and techniques which were available at that time to cure the sick and diseased.

Primitive man apparently often distinguished between ordinary conditions (such as old age, coughs, colds, and fatigue) and illnesses caused by spirits and evil forces that required the special services of a medicine man, witch doctor etc.

Since illness among primitive peoples was caused by gods, spirits, and magic, the purpose of diagnosis was to determine the offense committed and the person or spirit administering the punishment.

Surgery at that time was consisted principally as treatment for wounds and injuries to the bones. Hemorrhage was controlled by pressure, tourniquet, (any device for arresting bleeding by forcibly compressing a blood vessel, as a bandage tightened by twisting.) by some plant substances and binding of blood vessels was apparently unknown.

Although amputations (to cut off a body parts like limbs through surgery) were performed, they seem to have been mainly related with the religious or cultural practices.

During surgery, drugs were used to make the body less sensitive or to relieve severe pain from a wound. Apparently primitive societies were subject to many of the same diseases which afflict humans today like stomach upsets, diarrhea, respiratory illnesses, rheumatic ailments etc.

There were methods of preventing disease other than ceremonial and religious among some primitives, but the time of their introduction is unknown. Long before the colonial period in Africa, some tribes had practiced a type of protection against smallpox by variolation (inserting fluid from smallpox blisters under the skin). This was aimed at producing a mild form of the disease which would save the person from severe illness, for it was recognized that one never acquired it a second time.

Primitive man also observed that some dread diseases never struck a person twice and worked out ways of purposely contracting a mild case rather than risk the full-blown effects.

He recognized that excessive bleeding could be stopped by applying extreme heat to a wound, but he also believed that releasing moderate amounts of blood by opening a vein improved certain conditions. Of course many of his most favoured techniques had no rational or pharmacological basis, but he certainly recognized the psychological benefits to the sick of a healer's even appearing to do something effective, that under certain conditions the body seems better able to cure itself.

The first medical diagnoses made by humans were based on what ancient physicians could observe with their eyes and ears, which sometimes also included the examination of human body. The ancient Greeks attributed all disease to disorders of bodily fluids called humors, and during the late medieval period, doctors routinely performed uroscopy.

Later, the microscope revealed not only the cellular structure of human tissue, but also the organisms that cause disease. More sophisticated diagnostic tools and techniques - such as the thermometer for measuring temperature and the stethoscope for measuring heart rate - were not in widespread use until the end of the 19th century.

The clinical laboratory would not become a standard fixture of medicine until the beginning of the 20th century.

Now we have variety of equipments and methods to diagnose, treat, and prevent the diseases. Some of the more important are discussed below:

1. CT or CAT scans are special x-ray tests that produce cross-sectional images of the body using x-rays and a computer. These images allow the radiologist, a medical doctor who specializes in images of the body, to look at the inside of the body. CT scans are frequently used to evaluate the brain, neck, spine, chest, abdomen, pelvis, and sinuses.
2. An MRI (or magnetic resonance imaging) scan is a radiology technique that uses magnetism, radio waves, and a computer to produce images of body structures. The image and resolution produced by MRI is quite detailed and can detect tiny changes of structures within the body.
3. The electrocardiogram (ECG or EKG) is a diagnostic tool that is routinely used to assess the electrical and muscular functions of the heart. Most often, the ECG assessment includes the determination of the rate, assessment of the rhythm, evaluation of the electrical conduction patterns of the heart.

4. Ultrasound is an imaging technique which uses sound waves that are beamed into the body causing return echoes that are recorded to "visualize" structures beneath the skin. The ability to measure different echoes reflected from a variety of tissues allows a shadow picture to be constructed.
5. Immunization (vaccination) is a way to improve your immune system and prevent serious, life-threatening diseases. Various types of vaccines are given to children and adults at different stages of life which prevents them from various fatal diseases. Some of the prominent diseases for which vaccines are administered are polio, measles, hepatitis etc.

- Our body is extremely effective at achieving and maintaining good health, if it is given what it needs
- our dietary intakes may include natural food products, processed food, fast food or junk food.
- The methods used for processing foods include canning, freezing, refrigeration, dehydration and aseptic processing.
- Fast food, is defined as any food packed with "full of calories", which contains abundance of fat, sugar, sodium, and other chemicals, which has less nutritional value.
- Nutritional imbalances like overnutrition and undernutrition may lead to severe health difficulties.
- Malnutrition is a condition resulting from not consuming enough nutrients.
- Physical activity reduces the risk of premature death in general, and of coronary heart disease, hypertension, colon cancer, and diabetes mellitus in particular.
- Insufficient rest and sleep can shorten life of an individual.
- Drug abuse interfere with the ability to think clearly, exercise good judgment, controlling behavior, and feel normal
- Smoking is a first step before someone gets into some serious drug addiction.
- The Holy Qur'an attaches great importance to personal and environmental cleanliness.

KEY

POINTS

- Blood in our bodies is pumped by the heart through a network of arteries and veins.
- Blood is made of three specialized elements called erythrocytes (red blood cells), leukocytes (white blood cells) and platelets that are suspended in a complex liquid called plasma.
- Leukemia is a cancer of blood-forming cells in the bone marrow.
- Anemia is a common blood disorder that is caused by an acquired or inherited abnormality of red blood cells to provide adequate oxygen supplies to body tissues.
- Haemophilia is a rare bleeding disorder in which the blood doesn't clot normally.
- Microorganisms like bacteria and viruses are the major source of many diseases.
- You are more likely to get TB if you have a weak immune system.
- Whooping cough — or pertussis — is an infection of the respiratory system caused by the bacterium *Bordetella pertussis*.
- Tetanus, also known as lockjaw, is a serious but preventable disease that affects the body's muscles and nerves.
- Diphtheria is an acute infectious disease caused by the bacteria *Corynebacterium diphtheriae*.
- Cholera is an infection of the small intestine that causes a large amount of watery diarrhea.
- Smallpox is the only disease that has been completely wiped out throughout the world.

KEY

POINTS

- Polio is an acute viral infection caused by polio virus.
- Measles is a highly contagious viral disease of the children caused by the measles virus (a paramyxovirus) which spreads through respiratory droplets.
- Acquired immunodeficiency syndrome (AIDS) is fatal disease caused by a virus called Human immunodeficiency virus (HIV).
- Fungi are a great source for the production antibiotics and still many are causing serious diseases and thus have pathogenic nature.
- The causative agents of ringworm are collectively known as dermatophytes.
- Parasites are living things that use other living things - like your body - for food and a place to live.
- Malaria is an infectious disease caused by a parasite, Plasmodium, which infects red blood cells.
- First aid is an immediate help given at the place of accident, till the patient is taken to the hospital.

EXERCISE

A. Select the correct answers in the following questions.

1. Fast food or junk food has _____ nutritional value.
 - a. Less
 - b. High
 - c. Moderate
 - d. No
2. Malnutrition means
 - a. Consuming enough nutrients
 - b. Consuming not enough nutrients
 - c. Consuming fats only
 - d. Eating at irregular intervals
3. In human body the first choice for the body to consume will be
 - a. Body protein
 - b. Body fats
 - c. Body vitamins
 - d. Glycogen
4. What is drug abuse?
 - a. Using drug when it is required
 - b. Taking drug in control quantities
 - c. Using drugs irregularly
 - d. Taking a prescription medication that is not prescribed
5. Which one of the following can results in increasing blood cholesterol level?
 - a. Tar
 - b. Nicotine
 - c. Carbon dioxide
 - d. Carbon monoxide

6. What could be one of the possible health risk associated with smoking
- Production of red blood cells decreases
 - Brain cell degrade at a fast rate
 - Hardening and narrowing of arteries accelerate
 - All of the above
7. Erythrocyte is another name for a
- Red blood cell
 - White blood cell
 - Platelet
 - Plasma
8. Leucocyte is another name for a Red blood cell
- Red blood cell
 - Platelet
 - Plasma
 - White blood cell
9. Which of the following blood components provide the major defense for our bodies against invading bacteria and viruses?
- Platelets
 - Plasma
 - White blood cells
 - Red blood cells
10. Most of the volume of normal human blood is composed of
- Platelets
 - Plasma
 - White blood cells
 - Red blood cells

11. In Leukemia the white blood cells are:

- a. Defective
- b. Numerous but defective
- c. Produce in less number
- d. Helping the body immune responses

12. In anemia the body is unable to get:

- a. Proper immune response
- b. Proper blood circulation
- c. Adequate amount of nutritional support
- d. Adequate amount of oxygen supply

13. The main factor behind hemophilia is the absence of:

- a. Gene for platelets production
- b. Normal bone marrow
- c. Clotting factor protein
- d. Normal hormonal control

14. One of the following is a bacterial disease:

- a. Small pox
- b. AIDs
- c. Diphtheria
- d. Measles

15. Tuberculosis is treated by:

- a. Antiviral drugs
- b. Antibiotics
- c. Surgery
- d. Chemotherapy

16. The agent that cause typhoid fever is:

- a. Salmonella typhi
- b. Escherichia coli
- c. Vibrio cholerae
- d. Shigella

17. Which symptom of small pox infection appears first?
- Rash
 - Fever
 - Painful muscles
 - Bleeding from nose
18. Which of the following is NOT a symptom of polio?
- Runny nose
 - Paralysis
 - Breathing difficulty
 - Unable to walk
19. Paramyxovirus causes which one of the following disease?
- Typhoid
 - Measles
 - Polio
 - Small pox
20. Which organ does hepatitis affect?
- Heart
 - Brain
 - Liver
 - Kidneys
21. HIV is transmitted when the _____ of an infected person comes into contact with the blood or mucous membrane of a healthy person.
- clothing or skin
 - blood or other body fluids
 - drugs or alcohol
 - blood or hair

22. HIV is _____.
- a virus that attacks the immune system
 - a sexually transmitted virus
 - the virus that causes AIDS
 - all of the above
23. Drug abusers are at risk for HIV infection _____.
- only when they inject drugs
 - because drugs can affect the way people make decisions
 - when they share drug injection equipment
 - both B and C

B. Write answers to the following questions.

- Cleanliness ensures health. Elaborate the statement.
- Briefly describe the composition of the blood.
- Leukemia and anemia are blood disorders. State their causes and their effects on the body.
- Eating behaviour are a major cause of health disorders. List down some health issues which have a relationship with our eating behaviours.
- Differentiate between malnutrition and under nutrition.
- Proper sleep and physical activities are vital for healthy growth and healthy life. Give your assessment of this statement.
- Enlist the viral, bacterial, fungal and parasitic diseases that you have studied in this unit.
- Give a detail note on the causes, symptoms and preventions of the following diseases.

b. Malaria

c. Ringworm

9. Polio can be prevented by vaccination. Pakistan is one of the few countries in the world where polio cases have been still identified. Investigate into the causes why people in some parts of the country are hesitant to give polio vaccines to their children.

10. Smoking is the first step to drug addiction. Enlist some of the health hazards associated with smoking.

Population and Environment

After studying this unit the students will be able to:

- Describe the rate of human population growth in Pakistan and neighbouring countries.
- Assess how the size and rate of growth of human population are determined by birth rate, death rate, immigration, emigration, urbanization and carrying capacity of the environment.
- Explain the impact of over population on environment.
- Describe how over population is the major hindrance in the sustainable development of any region.

Introduction

Human population growth has become a source of concern for the modern day world. The population is increasing rapidly. The reason why it is regarded as a major concern is because it has affected the economic, political, environmental, and social spheres of life. Although we see this problem more significant in the poor and developing countries of the world yet the rich and developed nations are also equally affected by this problem. For example all of us living in this world share the same planet earth. Our atmosphere is the same; our resources are the same and environmental hazards see no rich or poor. So in this context over population may be a problem in one part of the world but its environmental impacts may be obvious in other parts of the world.

World Scientists Warning to Humanity

Pressure resulting from unrestrained population growth put demands on the natural world that can overwhelm any efforts to achieve a sustainable future. If we are to halt the destruction of our environment, we must accept limits to that growth.



Some of the common factors like unemployment, poverty and the restriction of economic expansion results from overpopulation. When the population increases, the cost on health, education, and other areas of urban growth are affected. In this chapter you will explore various issues related with human population and its growth.

4.1 Growth of Human Population

Before and during the 19th Century the world's population was growing steadily but it remained in a stable state. The 20th Century brought advancements in agriculture and technology, which caused dramatic increases in human population growth. These increases have continued through to the 21st Century.

The most basic (though not necessarily easiest or most accurate) way to measure population is simply to count everyone. This is known as a census and is usually undertaken by government officials. In the past, religious organizations carried out censuses, but usually on a local or regional level. The Roman Empire conducted censuses in order to measure the pool of military-age men and for taxation purposes. In Islamic world the first census was conducted by Hazrat Umar Farooq (R.A.A).

For Your Information

The human population has increased almost continually throughout history. In 10,000 B.C., there were between one and 10 million humans. By 1,000 B.C. there were 50 million. In A.D. 600, worldwide population had reached 200 million. At the dawn of the 20th century, 1.5 billion humans lived on the planet.

[source: Historical Estimates of World Population]

In modern world no body can deny the importance of census as it is a prerequisites in any country's successful planning. This has paved way for a systematic study of various elements of population.

Demography (from the Greek word meaning "description of people") is the study of human populations. The discipline examines the size and composition of populations, as well as their movement of people from one region to another region. Demographers also analyze the effects of population growth and its control. Several demographic variables play central roles in the study of human populations, especially fertility, mortality and life expectancy, migration, urbanization, and carrying capacity of the environment.

a. Birth Rate

To determine a country's fertility rate, demographers use governmental records to figure the crude birth rate (the number of live births for every thousand people in a population).

a. Table: 4.1 Analysis of birth rate of different countries.



Demographers calculate this rate by dividing the number of live births in a year by the total population, and then multiplying the result by 1,000.

b. Mortality and expectancy

Mortality, or the number of deaths in a society's population, also influences population size. Similar to the crude birth rate, demographers calculate the crude death rate, or the number of deaths annually per 1,000 people in the population. Demographers (persons working on different aspects of population) calculate this figure by dividing the number of deaths in a year by the total population, and then multiplying the result by 1,000.

Table 4.2 Comparison of highest death rate in the world.



Infant mortality rate, which is the number of deaths among infants under age one for each 1,000 live births in a year, provides demographers with another measure. A low infant mortality correlates with a higher life expectancy, which is the average lifespan of a society's population.

c. Migration

Migration (the movement of people from one place to another) affects population size. While some migration is involuntary, such as when slaves were brought to America, other migration is voluntary, such as when families move from cities into suburbs.

Migration into an area, called immigration, is measured as the immigration rate, which is the number of people entering a region per each 1,000 people in the population. Migration out of an area, or emigration, is measured as the emigration rate, which is the number leaving per each 1,000 people in the population. Internal migration is the movement from one area to another within a country's borders.

d. Carrying Capacity

As population density in a given area increases, it approaches what's known as the carrying capacity. This is the maximum number of humans an area is capable of supporting in terms of available resources.

For animals, this is easy to calculate. A goat, for example, might need 50 square yards of grass to survive. An area of 200 square yards therefore has a carrying capacity of four goats.

Calculating carrying capacity for humans is much more complex. We can use technology to improve our resource production. We can ship in resources from other areas. We can create sanitation systems and other infrastructure to support higher density. What happens when we reach carrying capacity in an area? There are several options:

- People leave for a different area.
- People become generally less healthy, and thus less able to reproduce.
- Population pressure leads to war.
- Unsanitary conditions and close proximity lead to a disease outbreak.

For Your Information

World Population Day is observed on July 11. Its purpose is to raise awareness about various global population issues.



4.2 Population Growth

Fertility, mortality, and migration all influence the size of a population. Poorer countries tend to grow almost completely from internal causes (for example, high birth rates), while richer countries tend to grow from both internal causes and migration.

Demographers determine a population's natural growth rate by subtracting the crude death rate from the crude birth rate. The world's low-growth nations tend to be more industrialized, such as the United States and European countries. The high-growth countries tend to be less industrialized, such as countries of Africa and Latin America. Table 4.3 gives an overview of the various figures about the different demographic variables of Pakistan along with some of its neighbouring countries.

Table 4.3: Demographics of selected countries

Country	Births per 1,000 population	Deaths per 1,000 population	Population million	Growth rate (percent)
CHINA	12.2	6.9	1,300	0.49
PAKISTAN	25.1	7.1	177.2	1.51
BANGLADESH	23.8	9.1	158.1	1.27
INDIA	21.3	7.5	1,100	1.38
AFGHANISTAN	40	15	29.121	2.21

4.3 The Impacts of Overpopulation on the Environment

Over the last hundred years there has been a sharp rise in population. This problem is more serious in the developing world as compared to the developed world. Consistent rise in the population is posing serious challenges to the developing world.

Unfortunately, due to bad governance and lack of strong economic growth people living in these areas are suffering from poverty, hunger, and disease.

Any area has a limited carrying capacity in terms of resources and space. Once that carrying capacity is taken over by over population then slowly and gradually degradation takes its root.

Environment of such area gives a clear picture of how overpopulation devastates and affects the lives of the people living in such areas. In the following section we will see how overpopulation has its impacts on the environment.

Effects of Agriculture

The ever-increasing human population growth requires an effective method for more food growth, which has resulted, in extensive agriculture. Bringing more land under cultivation results in the destruction of habitats.

Extensive agriculture requires supply of water and development of canals, which inturn causes water- logging and salinity.



Fig. 4.1 Salinity : One of the side effects of extensive development of canal system



Fig: 4.2 One of the tools of modern day agricultural practices. These and other types of extensive sprays of insecticides and pesticides are a potential threat for different types of pollution.

In order to increase the yield of agricultural products use of fertilizers and pesticides is a common practice these days. Over-use of fertilizers has polluted soil and water. In the same way over-use of pesticides and herbicides can make water toxic, which can affect aquatic life.

Plants in which genes have been altered absorb more nutrients, making soil depletion a problem. Forests are destroyed for cultivation.

Cutting forests and clearing land for agriculture results in soil erosion. Excessive irrigation can cause loss of top fertile soil. Soil erosion results in silting which decrease the life span of dams.



Fig 4.3 Sixty square miles of rain forest are destroyed each year to make way for expanding coca farms.

In this way different activities aimed for increasing agriculture somehow is resulting in the destruction of natural environment of an area.



Fig: 4.4 Terhola dam because of which the reservoir has lost the storage capacity to a reasonable level and now the dam is left with two-third capacity to store water.

b. Urbanization

More and more people are migrating from rural areas to urban environment. People migrate from rural areas to big cities in search of jobs and comforts of life.

The shortage of housing facilities becomes acute with this influx of people. About 80 % of the housing units in big cities are substandard.



Fig: 4.5 One of the significant consequences of urbanization is that most of big cities of Pakistan are faced with long queues of never ending traffic jams.

The influx of the people puts great pressure on the basic facilities such as water, electricity, gas and public transport. The traffic hazards increase, health care facilities fall short and the sewage system is distributed. The migration from rural areas creates shortage of labour in agriculture sector.



Fig: 4.6 Poor city planning: Easy way for disposal of domestic waste is to open sewerage lines directly into the nearby passing irrigation canals and polluting the precious irrigation water. Rapid trend of urbanization has put tremendous pressure on the old and out dated sanitation system in most of big cities of Pakistan.

c. Overgrazing

With fast growing population the demand for meat and dairy products are also increasing. However, there are number of other products which we can get form them. Can you name few such products?

Cattle raring is a profitable business. Cattle are fed mainly on plants. Grassland can support a specific numbers of cattle. It is called the carrying capacity of that grassland. Animals consume the upper portion of grasses. The roots are alive, holding the soil particles together and absorbing water and minerals. The plants recover and again grow to their normal size. However, when more then required number of animals graze, plants are not able to recover and they ultimately die.

Overgrazing results in barren and exposed soil which is easily eroded and results in desertification.

d. Deforestation

One of the important aspects of rapidly increasing population is the deforestation. The unwise and unplanned destruction or removal of trees is called deforestation. Overpopulation put a direct impact on environment. Urbanization requires more land, thus forests are cut to build roads and houses etc. More land is required for cultivation. Trees are removed to develop pastures for grazing. Wood is used both as timber or fuel wood. All these activities lead to removal of trees.

Forests are our most precious wealth. Our life is greatly dependent on forests. They are the natural factories for the production of oxygen. Forests provide green cover to the earth, a living place to wildlife, fuel, timber and recreation to man. They control floods, prevent formation of deserts and keep the air clean.

Deforestation leads to, soil erosion, destruction of habitats, extinction of many species, floods, climatic changes and desertification (the process of formation of deserts)

4.4 Overpopulation and Sustainable Development

Planet earth has limited resources like fossil fuels, water, forests, food etc and these are being constantly used and depleted with every passing moment. Excessive and unwise use of these resources have convinced conservationists and planners that if some urgent measures are not taken in this regard then the world may face extreme shortage or these resources may vanish forever.

One strategy to cope this situation is to use the resource in such a way that it can be used for the present generation but at the same time it is conserved for the coming generations.

The idea of sustainable development grew from numerous environmental movements in earlier decades. Summits such as the Earth Summit in Rio, Brazil, 1992, were major international meetings which introduced the concept of sustainable development to the world.

According to the World commission on Environment and development sustainable development is defined as a development that meets the needs of the present without compromising the ability of future generations to meet their own needs



Fig: 4.7 Heads of state and government gather for a group photograph as the media, delegates and staff members look on at the United Nations Earth summit in Rio de Janeiro, Brazil, on 13 June 1992.

Population is key factor in planning. Every country makes its long term and short term plans keeping in view its population. Any plan for sustainable development requires proper system of check and control of population.

In the present world the idea of sustainable development is facing serious challenges due to rapid growth in population especially in the developing and poor countries of the world.

With limited resources and increase in poverty rapid population growth in the world's poorest countries is a major obstacle to poverty reduction. People living below the poverty line are increasing on daily basis.

Unwise and unmanaged environmental exploitation by rapidly growing population is a major hurdle in sustainable management of environmental resources which ultimately lead to environmental degeneration and degradation.

Health facilities and availability of balanced and nutritious diet are some of the problems to which people in the developing world are faced with. Governments in these countries have to invest more in health and infections and epidemics seriously affect their economic development.

One of the significant effects of overpopulation is the rising levels of unemployment and inflation in the third world countries of the world which can increase the risks of political instability and conflict and can impact the development process in any region of the world.

So in these types of circumstances the concept of sustainable development face serious threats from overpopulation and countries facing this problem must realize that until and unless they are not able to control their population prosperity will remain a dream never to be achieved.

KEY

POINTS

- Rapidly growing population is regarded as a major concern because it affects economic, political, environmental, and social spheres of life.
- The 20th Century brought advancements in agriculture and technology, which caused dramatic increases in human population growth.
- Census simply means counting everyone in a particular area and is usually undertaken by government officials.
- Demography is the study of human populations.
- Crude birth rate (the number of live births for every thousand people in a population). It is calculated by dividing the number of live births in a year by the total population, and then multiplying the result by 1,000.
- Crude death rate, or the number of deaths annually per 1,000 people in the population. calculate this figure by dividing the number of deaths in a year by the total population, and then multiplying the result by 1,000
- Migration into an area is called immigration and migration out of an area, is called emigration.
- Carrying capacity is the maximum number of humans an area is capable of supporting in terms of available resources.

KEY

POINTS

- Demographers determine a population's natural growth rate by subtracting the crude death rate from the crude birth rate.
- Consistent rise in the population is posing serious challenges to the environment.
- Sustainable development is defined as a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

EXERCISE

A Select the correct answers for the following questions.

1. A population with birth rate equal to death rate is:
a. Increasing
b. Decreasing
c. Stable
d. Growing
2. Each environment supports a limited population depending upon its:
a. Biotic potential
b. Carrying capacity
c. Birth rate
d. Reproductive potential
3. Number of births per 1000 is:
a. Growth rate
b. Conception rate
c. Reproduction rate
d. Crude birth rate
4. The study of population is called
a. Demography
b. Population explosion
c. Population dynamics
d. Census
5. Removing natural resources and adding to environmental problems through pollution are major factors in a process called _____.
a. The green revolution
b. Environmental degradation
c. The biotechnological revolution
d. The greenhouse effect
6. The changes in population take place primarily due to the changes in:
a. Births
b. Migration
c. Death
d. All of the above

7. Crude death rate is
- Total death in a specific year / total population in that year multiplied by 1000
 - Total population in that year - total death in a specific year
 - Total population in that year + total death in a specific year
 - Total death in a specific year / total population in that multiplied by 100 year
8. Crude death rate is also known as
- Mortality rates
 - Infant mortality rate
 - life span
 - None of these
9. The maximum number of year that an individual could live
- Life span
 - Life expectancy
 - Birth rate
 - Fertility
10. What is the official definition of Sustainable Development?
- Reducing environmental impact
 - Using less energy in production
 - Economic development that takes future generations into account
 - None of these

11. Why is the rate of urban growth in the world's less developed regions so much higher than elsewhere?
- Rates of population growth are higher in developing countries as compared to industrialized nations.
 - Rates of population growth are lower in developing countries than they are in industrialized nations.
 - There is widespread internal warfare in rural areas.
 - There is lack of education in the developing countries
12. As the population of developing countries undergoes a demographic transition in the years to come, what is likely to be the consequence?
- The population of these countries will steadily fall.
 - There will be rapid growth of cities as more people migrate there in search of employment.
 - There will be less famine and food shortages will decrease.
 - There will be a decrease in religiosity.
13. Urbanization mean:
- The overcrowding of immigrant neighborhoods
 - The result of what happens to an individual when exposed to city life.
 - Decisions reached about the use of available land in a city
 - Rapid growth of cities

14. Deforestation brings about:

- a. Increased sunlight
- b. Weeds or unwanted plants Control
- c. Soil erosion
- d. Increased grazing area

B. Write answers to the following questions.

- Q.1 Define demography?
- Q.2 Differentiate between birth rate and death rate.
- Q.3 What do you mean by infant mortality rate?
- Q.4 Define the term migration. Differentiate between immigration and emigration.
- Q.5 What is the significance of carrying capacity of an area?
- Q.6 What do you mean by population growth? Give a comparative account of population growth of Pakistan and its neighbors.
- Q.7 How do overpopulation has its impact on the agriculture and forests?
- Q.8 Sustainable development is key to survival in this modern day world. Evaluate the statement critically.

Unit 5

Energy Sources

After studying this chapter the students will be able to:

- Describe energy sources (fossil fuels, hydrogen as fuel, nuclear energy, hydal, wind and solar energy).
- Explain conventional and non conventional energy sources, renewable and non renewable energy sources, measurement of energy (natural gas and electricity).
- Identify the role energy sources plays in the development of a country.
- Recognize that limited energy sources are available to Pakistan.
- Critically reflect on the nuclear energy usage in the world and its impact on the life on Earth.
- Compare the annual production of fossil fuels and alternate fuels in Pakistan with their consumption.
- Evaluate the ways of conservation and effective utilization of the available energy sources in Pakistan.
- Describe thermal pollution, fossil and nuclear pollution and fuel hazards.
- Analyze various factors existing around in their surroundings leading to thermal pollution, fossil fuel pollution and nuclear fuel hazards and to suggest remedial measures to overcome it.
- Suggest various methods of every source protection and manage and suggest a plan for Pakistan.

Introduction

Energy is one of the most fundamental parts of our universe. We use energy to do work. Energy lights our cities, powers our vehicles, trains, planes and rockets. Energy warms our homes and , cooks our food. Energy from the sun gives us light during the day. Energy stored in plants is eaten by animals, giving them energy. Everything we do is related to energy in one way or another. Energy is defined as: "the ability to do work." When we eat, our bodies transform the energy stored in the food into energy to do work. Cars, planes, light bulbs, boats and machinery also transform energy into work. Where does energy come from? There are many sources of energy. In this chapter we will discuss various aspects of energy, its kinds, conservation and management.

5.1 ENERGY SOURCES AND THEIR SIGNIFICANCE

There are many different ways in which the abundance of energy around us can be stored, converted, and extended for our use. To help understand the key energy sources that will

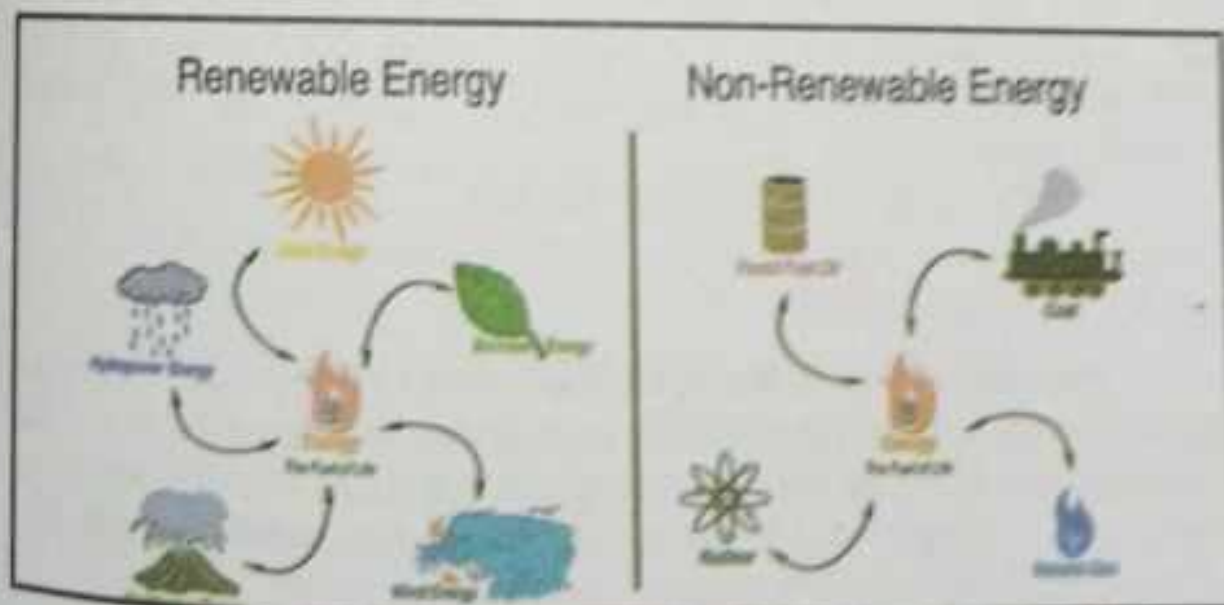


Fig: 5.1 Some of the renewable and non-renewable energy resources

play an important role in the world, the energy sources have been divided into two main categories: non renewable sources and renewable sources. Non renewable sources include the fossil fuels like coal, petroleum, and natural gas.

Conventional energy sources are typically fully developed and includes non renewable energy resources like fossil fuels as well as nuclear power while non-conventional sources which includes renewable energy resources like solar power, hydropower and wind power may be functional but are still undergoing development.

Fossil fuels are expensive and require established technologies that can produce energy round the clock. Non-conventional energy sources have a much smaller environmental impacts and they are renewable. Conventional sources of energy have a limited supply because eventually the nuclear elements and fossil fuels will be used up.

In addition, burning fossil fuels release significant amounts of greenhouse gases and contribute to environmental pollution. Non-conventional energy sources are still expensive and are often limited to producing energy only under certain circumstances such as sunny days for solar panels and windy days for windmills.

Let's study each source in detail.

5.1.1 FOSSIL FUELS

Fossil fuels have been widely used as a source of energy since the Industrial Revolution just before the dawn of the 20th century. Fossil fuels are relatively easy to use and it is easy to generate energy from it because they only require a simple direct combustion.

However, a problem with fossil fuels is their environmental impact. Not only does their excavation from the ground significantly alter the environment, but their combustion leads to a great deal of air pollution. Although there are many different types of fossil fuels the most important are: coal, petroleum, and natural gas.

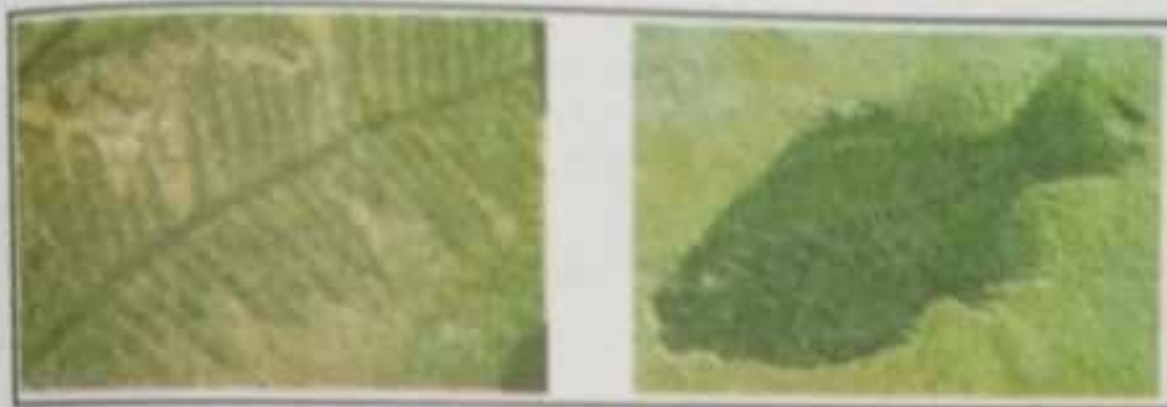


Fig. 5.1 Plant and animal fossils preserved in the rock are a source of fossil fuels

a. Coal

About 300 million years back, a large number of ferns and other prehistoric plants were common on the swamp-like earth. When those plants died and fell to the ground, they were covered with water and they slowly decomposed.

As decomposition took place in the absence of oxygen, much of the hydrogen content of the matter was eroded away, leaving a material rich in carbon.

The material was compressed over the years by sand and dirt, leaving the form of carbon known as coal. The nature of coal is such that the higher the carbon content, the more cleanly and brilliantly the coal burns.

For Your Information

Coal Reserves of Pakistan

Thar desert gives a look of barren and dry harsh landscape. Hidden deep in it lies what can possibly be called as black gold of Pakistan. Thar coal is one of the 5th largest coal reservoir in the world having a total of about 850 Trillion cubic feet of reserves which can possibly enable Pakistan to produce enough electricity to power the entire country.



The other states of coal, from lowest carbon content to highest, are "lignite," bituminous coal, and anthracite coal. If the coal is heated and compressed even more, the result is "graphite," almost completely pure carbon.

Coal is used extensively for the generation of electricity for running industries.

b. Petroleum

Petroleum, or "crude oil," is a liquid fuel that is present in various locations throughout the world. It has many uses, from the generation of electricity to the manufacture of medicines, plastics, and other commercial items.

Much like coal, petroleum is formed from the remains of biodegraded organic material. When animals that lived in the sea millions of years ago died underwater, their remains were gradually covered by layers of very fine dirt known as "silt" on the ocean floor. Then, as the years passed, pressure from the layers built up and compressed the organic material, forming the oil.



Fig: 5.3 Seax have enormous quantities of oil and to drill that oil rigs are used. These rigs create holes to drill oil wells.

c. Natural gas

Natural gas consists primarily of methane (CH_4). It is found associated with other hydrocarbon fuel. Natural gas is almost always found along with the deposits of petroleum.

When the petroleum is drilled, natural gas is also recovered. Wells with only natural gas also exist.

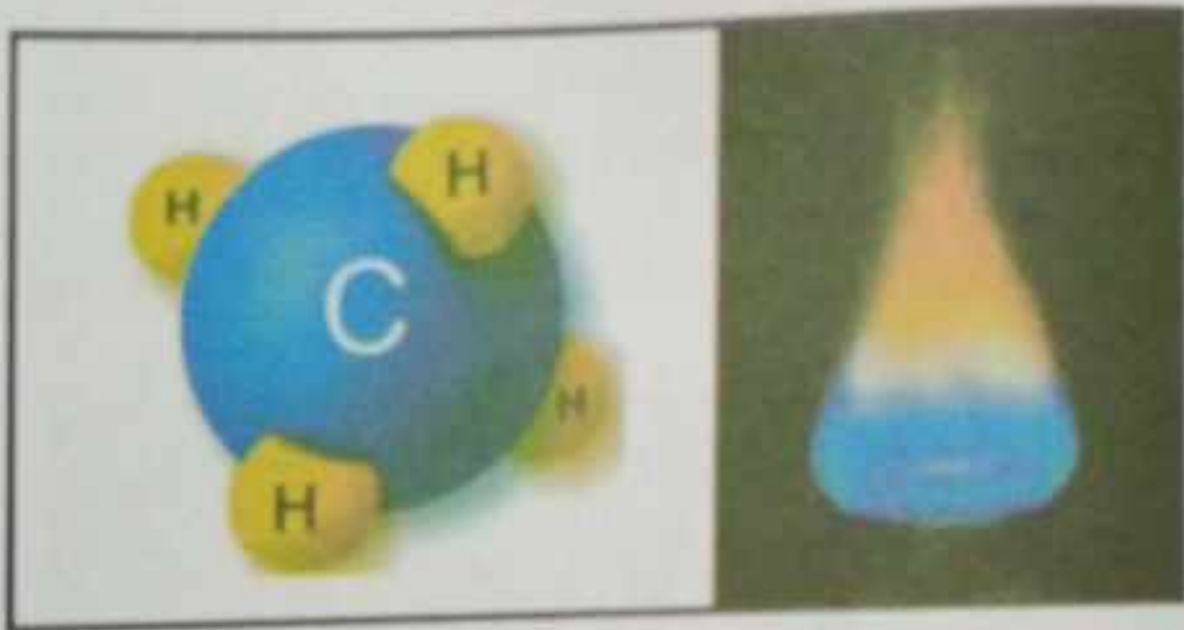


Fig. 5.1 Methane (CH_4) is chemically made up of one carbon to which four hydrogen atoms are attached. When added to the flame indicates methane when colour in the flame represents combustion. Combustion could be methane, ethanol, gas, oil, diesel, wood etc.

Many houses, offices, and other buildings are heated by natural gas heaters. The western hemisphere, Europe, and parts of Africa contain the largest natural gas deposits.

The gas is usually transported by pipelines. Compared to petroleum and coal, natural gas is relatively clean-burning, because it contains only trace portions of sulfur and nitrogen.

For Your Information**Sui Gas Field of Pakistan**

The Sui is located at a distance of about 650 kilometres (km) from Karachi in Dera Bugti, Balochistan. Sui is a major gas field of Pakistan. As a major production facility, Sui Gas Field (SGF) has the country's largest gas compressor station and a purification plant. At the time of its discovery, SGF was considered among the largest natural gas fields in the world. Despite diminishing reserves over time, SGF still remains the highest natural gas producing field in Pakistan.

**5.1.2 RENEWABLE ENERGY SOURCES**

Due to diminishing fossil fuels renewable energy may become a major energy choice for the 21st century. Among the most important of these sources is wind, hydroelectric and solar. Renewable energy sources are environmentally clean and virtually inexhaustible.

Their major drawbacks, however, are limited energy production (in most cases not suitable for large-scale power generation) as well as relative cost to build and maintain.

a. Wind energy

Wind has been used as a source of energy for centuries. About 3000 BC ago, people probably first used the force of moving air to push a boat with a sail through the water. This might have led to the invention of the windmills. These wind mills were first used in central Asia. Windmills were used in Europe more than 700 years ago to grind grains and pump water.

More recently wind power is used to turn wind turbines. In United States and Europe many wind farms routinely generate several mega watts of electricity a day.

Wind Power : Clean Way of Electricity Generation

Wind power is the fastest-growing energy source in the world. Turbines powered by wind are mounted on towers 100 or more feet above the ground, where the wind is faster and less turbulent.



In Pakistan efforts are being made to use wind energy for pumping water and producing electricity.

b. Hydroelectric energy

Man has utilized the power of water for years. Hydroelectric systems make use of the energy in running water to create electricity.

In coal and natural gas systems, a fossil fuel is burned to heat water. The steam pressure from the boiling water turns "propellers" called turbines. These turbines spin coils of wire between magnets to produce electricity.

Hydropowered systems also make use of turbines to generate electrical power; however, they do so by using the energy in moving water to spin the turbines.

Ghazi Barotha Hydropower Project

Ghazi Barotha Hydropower Project is a unique power project. It has a generation capacity of 1450 MW and it consists of three main components. The Barrage, the Power Channel and the Power Complex. The Project utilizes the normal Tarbela Dam releases to provide year round maximum power generation.



Water has kinetic energy when it flows from higher elevations to lower elevations. This energy spins the turbines and generates electricity.

In Pakistan hydroelectric power projects are contributing significantly to the cause of electricity production.

Although Pakistan has huge hydal power generation capacity mainly on river Indus but it has yet to exploit it to its maximum capacity. However, three main dams Tarbela, Mangla, and Warsak constructed for the purpose of generating electricity and irrigating agricultural land are vital for the energy sector in Pakistan.

c. Solar Energy

Most of the energy known to man is derived in some way from the sun. When we burn wood or other fuels, we actually release the stored energy of the sun. In fact, there would be no life on earth without the sun, which provides energy needed for the growth of plants, and indirectly, the existence of all animal life.



a.

b.



C.

Fig: 5.5 a. Solar geyser b. Solar cooker c. Solar panel powering artificial sun in space

Nowadays electric current is obtained from sun's energy. A device called a solar cell can change the energy of sun light to electrical energy. Such solar cells are frequently used in calculators, watches etc.

Batteries made up of solar cells are used to run radios, television, equipments in artificial satellites going around the earth. Solar cookers, solar geysers and solar house heating system are successfully working by using solar energy

Solar power has an exciting future ahead of it. Because solar power utilizes the sunlight, a resource that is everywhere. Solar panels can be attached to moving objects, such as automobiles to power those objects. Solar powered cars are being experimented these days.

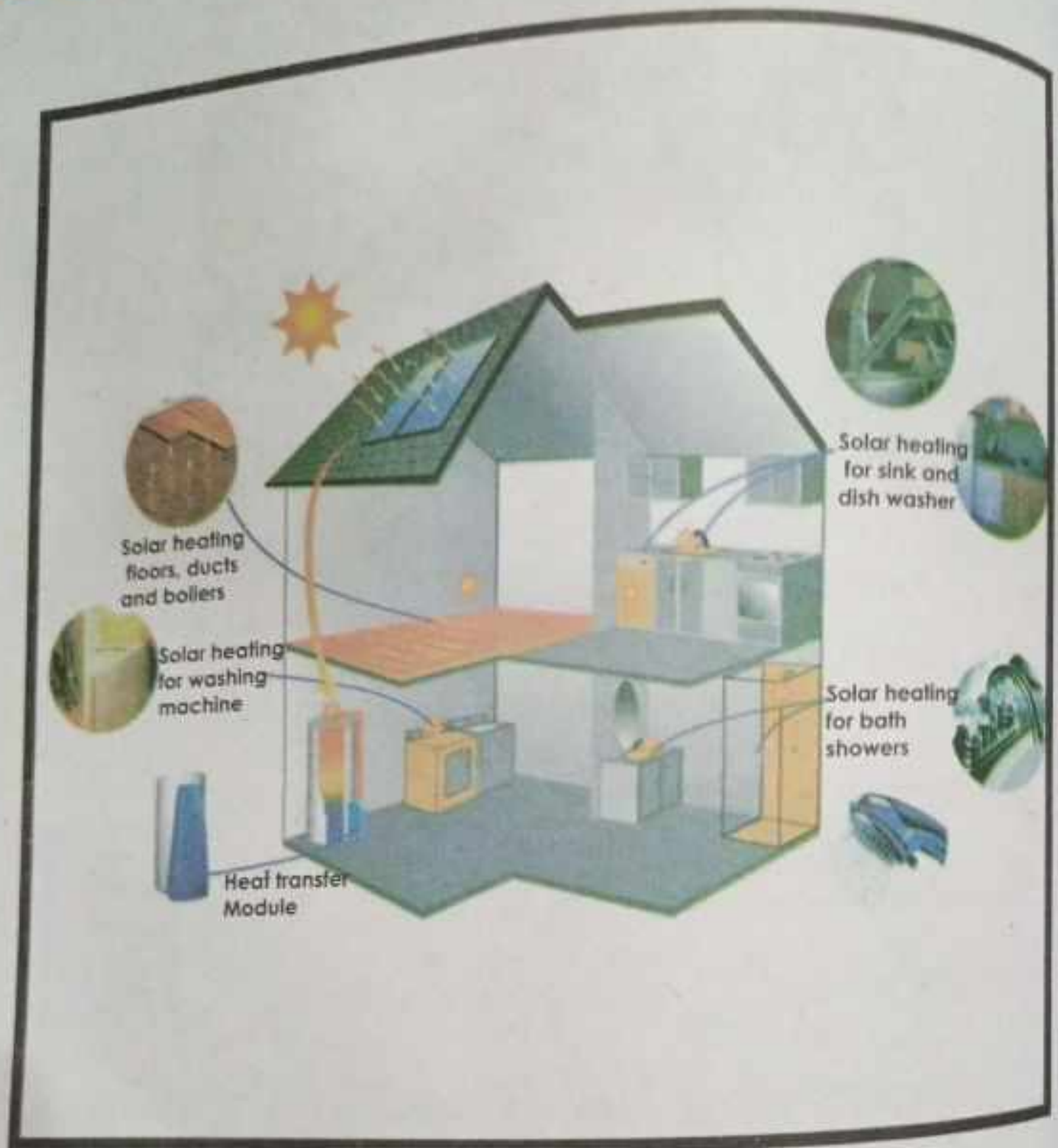


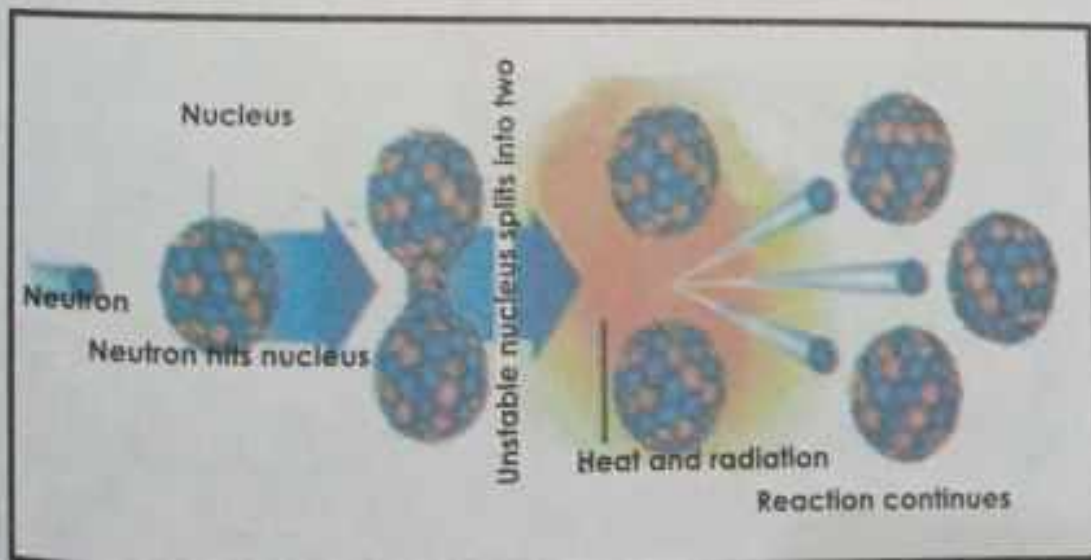
Fig: 5.6 Solar heating system for a house.

Do You Know?

There are two ways in which solar power can be converted to energy. The first, known as "solar thermal applications," involve using the energy of the sun to directly heat air or a liquid. The second, known as "photoelectric applications," involve the use of photovoltaic cells to convert solar energy directly to electricity.

5.1: 3 NUCLEAR ENERGY

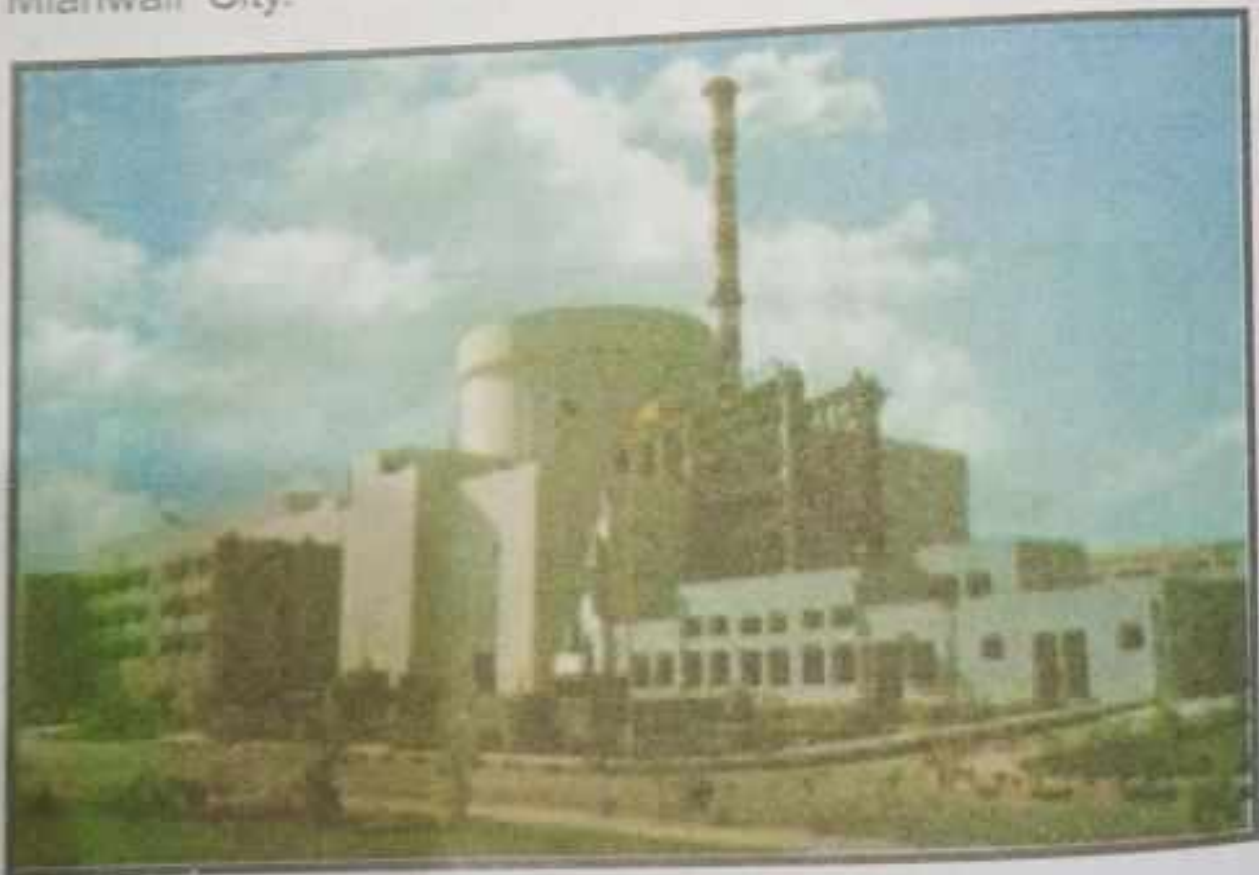
The diminishing availability of natural resources such as coal, petroleum, and crude oil has left scientists searching for an energy alternative. Harnessing the power of the atom appears to be one of the solutions. Fission and fusion reaction are the two types of nuclear reaction with the help of which energy can be produced from an atom. Nuclear energy is the energy released from the nucleus of the atom when it is hit or bombarded by a slow moving atomic particle, called neutron. When the atom of Uranium 235 is hit by the neutron, it splits up into several parts. With the release of enormous amount of energy this process is known as nuclear fission. It is carried in specially designed nuclear reactors.



Cold water is pushed in the core of nuclear reactor, which carries away heat of the nuclear reactor and turns into steam. The steam is ejected into the steam turbine which begins to turn the generator to produce electricity.

In Pakistan Karachi Nuclear Power Plant (KANUPP) and Chashma Nuclear Power Plant (CHASNUPP-1) are the two main nuclear power plants which are producing electricity. KANUPP has a capacity to produce 137 Mega Watts of electricity. It is located at Paradise Point on the Arabian Sea Coast, about 15 miles to the west of Karachi.

CHASNUPP-1, the second nuclear power plant in Pakistan, was started in 1992 with the help of People's Republic of China. CHASNUPP-1 has a capacity of 325 Mega watt of electricity. The Plant is located in the province of Punjab near Chashma Barrage on the left bank of River Indus, 32 Km south of Mianwali City.



a. Chashma Nuclear Power Plant



b. Karachi Nuclear Power Plant (KANUPP)

Fig. 5.8

5.1.4 HYDROGEN AS FUEL

Hydrogen is the simplest element. An atom of hydrogen consists of only one proton and one electron. It is also the most plentiful element in the universe but it is always present combined with other elements e.g. Water (H_2O).

Hydrogen is also found in many organic compounds, notably the hydrocarbons that make up many of our fuels, such as gasoline, natural gas, methanol and propane.

Hydrogen can be separated from hydrocarbons through the application of heat - a process known as reforming. Currently, most hydrogen is made in this way from natural gas.

An electrical current can also be used to separate water into its components of oxygen and hydrogen. This process is known as electrolysis. Some algae and bacteria, using sunlight as their energy source, even give off hydrogen under certain conditions.

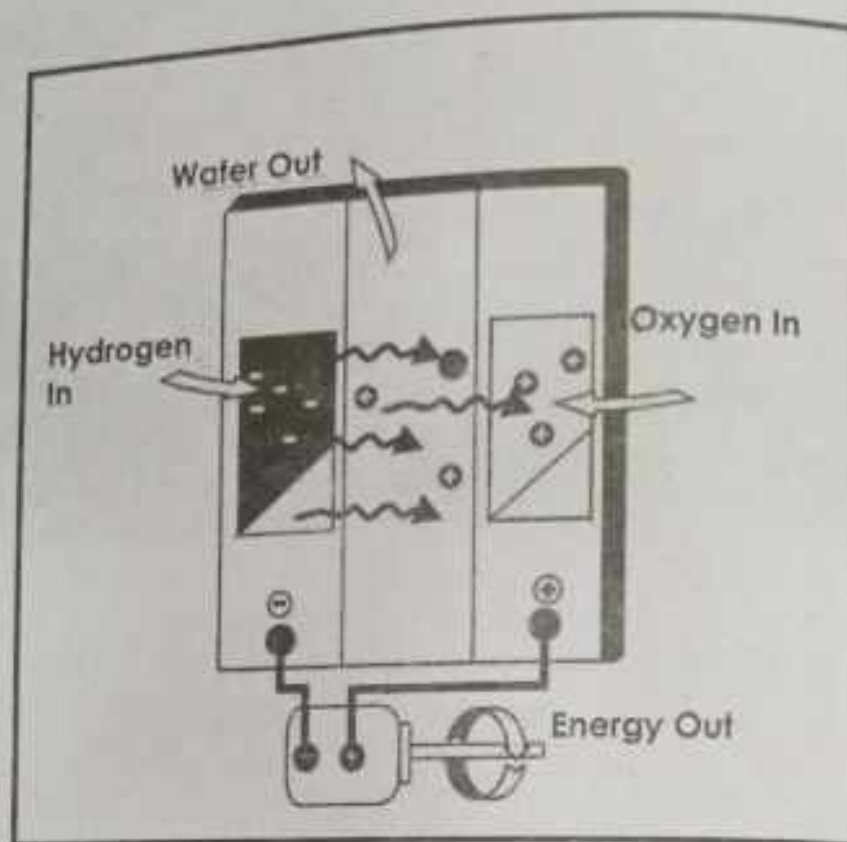


Fig: 5.9 Hydrogen fuel cell

A fuel cell combines hydrogen and oxygen to produce electricity, heat, and water. Fuel cells are often compared to batteries. Both convert the energy produced by a chemical reaction into usable electric power.

Fuel cells are useful to be used as a source of heat and electricity for buildings, and as an electrical power source for electric motors propelling vehicles.

Fuel cells operate best on pure hydrogen. But fuels like natural gas, methanol, or even gasoline can be reformed to produce the hydrogen required for fuel cells.

Hydrogen Fuel in Space Shuttle



Hydrogen is high in energy, yet an engine that burns pure hydrogen produces almost no pollution. NASA has used liquid hydrogen since the 1970s to propel the space shuttle and other rockets into orbit. Hydrogen fuel cells power the shuttle's electrical systems, producing a clean byproduct - pure water, which is used by the crew for drinking.

5.3 MEASUREMENT OF ENERGY

Worldwide, two systems of units of measurement are commonly used today: the Metric System (Système International) and the British System. Energy can be converted into work. Energy can be represented by the following simple equation:

$$\text{Work} = \text{Force} \times \text{Distance}$$

Energy is defined as the ability to do work. However, work is defined as a force applied to some form of matter (object) multiplied by the distance that this object travels.

Physicists commonly describe force with a unit of measurement known as a newton (after Sir Isaac Newton). A newton is equal to the force needed to accelerate (move) a mass weighing one kilogram to a distance of one meter in one second in a vacuum with no friction. The work or energy required to move an object with the force of one newton over a distance of one meter is called a joule.

2. MEASUREMENT OF ELECTRICITY

Electric meter is connected with the live wire of main supply. Live wire is connected with the field coils of the meter. Inside the field coil, there is another coil, which can rotate about its axis. When current passes through meter, magnetic field is produced due to which coil inside the field rotates. The disc rotating along with coil can be seen from outside. The gears attached to the disc display meter reading on the dial. The reading is in kilowatt-hours (kW), which is simply called a unit.



Fig: 5.10 Electric Meter.

b MEASUREMENT OF NATURAL GAS

Gas meter are installed to measure gas consumption. Natural gas is measured in cubic meter (m^3). The gas before entering the house passes through the gas meter, which turns a wheel. The gears attached to the wheel display the volume of the gas consumed on the dial. Now a days gas bills are being charged on the base of British thermal unit (BTU). It is also the unit of energy. One BTU is equal to 1055 joules.



Fig: 5.11 Gas meter/

5.3 ENERGY IN DEVELOPMENT OF A COUNTRY

Energy has become a fundamental aspect of human existence. The development of a country can be judged by the amount of energy it consumes. Generally we see that the developed country has larger demand for energy compared to a developing or under developed country.

Modern day industries cannot sustain their activities without uninterrupted energy supplies. This in turn, ensures the creation of employment opportunities which ultimately generate economic activities and increases the standard of life of a nation. Development in the fields of agriculture, health, education, industry etc require energy and lack of investment in terms of energy in these fields mean no development and low standard of life.

Access to energy is therefore a prerequisite for sustainable development.

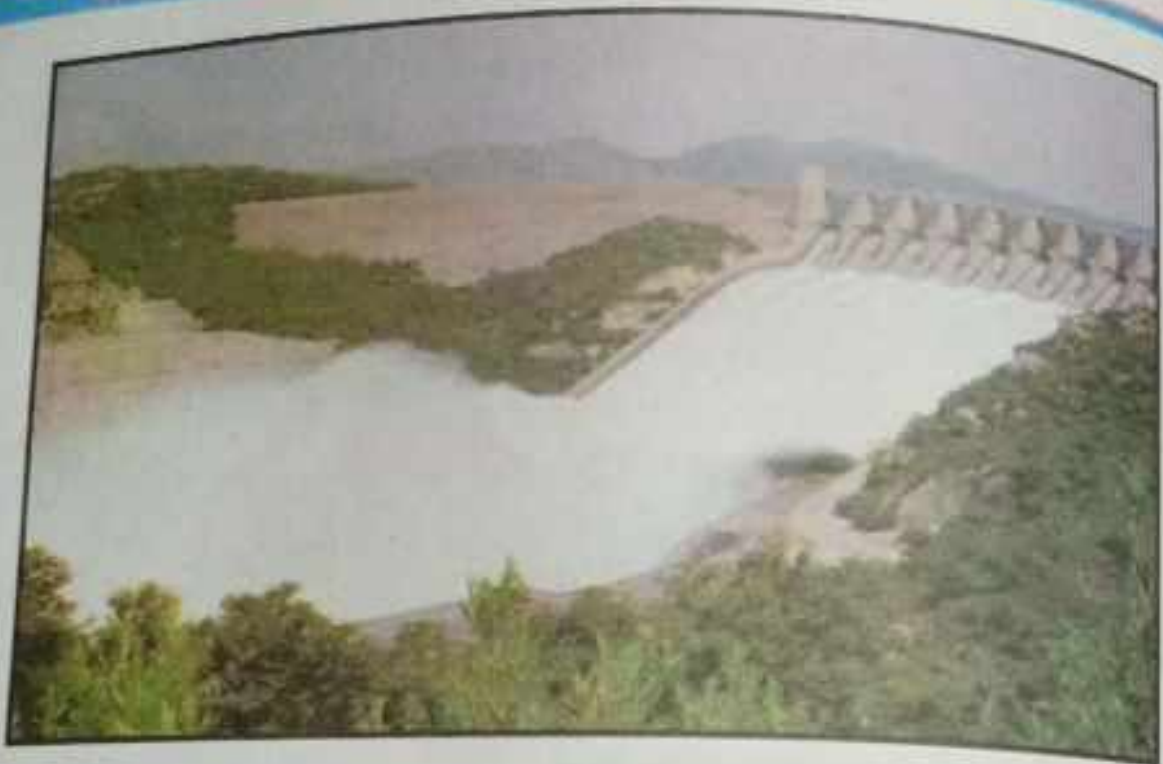


Fig. 5.12 Hydel power is still regarded as the cheapest source of energy

Pakistan's economy is growing steadily. This growth demands higher energy consumption. Pakistan mainly depends upon oil and gas resources to fulfill energy requirements. Indigenous resources of oil are not enough for the growing economy. As a result Pakistan has to import large quantities of oil and oil based products from Middle East countries.

Although Pakistan is blessed with a huge potential for hydel energy but proper planning and a clear strategy in this regard has yet to be devised.

Pakistan total primary energy supply during the year 2007- 2008 was 62.88 MTOE (million tons of oil equivalent) more than 99% of this energy was supplied through conventional energy sources such as oil, gas, hydel and nuclear, etc. whereas less than 1% supplied through micro/mini renewable energy (RE). Today, only 55% of Pakistan's population has access to electricity.

The nation is currently facing power supply shortage the worst to ever hit the country. The occurrence of prolonged and frequent power breakdowns has had a negative impact on industry operation, the economy and the livelihood of citizens in general.

While the energy shortage continues to grow, abundant indigenous sustainable energy resources such as wind, solar and biomass remain virtually untapped.

Currently, approximately 66% of power generation in Pakistan is derived from fossil fuels (primarily oil and gas) followed by hydroelectricity (30%) and nuclear energy (3%).

5.4 ENERGY AND ENVIRONMENT

Humans are always in search of different sources of energy to make their lives comfortable and stable but sometimes these sources of energies becomes hazardous to them and their environment.

Humans are at risk whether it is burning of fossil fuels or production of electricity through nuclear power plant. Emissions and contaminations all pose serious consequences on the lives of human.

In the following section we will see how production of energy from various sources affects our lives and what the possible remedial measures are in this regard.

Thermal pollution

The word therm means heat and heat is a form of energy. It is the kinetic energy associated with the motion of atoms and molecules. Thermal process is that process in which heat is produced or is converted into other forms of energy.

In this process heat exchange between system and surrounding may occur. Combustion reaction is an example of thermal process.

In combustion reaction carbon dioxide (CO_2), water (H_2O), light and heat are produced. If oxygen supply to the reaction is insufficient, then carbon monoxide (CO) may also be produced. Certain fuels also contain sulphur.

When they burn, sulphur dioxide (SO_2) is given off. Coal and fuel oil contain upto 3% of sulphur and petrol about 0.05%. quite low concentration of SO_2 can damage the leaves of plants and stunt their growth and they can also make people's respiratory illness much worse.

Carbon monoxide (CO) is poisonous and can cause death, even if its concentration is in decimals. High concentration of CO_2 also has adverse effects on the environment. It helps in increasing the temperature of our atmosphere due to green house effect.



Fig: 5.12 Thermal pollution emitting from chimneys.

Remedial measures

- Maximizing the efficiency of heat engines to minimize heat loss.
- Less burning of fossil fuels and avoiding energy wastages.
- Industries and factories should follow strict norms to reduce thermal pollution.
- Temperature of industrial waste water from power plants, paper industries, and cement industries should be reduced by the adoption of cooling ponds and towers.

Nuclear Fuel Hazards

Radioactive material emit certain radiation. These radiations have the ability to penetrate gases, liquids and even solids. The radiations are:

- 1) Alpha radiations
- 2) Beta radiations
- 3) Gamma radiations

Penetration power of these radiations is different due to their size, velocity and nature.

Controlled nuclear reactions are useful for humanity but when they are out of control or when they occur in open, they damage the whole area. These rays are carcinogenic (causing cancer) and also cause deformation in new born babies.

Remedial measures

To avoid such hazards care must be taken in performing nuclear reactions and disposing off nuclear wastes. The design of the nuclear reactor must include provisions for human (operator) error and equipment failure.

Famous accidents of civil nuclear power generation

The three significant accidents in the 50-year history of civil nuclear power generation are:

Three Mile Island (USA 1979) where the reactor was severely damaged but radiation was contained and there were no adverse health or environmental consequences.



Chernobyl (Ukraine 1986) on 26 April 1986, reactor no. 4 of the Chernobyl nuclear power station exploded. One hundred times more radiation was released than by the atom bombs dropped over Hiroshima and Nagasaki.



Famous accidents of civil nuclear power generation

Fukushima (Japan 2011) Fukushima Daiichi nuclear power plant, 150 miles northeast of Tokyo, was severely damaged by the earthquake and tsunami the world's worst nuclear accident in 25 years.



In any nuclear reactor some sort of cooling is necessary. Generally nuclear reactors use water as a coolant. However some reactors which cannot use water use sodium or sodium salts. There is a series of physical barriers between the radioactive core and the environment.

5.5 ENERGY CONSUMPTION AND CONSERVATION

After obtaining preliminary information, you would have realized the value and importance of energy in modern society. You may have also noticed that conventional sources of energy are limited. Exploitation of non-conventional energy sources is still in initial stages of research and development. The fuel that burns in factories, transport vehicles or perform other activities is mainly obtained from the underground deposits in the form of coal, oil, natural gas and other similar raw forms. These deposits are rapidly decreasing.

The rapid growth in population increases the pressure on the use of resources. The excessive and unwise use of resources affects the environment. After all, one day, all the resources of energy will be exhausted. It is, therefore, highly important for us to avoid wastage of energy and conserve energy by taking suitable steps at our homes, schools, industries and offices etc.

Conservation of energy in homes

To conserve energy at homes, we must put off the electrical appliances and close gas and water valves, when not required. We should use electrical appliances that use comparatively lesser energy e.g. tube lights, energy saver bulb etc. We should design our homes such that we get maximum benefits of sun light and proper ventilation.

Conservation of energy in schools

We must take steps to minimize energy consumption, like designing schools such that it is properly ventilated and get maximum benefits of the sun light.

Conservation of energy in industries

Industries play an important role in the development of a country. These industries run with consumption of energy. Although they need huge amount of energy but consumption of energy could be minimized by better management, reuse of by products and proper maintenance of machinery.

KEY

POINTS

- Energy is defined as: "the ability to do work."
- Energy sources have been divided into two main categories: non renewable energy sources and renewable energy sources.
- The renewable energy sources are solar, wind, hydroelectric, biomass, and geothermal power.
- Non renewable sources include the fossil fuels like coal, petroleum, and natural gas.
- Fossil fuels are relatively easy to use and it is easy to generate energy from it because they only require a simple direct combustion.
- When prehistoric plants died and fell to the ground, they were slowly decomposed in the absence of oxygen. The material was compressed over the years by sand and dirt, leaving the form of carbon known as coal.
- Petroleum is formed from the remains of biodegraded organic material.
- Natural gas consists primarily of methane and is found associated with other hydrocarbon fuel.
- Nuclear energy is the energy released from the nucleus of the atom when it is hit or bombarded by a slow moving atomic particle, called neutron.
- Two systems of units of measurement are commonly used today. These are Metric System (Système International) and the British System.
- The development of a country can be judged by the amount of energy it consumes. Generally we see that the developed country has larger demand for energy compared to a developing or under developed country.

KEY POINTS

- Thermal process is that process in which heat is produced or is converted into other forms of energy.
- Radio active materials emit certain radiation which has the ability to penetrate gases, liquids and even solids.
- To avoid wastage of energy and conserve energy by taking suitable steps at our homes, schools, industries and offices etc.
- To conserve energy at homes, we must put off the electrical appliances and close gas and water valves, when not required. We should use electrical appliances that use comparatively lesser energy.

EXERCISE

A. Select the correct answers for the following questions.

- Fuel formed under the earth's surface by the decomposition of organic matter is called _____.
 - Organic fuel
 - Biogas
 - Fossil fuel
 - Inorganic fuel
- Which of the following causes the least pollution when burnt?
 - Petrol
 - Diesel
 - Coal
 - Natural gas
- Which of these is not a renewable source of energy?
 - The sun
 - Natural gas
 - Wind
 - Ocean tidal energy
- A solar cell is made up of
 - Silicon
 - Teflon
 - Titanium
 - Magnesium
- A solar cell converts _____.
 - Heat energy into electrical energy
 - Solar energy into electrical energy
 - Heat energy into light energy
 - Solar energy into light energy
- The fuel used in the nuclear reactor is _____.
 - Cadmium
 - Uranium
 - Radium
 - Thorium

EXERCISE

7. The state of coal, with lowest carbon content is _____
- a. Bituminous coal
 - b. Anthracite coal
 - c. Lignite,
 - d. None of these
8. A unit of electricity means
- a. Megawatt
 - b. Nanowatt
 - c. Kilowatt hour
 - d. Joule
9. Which of the following problems is associated with the burning of coal?
- a. Acid rain
 - b. Carbon dioxide emissions
 - c. Ash with toxic metal impurities
 - d. All of these
10. Solar energy stored in material such as wood, grain, sugar, and municipal waste is called _____.
- a. Fossil fuels
 - b. Biomass
 - c. Geothermal energy
 - d. Natural gas
11. The world faces an energy crisis because _____.
- a. World demand for energy will increase
 - b. World oil production will peak and begin to decline
 - c. Shortages and the resulting escalation of prices can shock the economic and political order.
 - d. All of the above

**EXERCISE**

12. A fuel cell combines hydrogen and _____ to produce electricity, heat, and water.

- a. Carbon
- b. Oxygen
- c. Uranium
- d. Silicon

13. Fossils are the

- a. Dead remains of living organism
- b. Coal mines
- c. Kind of natural resource
- d. Living beings

14. Petroleum is mixture of

- a. Petrol
- b. Diesel
- c. Petroleum gas
- d. All of these

15. Burning of fossil fuel causes

- a. Air pollution
- b. Global warming
- c. Both (a) & (b)
- d. None of these

B. Answer the following questions.

1. What would happen if there was no electricity?
2. What is Overuse of electricity?
3. What are the advantages and disadvantages of using petroleum?
4. Give two examples of ways to conserve energy at home?

EXERCISE

5. What is a conventional source of energy?
6. What is the importance of conserving energy?
7. What is mmbtu?
8. Describe various types of fossil fuels.
9. Write short note on the following:
 - a. Coal as fossil fuel
 - b. Petroleum
 - c. Wind as source of energy
10. Write in detail the nature and utility of any two non conventional sources of energy?
11. Compare renewable energy sources with non-renewable sources.
12. Differentiate between conventional energy sources and non-conventional energy sources.
13. Briefly write the process of formation of fossil fuels.
14. Describe the role of energy in the development of a country.
15. How critical is hydel power generation for Pakistan. Discuss.
16. Nuclear power is regarded as one of the strategy for fulfilling the gaps of power shortages. How Pakistan has been able to use nuclear technology successfully and what hazards are associated with the use of nuclear energy?

Glossary

acid. A compound that yields hydrogen ions (H^+) when in aqueous solution. Acids have a sour taste and turn blue litmus red.

alcohol. Organic compound used in gums, resins, dyes and perfumes. Fermentation produces ethanol not alcohol.

alkali. A base that is soluble in water.

atomic number. The number of protons in an atom.

atomic symbol. The letters representing each of the elements.

atomic weight. Sum of number of protons and neutrons in the nucleus.

atoms. Composite particles of protons, neutrons and electrons. The smallest part of a substance that can take part in a chemical reaction.

base. A compound that yields hydroxide (OH^-) ions when in aqueous solution. Bases have a bitter taste, feel greasy, soapy and turn red litmus blue.

boiling point. The temperature at which a liquid starts boiling.

bond. A chemical link between atoms.

carbohydrates. The major energy source within plants and animals: sugars, starches and glucose polymers.

carbon. The basic element in all organic compounds.

catalyst. A substance that reduces the activation energy of a reaction.

cell. The smallest independent part of an organism.

chain reaction. Polymerisation initiated by the bonding of a free radical with a monomer.

charge. The amount of unbalanced electricity in a system. Either positive or negative.

chemical (empirical) formula. The ratio of elements in a substance. For example: the chemical formula of common salt is $NaCl$, sodium and chlorine in a ratio of 1:1.

chemical reaction. The transformation of substances by the rearrangement of their atoms.

chromosomes. Thread like structures found in the nucleus of the cell and carrier of hereditary material.

compound. A substance containing more than one element.

conduction. Heat or electricity transfer through molecular interaction, eg: heat passing along a metal bar.

DNA: Deoxyribonucleic acid. Twisted helical polymer chains. See chromosomes.

electric current. A flow of electrons through a conductor, the amount of the current is proportional to the rate of electron flow.

electrons. Negatively charged atomic particles spinning around the nucleus in its orbits.

electromagnetic waves. Waves with both an electric and magnetic component. They are: radio, micro, infra-red, visible light, ultraviolet, X rays and gamma rays.

element. A substance composed of atoms all with the same atomic number. A substance that cannot be split chemically into smaller substances.

energy. The capacity to do work. Work is done by transferring energy from one form to another. For example the chemical energy in a fuel is converted to thermal energy as it burns.

exothermic reaction. A reaction from which heat is lost eg: combustion.

fats. Molecules of fatty acids or glycerol. Used as a food store, insulation and for shock absorption.

fecundity. The ability to breed.

field. A region in space that is defined by a vector function. Common fields are: gravitational, electric and magnetic.

fission. Splitting the nucleus of an atom into smaller nuclei.

force. An action (transfer of energy) that will accelerate a body in the direction of the applied force. See Newtons Laws of Motion.

fusion. 1. Change of state of a substance from a solid to a liquid. 2. The joining together of two atomic nuclei.

gene. A unit of inheritance. A section of DNA. comprising a sequence of four bases: adenine, guanine, cytosine and thymine.

heat. The internal energy of a body (substance).

Glossary

hydrocarbon. Compounds containing only hydrogen and carbon atoms.

ingots. Mass of metal cast into a convenient shapes

inheritance. The features of an organism are determined by a set of chromosomes. These originate in the parents and are passed on to an offspring during fertilisation. It follows then that since chromosomes are inherited, all the features of an organism must be inherited.

isotope. An element that has more or less neutrons than normal. Many isotopes are radioactive.

kinetic energy. The energy possessed by a body in motion.

mass. The quantity of matter in a body.

metals. Elements characterised by their opacity, malleability and thermal and electrical conductivity.

molecular formula. The number and types of atom in a molecule. For example the molecular formula of methane is CH_4 , one atom of carbon and four atoms of hydrogen.

molecule. A group of atoms bonded together. It is the smallest part of a substance that retains the chemical properties of the whole.

monomers. Small molecules that link together to form a polymer.

neutralization. A reaction in which the characteristics of an acid or base disappear.

neutrons. Particles with no charge forming part of an atomic nuclei.

noble gases. Elements with zero valency. They form group 0 in the periodic table and are non-reactive.

organic compounds. Substances that contain Carbon.

ozone. An isotope of oxygen that blocks ultra-violet radiation. Normally found in the stratosphere.

pathogenic. Capable of causing disease

pH Scale. The strength of acids and bases. Pure water has a pH value of 7, acids have a lower value and bases higher.

phase changes. Freezing or boiling.

photosynthesis. The conversion of water and carbon-dioxide by plants into glucose and oxygen. Light is used as an energy source.

Glossary

polymerisation. The repetitive bonding of small molecules (monomers) to produce large molecules (polymers).

polymers. Long chain molecules such as PVC, nylon or DNA produced by the polymerisation of monomers.

potential energy. Amount of usable energy within a body at rest.

power. Amount of work done per second.

products. The substances produced in a chemical reaction.

proteins. Amino acid polymers with specific biological functions, especially the growth, regeneration and repair of cells.

radiation. 1. Transfer of heat between bodies without a change in the temperature of the intervening medium. 2. Any release of energy from its source.

radioactivity. The spontaneous release of energy from atomic nuclei.

reactants. The substances that take part in a chemical reaction.

reproduction. Reproduction is the process by which a new organism is produced.

resistance. Opposition to current flow in a conductor.

respiration. The production of energy by the oxidation of glucose.

skepticism. A doubting or questioning attitude or state of mind;

temperature. How hot one body is when compared to another.

weight. The gravitational force exerted on a mass.

work. The amount of energy transferred to a system.

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