Science Notes Part 36 To 40

36] Air, water and soil pollution

Air, water and land are the most important natural resources. Human beings are responsible for changing the environment to fulfill their needs of food, clothing, housing, transport and industry.

Human beings damage the healthy environment by uncontrolled activities. Most of the environmental problems are related to the increase in population, development in agriculture, transport and industry.

Air pollution

Air pollution is the outcome of any change in the composition of air, either by physical or chemical methods that cause harmful effects on health.

Sources of Air Pollution

There are two sources namely,

1. Natural sources
2. Man-made (anthropogenic) sources.

Natural sources

Volcanic eruption, forest fire, sea salt sprays, biological decay, photochemical oxidation of terpenes, marshes, pollen grains, and spores are some natural sources. Radioactive minerals present in the earth's crust are the sources of radioactivity in the atmosphere.

Man-made sources

Industrial emissions, vehicles, aeroplanes, power-stations, burning of fuels, etc.,are man-made sources. Air pollution is caused mainly due to burning of fuels to run vehicles and the smoke emanating from chimneys of factories and power stations.

Air contains 20.9% Oxygen, 78% Nitrogen, 0.03% Carbon Dioxide, Neon, Krypton, Hydrogen and Water vapour in small quantities. Vehicles cause 50% of the air pollution in India.

The Greenhouse Effect

Some of the infrared radiation from the earth passes through the atmosphere but most of it is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. This warms up the Earth's surface and the lower atmosphere.

Air Pollutants

The following table shows a few air pollutants and their effects on human health and environment.

S.No	Name of the Air pollutants	Sources	Effects
1	Carbon monoxide	Combustion of fuels	It reacts with haemoglobin in human blood forming carboxy-haemoglobin. It may lead to death.
2	Carbon dioxide	Burning of coal/ timber	It leaders global warming
3	Nitrogen oxides	Automobile exhausts	It causes acid rain.
4	Sulphur dioxide	Burning of sulphur	It causes irritation in the eyes, lung cancer and asthma.

Acid Rain

Oxides of nitrogen, sulphur, and carbon produced by combustion of coal, petroleum, etc,. dissolve in atmospheric water vapour. They form their corresponding acids like nitric acid, sulphuric acid, etc., and reach the earth's surface as acid rain.

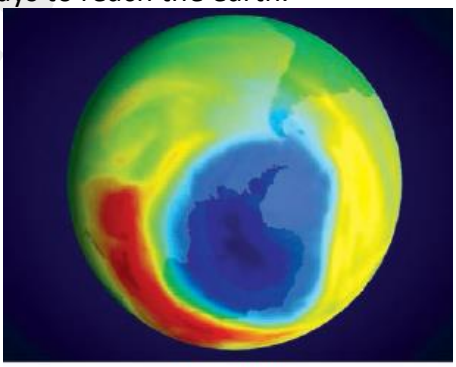
Effects of acid rain

- It irritates the eyes and the skin of human beings.
- It inhibits germination and growth of seedlings.
- It affects the fertility of soil, destroys plant and aquatic life.
- It causes corrosion of many buildings, bridges, etc.,

The increase in the concentration of greenhouse gases (CO_2, methane) in the atmosphere allows radiations of short wavelength reflect back to earth. The consequent increase in the global mean temperature due to greenhouse gases is called global warming.

Ozone Depletion

Ozone is a colourless gas, found in the upper atmosphere (stratosphere) and is highly beneficial. The Ozone layer is thinning due to the emission of pollutants into the atmosphere. Holes caused in the ozone layer allow the harmful UV rays to reach the earth.



Ozone hole

Control of air pollution

Air pollution can be minimized by following ways:

Use of crude oil should be avoided and use of high quality fuels, unleaded petrol, bio-diesel and Compressed Natural Gas (CNG) should be recommended.

Use of automobiles should be minimized. Industrial smoke must be filtered before releasing it into the atmosphere. Planting of more trees to get pure air (O_2) and reduce the CO_2 content in the environment.

Water pollution

Water is said to be polluted, when there are undesirable changes in the physical, chemical and biological conditions of water that make it unfit for human consumption.

Water becomes polluted in many ways:

- Stagnant water becomes polluted day by day. It gives out a foul smell and mosquitoes breed there in large numbers causing malaria.
- Pond water get polluted due to human activities like bathing and washing clothes.

Sources of water pollution

Water pollution reduces the amount of pure fresh water that is available for agriculture, drinking, cleaning, swimming and fishing. The pollutants that affect water come mainly from industries, farms and sewage systems. Industries dump huge amounts of waste products into water bodies.

Wastes from farms include animal waste, fertilizers and pesticides. Most of these materials drain off from fields into nearby water bodies. Sewage systems carry waste from homes, offices and industries into water bodies.

Hot water released into water bodies can also upset the natural cycle. This is called thermal pollution. Hot water can kill aquatic animals and plants that can survive only in low temperature. It also reduces the amount of dissolved oxygen in water. Mostly heated water comes from industries and power plants that use water for their cooling towers.

Control and preventive measure

- Treating waste in effluent treatment plant before it is discharged into the water bodies.
- Reusing the treated water either for gardening or cooling purpose, wherever possible.
- Over usage of water should be prevented.
- Wash clothes at a place away from the well.

Water Pollution

Purification of water

Cleaning of waste water is a process of removing pollutants before it enters a water body. This process of waste water treatment is commonly known as **Sewage Treatment.**

What is sewage?

Sewage is waste water released by homes, industries, hospitals, offices and other users. It also includes rain water that runs down the streets during a storm or heavy rain.

Land Pollution

Pollution of the earth's natural land surface by industrial, commercial, domestic and agricultural waste is called land pollution. Throwing waste materials like plastic objects, animal waste, dye effluent , trash and garbage causes land pollution.

Waste Water Treatment Plant

Treatment of waste water involves physical, chemical and biological processes.

1. At first, waste water is passed through bar screens.
2. Large objects like sticks, cans and plastic packets are removed.
3. The water is then passed through a grit chamber in which sand is removed.
4. The water is then allowed to settle in a large tank.
5. Solid materials settle at the bottom.
6. Then the water is transferred to the next tank through a skimmer. This skimmer removes the floating solids like oil and grease.
7. Next, air is pumped through water in an aeration tank to help aerobic bacteria to grow. The bacteria consume unwanted matters that still remain in water.
8. The treated water has a very low level of organic material and suspended matter. It is discharged into a river.

Waste water treatment plant

Sources of land pollution

Land is polluted by excessive usage of fertilisers, pesticides, sewage wastes and factory wastes. It is mainly polluted by garbage.

Some land pollutants, called hazardous wastes cannot be disposed easily. Chemicals used in dry cleaning are examples of such wastes. Proper disposal of hazardous wastes is vital maintain a safe and healthy environment.

The use of excessive amounts of fertilizers may decrease the productivity of the soil. Pesticides destroy the insects of soil. It can result from removal of trees and other plants that hold soil in place. Wind can then easily blow the soil away and rain water can wash it away. Careless farming methods, clearing of land for construction projects such as laying of roads and real estate development also cause pollution.

Science Today – Biopal

The trade name of the fully biodegradable plastic material naturally produced by the micro-organism is Alcaligen. The plastic is homopolymer i.e. Poly Hydroxy Butyrate(PHB).

Bioplastic is a form of plastic derived from renewable biomass sources such as vegetable oils, corn starch and pea starch, by the action of microorganisms.

The Eumycetes and the Schizomycetes microorganisms are responsible for degradation.

Bioplastics are biodegradable, biocompatible and renewable.

Uses of bioplastics

Bioplastics are used in many ways such as packaging, agriculture and medicine.

Packaging: Trays and containers for fruits, eggs, meat and bottles for soft drinks.

Agriculture: plant pots for flowering and vegetable plants.

Medicine: To produce artificial heart valves, tooth reconstruction, bone fracture plates and artificial skin.

Pollution Patrol

Polluting the Planet

1. Over a million tons of oil are deliberately discharged into the world's oceans every year by tankers, during the routine cleaning of their tanks.
2. Fertilizers help crops grow fast but they also poison rivers and streams.
3. A seabird that gets covered in oil is obviously in great distress because oil destroys the way covering of its feathers and so, the feathers get waterlogged. This often cause the bird to down or die of cold.
4. Gases like sulphur dioxide released from power stations and factories kill many species of lichens and mosses.
5. Pesticides make birds lay eggs with unnaturally thin shells.
6. Today, literally tens of thousands of pollutants are present in air, water and soil and they are incorporated into plant and animal tissues.
7. Pollution is no longer a local or even a national phenomenon. It is a global problem.
8. The release of Chloro Fluro Carbon (CFC) from refrigerators has caused the breakdown of the ozone layer. It causes skin cancer.
9. Coral reefs are damaged.

It has been suggested that we should plant eucalyptus trees all along the sewage ponds. These trees absorb surplus waste water rapidly and release pure water vapour into the atmosphere.

Solution

Small contributions on our part can make a huge difference in the state of the environment. Always remember these three R's and follow them in your day-to-day life.

- Reduce
- Recycle
- Reuse

Environment provides a very close association and high degree of inter-dependence between the living and non-living components of the earth. Among all the non-living components, water is an essential factor. The world is heading towards a water crisis due to natural and man-made hazards.

To save our earth, we have to plant more trees growing more trees, will increase rainfall and will provide a good climate to live. The oxygen content will also increase. This will save our children from the evil effects of pollution.

Water (Prevention and control of pollution) Act, 1974.
Air (Prevention and control of pollution) Act, 1981.
Environment(Protection) Act, 1986.

37] Atomic Structure

All living and non-living things are made up of matter. Atoms are the building book of all matter. Atoms are extremely small in size and are expressed in terms of 10^{-10} m (1 A^0).

Ancient Views on Atomic Structure

Ancient scholars and philosophers in India, believed that matter consisted of ultimate minute indivisible particles(anu). They further argued that the combination of two or three atoms form a material. This idea is the same as the idea of molecules. Later, in about 400 BC, the Greek Philosopher Democritus, also proposed that matter is made up of atoms. The word **'atom'** was coined because these small particles of matter were assumed to be indivisible. In Greek language, atom means **'incapability of being cut'.**

We know that, the smallest portion of a word which is further indivisible is called a letter. Similarly, if we break a magnesium ribbon into several fragments, at one stage it cannot be broken further into smaller particles. This indivisible smallest particle of an element is calles an atom.

Laws of chemical combination

The ideas of these philosophers were not universally accepted because there was no experimental evidence to support them. Scientists continued to accumulate the data and as time passed, more and more observations and views regarding the qualitative and quantitative aspects of matter were noticed. These observations led to some general statements which are now known as the **Laws of Chemical Combination.** They include:

1. Law of Conservation of Mass
2. Law of Definite Proportion
3. Law of Reciprocal Proportion
4. Law of Multiple Proportion and
5. Gay Lussac's Law of Combining Volume

Let us discuss the first two laws of chemical combination

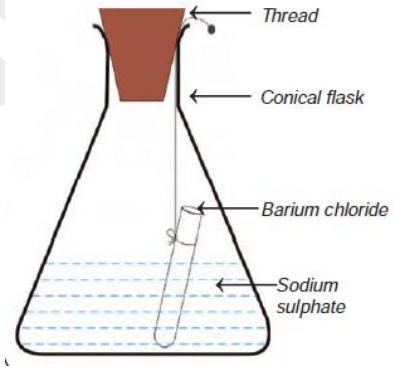
Law of Conservation of Mass:

(LAVOISIER 1774)

Is there any change in mass, when a physical change takes place?

You notice that there is no change in mass. Hence, during a physical change the total mass of the matter remains the same.

The barium chloride solution reacts with the sodium sulphate solution to form a white precipitate of barium sulphate and sodium chloride.



The mass of the flask before and after the chemical reaction is found to be the same.

From the conclusions drawn from the above activities, the Law of Conservation of Mass can be stated thus: "Mass can neither be created nor destroyed during a physical or a chemical change".

In other words, the total mass of material present after a physical change chemical reaction is just the same as the total mass before the physical change chemical reaction.

Law of Definite Proportion:

(PROUST 1779)

Joseph Proust noticed that all the compounds of two or more elements and each such compound had the same elements in same proportions, irrespective of where the compound came from or who prepared it. For example, water obtained from different sources like rain, well, sea, and river will always consist of the same two elements hydrogen and oxygen, in the ratio 1:8 by mass. Similarly, the mode of preparation of compounds may be different but their composition will never change. It will be in a fixed ratio. Hence, the Law of Definite Proportions can be stated as. "A pure chemical compound prepared by any method consists of the same elements combined together in a fixed proportion by mass".

Joseph Louis Proust (1754 - 1826)

Dalton's Atomic theory

Keeping in view, the law of chemical combinations and the work of Greek philosophers, a meaningful atomic theory was finally proposed by a British school teacher, John Dalton Between the years (1803 and 1807). His theory was based on the following postulates.

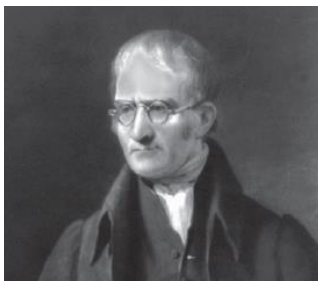
1. Matter is made up of small, indivisible particles called atoms.
2. Atoms can neither be created nor destroyed.
3. Atoms of the same element are identical in all respects.
4. Atoms of different elements are different in all respects.
5. Atoms of different elements may combine with each other in a fixed simple whole number ratio to form "compound atoms" (or molecules).
6. The atom is the smallest particle of matter that takes part in a chemical reaction.

Merits of Dalton's Atomic Theory

1. It gave a satisfactory explanation for the laws of chemical combinations. (law of conservation of mass and law of definite proportions)
2. It explained most of the properties of gases and liquids known at that time.

Demerits of Dalton's Atomic Theory

1. It failed to explain why the atoms of different elements differ in their size, mass and valency.
2. It failed to explain how and why atoms of different elements combine to form compounds.
3. It did not explain the nature of binding forces that hold the atoms together in a compound.
4. It could not clearly distinguish between an atom and a molecule.



John Dalton, son of a poor weaver, began his career as a village school teacher at the age of 12. He became the principal of the school seven years later. In 1793, he moved to Manchester to teach Physics, Chemistry and Mathematics in a college. He proposed his atomic theory in 1803. He carefully recorded each day, the temperature, pressure and amount of rainfall from his youth till the end. He was a meticulous meteorologist.

Electrical Nature of Matter

Before proceeding to understand the composition of an atom, it is better to learn the electrical nature of matter. Let's get to know the electrical nature of matter, by carrying out the following activities.

From these activities, we can conclude that on rubbing together, two objects become electrically charged. Where does this charge come from? This question can be answered by knowing that an atom consists of charged particles.

The first direct experimental evidence to prove the electrical nature of matter came from Michael Faraday. He demonstrated through his experiments that electricity is composed of particles called **'atoms of electricity'.**

It was George Johnstone Stoney, an Irish Physicist, who first proposed the term **'electron'** for 'atom of electricity' in 1891.His contribution to research in this area laid the foundations for the eventual discovery of particles by J.J. Thomson in 1897.

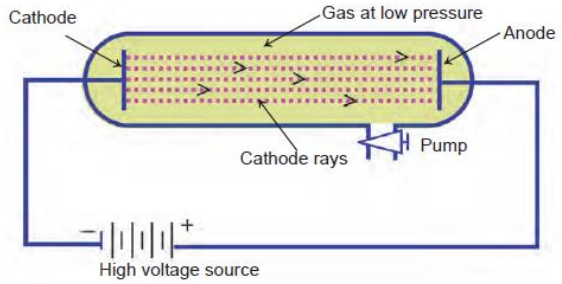
Discovery of Fundamental Particles

The experiment that was conducted to investigate the phenomenon that takes place when high voltage is applied to a tube containing gas at low pressure, laid the foundation to the discovery of fundamental particles.

In 1878, Sir William Crookes, while conducting an experiment using a discharge tube, found certain visible rays travelling between two metal electrodes. These rays are known as Crooke's Rays or Cathode Rays. The discharge tube used in the experiment is now referred to as Crookes tube or more popularly as Cathode Ray Tube **(CRT)**. It is a long glass tube filled with gas and sealed at both the ends. It consists of two metal plates (which act as electrodes) connected with high voltage. The

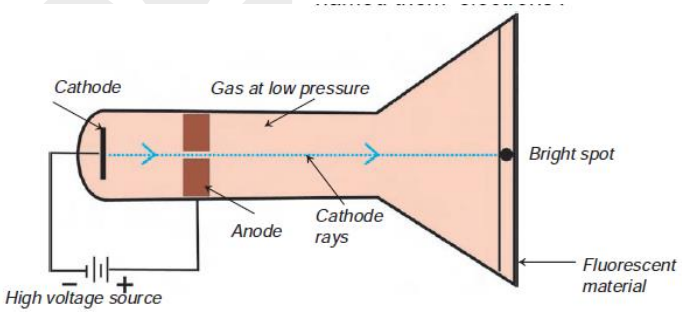
The fact that air is a poor conductor of electricity is a blessing in disguise for us. Imagine what would have happened if air had been a good conductor of electricity. All of us would have got electrocuted, when a minor spark was produced by accident.

electrode which is connected to the negative terminal of the battery is called the cathode (negative electrode). The electrode connected to the positive terminal is called the anode (positive electrode). There is a side tube which is connected to a pump. The pump is used to lower the pressure inside the discharge tube.



Discovery of electron

Later, J.J. Thomson found that when a high voltage of 10,000 V was applied between the electrodes present in a partially evacuated cathode ray tube at a pressure of 0.01mm of mercury, a bright spot of light was formed on the screen coated with a fluorescent material placed at the other end of the tube. The fluorescent material coated on the screen started to glow because it was struck by the ray, which originated from the cathode. Since these rays were emitted by the cathode, he called these rays as cathode rays. Later, he named them 'electrons'.



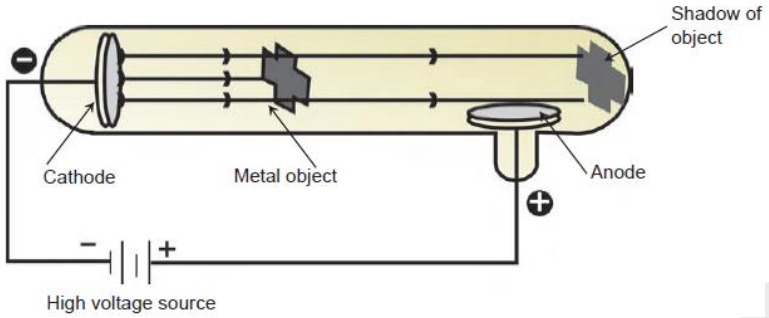
FLUORESCENT MATERIAL : When invisible radiation falls on materials like zinc sulphide, they emit a visible light (or glow). This is called fluorescent material.

Properties of Cathode rays

J.J. Thomson and others studied the properties of cathode rays by conducting the following experiments.

Experiment 1

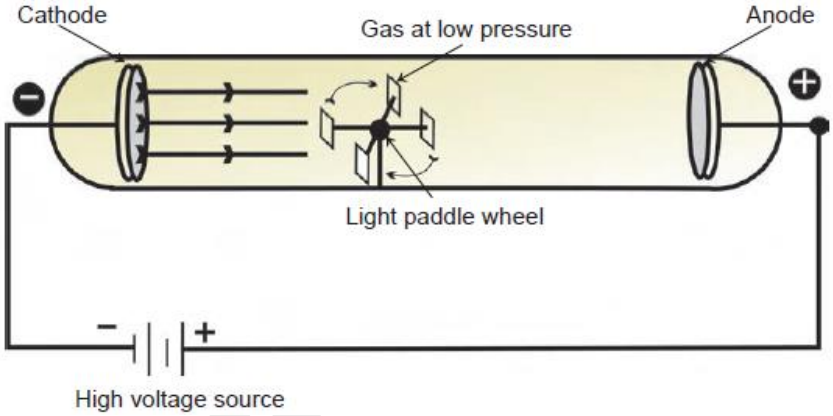
Cathode rays fall on a small object which is placed in between the cathode and the anode. A shadow of the same size and shape as that of the object is observed on the wall, opposite to the cathode.



Conclusion: Cathode rays travel in straight lines parallel to each other.

Experiment 2

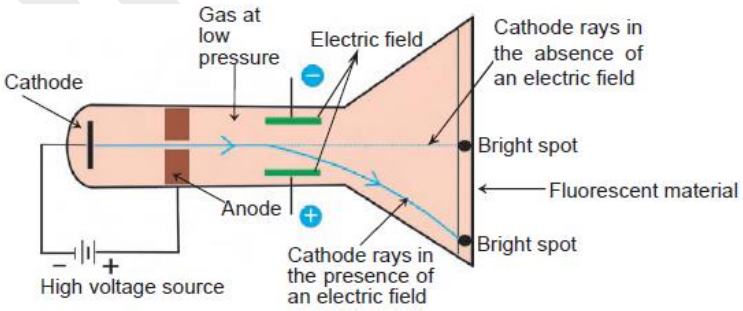
When cathode rays fall on a light paddle wheel which is placed in between the cathode and the anode, the wheel starts rotating.



Conclusion: Cathode rays are made up of small particles that have mass and kinetic energy.

Experiment 3

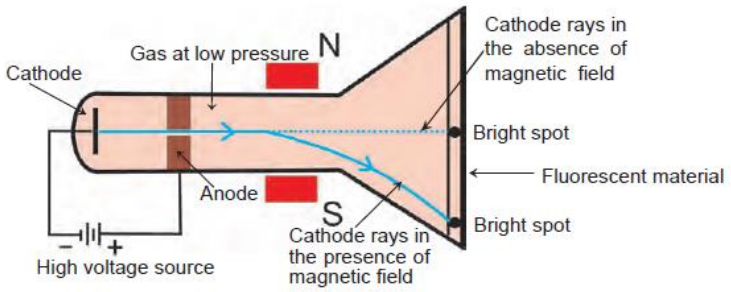
When cathode rays are passed through an electric field, they are deflected towards the positive plate of the electric field.



Conclusion: Cathode rays are negatively charged particles.

Experiment 4

When cathode rays are passed through a magnetic field, the deflection of the rays is seen perpendicular to the applied magnetic field.



Conclusion: The direction of deflection indicates that the cathode rays consist of negatively charged particles. These negatively charged particles are called **electrons.**

Experiment 5

These experiments are repeated using different gases / different cathodes in the discharge tube. The properties of cathode rays do not undergo any change.

Conclusion: The nature of the cathode rays does not depend on the nature of the gas filled inside the tube or the cathode used.

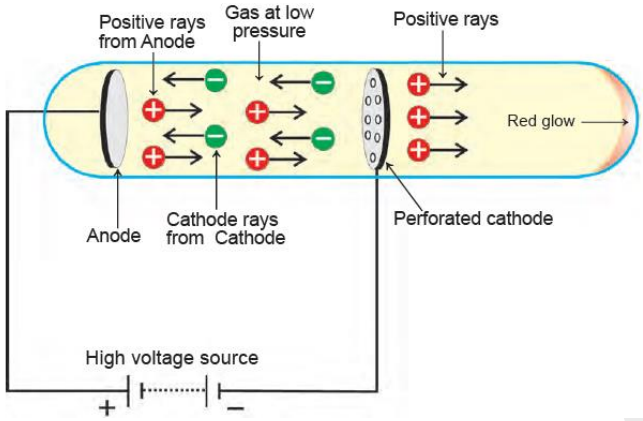
"J.J.Thomson a British Scientist, is credited with the discovery of electrons and isotopes"

Discovery of protons

The presence of positively charged particles in the atom has been precisely predicted by Goldstein based on the conception that the atom being electrically neutral in nature, should necessarily possess positively charged particles to balance the negatively charged electrons.

Goldstein's Experiment (1886)

Goldstein repeated the cathode ray experiment by using a perforated cathode. On applying a high voltage under low pressure, he observed a faint red glow on the wall behind the cathode. Since anode, they were called anode rays or canal rays or positive rays. Anode rays were found as a stream of positively charged particles.



When hydrogen gas was taken in a discharge tube, the positively charged particles obtained from the hydrogen gas were called PROTONS. Each of these protons are produced when one electron is removed from one hydrogen atom.

$$H \longrightarrow \underset{\text{Proton}}{H^+} + \underset{\text{Electron}}{e^-}$$

Thus, proton can be defined as an hydrogen ion (H+) (Ions are charged particles).

Properties of Anode Rays

1. Anode rays travel in straight lines.
2. Since they rotate the light paddle wheel placed in their path, they consist of material particles.
3. Anode rays are deflected by electric and magnetic fields. Since they are deflected towards the negatively charged plate, they consist of positively charged particles.
4. The properties of anode rays depend upon the nature of gas taken in the discharge tube.
5. The mass of the particle is the same as the atomic mass of the gas inside the discharge tube.

Properties of fundamental particles

Particle	mass (atomic mass unit)	Relative charge
ELECTRON(e)	0.00054 a.m.u	-1
PROTON(p)	1.00778 a.m.u.	+1

WHY ATOMIC MODEL?

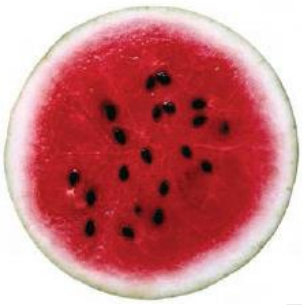
The study of the electrical phenomenon in gases led to the historic conclusion that atom is divisible and is made up of Electrons and Protons.

The study of the properties of the fundamental particles, the electrons and protons, led to the conception of various atom models.

An atom model is the description that depicts the arrangement of various fundamental particles inside an atom. The systematic study of various atomic models gives us an insight into the understanding of the primary structure of an atom.

Thomson's Atomic Model (1904)

Thomson's Atomic Model can be compared to a watermelon or a ripened guava. The red edible portion of the watermelon represents the positive sphere. The black seeds look like the electrons embedded in an atom.

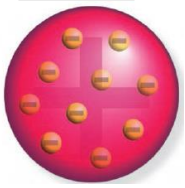


According to J.J. Thomson,

1. An atom consists of a positively charged sphere with electrons embedded in it.
2. The positive and negative charges are equal in magnitude; hence the atom as a whole is electrically neutral.

Thomson's scientific model of the atom is popularly known as the 'plum pudding' model.

Limitation of Thomson's model



Thomson's model could successfully explain the electrical neutrality of atom. However, it failed to explain how the positively charged sphere is shielded from the negatively charged electrons without getting neutralised. Apart from electrons and protons, an atom contains a neutral particle called the neutron.

38] Electricity and Heat

Electricity plays a very important role in our daily life. It is a form of energy that helps us in many ways. Most of the comforts of modern life would not be there, if there is no electricity.

We are often advised to avoid handling electrical appliances with wet hands. Why? Water, with dissolved salts in it, is a good conductor of electricity. Our body is composed of 70% water with dissolved substances. This makes us good conductors of electricity. This is why we should not touch live electric wires with bare hands.

Wearing rubber gloves and rubber shoes will insulate us from electric shock to a certain extent.

The electricity that we use in our houses and factories is obtained from power stations. (A power station is a place where electricity is produced on a large scale by using various sources of energy like water, wind, heat etc.) We obtain a small amount of electricity from batteries and cells.

The electric power thus produced is used through circuits and controlled by switches.

Three kinds of circuits

The flow of current requires a closed conducting path. This path is made by connecting a cell or a battery, a switch (key) and a bulb by means of wires. This closed conducting path is known as an electric circuit. Recall your experience of drawing a circuit with symbols of the components.

Simple circuit

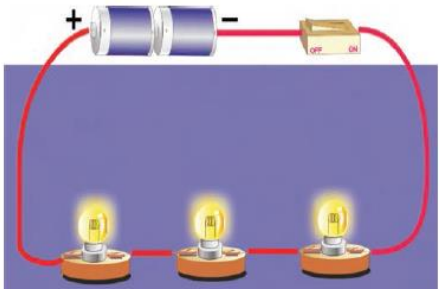
A circuit made up of a cell, a switch and a bulb is known as a simple circuit. When the switch is put on, the bulb glows. This is because there is a continuous or closed path for the electric current to flow.

Series and Parallel Circuits

Murugan and Ramu are friends. One day, they were discussing the formation of a circuit. They were very eager to construct a circuit with more than one bulb. They tried and constructed a circuit with three bulbs in two different ways. Let us also try to construct this circuit.

Series Circuit

The first circuit as described above is given here. When you look at the circuit, it is obvious that the bulbs are connected end to end. This type of circuit is known as series circuit. Here the current can flow only in one direction and the same amount of electric current flows through all the bulbs.

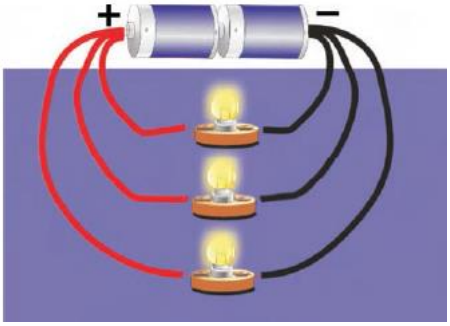


What happens when one of the bulbs in the circuit is removed or fused? The other bulbs do not glow because the circuit is not complete now.

Parallel Circuit

Observe the second circuit. Here each bulb is connected to the battery terminals by separate wires. This type of circuit is known as parallel circuit. In this circuit, different amount of current passes through the bulbs.

What happens when one of the bulbs in the circuit is removed or fuses off? The other bulbs continue to glow because they have separate conducting paths.



The electrical appliances in our houses are all connected in a parallel circuit. It is done so because only in a parallel circuit, current flows through each appliance separately. Even if we switch off any of the appliances, the others will continue to work.

Conduction of Electricity in Liquids

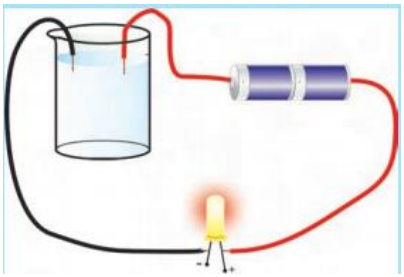
We know that the metals like copper, aluminium, iron, gold, etc. allow electric current to pass through them. They are called Conductors.

Materials like wood, plastic, rubber, glass etc. do not allow electric current to pass through them. They are called Insulators.

We observe

Construct a circuit using two cells, an LED and connecting wires. Immerse the two free ends of the wires into a beaker containing water or any liquid without touching each other. If the LED glows, the liquid conducts electricity. If the LED does not glow, the liquid does not conduct electricity.

If the brightness of the LED glow is high, than those liquids are good conductors. If the brightness of the LED is low, it indicates that less current is flowing through those liquids and they are poor conductors of electricity. If the LED does not glow, it denotes that such liquids are insulators.



Some liquids are good conductors of electricity and some are poor conductors.

Does distilled water (pure water) conduct electricity? No, it does not because it is an insulator. When a pinch of salt is dissolved in distilled water, you obtain a salt solution. It becomes a good conductor of electricity.

The water we get from sources such as taps, hand pumps, wells and ponds is not pure. It contains some small amount of natural salts and so, this water is a good conductor of electricity.

Aqueous solutions of acids, bases and salts are good conductors of electricity. But the level of conductivity varies from one liquid to another.

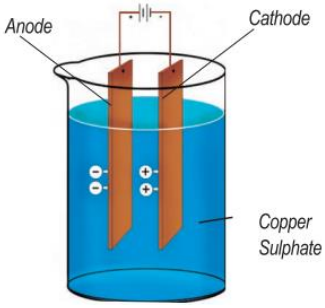
CHEMICAL EFFECTS OF ELECTRIC CURRENT

What happens when current is passed through liquids / solutions? The current will cause a chemical change, when it is passed through solutions. This is known as chemical effect of electric current.

Let us take copper sulphate solution in a beaker. Immerse two copper plates into the solution. One plate is connected to the positive end of a battery (known as anode) and the other plate is connected to the negative end of the battery (known as cathode).

When current passes through the solution, it splits up into positive copper ions and negative sulphate ions. The positive copper ions are attracted towards the cathode and get deposited on the cathode. The negative sulphate ions are attracted towards the anode and react with copper in the anode converting it into copper sulphate.

This shows that electric current has a chemical effect on copper sulphate and it brings about a chemical change. This process is known as electrolysis.



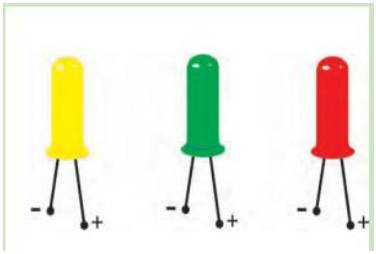
The two conductors that are immersed in the solution where the current enters and exits the solution are called electrodes (the copper plates in the above activity).

A substance that conducts electric current either in the form of a solution or in a fused state is called an electrolyte (copper sulphate solution in the above activity).

The process by which an electrolyte is decomposed with the help of electricity is called electrolysis.

LIGHT EMITTING DIODE (LED) An electric bulb is used in the electric circuit to confirm the flow of current in the circuit. However, the electric bulb may not glow if the flow of current is weak. So we use an LED instead of an electric bulb. LED is Light Emitting Diode made up of semiconductor materials. A very small amount of current is sufficient to make an LED glow. LEDs are available in electrical shops. They have two legs, one short and one long. The short leg is to be connected to the negative terminal and the long

leg to the positive terminal. LEDs are available in different colours such as red, green, yellow, blue, white and are increasingly being used in many applications. LEDs are greatly used for lighting.



APPLICATIONS OF CHEMICAL EFFECTS OF ELECTRIC CURRENT

The two common applications of chemical effect of current are:

Electrorefining: This is a process by which metals like gold and silver are refined or purified.
Electroplating: This is a process in which a layer of one metal is coated over another metal by electrolysis.

Electroplating

Have you ever seen gold plated jewellery (imitation jewellery)?. They are made by electroplating gold on cheaper metals like silver to make them look more attractive. What is electroplating? The process of depositing a thin layer of a metal on any conducting surface by the method of electrolysis is known as electroplating.

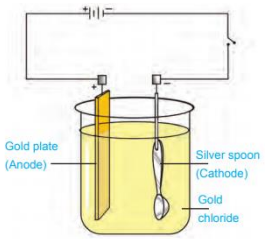
In electroplating, the article (metal) to be coated is taken as the cathode. The metal to be deposited over it would be the anode and the appropriate solution, the electrolyte.

Electroplating a silver spoon with gold

To coat a silver spoon with gold, acidified solution of the metal to be coated (gold chloride with hydrochloric acid) is taken as electrolyte and the article to be electroplated(silver spoon) is taken as cathode. A thick plate of the metal to be deposited (gold plate) is taken as anode.

The silver spoon is cleaned with dilute acid solution to remove the oxide layer from its surface and washed in running water until it is free from the acid.

The silver spoon thus cleaned (taken as cathode) is suspended into the acidified gold chloride solution (electrolyte) kept in a beaker. A thick plate of gold (taken as anode) is also suspended into the gold chloride solution. The circuit is completed using a battery and key. Current is passed through it for about 15 minutes. Then the electrodes are removed from the solution. The silver spoon will look like a gold spoon.



Uses of Electroplating

Electroplating is very useful and is widely used in industries. For example, chromium plating is done on many objects like car parts, wheel rims and bath taps. Silver plating is used on tableware and electrical contacts; it is also done on engine bearings.

More to know

Zinc coated iron is called Galvanized Iron (GI). This iron is used in water taps (GI pipes), since they have high resistance to corrosion.

To be electroplated	***Cathode***	***Anode***	***Electrolyte***
Zinc	*Iron*	*Zinc*	*Zinc sulphate*
Silver	*Iron*	*Silver*	*Silver nitrate*
Gold	*Silver*	*Gold*	*Gold chloride*

Silver Ring : before and after gold plating

The most extensive use of gold plating is on jewellery and watch cases. Zinc coatings prevent the corrosion of steel articles, while nickel and chromium coated articles are used in automobiles and household appliances.

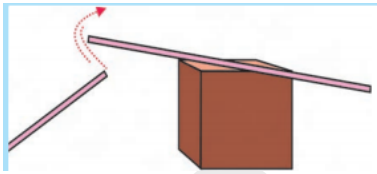
ELECTRIC CHARGES AT REST

The most dramatic natural phenomenon we observe on the earth is lightning. Lightning is an electric spark. We also see sparks on an electric pole, when wires become loose. These phenomena are quite common. How do they occur? What is the reason behind it? Actually in ancient times, people did not understand the cause of lightning. But now, we know that lightning is caused by the accumulation of electrical charges in the cloud. Let us learn about electric charges.

Activity

Place a few bits of paper on a table. Bring an inflated balloon near the paper bits. The paper bits are at rest. Now rub the balloon with a piece of wool and bring it near the bits of paper. we find the paper bits jump and stick to the balloon.

Take a plastic straw, rub it with a piece of wool and place it on the wooden block. Take another straw, rub it with the piece of wool and bring it near the first straw. We notice the straws repel each other.



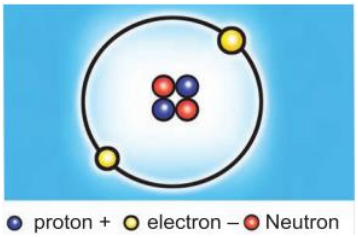
From the above activities, we can easily conclude that both the balloon and the straw undergo some change when they are rubbed with a woollen material. They acquire a property known as an electric charge. This is because there is a transfer of charges between themselves due to friction; ie., in each case the object gets charged by rubbing. These objects are called charged objects.

All these things happen because of static electricity. Static electricity is the accumulation of electrical charges on the surface of a non-conducting material. It is called “static” because there is no current flow. What is a charge? To understand ‘charge’, we have to look at things on an extremely small scale. Everything we see around us is made of atoms.

The atom is made of 3 types of particles. They are: (i) electrons (ii) protons (iii) neutrons. The electron is negatively charged, the proton is positively charged and the neutron has no charge, it is neutral.

Atoms usually have equal number of positive and negative charges(protons and electrons). Hence, an atom is electrically neutral. This is why most objects around us are electrically neutral.

An atom is said to be electrically charged, when the number of protons and the number of electrons is not equal. When the number of protons is higher than the number of electrons, the object is said to be positively charged. When the



number of electrons is more than the number of protons, the object is said to be negatively charged. Hence the charged objects can either have positive charge or negative charge.

We notice that during the process of charging, only electrons are transferred from one object to another, while protons and neutrons are tightly bound to the nucleus of an atom and do not come out of the atom.

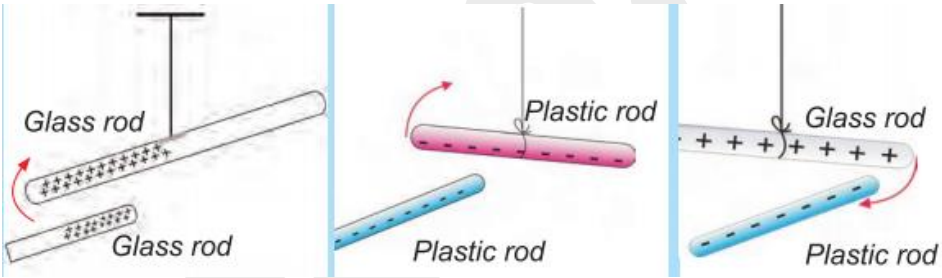
We observe

Take a glass rod and rub it with a piece of dry silk. Suspend this glass rod from its middle with a silk thread. Bring it close to another glass rod which is also rubbed with a silk piece. What happens?

Now rub a plastic rod with a piece of wool. Suspend the plastic rod from its middle with a silk thread. Bring it close to another plastic rod that is also rubbed with wool. What happens?

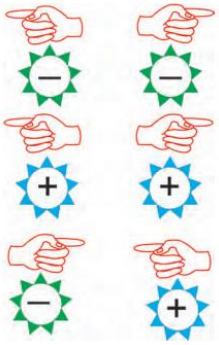
We observe that in the above two cases the suspended rods repel each other. Now bring the rubbed plastic rod near the suspended glass rod and watch what happens? We notice that the glass rod and the plastic rod get attracted towards each other.

We have learnt that an object can be charged by rubbing. Do all bodies get the same kind of charge? Let us answer this question by performing the above activity.



From those activities we can conclude that

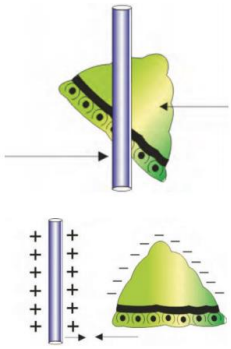
1. There are two kinds of charges.
   a). Positive charge - the charge that is acquired by the glass rod when rubbed with silk
   b). Negative charge – the charge that is acquired by the plastic rod when rubbed with wool
2. There exists a force between the two charges



3. Like charges (positive and positive) or (negative and negative) repel each other.
4. Unlike charges (positive and negative) attract each other.

Transfer of Charges

Charging by Friction

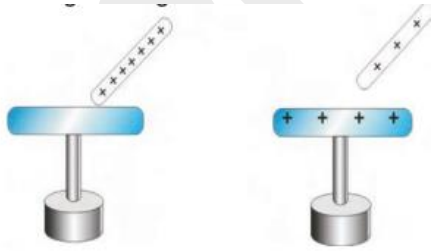


When an object is rubbed with another object, the atoms in the objects get rubbed and a transfer of electrons takes place between the atoms of the two objects. One object loses electrons, while the other gains electrons. Thus, the gain of electrons or loss of electrons makes both the objects charged.

Charging by Conduction

An object can also be charged by simply touching it with an electrically charged object. This process of charging is called charging by conduction.

When a charged body is placed in contact with another body, charges get transferred to the other body and both get charged.

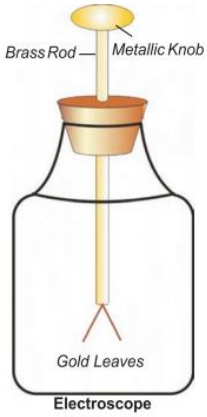


Charging by Induction

A neutral object can be charged even without touching the neutral body with a charged body. This type of charging is called charging by induction. This is done by bringing a charged body say positively charged, just close to the neutral body. When this is done, the side closer to the charged body gets an opposite charge i.e. negative chargeand the farther side gets the same charge (positive charge). When you touch the farther side with hands and remove the charged body, the neutral body gets charged negatively. Here no transfer of electrons takes place between the objects.

Electroscope

An electroscope is a device used to detect and measure electric charges.



Electroscope

When a charged body comes into contact with a body which is not charged, the electric charges jump from the charged body to the uncharged body till the charges on both the bodies become equal. This process is called ***discharging****.*

It works on the principle of transfer of charges by Conduction or Induction.

An electroscope is made up of a metallic rod (usually brass) placed inside a glass jar. The upper end of the rod has a metallic knob and the lower end of the rod has two thin metallic leaves hanging parallel to each other. They are called leaves because they are very thin. The early electroscopes used gold leaves and so they were called gold leaf electroscopes.

When a charged object touches the knob of the electroscope, the charge is transferred to the knob because of conduction. This charge is then transferred to the gold leaves through the metal rod.

The leaves, now repel each other (because they have similar charges) and separate out. By observing this we can check, if a body carries charge.

We can also find the nature of the charge by charging the gold leaf electroscope by induction.

Connecting a charged object to the earth with the help of conducting wires or physical contact is called Earthing. The earth is considered to be a huge reservoir of electrons. Depending upon the charge on the object, the earth provides or accepts electrons from a charged object connected to it.

Many electrically operated devices in our homes (E.g. washing machines, refrigerators wet grinders etc.,) have earth connection. This will protect humans from fatal electric shocks and will save the appliances from damage.

Story of Lightning and Thunder

Lightning is an awe inspiring display of electricity in nature. You might have seen lightning during thunderstorms. Lightning occurs because of a massive electric charge flowing from cloud to cloud, from one part of the cloud to another or from the cloud to the ground.

Thunder clouds (rain clouds) carry electric charges and these charges separate out within the cloud. The lower portion of a cloud generally carries negative charges and the upper portion carries positive charges.

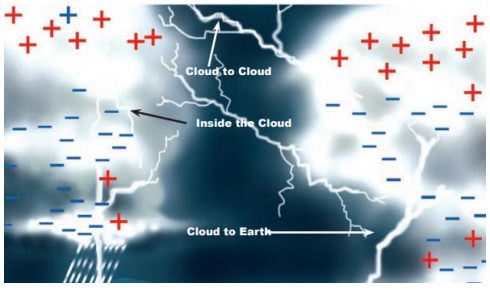
These charges inside the clouds build up. They cannot flow from one cloud to another or to the ground because the air between them acts as an insulator, but when huge amount of charges build up, the insulating property of the air suddenly breaks down. As a result, an electric discharge takes place between two oppositely charged clouds or between a charged cloud and the surface of the earth. This causes the flash of lightning that we see in the sky.

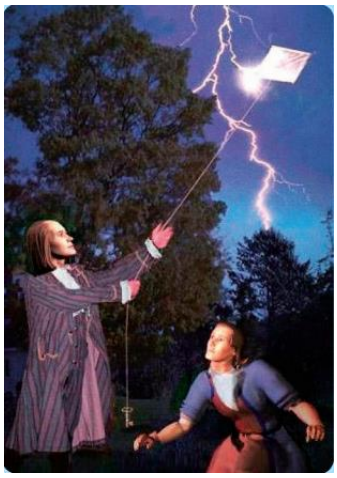
The enormous amount of heat produced during lightning causes the air to suddenly expand and vibrate. This vibration is the cause of thunder.

Lightning-Safety

Lightning is a high energy electric discharge. It strikes the earth with a lot of energy and heat. It could be very dangerous. Therefore, we must know how to protect ourselves during thunderstorms. Some safety measures that could be taken are

1. Do not take shelter under a tree during thunderstorms. If the tree gets struck by lightning, it could catch fire and can cause great harm to you.
2. Take shelter inside buildings, cars or buses.
3. Do not run across large open fields or high grounds.
4. If you can't find a safe place, you should crouch down in a low-lying place.





"Benjamin Franklin carried out the famous 'Kite Experiment' to prove that lightning is an electrical phenomenon. He flew a kite in the sky on a stormy day and tied the other end of the kite string to a metal key. Lightning struck and electricity got transferred to the metal key. Franklin was fortunate enough to have been saved from a massive electric shock."

Lightning Arrester

In order to protect tall buildings from lightning, a device called the lightning arrester is used. It was invented by Benjamin Franklin. It is a metal rod with pointed edges. It is fixed at the top of the building to be protected. This rod is connected to the ground with the help of a conducting cable. The lower end of the cable is connected to a copper plate buried deep into the earth. Lightning strikes the rod and the electric charges are carried harmlessly to the ground through the cable.

HEAT

We can say that the terms 'hot' and 'cold' are relative. We usually get an idea of how hot or cold an object is, by touching it. Temperature cannot be measured accurately this way. Scientists have defined the quantity of temperature that gives the measure of hotness or coldness of a body

Heat is defined as a form of energy which flows from a body at higher temperature to a body at a lower temperature. Temperature is measured by using thermometers.

Effects of heat:

The sun is a major source of heat. Without heat from the sun, it would be difficult for any form of life to survive

on this earth. We experience various effects of heat in our daily life: Wet clothes drying in the sun, burning of a candle or an oil lamp, ice melting in a glass of water and food getting cooked.

(i) Rise of temperature

The temperature of a body rises when it is heated. On the other hand the temperature falls, when heat is taken away from it. Hence heating changes the temperature of a substance. Different substances require different amount of heat to attain the same rise in temperature.

Example: Oil gets heated up faster than water.

(ii) Change of state

When we heat a solid, it begins to melt at a certain temperature known as melting point and becomes a liquid. Similarly, when a liquid is heated it begins to boil at a particular temperature called its boiling point and becomes a gas. we understand that a change of state occurs when substances are heated.

(iii) Change in physical properties

Heat changes the physical properties of a substance. For E.g. Zinc, is brittle and hard at room temperature. It becomes soft and flexible when heated to a high temperature. Iron, on being heated becomes malleable and can be easily moulded into any shape. The electrical resistance of a conductor increases on heating. A magnet loses its magnetism on being heated.

(iv) Chemical change

Heat accelerates chemical processes. Calcium carbonate decomposes on heating.

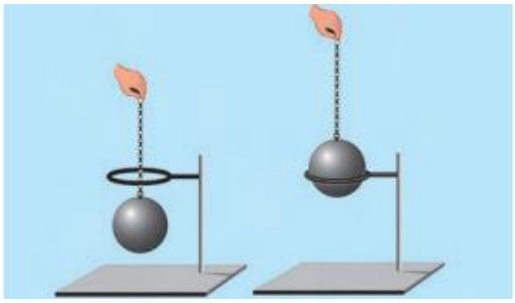
(v) Expansion

Substances expand on heating and contract on cooling.

Expansion of solids

Ball and ring experiment':

Take a metal ring and an iron ball. The diameter of the ball should be in such a way that it could just pass through the ring at room temperature. When the ball is heated in a flame and then placed on the ring, it would not pass through it.



This experiment shows that the ball expands on heating. It can also be observed that the ball will pass through the ring, after it gets cooled.

From the above activity, we can infer that solids expand on heating. When the temperature of a substance is increased, its molecules or atoms, on an average move faster and further apart. The result is an expansion of the substance. This is called 'Thermal Expansion'.

Except a few substances, all solids, liquids and gases expand on heating. Expansion takes place in all three states of a substance. For the same amount of heat given, solids expand the least, while gases expand the most.

Thermal expansion finds a large variety of applications in our daily life.

1. When railway lines are laid, some space is left between the two rails (made of iron) to allow for their expansion during summer. If this is not done, the rails would expand and bend, thereby causing derailment of trains.

2. The telephone wires between two poles sag in summer and go taut (stretched tightly) in winter. The wires are laid in such a way that they are allowed to expand or contract.

3. A glass stopper stuck in the neck of a bottle can be loosened by slightly warming the neck of the bottle. The neck alone expands but not the stopper. Similar is the case with the pen.
4. A thick glass tumbler usually cracks, if a very hot or cold liquid is poured into it. Glass is a bad conductor of heat. The inner surface of the glass expands more than the outer surface, when a hot or cold liquid is poured into it. Due to this unequal expansion, the glass cracks.

Expansion of liquids

Like solids, liquids also expand appreciably, when they are heated. A liquid has a definite volume but it has no definite shape. Therefore, only volume expansion is taken into account. The expansion of liquids is greater than that of solids.

Expansion of gases

When the temperature of a gas increases on heating, its volume increases and it expands. Do you know why tyres filled tightly with air, burst in hot summers? It is because the air inside the tyre expands due to heat.

A balloon fixed to the neck of a bottle blows up, when the bottle is placed in a bowl of hot water. When it is taken out of the bowl, the balloon contracts. This is mainly because of the expansion of air inside the balloon due to heating.

TRANSFER OF HEAT

Heat always flows from a higher temperature to a lower temperature. There are three different ways in which heat is transferred from one body to the other.

They are:

(i) Conduction

(ii) Convection

(iii) Radiation.

Conduction of heat

Heat flows from one object to the other, when they are in contact with each other. For example, a metal spoon left in hot water absorbs heat from the water and becomes hot. If you touch the metal

spoon now, you will feel the heat. This method of transfer of heat from a body at a higher temperature to a body at a lower temperature, when they are in direct contact is called thermal conduction.

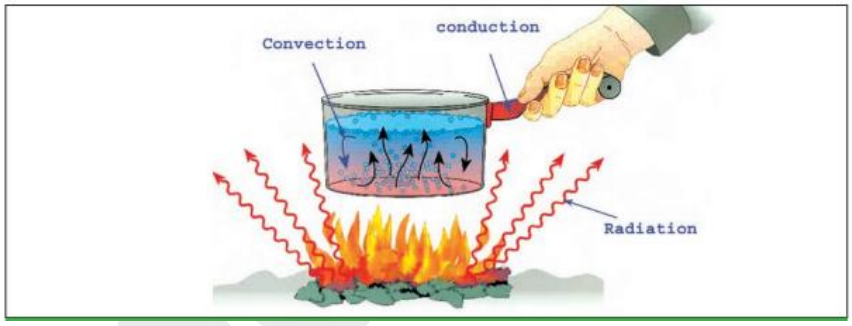
Convection

When fluids (liquid and gas) are heated, the molecules closer to the source of heat get heated first and expand, thereby decreasing the density of the liquid. The lighter molecules rise up and the cooler and heavier molecules come down. This is called convection. Thus, convection is the transfer of heat due to the actual movement of particles.

Radiation

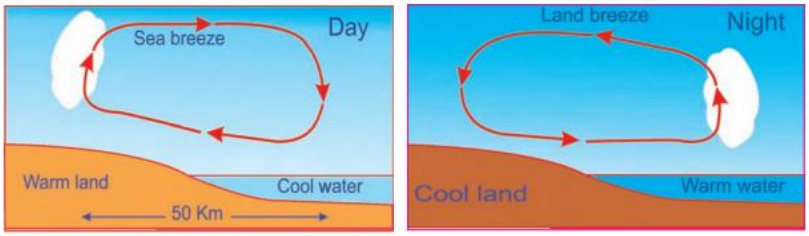
The sun is far away from the earth. Most of the space between the sun and the earth is empty, but still the warmth of the sun reaches the earth. The heat of the sun cannot reach us by conduction or convection, as there are practically no molecules between the sun and the earth to carry the heat through.

The process by which heat is transferred without the help of any material or medium is called **radiation**.



Winds are caused by convection currents. During the day, the land warms up more than the sea. The warm air over the land rises and the cold air from the sea moves in to replace it. So during the day, breeze blows from the sea to the land. This is sea breeze.

At night, the land cools down faster than the sea. The warmer air over the sea rises. Cold air over the land moves in to replace it . So during the night, breeze blows from the land on to the sea. This is land breeze.



39] Diversity in Living Organisms

Our world is filled with many varieties of living organisms. Animals vary in size from the tiny amoeba to the huge blue whale. However, their bodies can adapt to their living condition.

1.1. Cell as a Fundamental unit of Life

Cell is the structural and functional unit of all living organisms. Cell was discovered by Robert Hooke in 1665.

Theodor Schwann and Matthias Jacob Schleiden postulated the cell theory in 1839. The two important postulates of the cell theory are:

1. *All living organisms are made up of cells.*
2. *New cells are formed only from the pre-existing cells.*

Types of Human Cells Related to Function

Based on the function, the size and the shape of the cells differ. Generally, cells are round, spherical or elongated. Some cells are long and pointed at both ends. They are spindle shaped. Cells, sometimes, are quite long. Some are branched like the nerve cell or a neuron. The following table shows the various types of cells and their shape.

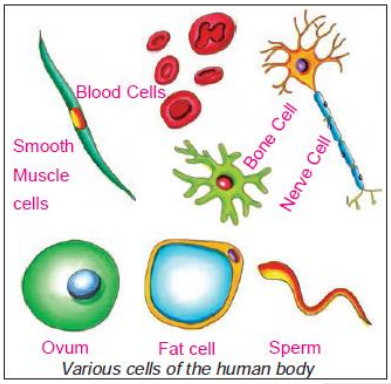
Example:-

Cells	**Shape**
Nerve cells	Star
Flame cells	Tubular
Gland cells	Cuboidal
Squamous epithelium	Polygonal
Columnar epithelium	Cylindrical
Egg cells	Oval
RBC	Round
Fibrous Muscle cells	Elongated

Let us learn about the cells and the functions of certain cells. A list is provided below :

Cells	Function
Squamous epithelium	Protective & give shape
Muscle cells	Contractile & Retractile
Fat cells	Storing more fat droplets
Nerve cells	Conduction of nerve impulses
Bone cells	Rigidity

Rods and cone cells	Vision & colour
Ear cochlear cells	Conduction of sound waves
Gland cells	Secretory



Various cells of the human body

Structure and Functions of cell Organelles

The cell organelles are present in the cytoplasmic matrix, which are the living structures of the cell. They have the properties of growth and multiplication at the time of necessity within the cell.

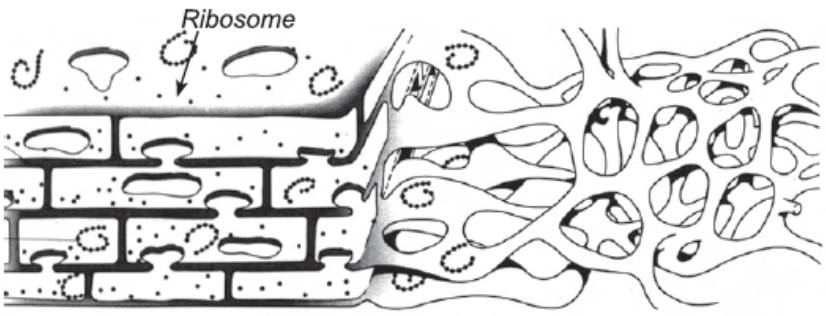
Cell Organelles and their Functions

The Cell Organelles are

1. Endoplasmic Reticulum
2. Ribosome
3. Golgi apparatus
4. Lysosomes
5. Mitochondria
6. Centrioles

1. Endoplasmic Reticulum

The electron microscopic study by Porter in 1945 revealed a network of membranous system with vacuoles in the endoplasm. This was named as endoplasmic reticulum by Porter in 1952. It is assumed that the endoplasmic reticulum originated by evagination of the nuclear membrane. Two types of endoplasmic reticulum have been observed. They are rough ER and smooth ER, based on the presence or absence of ribosome in the ER respectively.



Structure of Endoplasmic Reticulum

Functions of the Endoplasmic Reticulum

1. The endoplasmic reticulum provides an ultra structural and skeletal framework to the cell.
2. The smooth endoplasmic reticulum helps in the synthesis of lipids and in the breaking down of glycogen.
3. During cell division, the endoplasmic reticulum membranes disappear and form a new nuclear envelope after each nuclear division.

2. Ribosome

Many minute spherical structures known as ribosomes remain attached with the membrane of endoplasmic reticulum and form the (granular) rough endoplasmic reticulum. The ribosomes are produced in the nucleolus. Each ribosome is composed of two structural units, one smaller and the other a larger unit. The small sub-units occur on the larger unit and form a cap-like structure. The ribosome also may occur freely in the cytoplasm. They are the sites of protein synthesis.

Three researchers, who made the crystal structure of the ribosomes received the Nobel Prize for Chemistry in the year 2009 – ***Venkatraman Ramakrishnan,*** *an Indian born U.S.A scientist,* ***Thomas Steitz of*** *U.S.A and* ***Ada Yoath*** *of Israel.*

3. Golgi Apparatus

The electron microscopic observation of Golgi bodies reveals the presence of three membranous components. They are

i. Disc shaped group of flattened sacs or cisternae
ii. Small vesicles
iii. Large vacuoles

Functions

1. It produces secretory vesicles like zymogen granules that may have enzymes inside.
2. It forms certain yolk substances in the developing oocytes.
3. It helps in retinal pigment formation in the retinal cells.
4. It helps in the formation of acrosome in sperm cells.

4. Lysosomes

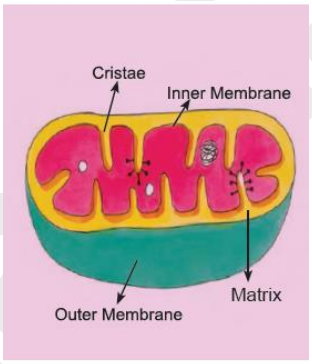
Lysosomes are a kind of waste disposal system of the cell. Lysosomes originate either from the Golgi apparatus or directly from the endoplasmic reticulum. Each lysosome is of a rounded structure. It is filled with dense material.

Functions

1. Lysosomes help to keep the cell clean by digesting any foreign material as well as worn-out cell organelles.
2. When the cell gets damaged lysosomes may burst and the enzymes digest their own cell. Therefore lysosomes are also known as suicidal bags of a cell.

5. Mitochondria

In the cytoplasm of most cells, large size filamentous, rounded or rodlike structure known as mitochondria may be seen. The mitochondria are bounded by two membranes made of proteins. The outer membrane forms a bag like structure around the inner membrane, which gives out many finger like folds on the lumen of the mitochondria. The folds of inner mitochondrial membrane are known as cristae.



Internal structure of Mitochondria

Functions

Mitochondria are considered to be the power houses of the cell because they are the seat of cellular respiration. They also synthesize the energy rich compound ATP- Adenosine Tri Phosphate.

6. Centrioles

Centrioles were first described by **Henneguy** and **Leuhossek** in 1897. The centrioles are micro tubular structures, found in two shapes-rods and granules located near the nucleus of the animal cell. At the time of cell division, the centrioles produce spindle fibres and astral bodies. They also decide the plan of cell division.

Nucleus

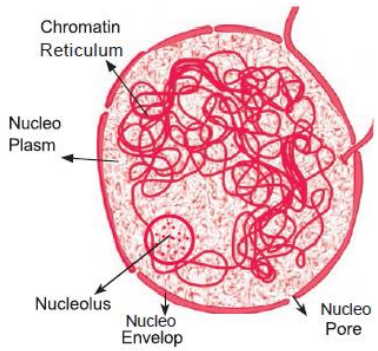
The nucleus is a highly specialised cell organelle which controls all the activities in a cell. It is the brain of a cell. It is round or oval in outline and possesses four parts.

They are :

1. Nuclear Membrane
2. Nucleoplasm
3. Chromatin Reticulum

4. Nucleolus

The nuclear membrane is the outer delicate covering of the nucleus. It contains pores of different dimensions. The nucleoplasm is the protoplasmic substance of the nucleus. It is also known as nuclear sap. Chromatin Reticulum is composed of a network with highly elongated chromatin Threads which overlap one another and are embedded in the nucleoplasm. At the time of cell division, the chromosomes become clearly visible.



Structure of Nucleus

The nucleolus is generally present in the nucleus of most of the cells. The nucleolus become enlarged during active period of cell division and are less developed in quiescent stage. It is often called as cell organizer.

Functions

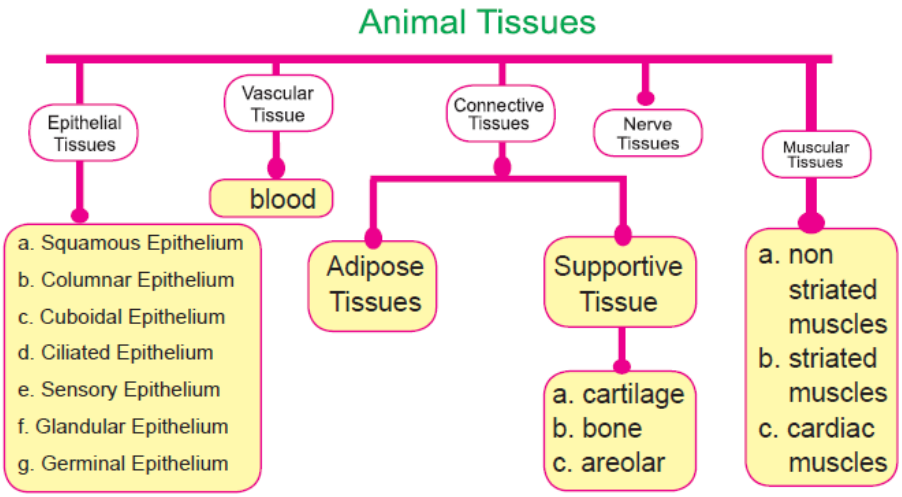
1. It controls all metabolic processes and hereditary activities of the cell.
2. The nuclear membrane allows exchange of ions between the nucleoplasm and the cytoplasm.

Organization – Cells – Tissues – Organs – Organ system

In multicellular animals, cells multiply by the process of cell division and specialise themselves in performing a particular function. For example, the muscle cells perform contraction and relaxation of organs that help in locomotion and conduction.

Tissues

A group of cells having common origin, structure and function is referred to as tissue. The bodies of animals are composed of several distinct tissues. On the basis of the function, We can classify animal tissues into five broad categories.

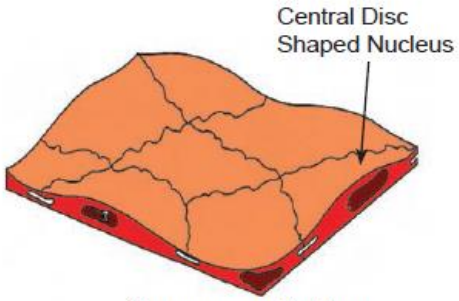


1.Epithelial Tissues

Epithelial tissues cover most organs and cavities within the body. Since the cells are closely packed, there is very little space between them. The absence of intercellular space is the characteristic of epithelial tissues. The cells in this tissue remain attached to the basement membrane that separates it from the other tissues. Based on the shape, arrangement of cells and the functions, Epithelia are classified into seven types.

A. Squamous Epithelium

Squamous epithelium consists of a single layer of flattened cells with a central disc like nucleus. The inner lining of the cheek and the membranes within the body are examples of this epithelium.



Squamous epithelium

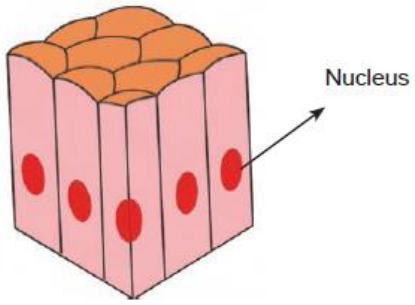
Functions

Protection is their function. In the alveoli they help in exchange of gases.

B. Columnar Epithelium

The cells are cylindrical and tall, the height of each cell being greater than its width. The oval nuclei are usually found at the base of these cells.

E.g. : The inner lining of the intestine.



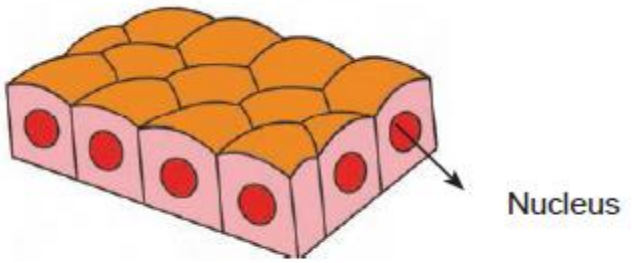
Columnar Epithelium

Function

Secretion of enzymes in the stomach and absorption of digested food in the intestine.

C. Cuboidal Epithelium

The cells of this epithelium are cube shaped. The walls of the intestine and the endocrine glands are examples of Cuboidal type of epithelium.



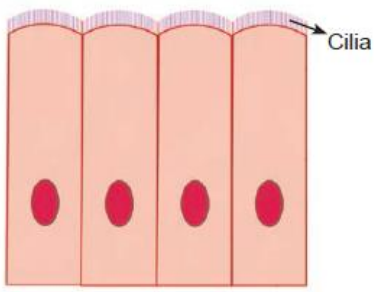
Cuboidal Epithelium

Function

This tissue helps in secretion and re-absorption of water in kidney tubules.

D. Ciliated Epithelium

Its structure is like the columnar epithelium. In addition it contains a number of fine protoplasmic projections called cilia. The wind pipe or trachea is internally lined by ciliated epithelium.



Ciliated Epithelium

Function

They remove the dust particles by the vibration of the cilia.

E. Sensory Epithelium

Some of the epithelial cells are modified to respond to stimuli and they form the sense organs.

2. Vascular Tissues

This is a liquid tissue adapted for the transportation of the nutritive materials, respiratory gases, excretory materials and others. It consists of 55% plasma and 45% blood cells. There are three kinds of blood cells.

They are,

i) Red Blood Cells (Erythrocytes) : RBC

ii) White Blood Cells (Leucocytes) : WBC

iii) Blood Platelets (Thrombocytes)

i) Erythrocytes: The Red Blood Cells are present in vast majority. Each red cell is a circular or biconcave disc without a nucleus. These are formed in the bone marrow. Their life span is between 100 and 120 days. They contain haemoglobin, a respiratory pigment that chiefly carries oxygen from the lungs to the other parts of the body.

ii) Leucocytes: The nucleated white blood cells are irregular and contain no pigment. They are produced in the bone marrow and in the lymph glands. The life span of WBC is two to three weeks.

They are the police force of the body and protect it from disease producing organisms.

iii) Thrombocytes: The blood platelets are the smallest of the blood cells.

They are responsible for the clotting of the blood when blood vessels are damaged.

3. Connective tissues

The cells of connective tissues are loosely spaced and embedded in an inter cellular matrix. The matrix may be a jelly like fluid, dense or rigid. They are of two types.

They are

A) Adipose tissue

B) Supportive tissue

A) Adipose Tissue:- This is modified for storing fat. The inter cellular material is more or less absent. It is found chiefly below the skin and in between the internal organs.

B) Supportive Tissue:- This tissue gives support to the entire body. The supportive tissues are of three types. They are :

i) Cartilage tissue

ii) Bone tissue

iii) Areolar tissue

i) Cartilage Tissue:- It has widely spaced cells. The solid matrix is composed of proteins and sugars. The cartilage smoothens the bone surface at the joints and is also present in the nose, ear, trachea and larynx.

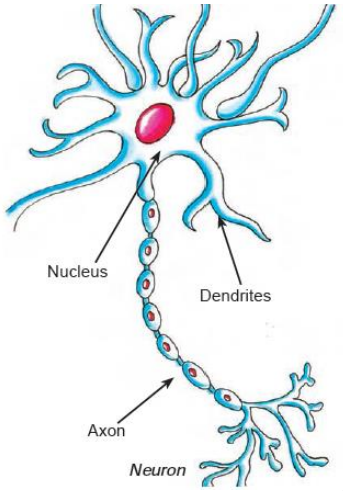
ii) Bone Tissue:- It forms the framework that supports the body. Bone cells are composed of calcium and phosphorous compounds. Two bones can be connected to each other by the ligament. This tissue is very elastic and the ligaments contain very little matrix.

iii) A reolar Tissue:- It is found between the skin and the muscles around the blood vessels, nerves and in the bone marrow. It fills the space inside the organs. It supports the internal organs and helps in repairing the tissues.

4. Nervous Tissue

The nervous tissue is formed of nerve cells called neurons and nerve fibres. It has highly developed powers of irritability and conductivity. The brain, spinal cord and nerves are all composed of nervous tissues.

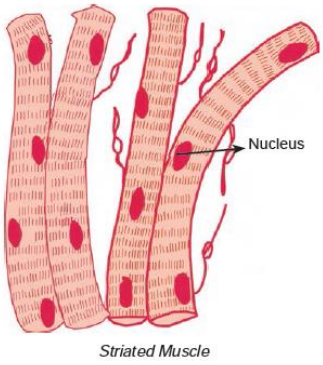
Neurons: It is a structural unit of the nervous system. It has a cell body called cyton which assumes



different shapes in the different regions of the nervous system, and a long tail called axon. Neurons may be either rounded or oval shaped. The protoplasm of the cyton has a number of small dark granules referred to as **Nissil's bodies**. The cyton gives out numerous branches called dendrons. These in turn, divide into finer branches called dendrites.

5. Muscular Tissue

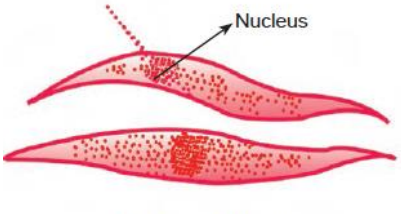
It consists of elongated cells, also called muscle fibres. This tissue is responsible for movement in our body. Muscular tissue contains proteins called **Contractile Proteins**. There are three types of muscular tissues:



Striated Muscle

a) Striated Muscle: Since these muscles are attached to the skeleton, they are also called Skeletal Muscles. Each muscle fibre in this muscle is a long parallel sided cylindrical structure with cross striations and are hence named striped muscles. There are a number of nuclei placed near the periphery. They are covered by a membrane called Sarcolemma. Since their contraction is under conscious control they are also called voluntary muscles.

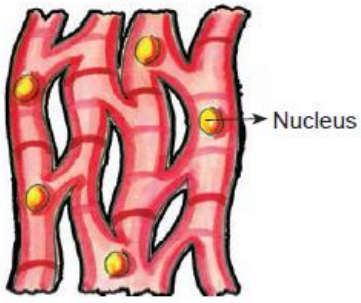
b) Non-striated muscles: The cells are arranged to form a sheet of muscular tissue commonly found in the wall of the digestive tract, urinary bladder and other internal organs. They are not under the



Non-striated Muscles

control of our willpower. So, they are called involuntary muscles.

c) Cardiac muscle: In structure it is between the striped and unstriped muscles fibres. These are found only in the heart. They are multi nucleated but the nuclei are centrally located. **Dark** and **Light** bands are present. The muscle of the heart show rhythmic contraction and relaxation **throughout life**. These involuntary muscles are called cardiac muscles.



Cardiac Muscle

Organs

Two or more kinds of tissues associate together to form an organ. An organ is a specialized part of the body performing some specific functions. For example, the eye, has epithelial tissue, connective tissue, nervous tissue and muscular tissue. We have many such organs in our body like eyes, ears, lungs, etc. Now let us study in detail the structure of the eyes.

The eyes (Photoreceptor)

The sense organ eye is concerned with vision. The eye which is spherical in shape is kept in the orbit of the skull. The eye is made up of three coats.

1. the outer- Sclerotic coat
2. the middle - Choroid coat
3. the inner - Retina coat

1. Sclerotic coat

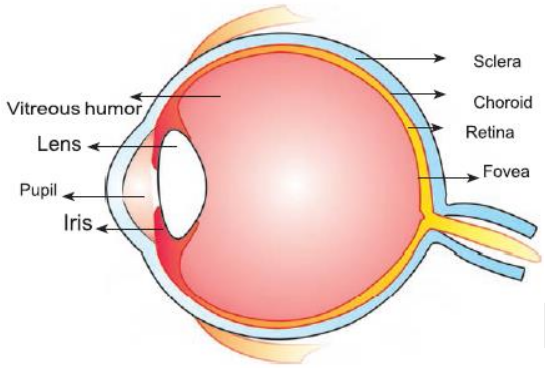
The outer sclerotic coat is white in colour except in the front where it forms the transparent cornea.

2. Choroid coat

It is highly vascularised and deeply pigmented. In front of the eye the choroid coat forms the iris and lens. An opening called the pupil is present in the centre of the Iris.

3. Retina coat

Retina is the sensitive part of an eye. It contains two types of receptor cells - the rods and cones. Rods are sensitive to different shades of light but not to colour. Cones are sensitive to colour. The fovea or yellow spots of the retina are densely packed with cones. It is the part, that is used when



Cross-Section of the eye

one concentrates on something. e.g. when reading, sewing etc. The lens is transparent, elastic and biconvex in shape. It is attached by ligaments to the ring shaped ciliary muscles. The aqueous humor is a clear, watery liquid between the cornea and the lens. The vitreous humor is a viscous liquid which fill the space between the lens and the retina. Vitreous humor helps in image formation and in maintaining the spherical shape of the eye.

Organ System

Several organs of the body together perform a common function. They constitute an organ system. Now let us discuss the excretory system and their functions.

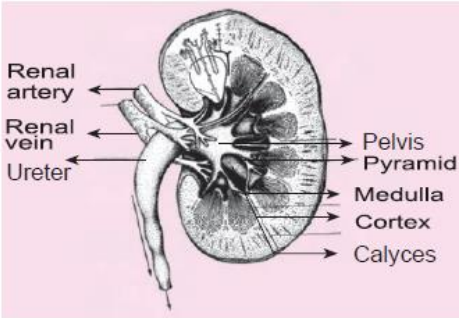
Excretory system

Excretion is the elimination of metabolic waste products from the body. The major function of the excretory system is the elimination of nitrogenous waste products from the body. The mammalian urinary system consists of two kidneys, ureters and an urinary bladder.

Kidney

There is a pair of kidneys located inside the abdomen on either side of the vertebral column in the lumbar region and against the posterior abdominal wall. The right kidney is slightly on the lower side due to the presence of the liver. The outer surface is **convex** and the inner surface is concave. The concave side is called **hilus**.

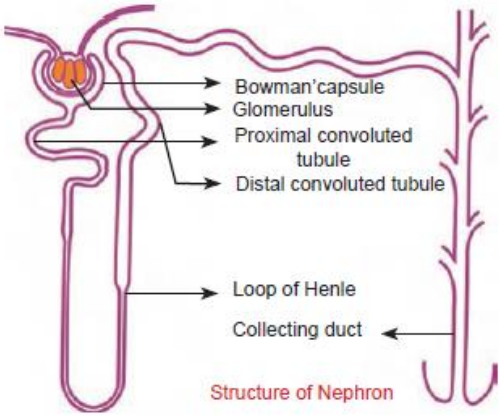
A vertical section of the kidney shows an outer dark portion called the **cortex** and an inner pale region called medulla. The medulla has a number of cone like structures called **pyramids**. The



Vertical section of the kidney

pelvis projects in between the pyramids as cup like spaces called **calyces. Nephrons**

The kidney contains many minute tubular nephrons.These are the structural and functional units of the kidney.



Functions of the Kidney

- The kidney not only removes the waste product from the blood but also maintains a constant composition of blood.
- It maintains the p H of blood.
- The kidney regulates the loss of excess water from the body.

HOMEOSTASIS

Homeostasis is the maintenance of a constant internal environment of the body. It was first pointed out by the French physiologist **Claude Bernard** in 1857. All mammals are capable of maintaining a constant body temperature despite changes in the external temperature. Behavioural and physiological responses are two important regulating mechanisms that maintain the stability of Homeostasis.

For example

The control of blood glucose level is a good example of homeostasis and it involves the secretion of atleast six hormones. A rise in the blood glucose level stimulates insulin secretion whereas a fall in the blood glucose level inhibits insulin secretion and stimulates the secretion of glucagon and other harmones which raise blood glucose levels.

Cellular Respiration

Respiration is the process by which chemical energy in organic molecules is released by oxidation. This energy is then made availabe to living cells in the form of ATP.

The biochemical process which occurs within cells is called cell respiration. If it uses oxygen, it is called as **aerobic respiration**. If the process takes place in the absence of oxygen, it is termed as **anaerobic respiration.**

Aerobic respiration

It involves the utilisation of free oxygen and results in complete oxidation of glucose into carbon-dioxide and water.

Anaerobic Respiration or Fermentation

Here oxygen is not utilized for respiration. So, it is called anaerobic respiration. It is often referred to as fermentation.

A variety of micro organisms use anaerobic respiration as their major source of ATP - E.g. bacteria, yeast.

Metabolism

The word **metabolism** has its root from the Greek word **Metabole** which means **change.** The sum total of the biochemical reactions involved in the release and utilization of energy or energy exchange within the organism is termed as metabolism. Such a chemical reaction in the metabolic process can be divided into two categories.

1. Anabolism

The simple substances obtained from the food are converted into cellular substance. This process is called Anabolism. During this process energy is not released.

For example,

Glucose → Glycogen and other sugars

Amino acids → Enzymes, hormones, proteins

Fatty acids → Cholesterol and other steroids.

2. Catabolism

Organic substances which are obtained from the food are broken down to produce energy for the purpose of physiological functions of the cells. This process is called as **catabolism**.

The following are examples for catabolism.

Glucose → CO_2 , Water and heat

Protein → amino acid

Fats → Glycerol, fatty acid, etc.

The repeated anabolism and catabolism reactions in the metabolic process maintain the homeostatic condition of the body. Because of the metabolic process, the ionic balance is being maintained in the body.

The metabolic process is responsible for movement, growth, development, maintenance and repair of the cells, tissues and the human body.

This metabolic process occurs in different organs of living species.

D sign of the Body – Its Beauty – Structure and Function – some Examples

Our body structure suits its function. The human foot, which was originally a climbing structure, has been readapted for bipedal walking and running.

Likewise, there are various animals that range from unicellular to multicellular organisms whose body structures suit their function and the movements they make.

Some animal movements are very beautiful. For example, an insect walking on the reverse of a leaf, the soaring of eagles and the running of Jaguar and other animals.

Soaring of eagle

Body Contour

Contour is nothing but the shape of the body. Observe a race horse. Its body has been beautifully designed by nature. The body is spindle-shaped, its streamlined contour offering minimum resistance in air.

Racehorse

The body of fish is also streamlined so that it can freely swim in the water.

Fish - Rohu (Belongs to Kendai)

The nature of the flight of an aeroplane differs from that of birds, animals and insects. Planes have fixed wings that create lift when air flows past. They move forward by pushing air through a jet engine or around a propeller very swiftly.

The wings of animals do both these jobs at once. When the wings flap downwards, the body of a bird or a bat or an insect is pushed forward and it is kept aloft and stable in its flight.

Bat

Bats are the only mammals that truly fly, by flapping their wings. The wing of bat is a fold of skin called patagium supported by all digits of the hand except the first.

Now let us learn about the various shapes of beaks.
They have been beautifully designed by nature to suit their feeding habits.

Pelicans feed on fish, which they scoop up in the flexible pouch that lies under their long beaks.

Pelicans

When a bird eats insects, worms or berries, its bill or beak helps it to get the food it wants. For most birds, bill is a special tool that has the right shape. In fact, the bills of many birds work just like the tools you may have at home.

Sparrow

A sparrow eats seeds it finds on the ground. Its bill helps it to pick up things easily. A heron gets its food found in water. It lifts fish out of water, and swallows them.

Heron

40] Conservation of Plants and Animals

CONSERVATION OF FOREST AND WILD LIFE

Topslip: This is one of the forest areas in the state, which is rich in bio-diversity.This is the Anaimalai Tiger Reserve.

Trees provide a number of economically valuable commodities, the most important being timber, fuel wood, bamboo, resins, gums and leaves.

Trees also support living organisms like animals, birds, insects and also many micro organisms. it is said that forests are signs of prosperity.

Forests are of immense economic importance as they are a source of livelihood for many different human settlements as well as governments. They also provide timber and timber products which are a source of income for many people.

They are habitats to diverse animal and plant species, they prevent soil erosion and help in maintaining the water cycle.

Hence it is important that we should conserve the existing forests covering the Himalayas, the Western and Eastern Ghats, and start establishing more National Parks and sanctuaries and maintaining properly the existing ones. Let us wander into the forest and explore its wonders.

Conservation can be defined in simple terms, as the management of resources in such a manner that largest number of people benefit for the longest possible time without harming the natural or ecological balance.

All non-domesticated and non cultivated biota found in the natural habitat are termed wildlife.

Need for Conservation

- Wildlife is an asset to be protected and preserved because of its aesthetic, ecological, educational, historical and scientific values.
- Wildlife is essential for ecological balance.
- Wildlife is a big boost to tourism.
- The innumerable plants could yield products of immense medicinal value.
- Wildlife is an important source of genetic material used in genetic engineering.

India being a sub-tropical country, the temperature in most parts of the country is conducive to plant growth.

All non-domesticated and non cultivated biota found in the natural habitat are termed wildlife. Based on this, the forests can be divided into five major types.

1. **Desert (Dry forests)** - Rajasthan, Southern parts of Punjab & Haryana
2. **Deciduous forests** – Peninsular region

3. **Tropical Evergreen forests** - Western Ghats, hilly areas in North Eastern India, The Sub Himalayan belt
4. **Hilly (mountainous) forests** – The Himalayas, Southern India
5. **Tidal forest** - Estuaries of Ganges & Mahanadi.

Plot or shade the different types of forests in India

FORESTATION AND AFFORESTATION

Selfish and anti-social elements have been destroying our natural wealth. Deforestation is one such dangerous act harming the ecological balance in the hilly areas.

The ill-effects of deforestation are reduced rainfall, change in climatic conditions, soil erosion and greenhouse effect (global warming). The process of planting new trees is called afforestation. This is generally done in deserts and open grounds to check the velocity of wind.

Afforestation is aimed at two kinds of forestry programmes such as **social forestry** and **agro forestry**.

In a locality, 'Tree lovers Club' can be started, and more people can be invited to join these clubs'. Tree saplings can be planted on the road side. Sapling can be gifted to friends on special occasions and celebrations.

Social Forestry

In India, the Social Forestry Project was started in 1976. Its aim is to promote natural forests and create forests on unused lands. Social forestry also aims at raising plantations by the common man so as to meet the growing demand for timber, fuel wood, fodder etc. thereby reducing the pressure on the traditional forest area.

Agro Forestry

Planting of trees in and around agricultural boundaries and on marginal, private lands, in combination with agricultural crops is known as agro-forestry. The land can be used to raise agricultural crops and trees and to rear animals.

AFFORESTATION

More to know

Cutting down forests increases the amount of carbon dioxide in the atmosphere, which can affect climate and destroy homes of many animals and plants. Deforestation leads to soil erosion, irregular rainfall and global warming.

FLORA AND FAUNA

India has a large variety of plants, about 45,000 species in number. Of these

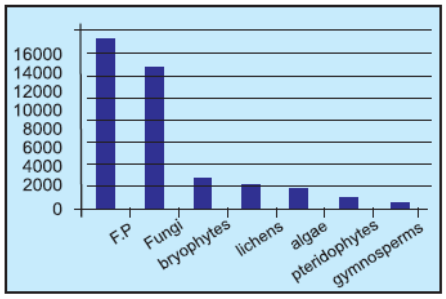
- Flowering plants - 15,000
- Algae - 1,676
- Lichens - 1,940
- Fungi - 12,480
- Gymnosperms-64
- Bryophytes - 2,843
- Pteridophytes - 1,012

India can be divided into eight distinct floristic regions.

India has a great variety of fauna numbering 81,251 species, which represent 6.67 % of the world's fauna. Of these,

- Insects - 60,000
- Mollusca - 5,000
- Mammals – 372
- Birds- 1,228
- Reptiles – 446
- Amphibians – 204
- Fishes - 2, 546

The Zoological Survey of India (ZSI) is responsible for carrying out surveys of the faunal resources of the country.

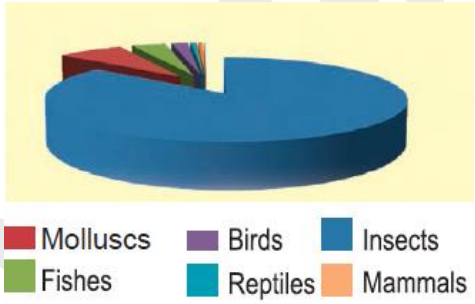


Deforestation refers to the indiscriminate cutting down of forest trees for use in wood-based industries (furniture making, paper, plywood) as domestic fuel and to accommodate agriculture and industries, in many parts of our country natural vegetation is being destroyed illegally.

ENDANGERED SPECIES

Why did animals begin to live on land?

The very earliest creatures lived in water. Then, plants began to grow on land. These provided a new source of food and some animals came away from water to the land. They developed lungs instead of gills for breathing.



The first to come on land were the amphibians.

How did the dinosaurs become extinct?

They are prehistoric animals and disappeared due to natural calamities. Their names are of Greek terms. The word dinosaur means 'terrible lizard' Today many species of animals are in danger of extinction. They include rhinos, whales, wolves, eagles and a few rain forest birds. Some are being killed for their horns, skins, bones or the land they live on. Others are being poisoned by man - made chemicals and are caught in traps. In ancient days, kings and high officials of Royal Britain hunted many wild animals. Today, poachers keep hunting the animals for their own benefits. Monal found in Himachal Pradesh is one of the most beautiful birds and it has been hunted to the level of extinction.

Species that are less in number and are in considerable danger of becoming extinct are termed as **Endangered Species**.

There are many Projects which were proposed by the Government of India. such as Project Tiger, Project Elephant, Operation Rhino, Gir Lion Project and the Crocodile Breeding Project.

"Project Tiger" The population of tigers (*Panthera tigris*) reduced from 40,000 to 1827 in 1972. On 1st, April 1973, Project Tiger was launched by the Government of India, it resulted in the increase of population of tiger.

"Project Elephant" Elephant is our National heritage animal. The population of the Indian elephant- Elephas maximus, is threatened due to habitat destruction and poaching for ivory. An ambitious programme "Project Elephant" was launched by the Ministry of Environment and Forests, which focuses on solving the problems of humans and elephants competing for the same habitat.

"Operation Rhino" Number of Indian rhinos or one horned Rhinoceroses (*R.unicornis*) are lost due to hunting and natural calamities. To protect the Indian species, a centrally sponsored

Due to deforestation and various causes, the populations of several species of plants and animals are at the verge of extinction and are considered endangered rehabilitation programme was undertaken in Dudhwa National Park.



"Lion Sanctuary" In 1972, a five year plan was proposed by the Government of Gujarat, to protect this magnificent feline species in the Gir Sanctuary. Its National Park and ecological balance of the habitat are properly protected. This has resulted in an increase in lion population.

Crocodile Breeding Project:

Crocodile Breeding and Management Project was launched by the Government of India in 1975 for all the three endangered crocodile species namely, the fresh water crocodile (*Crocodylus palustris*), saltwater crocodile (*Cricidylus porosus*) and the rare gharial (*Cravialis gangeticus*)

RED DATA BOOK

It is a record book. The International Union for Conservation of Nature and Natural Resources (IUCN) maintains the Red Data Book. The Red Data Book contains a record of animals which are identified as endangered species or animals which are on the verge of extinction.

In India, animals like the Indian one - horned Rhino, Nilgiri Tahr, Lion - tailed Macaque, Asiatic Lion, Indian Tiger, Olive Ridley turtle and birds like Hornbill, Monal, Great Indian Bustard, and Pheasant are on the verge of extinction.

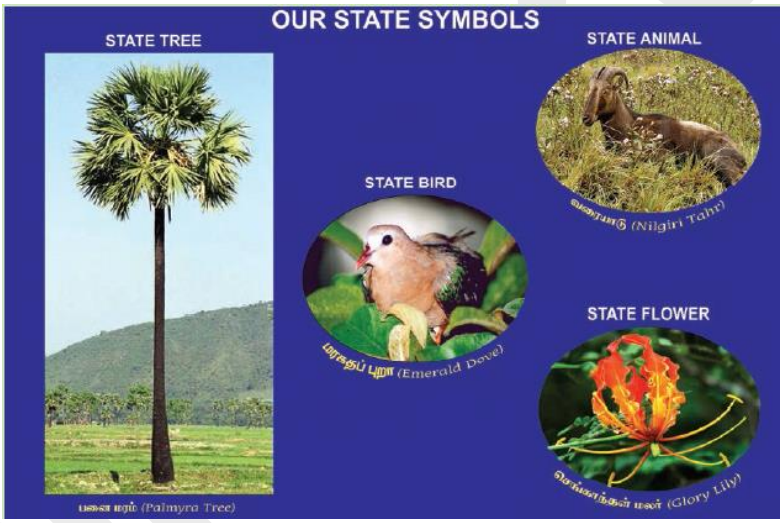
More to know

NGC (National Green Corps) of the Ministry of Environment and Forests, Government of India.

National Animal - Tiger
National Bird - Peacock
National Flower - Lotus
National Fruit - Mango
National Tree - Banyan tree
National Heritage Animal- Elephant

Lion, Tiger, Leopard, Snow leopard and Clouded leopard are found in India.Cheetahs became extinct in the 1950s.

The breeding area of the famous Olive Ridley's turtle is the Coast of Odisha while the Hawksbill Turtle is on the Coast of Tamil Nadu.



MIGRATION

All animals have an instinctive perception of the changes in temperature and just as people seek or spend their summer in cool places and their winter in warm places, all animals that can do so, shift their habitat in various seasons

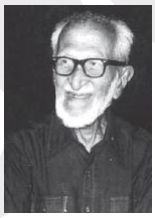
-ARISTOTLE , 384 – 322 B.C, *History of animals*

Aristotle recognized the seasonal movements of animals 2000 years ago. Migration is the phenomenon of the movement of animals from their habitat to some other habitat for a particular time or period every year for a specific function like safe breeding. The Vedanthangal Bird Sanctuary is one of the most spectacular breeding grounds in India. This Sanctuary has been protected by the local people for over 250 years. **Vedanthangal** is a home for migratory birds such as pintail, garganey, grey wagtail, blue-winged tail, common sandpiper and other birds.

Navigation Databanks of MigratoryBirds

Each year as the days shorten and the food supply dwindles, many bird species prepare themselves for a long flight to warmer and more congenial climates. Then one day, driven by deep ancestral urges, they set out for unknown destinations. For example, the swallows of Northern Europe may fly 6800 miles (11,000 km) or so, to their African wintering grounds. When they move in groups they are protected from their predators. Many birds that migrate may be sensitive, to variations that occur in the earth's magnetic field. With the help of that, they find their destinations. Racing pigeons find their way home only by this method.

Migration of birds



Dr.Salim Ali (1896 – 1987) Orinthologist, known as "the bird man of India"

More to know

When a swarm of desert locust is on the move (a single swarm is about 50,000 million) it eats 3000 tons of vegetation in one day.

- *The salmon fish travel up to 1500 miles (2400 km) from the sea to fresh water for breeding. Most of them die after breeding due to exhaustion.*
- *The Brazilian turtles travel up to 1250 miles (2000 km) in eight weeks time for breeding*
- *Barren grounds Caribou of North America travel over 3700 miles (5000 km) the longest annual migration of any mammal*

Migration of turtle

Wild life sanctuary and National Parks

Why do herds of elephants enter the villages ?

It is not the herd of wild elephants that enter the village, or field etc. Humans have occupied their habitat (territory).

The Government has taken many steps to protect wild life by creating Sanctuaries and National Parks.

Sanctuaries : Sanctuaries are places where the animals are well protected from any danger. Hunting or capturing is highly prohibited there. In our country there are about 500 sanctuaries. One of the most important missions of sanctuaries, beyond caring for the animals is educating the people. The individuals should be educated about the importance of animals so that the animals can be protected, and a good ecological balance can be maintained.

Bio-diversity Loss

Loss of bio-diversity occurs when either the habitat essential for the survival of a species is destroyed or a particular species is destroyed. The former is more common. The latter reason is encountered when particular species are exploited for economical gain and hunted for sports or food.

Peacock

The main objectives and advantages of bio-diversity conservation are as follows:

- To preserve the continuity of food chain.
- The genetic diversity of plants and animals is preserved.
- It provides immediate benefits to the society such as recreation and tourism.
- It ensures the sustainable utilization of life supporting systems on earth.

Some important Sanctuaries in Tamilnadu

S.No	Name of the Sanctuary/ Location	Animals
1	Mundanthurai and Kalakkadu Sanctuary - Tirunelveli	Lion – tailed monkey, Tiger
2	Srivilliputtur Sanctuary – Virudhunagar	Grizzled squirrel, Barking Deer
3	Vedanthangal Sanctuary – Kancheepuram	Cormorants, Grey Heron
4	Mudhumalai Sanctuary – The Nilgiris	Elephants , Gaur, Langur
5	Viralimalai Sanctuary – Tiruchirappalli	Wild Peacocks
6	Kodikkarai Sanctuary - Nagapattinam	Chital, Wild Bear

NATIONAL PARKS: National Park is an area dedicated to protect the environment, the natural objects and the wild life there in. Many National Parks were initially wild life sanctuaries. There are about 89 National Parks in India.

Some important National Parks in India

Name and Location	Important Species
1. Bandipur National Park, Mysore – Karnataka	elephant, panther, barking deer, tiger, sambar.
2. Corbett National Park, Garhwal – Uttarpradesh	four horned antelope, elephant, chital, tiger, nilgai.
3. Gir National Park, Junagarh - Gujarat	Asiatic lion, panther, nilgai wild boar, chinkara.
4. Kaziranga National Park, Jorhat - Assam	elephant, one horned rhinoceros, wild buffalo, tiger, leopard.
5. Periyar Sanctuary, Idukki - Kerala	elephant, chital, nilgai, sambar, tiger, barking deer.

THREATS TO BIO-DIVERSITY

Currently bio-diversity is estimated to range from 10 to 100 million species, of which only 1.4 million have been formally catalogued. There are 12 mega diversity centres in the world. India is one among them. Diversity among the living organisms is known as Biodiversity. The bio-diversity of the earth is unimaginable.

The natural causes for the loss of bio-diversity are floods, earthquakes, landslides, natural competition between species, lack of pollination and diseases. At the same time, man is the only cause for the loss of bio-diversity.

Destruction of habitats occurs in the wake of developmental activities like housing, agriculture, construction of dams, reservoirs, roads, railway tracks etc. These developmental activities affects bio-diversity.

Even the loss of a single species is a tragedy, because each form of life is a storehouse of irreplaceable genetic resources. Extinction is an irreversible process and when a species becomes extinct it leads to a cascade of extinctions.

All life on earth is interdependent and man is only a strand in this delicate web of relationships.

We keep rapidly eliminating the conditions necessary for the continued existence of bio-diversity due to over exploitation and ignorance.

Traditional knowledge & people's initiatives in bio-diversity

Sacred grove

These are the tracts of forests that are communally protected. As they have a temple or a deity pertaining to a particular forest, conservation of the sacred grove is of high priority and the whole community is involved in it. Tradition of tree worship (to protect) is observed all over India.

Worship of the species varies according to community, region, as well as use value as per availability. Because of traditions these species are protected. Traditional practices still followed by the tribals do not commercialize forest products and they never exploit them in an unsustainable manner.

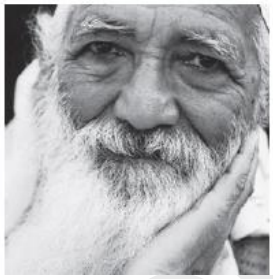
Traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural value beliefs and rituals including the development of plant species and animal breeds.

Sacred grove

HUMAN WILD LIFE CONFLICTS

It is a well known fact that man has been the sole creature responsible for the destruction of a large number of habitats, by over population, crowding, over exploitation etc. As human population keeps on increasing, we move into the forest land and occupy the habitats of plants and animals. So conflicts arise between the animals and man. Animals like elephants, wild buffaloes, and tigers come in groups to the farmlands for food and water and destroy them. Human beings encroach their lands for their benefits. So the animals are not to be blamed.

Protecting the environment is every one's responsibility. There is an increased awareness among the people towards the conservation of ecologically sensitive areas. Green Peace – a group devoted to environmental protection was responsible for the ban on whaling. In India, the Chipko movement was initiated by Sunderlal Bahuguna who stopped the felling of trees in some parts of the Himalayas. Some of the activities in the areas of environmental conservation include:



Sunderlal Bahuguna

- Holding rallies and marches to bring about a mass awakening to environmental issues.
- Spreading awareness through mass media.
- Introducing environmental legislation to tackle the issue.