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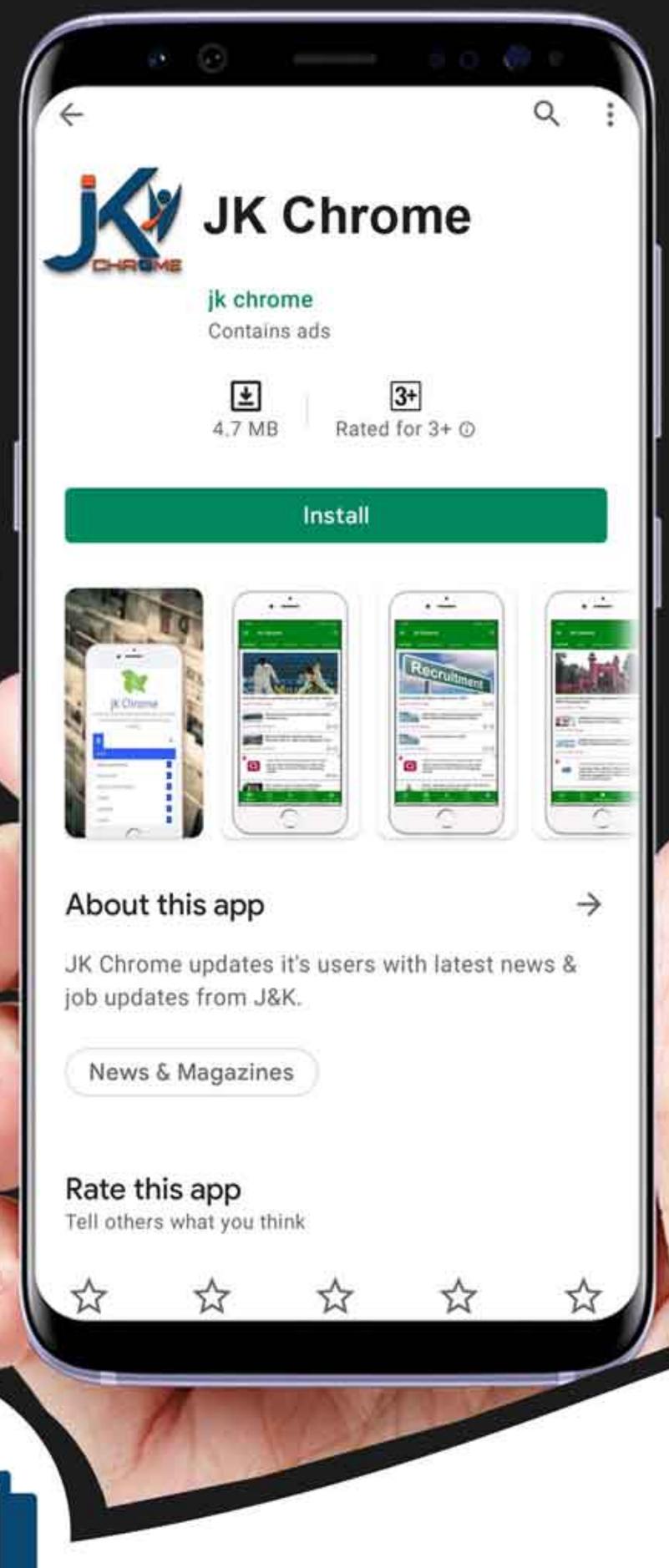

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Chapter 1

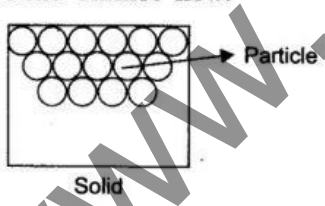
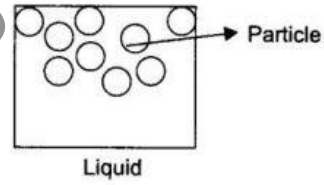
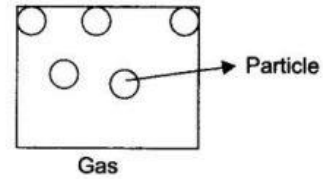
Matter in Our Surroundings

Facts that Matter

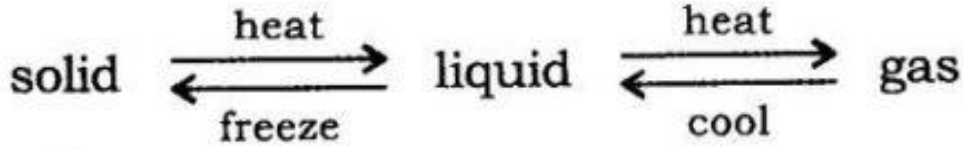
Introduction

- Everything in this universe is made of materials which scientist has names 'matter'.
- **The matter** is made up of very small tiny particles. It is not continuous but is particulate.
- **The matter** is anything that occupies space and has mass.
- Particles of matter have space between them and are continuously moving.
- Particles of matter attract each other.

States of Matter: It has 3 states.

Solids	Liquids	Gases
Strong intermolecular force.	Weak intermolecular force.	Very weak intermolecular force.
Very less intermolecular space.	Large intermolecular space.	Very large intermolecular space.
Have definite shape and volume.	No definite shape but definite volume.	No definite shape and volume.
High density, melting point and boiling point.	Density is lower, low melting and boiling point.	Density is very low.
Solids cannot be compressed.	Liquids can be compressed.	Gases are highly compressible.
Solids cannot flow.	Liquids can flow.	Gases can flow.
		

Matter can change its state from solid to liquid and from liquid to gas and vice-versa.



Effect of temperature: On increasing the heat, the particles gain energy and start vibrating with greater energy. Due to increased kinetic energy the particles overcome the force of attraction and a new state is obtained.

Melting point: The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point.

Boiling point: The temperature at which a liquid starts boiling at the atmospheri pressure is known as its boiling point. Boiling is a bulk phenomenon.

Latent heat of fusion: The amount of heat energy required to change 1 kg of a solid into liquid at its melting point is called the latent heat of fusion of the solid.

Latent heat of vaporization: The amount of heat energy required to change 1 kg of a liquid to vapour at atmospheric pressure, at its boiling point is called the latent heat of vaporization of the liquid.

Effect of change of pressure on the matter: On pplying pressure, the particles of matter can be brought close together and he st te of matter can be changed. For example, CO_2 gas can be solidified by applying pressure and lowering temperature.

Evaporation: The phenomenon of hanging of a liquid into its vapour state at any temperature below its boiling point is called evaporation. Evaporation is a surface phenomenon.

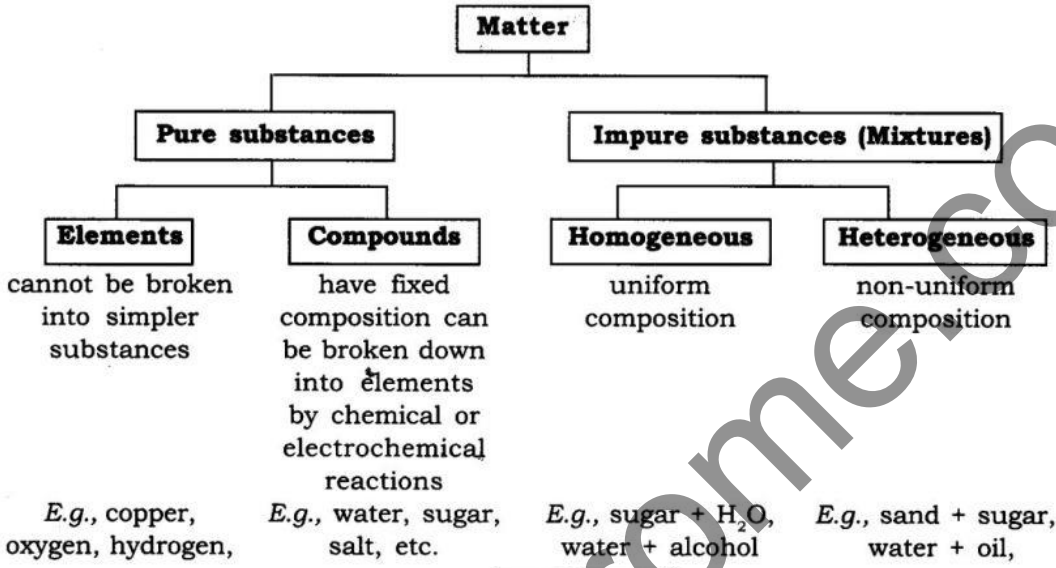
Factors affecting evaporation.

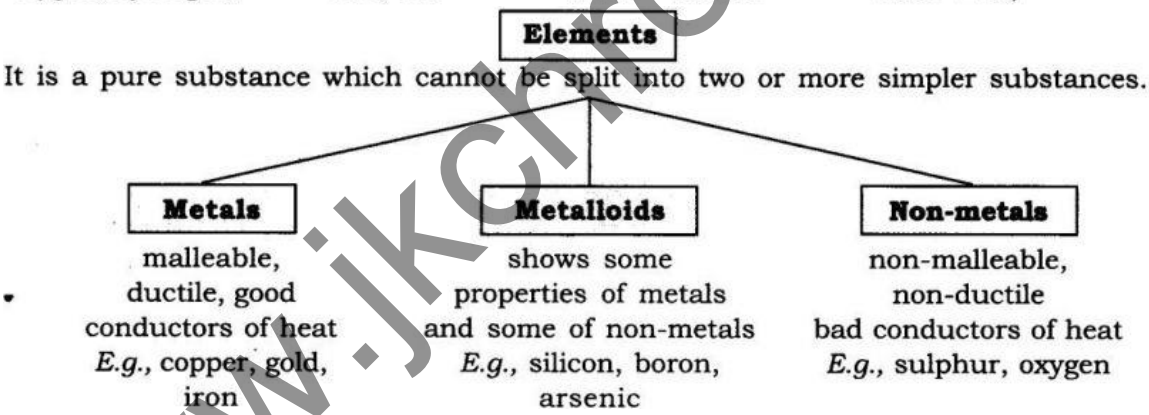
- An increase in urface area increases evaporation.
- An increase n temperature increases the rate of evaporation.
- A d cre se in humidity increases the rate of evaporation.
- An increase in wind speed increases the rate of evaporation.
- Evaporation causes a cooling effect.

Chapter 2

Is Matter Around Us Pure

Facts that Matter





Compounds

The compound is a pure substance made up of two or more elements combined chemically in a definite ratio.

Characteristics:

- The properties of compound differ from those of its constituents.
- Compound has fixed melting point and boiling point.
- Compound is a homogeneous substance.
- Constituent elements can be separated by chemical process.

Mixtures

It is made up of two or more elements or compounds mixed in any ratio/proportion.

Properties:

- It may be homogeneous or heterogeneous.
- The properties of constituent substances are retained.
- No new compound is formed.
- Elements can be separated by simple physical processes.
- It does not have a fixed melting and boiling point.

Separation of Mixtures:

Type of Mixture	*Separation method*
1. Two immiscible liquids. Example, oil + water	By using separating funnel
2. Ammonium chloride + sand	Sublimation
3. Dyes in black ink. (One solvent different constituents)	Chromatography
4. Two miscible liquids. (Acetone + water)	Distillation
5. Solid particles insoluble from (solvent) liquid. (Milk + Cream)	Centrifugation

Physical and Chemical Change

Physical Change	*Chemical Change*
• No new substance is formed.	A new substance is formed.
• Properties of constituent elements/ substance is retained.	Properties of constituent elements/substance changes.
• Change does not involve loss or gain of heat.	Loss or gain of heat may be involved in this reaction.
• This change is generally reversible.	This change is generally irreversible.

Solution

It is a homogeneous mixture of two or more substances.

Solute	*Solvent*
A substance which is dissolved in a solvent. *E.g.*, salt, sugar.	Liquid part of solution in which a substance is dissolved. *E.g.*, water.
Solute can be solid, liquid or gas.	Solvent can be liquid, solid or gas.

TYPES OF SOLUTION

Aqueous solution
A solution in which water is a solvent. E.g., salt + water

Non-aqueous solution
A solution in which water is not a solvent. E.g., sulphur + carbon disulphide.

Solution can be dilute or concentrated
(Depending on the amount of solute dissolving in solvent).

True solution
Solute particles completely dissolve in solvent and are not visible. E.g., sugar + water

Saturated solution
A solution in which no more solute can dissolve at given temperature.

Unsaturated solution
A solution in which more solute can dissolve at a given temperature.

- Concentration of solution = $\frac{\text{Amount of solute}}{\text{Amount of solution}}$ or $\frac{\text{Amount of solute}}{\text{Amount of solvent}} \times 100$
- Mass by mass percentage of a solution

$$= \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

- Mass by volume percentage of a solution

$$= \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$

Suspension	***Colloidal Solution***
• Size of solute particles are visible with naked eyes • Shows tyndall effect • Translucent • Solute particles settle down	Size of solute particles are not visible with naked eyes. Shows tyndall effect Translucent Colloidal particles do not settle down

Different Types of Colloid

Dispersed Phase	***Dispersing Medium***	***Type***	***Example***
Liquid	Gas	Aerosol	Fog, clouds, mist
Solid	Gas	Aerosol	Smoke, automobile exhaust
Gas	Liquid	Foam	Shaving cream
Liquid	Liquid	Emulsion	Milk, face cream
Solid	Liquid	Solution	Milk of magnesia, mud
Gas	Solid	Foam	Sponge, pumice
Liquid	Solid	Gel	Jelly, cheese, butter
Solid	Solid	Solid sol	Coloured gemstone, milky glass

Chapter 3

Atoms and Molecules

Facts that Matter

Law of Chemical Combination
Given by Lavoisier and Joseph L. Proust as follows:
1. **Law of conservation of mass:** Mass can neither be created nor destroyed in a chemical reaction. e.g., A + B → C + D Reactants → Products Mass of reactants = Mass of products

2. **Law of constant proportion:** In a chemical substance the elements are always present in definite proportions by mass.
E.g., in water, the ratio of the mass of hydrogen to the mass of oxygen is always 1 : 8 respectively.
These laws lacked explanation. Hence, ohn Dalton gave his theory about the matter. He said that the smallest particle of matter is called 'atom'.

Dalton's Atomic Theory

- Every matter is made up of very small or tiny particles called atoms.
- Atoms are not divisible and cannot be created or destroyed in a chemical reaction.
- All atoms of a given element are same in size, mass and chemical properties
- Atoms of different elements are different in size, mass and chemical properties.
- Atoms combine in the ratio of a small whole number to form compounds.
- The relative number and kinds of atoms are constant in a given compound.

Atom
Atoms are the smallest particles of an element which can take part in a chemical reaction.
Size of an atom: Atomic radius is measured in nanometres.

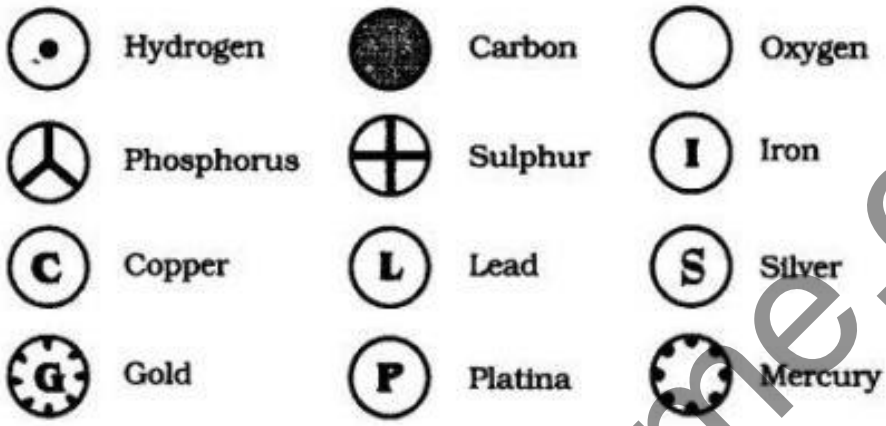
$$1\text{nm} = \frac{1}{10^9}\ \text{m}$$

$$\therefore \quad 1\text{m} = 10^9\ \text{nm}$$

Atomic radii of hydrogen atom = 1×10^{-10} m.

Symbols of atoms:

(a) Symbols for some elements as proposed by Dalton:



(b) Symbols of some common elements:

Name of the element	Latin name	Symbol
Hydrogen	–	H
Helium	–	He
Carbon	–	C
Copper	Cuprum	Cu
Cobalt		Co
Chlorine		Cl
Cadmium		Cd
Boron		B
Barium		Ba
Bromine		Br
Bismuth		Bi
Sodium	Natrium	Na
Potassium	Kalium	K
Iron	Ferrum	Fe
Gold	Aurum	Au
Silver	Argentum	Ag
Mercury	Hydragyrum	Hg

Molecule

It is the smallest particle of an element or a compound which can exist independently.

- Molecules of an element constitute the same type of atoms.
- Molecules may be monoatomic, diatomic or polyatomic.
- Molecules of compounds join together in definite proportions and constitute a different type of atoms.

Atomicity

The number of atoms constituting a Molecule is known as its a omicity.

Name of the element	Atomicity	Molecules formula
Helium	Monoatomic	He
Neon	,,	Ne
Argon	,,	Ar
Sodium	,,	Na
Iron	,,	Fe
Aluminium	,,	Al
Hydrogen	Di-atomic	H_2
Oxygen	,,	O_2
Chlorine	,,	Cl_2
Nitrogen	,,	N_2
Phosphorus	Polyatomic (Tetra)	P_4
Sulphur	Polyatomic (Octa)	S_8

Ions

The charged particles (atoms) are called ions, they are formed by attaining positive charge or negative charge on it.
Negatively charged ion is called anion (Cl^-).
Positively charged ion is called cation (Na^+).

Valency

The combining capacity of an element is known as its valency. Valency is used to find out how the atom of an element will combine with the atom of another element to form a chemical compound.
(Every atom wants to become stable, to do so it may lose, gain or share electrons.)

- If an atom consists of 1, 2 or 3 electrons in its valence shell then its valency is 1, 2 or 3 respectively,
- If an atom consists of 5, 6 or 7 electrons in the outermost shell, then it will gain 3, 2 or 1 electron respectively and its valency will be 3, 2 or 1 respectively.
- If an atom has 4 electrons in the outermost shell than it will share this electron and hence its valency will be 4.
- If an atom has 8 electrons in the outermost electron and hence its valency will be 0.

Name of the Element	Symbol	Valency	Ion.
Hydrogen	H	1	H^+
Helium	He	0	–
Lithium	Li	1	Li^+
Beryllium	Be	2	Be^{2+}
Boron	B	3	B^{3+}
Carbon	C	4 (Shares electrons)	–
Nitrogen	N	3	N^{3-}
Oxygen	O	2	O^{2-}
Fluorine	F	1	F^-
Neon	Ne	0	–
Sodium	Na	1	Na^+
Magnesium	Mg	2	Mg^{2+}
Aluminium	Al	3	Al^{3+}

Some elements show mor than one valency,hence termed as variable valency.

e.g., Iron shows valency II – Fe^{2+}
and valency III – Fe^{3+}
Copper shows valency I – Cu^+
and valency II – Cu^{2+}

Chemical Formulae

Rules: (i) The valencies or charges on the ion must balance.

(ii) Metal and non-metal compound should show the name or symbol of the metal first.

e.g., $Na^+ Cl^- \rightarrow NaCl$

(ii) If a compound consists of polyatomic ions. The ion is enclosed in a bracket before writing the

number to indicate the ratio.

e.g., $[SO_4]^{2-}$ → polyatomic radical

$H^{1+}\ SO_4^{2-}$ → H_2SO_4

Chemical formula of some simple compounds

(a) Calcium hydroxide

Symbol → Ca OH

Valency → +2 −1

Criss-cross.

Formula → $Ca(OH)_2$

(b) Aluminium oxide

Symbol → Al O

Valency → +3 −2

Formula → Al_2O_3

Molecular Mass

It is the sum of the atomic masses of all the atoms in a molecule of the substance. It is expressed in atomic mass unit (u).

e.g., $2H^+ + O_2 \quad H_2O$ [H = 1, O = 16]

$1 \times 2 + 16 = 18$ u

Formula Unit Mass

It is the sum of the atomic masses of all atoms in a formula unit of a compound. The constituent particles are ions.

e.g., $Na^+ + Cl^- \rightarrow NaCl$

$1 \times 23 + 1 \times 35.5 = 58.5$ u

Mole Concept

Definition of mole It is defined as one mole of any species (atoms, molecules, ions or particles) is that quantity in number having a mass equal to its atomic or molecular mass in grams.

1 mol = 6.022×10^{23} in number

Molar mass = mass of 1 mole → is always expressed in grams and is also known as gram atomic mass.

lu of hydrogen has → 1 atom of hydrogen 1g of hydrogen has → 1 mole of hydrogen

= 6.022×10^{23} atoms of hydrogen

Chapter 4

Structure of the Atom

Facts that Matter

- John Dalton assumed that atom is indivisible.
- In 1866 E. Goldstein discovered the presence of new radiations in a gas discharge tube and called them canal rays. These rays were positively charged radiations which led to the discovery of sub-atomic particle called proton.

In 1900 J.J. Thomson discovered the sub-atomic pa ticle—the electron with a negative charge.

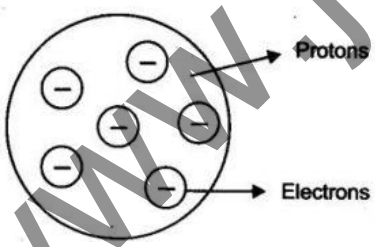
Difference in electron and proton

Negatively charged (e^-)	**Positively charged (p^+)**
Its mass is negligible.	Its mass is 1 unit.
Charge is – 1	Charge is + 1
J.J Thomson discovered it.	E. Goldstein discovered it.

The neutron was discovered by **Chadwick.** Neutrons have no charge.

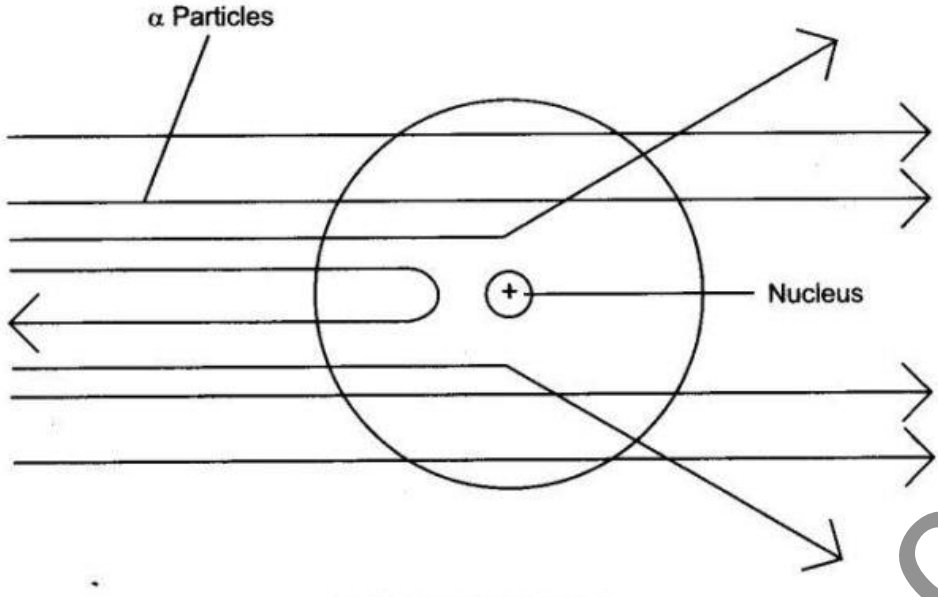
Structure of an Atom

1. Thomson's model of an atom



- In sphere of protons electrons are distributed
- +ve charge = –ve Charge
- Atom is electrically neutral.

2.Rutherford's model of an atom



Rutherford's Model

α-Particles: (+ 2 charge and 4 mass) when fast-moving a-particles are bombarded on very thin gold foil, following obs rvations were made:

- Most of the α-particles passed straight through the gold foil.
- Some of the α-particles were defl cted by the foil by small angles.
- One out of 12000 particles appeared to rebound.

Conclusions made by Rutherford based on his observations:

- Most of the space i side the atom is empty because a-particles passed through the gold foil.
- Very few particles were deflected from their path because +ve charge of the atom occupies a very little space.
- A very small fraction of a-particles were rebounded back, shows all + ve charge and mass of the gold atom is concentrated in a very small volume within an atom.
- The radius of the nucleus calculated was 105 times less than the radius of the atom.

Nuclear Model of an Atom

- Centre → +ve charge → called nucleus. All mass resides in nucleus.
- Electrons → revolve around the nucleus in orbits.

- Size of the nucleus is very small as compared to the size of the atoms.

Drawbacks of Rutherford's model of the atom: When an electron undergoes acceleration, it radiates energy. Thus revolving electron would lose energy and finally fall into the nucleus. Due to this atom should be highly unstable and hence matter would not exist in the form that we know.

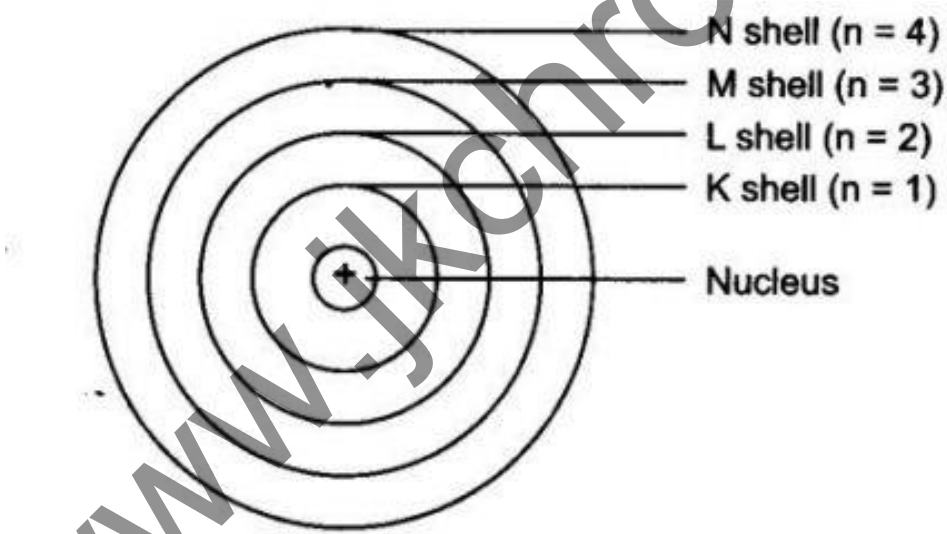
But we know that atoms are quite stable.

Bohr's Model of Atom

Postulates of Neil Bohr

- Only special orbits known as discrete orbits of electrons are allowed inside the atom.
- While revolving in discrete orbits the electrons do not radiate energy. These orbits are called energy levels

Orbits or shells are represented by K, L, M, N or the numbers, n = 1, 2, 3, 4



Bohr's Model

Neutrons

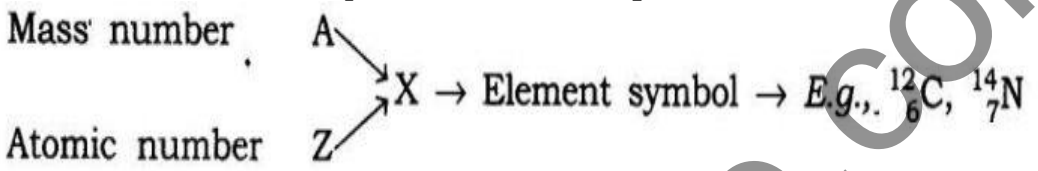
Distribution of electrons in different orbits (Shells) given by Bohr and Bury: Rules:

- Maximum number of electrons present in a shell is given by $2n^2$ (n = shell number)
  E.g., n = 1 (K shell) $2(1)^2 = 2$ electron

- The maximum number of electrons that can be accommodated in the outermost orbit is 8.
- Electrons are not accommodated in a given shell unless the inner shells are completely filled.

Definitions

- **Valency:** The combining capacity of an atom is called its valency,
- **Atomic number:** It is equal to a number of protons.
- **Mass number:** It is equal to the sum of protons and neutrons.



Isotopes: Atoms of the same element with same atomic number but a different mass number, are called isotopes.
Chemical properties → same but Physical properties → different

E.g., $^{12}_{6}C$, $^{14}_{6}C$

Applications of isotopes

- Anisotope of Uranium used as fuel.
- Anisotope of Cobalt is used in the treatment of cancer
- Anisotope of Iodine is used in the treatment of goitre.

Isobars: Atoms of different elements with same mass number but different atomic numbers are called isobars.

Chapter 5

The Fundamental Unit of Life

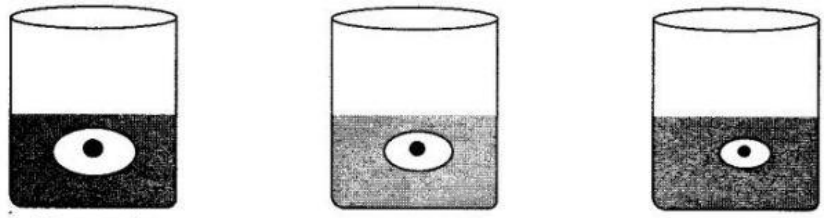
Facts that Matter

The smallest functional unit of life is a cell, discovered by Robert Hooke in 1665. A cell can independently perform all necessary activities to sustain life. Hence cell is the basic unit of life.
There are two types of cells plant cell and animal cell. The different cell organelles and their functions are as follows:

1. Plasma/Cell membrane: This is the outermost covering of the cell that separates the contents of the cell from its external environment. The plasma membrane allows or permits the entry and exit of some materials in and out of the cell so the cell membrane is called a selectively permeable membrane.

Some substances like CO_2 or O_2 gases can move across the cell membrane by a process called diffusion. The movement of water molecules (liquid) through such a selectively permeable membrane is called osmosis. Osmosis is the passage of water from a region of high water concentration through a semi-permeable membrane to a region of low water concentration.
If the medium surrounding the cell has a higher water concentration than the cell, the cell will gain water by osmosis. Such a solution is known as a hypotonic solution.

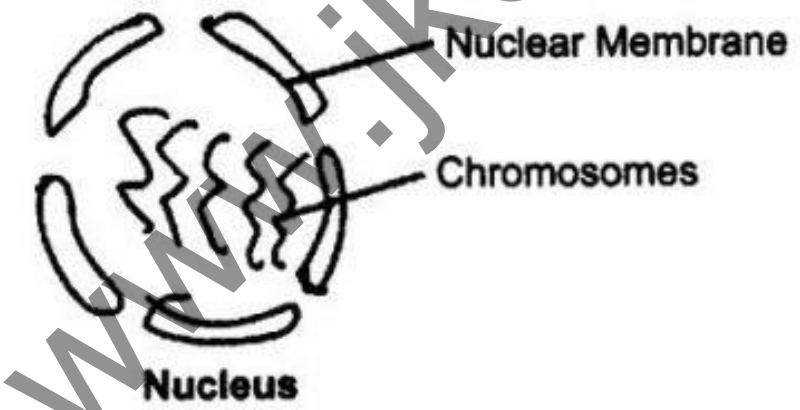
If the medium has exactly the same water concentration as the cell, there will be no net movement of water across the cell membrane. Such a solution is known as an isotonic solution. If the medium has a lower water concentration then the cell will lose water by osmosis. Such a solution is known as a hypertonic solution.



The plasma membrane is flexible and is made up of organic molecules called lipids and proteins. The flexibility of cell membrane also enables the cell to engulf in food and other material from its external environment. Such process is known as endocytosis. It is observed in Amoeba

2. Cell wall (Protective wall): Plants cells, in addition to the plasma membrane have another rigid outer covering called cell wall. The cell wall lies outside the plasma membrane. The plant cell wall is mainly composed of cellulose. It is a complex substance and provides structural strength to plant cells. When a living plant loses water through osmosis there is shrinkage or contraction of contents of the cell away from cell wall. This phenomenon is known as plasmolysis.

3. Nucleus (Brain of a cell): The nucleus has a double-layered covering called nuclear membrane. The nuclear membrane has pores which allow the transfer of material from inside the nucleus to its outside, i.e., to the cytoplasm.



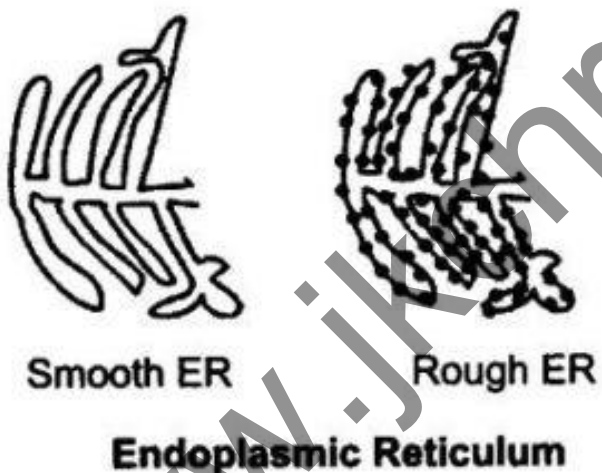
The nucleus contains chromosomes, which are visible as rod-shaped structures only when the cell is about to divide.
Chromosomes — contain information for inheritance of features from parents to next generation in form of DNA [Deoxyribo Nucleic Acid] molecules. Chromosomes are composed of DNA and protein. Functional segments of DNA are called genes. The nucleus plays a central role in cellular reproduction.

Prokaryotic Cells: In some organisms like bacteria, the nuclear material is not enclosed by nuclear membrane and membrane bound cell organelle are absent. Such nucleus is called nucleoid and such cells are known as prokaryotic cell. Such cells have single chromosome.
Eukaryotic Cells: Cells having well defined nucleus and having membrane bound cell organelle is termed as eukaryotic cell. Such cells have more than one chromosomes.

4. Cytoplasm: The cytoplasm is the fluid content inside the plasma membrane. It also contains many specialised cell organelles. Each of these organelles performs a specific function for the cell.

5. Cell Organelles: Every cell has a membrane around it to keep its content separate from the external environment. The different components of cell perform different function and these components are called cell organelles.

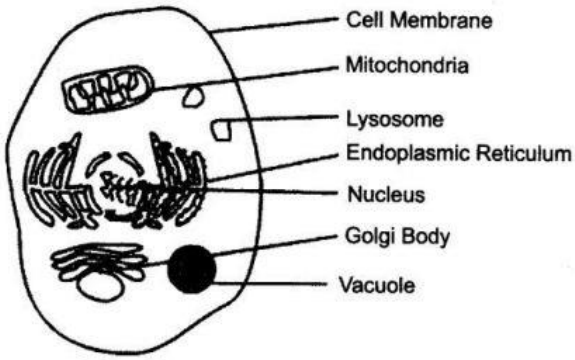
(i) Endoplasmic Reticulum (ER) (Channels, Network for transport):



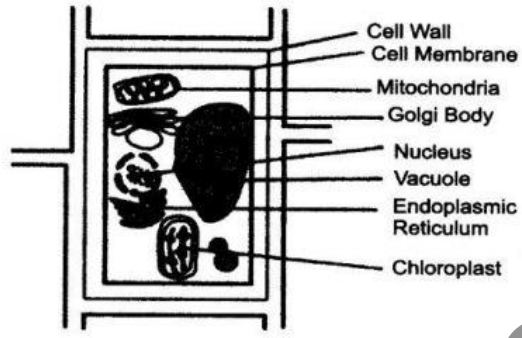
Endoplasmic Reticulum

The ER is a large network of membrane-bound tubes and sheets. It looks like long tubules or round or oblong bags.
There are two types of ER-Rough endoplasmic reticulum [RER] and smooth endoplasmic reticulum [SER]. RER has particles called ribosomes attached to its surface. The ribosomes Endoplasmic **Reticulum** are the sites of protein manufacture.

The SER helps in the manufacture of fat molecules, or lipids, important for cell function. Some of these proteins and lipids help in building the cell membrane. This process is known as membrane biogenesis. Some other proteins and lipids function as enzymes and hormones.



Animal Cell



Plant Cell

The one function of ER is to serve as channels for the transport of materials between various regions of the cytoplasm or between the cytoplasm and the nucleus. The ER also functions as a cytoplasmic framework providing a surface for some of the biochemical activities of the cell.

(ii) Golgi Apparatus (Packaging): The golgi apparatus, first described by Camillo Golgi, consists of a system of membrane-bound vesicles arranged approximately, parallel to each other in stacks called cisterns.
The material synthesised near the ER is packaged and dispatched to various targets inside and outside the cell through the Golgi apparatus. It's function include the storage, modification and packages of products in vesicles. In some cases complex sugar may be made from simple sugar in the Golgi apparatus. It is also involved in the formation of lysosomes.

(iii) Lysosomes [Suichg bags] (Cleanliness of cell): Lysosomes are a kind of waste dispatch and disposal system of the cell. Lysosome help to keep the cell clean by digesting any foreign material as well as worn-out cell organelles. For ign materials entering the cells such as bacteria or food, as well as old organelles, end up in the lysosome, which break them up into small pieces. They are able to do this because they contain powerful d gestive enzymes capable of breaking down all organic material. Under abnormal condition, when the cell gets damaged, lysosomes may burst and the enzymes digest their own cell. Therefore they are also known as "suicide bags"

(iv) Mitochondria (Powerhouse, Energy provider): Mitochondria are known as powerhouses of the cell. The energy required for various chemical activities needed for life is released by mitochondria in the form of ATP [Adenosine Triphosphate] molecules. ATP is known as energy

currency of the cell. Mitochondria have two membrane coverings instead of just one. The outer membrane is very porous while the inner membrane is deeply folded. They are able to make some of their own protein.

(v) Plastids: Plastids are present only in plant cells. There are two types of plastids chromoplasts and leucoplasts. Chromoplasts are the coloured plastids present in leaves, flowers and fruits. Plastids containing the pigment chlorophyll are known as chloroplasts. They are important for photosynthesis in plants. Chloroplasts also contain various yellow or orange pigments in addition to chlorophyll. Leucoplasts are found primarily in organelles in which materials such as starch, oils and protein granules are stored.

The internal organisation of the plastids consists of numerous membrane layers embedded in a material called stroma. Plastids are similar to mitochondria in external structure. Plastids ha e their own DNA and ribosomes.

(vi) Vacuoles (Storage): Vacuoles are storage sacs for solid or liquid contents. Vacuoles are small-sized in animal cells while plant cells have very large vacuoles [50% to 90% cell volume].

In plant cells, vacuoles are full of cell sap and provide turgidity and rigidity to the cell. In Amoeba, the food'vacuole contain the food items that is consumed it and contractile vacuoles expels excess water and some wastes from th cell.

Chapter 6

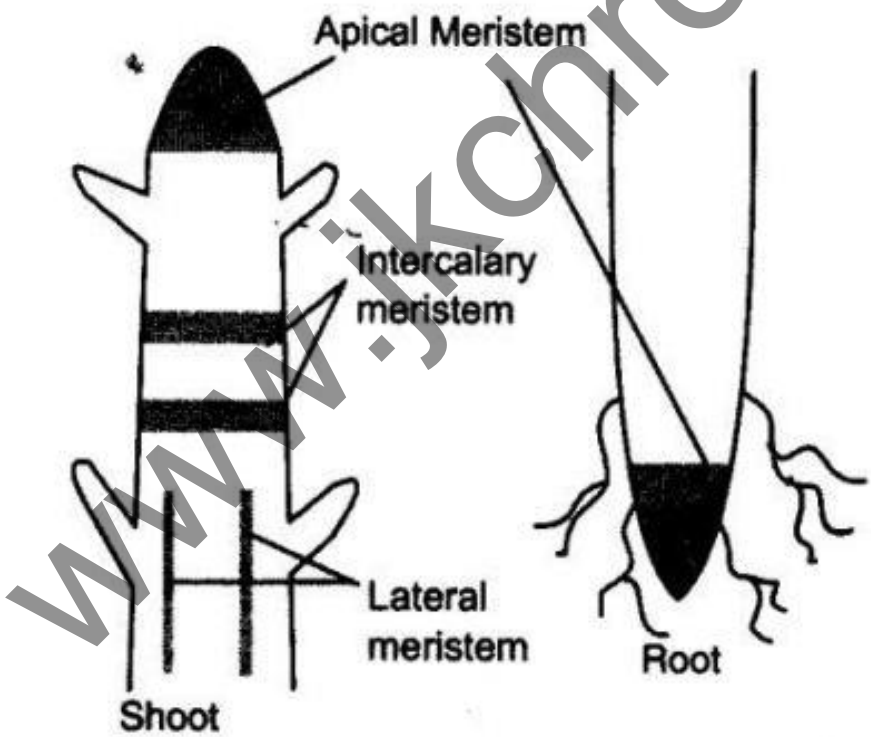
Tissues

Facts that Matter

Tissues
Group of cells having a common origin and similar function are termed as tissues.
A. Plant tissues: On the basis of the dividing capacity, plant tissues are of two types:

1. Meristematic tissues
2. Permanent tissues

1. Meristematic tissues: Consist of actively dividing cells. Meristematic tissues are of three types:



- **Apical meristem:** Present at the growing tips of stems and roots. Important function: To increase the length of stems and roots.

- **Intercalary meristem:** Present at the base of leaves or internodes. Important function: For the longitudinal growth of plants.
- **Lateral meristem:** Present on the lateral sides of the stems and roots. Important function: To increase the thickness of stems and roots.

2. Permanent tissues: Formed from meristematic tissues, the cells in the tissue loose the ability to divider Permanent tissues are divided into two categories:

- **Simple permanent tissue:** Consist of only one type of cells.
  Types of simple permanent tissues:
  - **Parenchyma:** Composed of unspecialised living cells with relatively thin cell walls, intercellular space, present in soft parts of the plant. Their main function is sto age.
  - **Collenchyma:** Composed of living and elongated cells with cell walls irregularly thickened at the comers. No intercellular space. It provides mechanical support and elasticity to plant. It helps in bending of leaves nd s ems.
  - **Sclerenchyma:** Composed of long, narrow, and thick-walled cells. This tissue is made up of dead cells and there are no intercellular spaces. Sclerenchyma cells are dead, present in seeds, nuts, the husk of a coconut, fibres of jute etc.
- **Complex permanent tissue:** Made up of more than one type of cells (Conducting t ssues.)
  Types of complex permanent tissues:
  - **Xylem:** Cond cts water and minerals from the roots to the differe t parts of the plant.
    Composed of four different types of cells—tracheids, vessels, xylem parenchyma and xylem fibres.
    Phloem: Conducts food material from the leaves to the different parts of the plant.
    Composed of four different types of cells—sieve tubes, companion cells, phloem parenchyma and phloem fibres.
    Protective tissue: It is made of a single layer of cells. E.g., epidermis. The epidermis of the leaf bears stomata.

B. Animal tissues: Animal tissues are classified into four types based on the functions they perform:

1. Epithelial
2. Connective
3. Muscular
4. Nervous

1. **Epithelial tissues:** Form the covering of the external surfaces, internal cavities and organs of the animal body. Various types of epithelial tissues are:
    - **Simple squamous epithelium:** Single layer of flat cells
      Location in the human body: Lining of the mouth, oesophagus, lung, alveoli, etc.
    - **Cuboidal epithelium:** Consists of cube like cells.
      Location in the human body: Lining of the kidney tubules and ducts of the salivary glands. It's function is secretion and absorption.
    - **Columnar epithelium:** Consists of elongated or column-like cells.
      Location in the human body: Inner lining of the intestine and gut. Its function is of secretion and absorption.
2. **Connective tissues:** Specialised to connect various body organs. Various types of connective tissues:, are:
    - **Areolar tissue:** Found in the skin and muscles, around the blood vessels, nerves, etc.
    - **Adipose tissue:** Acts as the storage site of fats; found between the internal organs and below the skin; acts as an insulator for the body.
    - **Dense regular connective tissue:** Main components are tendons and ligaments; tendons connect muscles to bones, while ligaments connect two bones together.
    - **Skeletal tissue:** Main components of skeletal tissues are cartilage and bone.
    - **Fluid tissue:** Blood is the vascular tissue present in animals.
3. **Muscular tissues:** Main function of muscular tissues is to provide movement to the body. Muscular tissues are of three types:
    - **Striated muscles or skeletal muscles or voluntary muscles:** Cells are cylindrical, unbranched and multinucleate.
    - **Smooth muscles or involuntary muscles:** Cells are long, spindle-shaped and possess a single nucleus.

- **Cardiac muscles or involuntary muscles:** Cells are cylindrical, branched and uninucleate.

4. **Nervous tissues:** Present in the brain, spinal cord and nerves.
    - **Neuron:** Cells of the nervous tissue.
    - **A neuron:** consists of a cell body, an axon and a dendrite.

Chapter 7

Diversity in Living Organisms

Facts that Matter

Diversity: This earth is full of organisms of various shapes and sizes. The largest Phylum of animal kingdom alone contains over a million species. There are varieties of plants, right from small grasses to tall Eucalyptus trees. This variety in living beings is called diversity.

Biodiversity: The variety of animals and plants living in a given geographical area is called biodiversity of that geographical area.
Need for a System of Classification: Because of the huge diversity in living beings it becomes very difficult task to study each of them one by one. To make their study easier animals and plants were categorized in groups and sub¬groups. Thus the system of classification started.

Classification by Aristotle: Aristotle classified animals according to their living environment. So he categorized them as either aquatic or terrestrial.

Drawbacks of Aristotle's Classification: Both in sea as well as on land we can find animals and plants. Moreover, there are very small animals, like sea-horse, along with large animals, like whale. So, this was not a good basis of classification.

Basis of Classification
(a) Presence or Absence of Nucleus in Cells
Prokaryotes: Those organisms which have cells without well defined nucleus are called prokaryotes.
Eukaryotes: Those organisms which have cells with well defined nucleus are Called eukaryotes. Presence of nucleus and membrane-bound organelles gives better efficiency to cells.

(b) Number of Cells in an Organism
Unicellular: Those organisms having single cell are termed as unicellular

organisms. In them the single cell is responsible for carrying out all necessary functions to maintain life.
Multicellular: Those organisms having more than one cell are called multicellular organisms. Because of more number of cells there can be some division of labour to gain more efficiency.

(c) Mode of Nutrition
Autotrophs: Organisms producing their own food are called autotrophs. All green plants are autotrophs. They have a pigment (chlorophyll) in green parts which facilitates photosynthesis.
Heterotrophs: Organisms dependent on either plants or animals are called heterotrophs.They don't have chlorophylls. All animals, fungi and certain bacteria and protozoa belong to this group.

(d) Level of Organisation in Body
In multicellular organisms which are small, like hydra particular group of cells are assigned a particular function. But in larger organisms, tissues group to form an organ, which in turn make organ system. For example, in human beings there are separate systems for performing specific tasks.

Even in larger plants there is separate root system for conduction of water and minerals, leaf for photo ynthesis and flowers for reproduction. Based on these characters organ sms can be further classified into various sub-groups.

Evolutionary Relationship or Phylogenetic Relationship
Charles Darwin wrote a book "Origin of Species' in 1859 and gave his theories of evolution. As per his theories all organisms have evolved from unicellular organisms. Primitive body designs came early in evolutionary history leading to more complex designs. This gave rise to such a huge diversity in life forms. Because of common ancestry, all organisms are related. The closer evolutionary relation between two organisms is also one of the basis of classification of organisms.

The Hierarchy of Classification—Groups
Biologists, such as Ernst Haeckel (1894), Robert Whittaker (1959) and Carl Woese (1977) have tried to classify all living organisms into broad categories, called kingdoms.

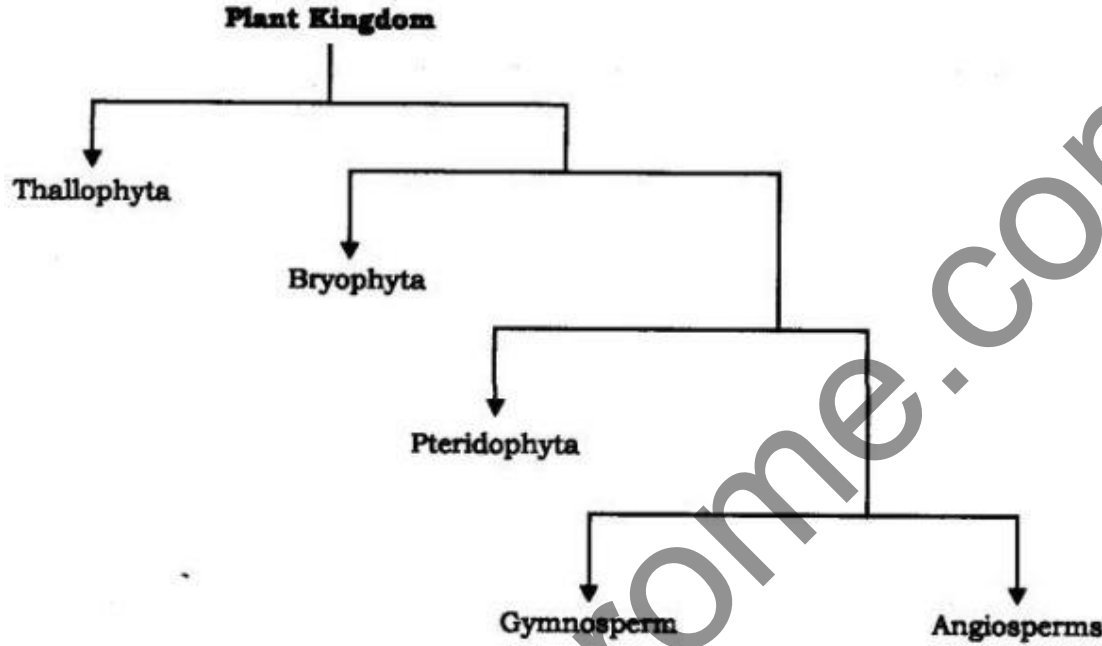
- **Whittaker's Five Kingdom Classification:**
  - Monera
  - Protista
  - Fungi
  - Plantae
  - Animalia.
- **Further Levels of Classification Beyond Kingdom**
  - Phylum (for animals)/Division (for plants)
  - Class
  - Order
  - Family
  - Genus
  - Species

Thus, by separating organisms on the basis of a hierarchy of characteristics into smaller and smaller groups, we arrive at the basic unit of classification, which is a 'species'. Broadly, a species includes all organisms that are similar enough to breed and perpetuate.

- **Monera**
  - These organisms do not have a defined nucleus or organelles and are unicellular.
  - Cell walls present in some organisms of this group.
  - Nutrition: Autotrophic or heterotrophic
  - Examples: Bacteria and blue-green algae
- **Protista**
  - Unicellular eukaryotic organisms.
  - Locomotion: By Jair-like cilia or whip-like flagella for moving around in some members.
  - Nutrition: Autotrophic or heterotrophic.
  - Examples: Algae, protozoans {Plasmodium, Entamoeba)
- **Fungi**
  - Heterotrophic eukaryotic organisms.
  - Nutrition: Saprophytic they use decaying organic materials as food.
- **Lichens:** Some fungi live in a symbiotic relationship with cyanobacteria. They are called lichens. The algal part provides food and the fungal part provides minerals and substratum.
- **Plantae**
  - Multicellular eukaryotes with cell walls.

- Nutrition: Autotrophs use chlorophyll for photosynthesis.
- • **Animalia**
  - Multicellular eukaryotes without cell walls.
  - Nutrition Heterotrophs.

Classification of Kingdom Plantae



Thallophyta or Algae: Plants that do not have well-differentiated body design fall in this group. The plants in this group are commonly called algae. These plants are predominantly aquatic. Examples are Spirogyra, Ulothrix, Cladophora and Chora

Bryophyta: These are called the amphibians of the plant kingdom. The plant body is commonly differentiated to form stem and leaf-like structures. However, there is no specialized tissue for the conduction of water and other substances from one part of the plant body to another. Examples are moss (Funaria) and Marchantia.

Pteridophyta: The plant body is differentiated into roots, stem and leaves and has specialized tissue for the conduction of water and other substances from one part of the plant body to another. Some examples are MarsUea,

ferns and horse-tails.

Important: The thallophytes, the bryophytes and the pteridophytes have naked embryos that are called spores. The reproductive organs of plants in all these three groups are very inconspicuous, and they are therefore called 'cryptogamae', or 'those with hidden reproductive organs'.

On the other hand, plants with well differentiated reproductive tissues that ultimately make seeds are called phanerogams. Seeds are the result of the reproductive process. They consist of the embryo along with stored food, which serves for the initial growth of the embryo during germination.

Gymnosperms: The plants of this group bear naked seeds and are usually perennial, evergreen and woody. Examples are pines and deodar.

Angiosperms: This word is made from two Greek words: angio means covered and sperma—means seed. The seeds develop inside an organ which is modified to become a fruit. These are also called flowering plants. Plant embryos in seeds have structures called cotyledons.

Cotyledons: Cotyledons are called 'seed leaves' because in many instances they emerge and become green when the seed germinates. The angiosperms are divided into two groups on the basis of the number of cotyledons present in the seed.

- **Monocotyledonous:** Seeds have a single cotyledon.
- **Dicotyledonous:** Seeds have two cotyledons.

Classification of Kingdom Animalia: Kingdom Animalia is further classified into several following phylum. Each phylum has it own classes, sub-classes orders, families, etc.

1. **Porifera**
   - These are non-motile animals attached to some solid support which comprises of spicules of calcium carbonate, silica.
   - There are holes or "pores', all over the body. These lead to a canal system that helps in circulating water throughout the body to bring in food and oxygen.
   - Animals are covered with a hard outside layer or skeleton which comprises of spicules of calcium carbonate, silica.

- They have very minimal differentiation and division into tissues.
- Examples: Sponges

2. **Coelenterata**
   - Aquatic animals.
   - There is a cavity in the body hence the name Coelenterate (coelom means cavity).
   - Body is made of two layers of cells.
   - Examples: Hydra, Jellyfish
3. **Platyhelminthes**
   - The body is bilaterally symmetrical, meaning that the left and the right halves of the body have the same design.
   - There are three layers of cells from which differentiated tissues can be made, which is why such animals are called triploblastic.
   - There is no true internal body cavity or coelom, in which well developed organs can be accommodated.
   - The body is flattened dorsiventrally, meaning from top to bottom, which is why these animals are called flatworms.
   - They are either free-living or parasitic.
   - Examples: Planaria, Liver fluke
4. **Nematoda**
   - Body is bilaterally symmetrical and triploblastic.
   - Body is cylindrical rather than flattened.
   - False body cavity or a pseudocoelom, is present.
   - These are very familiar as parasitic worms causing diseases, such as the worms causing elephantiasis (filarial worms) or the worms in the intestines (roundworm or pinworms).
   - Examples: Ascaris, Wucheraria
5. **Annelida**
   - These are bilaterally symmetrical and triploblastic.
   - True body cavity present.
   - Body is divided into many ring like segments, hence the name annelida.
   - Examples: Earthworms, Leech
6. **Arthropoda**
   - The largest group of animals.
   - These are bilaterally symmetrical and segmented.

- There is an open circulatory system, and so the blood does not flow in well defined blood vessels.
- They have jointed legs (the word 'arthropod' means jointed legs').
- Examples: Ants, Cockroach, Grasshopper, Scorpions

7. **Mollusca**
   - These are bilaterally symmetrical.
   - Reduced coelomic cavity.
   - The soft body is covered with a hard shell made of calcium carbonate.
   - Examples: Snails, Mussels.
8. **Echinodermata**
   - In Greek, echino means hedgehog, and derma means skin. Thus, these are spiny skinned organisms
   - Exclusively free-living marine animals
   - Triploblastic animals with coelom.
   - They have a peculiar water-driven tube system that they use for moving around.
   - Skeleton made of calcium carbonate.
   - Examples: Starfish and Sea urchins
9. **Protochordata**
   - These animals are bi aterally symmetrical, triploblastic and have a coelom.
   - In addition, they show a new feature of body design, namely a notochord, a least at some stages during their lives.
   - The notochord is a long rod-like support structure (chord*string) that runs along the back of the animal separating the nervous tissue from the gut. It provides a place for muscles to attach for ease of movement.

The notochord is a long rod-like support structure (chord=string) that runs along the back of the animal separating the nervous tissue from the gut. It provides a place for muscles to attach for ease of movement.

   - Examples: Balanoglossus, Herdemarda and Amphioxus.
10. **Vertebrata**

These animals have a true vertebral column and internal skeleton, allowing a completely different distribution of muscle attachment points to be used for movement. Vertebrates are bilaterally symmetrical, triploblastic, coelomic and segmented, with complex

differentiation of body tissues and organs. All chordates possess the following features:

- Notochord
- Dorsal nerve cord
- Triploblastic
- Paired gill pouches
- Coelomate

Vertebrates are grouped into five classes:

1. **Pisces**
    - Body is streamlined and has fins and tail for swimming.
    - Skin is covered with scales.
    - Skeleton can be made of bone or cartilage
    - Intake' of oxygen is by gills.
    - Cold-blooded animals.
    - The two-chambered heart is present
    - Examples: Fishes like Rohu, Tun Shark
2. **Amphibia**
    - They are adapted to live both on land and water.
    - Respiration is through either gills or lungs.
    - The three-chambered heart is present.
    - Examples: Frogs, Toads, Salamander
3. **Reptilia**
    - These are crawling animals.
    - Skin is rough and modified to withstand extreme temperatures.
    - The heart is three chambered in most, while four-chambered in crocod les.
    - Cold blooded animals.
    - Examples: Lizards, Turtles, Snakes
4. **Aves**
    - Body is covered with feathers and forelimbs are modified for flying.
    - Breathing through lungs.
    - Warms blooded animals.
    - The four-chambered heart is present.
    - Examples: Sparrow, Eagle, Crow, Parrot
5. **Mammalia**
    - Mammary glands are present which produce milk to nurture young ones.

- Skin is covered with hairs and has sweat glands and sebaceous glands.
- Warm-blooded animals with four-chambered heart.
- Most animals are viviparous (giving birth to live young ones), some are oviparous (producing eggs).
- Examples: Man, Horse, Kangaroo, Lion

Conventions for writing the scientific names:

1. The name of the genus begins with a capital letter.
2. The name of the species begins with a small letter.
3. When printed, the scientific name is given in italics.
4. When written by hand, the genus name and the species name have to be underlined separately.

Chapter 8

Motion

Facts that Matter

An object is said to be in motion when its position changes with time.

We describe the location of an object by specifying a reference poin . Motion is relative. The total path covered by an object is said to be the distance travelled by it.

The shortest path/distance measured from the initial to the final position of an object is known as the displacement.

Uniform motion: When an object covers equal distances in equal intervals of time, it is said to be in un form motion.

Non-uniform motion: Motions where objects cover unequal distances in equal intervals of time.

Speed: The distance travelled by an object in unit time is referred to as speed. Its unit is m/s.

Average speed: For non-uniform motion, the average speed of an object is obtained by dividing the total distance travelled by an object by the total time taken

$$\text{Average speed } (v) = \frac{\text{Total distance travelled}(s)}{\text{Total time taken } (t)}$$

Velocity: Velocity is the speed of an object moving indefinite direction. S.I. unit is m/s.

$$\text{Average velocity} = \frac{\text{initial velocity} + \text{final velocity}}{2}$$

$$\therefore \quad V_{av} = \frac{u+v}{2}$$

u = initial velocity

v = final velocity

Acceleration: Change in the velocity of an object per unit time.

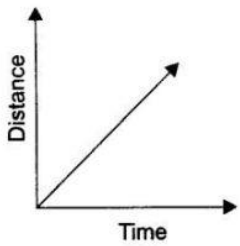
$$\text{Acceleration } a = \frac{v-u}{t} \quad \text{S.I. unit is } m/s^2$$

Graphical representation of motions

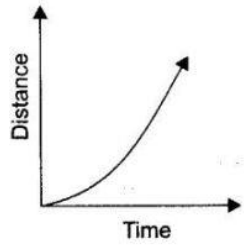
(i) Distance-time graph

For a distance-time graph, time is taken on x-axis and distance is taken on the y-axis.

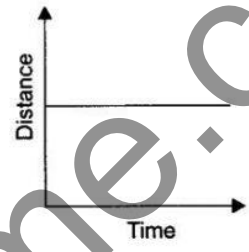
[**Note:** All independent quantities are taken along the x-axis and dependent quantities are taken along the y-axis.]



Uniform speed



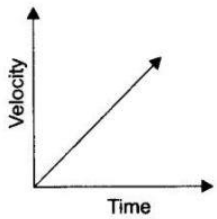
Non-uniform speed



Stationary

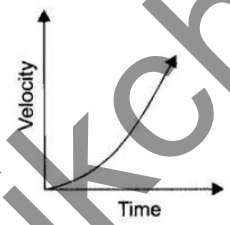
$\left(\text{speed} = \frac{\text{distance}}{\text{time}}\right)$

(ii) Velocity-time graph

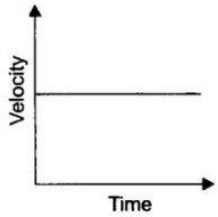


Uniform acceleration

$\left(a = \frac{v}{t}\right)$



Non-uniform acceleration

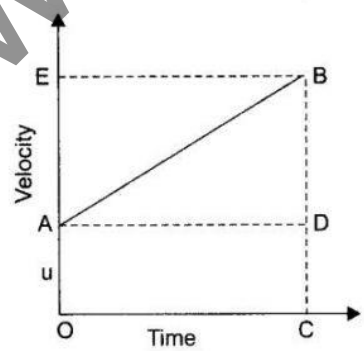


Uniform motion or no acceleration

Equation of motion by graphical methods

(i)velocity-time relation:

$v = u + at$



$OA = CD = u$

$OE = CB = v$

$OC = AD = t$

$BD = BC - DC$ (Change in velocity)

AD is parallel to OC.

$\therefore \quad BC = BD + DC = BD + OA$

$\therefore \quad BC = v$ and $OA = u$

We get $\quad v = BD + u$

$\therefore \quad BD = v - u \quad ...(1)$

In velocity-time graph, slope gives acceleration.

$$\therefore \quad a = \frac{BD}{AD} = \frac{BD}{OC}$$

$$\because \quad OC = t \text{ we get } a = \frac{BD}{t}$$

$\therefore \quad BD = at \quad ...(2)$

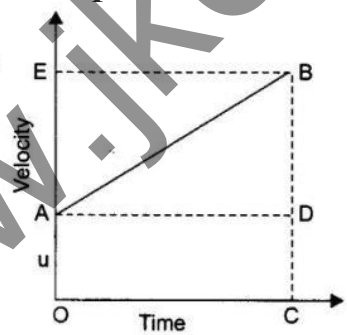
Substituting (2) in (1) we get

$$BD = v - u$$

$$at = v - u$$

$$\therefore \quad \boxed{v = u + at}$$

(ii) The equation for position-time relation:



Let us assume,

s = distance travelled by the object

t = in time t

a = with uniform acceleration.

$\therefore$ Distance travelled by the object is given by area enclosed with $OABC$ in the graph.

$\therefore \quad s = OABC$

= (area of rectangle $OADC$) + (area of ΔABD)

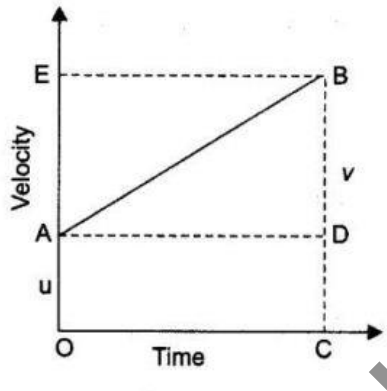
$$= (OA \times OC) = \frac{1}{2}\ (AD \times BD)$$

Substituting $OA = u,\ OC = AD = t$ and $BD = at$

We get $$s = ut + \frac{1}{2}\ (t \times at)$$

$\therefore$ $$\boxed{s = ut + \frac{1}{2}\ at^2}$$

(iii) Equation for position-velocity relation:



s = distance travelled by the object

t = in time t

a = moving with uniform acceleration

$\therefore$ s = area enclosed by trapezium $OABC$

$\therefore$ $$s = \frac{(OA + BC) \times OC}{2}$$

$\therefore$ $OA = u,\ BC = v$ and $OC = t.$

$\therefore$ $$s = \frac{(u + v)\, t}{2} \qquad \ldots(1)$$

Slope $$t = \frac{v - u}{a}$$ from the graph ...(2)

Substitute value of 't' in (1)

$\therefore$ $$s = \frac{u + v}{2} \times \frac{(v - u)}{a}$$

$$s = \frac{v^2 - u^2}{2a}$$

$\therefore$ $$\boxed{v^2 - u^2 = 2as}$$

Uniform circular motion: When a body moves in a circular path with uniform speed, its . motion is called uniform circular motion.

Chapter 9

Force and Laws of Motion

Facts that Matter

Force: It is a push or pulls on an object that produces an acceleration in the body on which it acts. S.I. unit of force is Newton.

A force can do three things on a body.

- It can change the speed of the body.
- It can change the direction of motion of a body.
- It can change the shape of a body.

Balanced forces: Forces are said to be balanced forces if they nullify one another and their resultant force is zero

Frictional force: The force that always opposes the motion of objects is called a force of friction.

The second law of motion: The rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of the force.

Mathematically,

$$F \propto \frac{p_2 - p_1}{t} \text{ or } \frac{m(v-u)}{t} \text{ or } ma$$

$F = k\ ma$ (where k is a proportionality constant)

$F = ma$ $(\because\ k = 1)$

Momentum: The momentum of an object is the product of its mass and velocity and has the same direction as that of the velocity. Its S.I. unit is kg m/s.

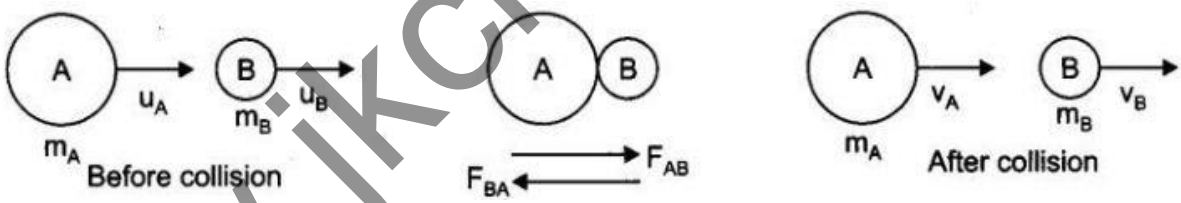
$(\rho = mv)$

1 Newton: A force of one Newton produces an acceleration of 1 m/s^2 on an object of mass 1 kg.

IN. = 1 kg m/s^2 (F = ma)

Third law of motion: To every action, there is an equal and opposite reaction and they act on two different bodies

Conservation of momentum: If the external force on a system is zero, the momentum of the system remains cons ant i.e., in an isolated system, the total momentum remains conser ed.



Suppose A and B are two balls, they have mass m_A and and initial velocities u_A and u_B as shown in above figure before collision. The two bodies collid and force is exerted by each body. There is change in their velocities due to collision.

Unbalanced forces: When two opposite forces acting on a body, move a body in the direction of the greater force or forces which brings motion in a body are called as unbalanced forces.

First law of motion: An object remains in a state of rest or of uniform motion in a straight line unless acted upon by an external unbalanced force.

Inertia: The natural tendency of an object to resist a change in their state of rest or of uniform motion is called inertia.

The mass of an object is a measure of its inertia.

Its S.I. unit is kg.

A body with greater mass has greater inertia.

($m_Au_A + m_Au_B$) is the total momentum of the two balls A and B before collision and ($m_Av_A + m_Bv_B$) is their total momentum after the collision.

The sum of momenta of the two objects before collision is equal to the sum of momentum after the collision, provided there is no external unbalanced force acting on them.

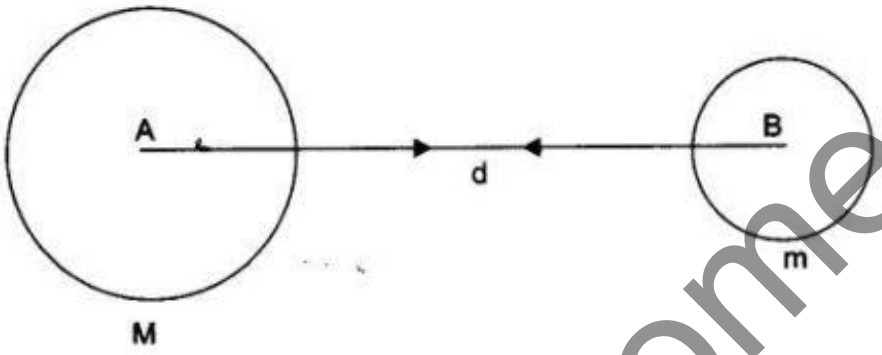
This is known as the law of conservation of momentum.

Chapter 10

Gravitation

Facts that Matter

The universal law of gravitation: Every object in the universe attracts every other object with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them.
The force is along the line joining the centres of two objects.



Gravitational force between two uniform objects is directed along the line joining their centres.

Let two objects A and B of masses M and m lie at a distance of d from each other as shown in the figure.

Let F be the force of attraction between the law of gravitation

$$F \propto \frac{Mm}{d^2}$$

$$F = G\frac{Mm}{d^2} \quad \because \quad G = \text{universal gravitational constant}$$

$$G = \frac{Fd^2}{Mm}$$

G is ca led a universal constant because its value does not depend on the nature of intervening medium or temperature or any other physical variable.

S.I. unit of G = Nm^2/kg^2

Value of G = 6.673 x 10-11 Nm^2/kg^2 (Found by Henry Cavendish)

Importance of universal law of gravitation

Universal law of gravitation successfully explained several phenomena like :

- the force that binds us to the earth.
- the motion of moon around the earth.
- the motion of planets around the sun.
- the tides due to the moon and the sun.

Freefall

When an object falls down towards the earth under the gravitational force alone, we say the object is in free fall.

The velocity of a freely falling body changes and is said to be accelerated.

This acceleration is called acceleration due to gravity, denoted by 'g'. Unit is m/s^2.

As $F = ma$ ($\because a = g$) ...(i)

$F = mg$ ...(ii)

and $F = G\frac{Mm}{d^2}$ ($\therefore$ Universal law of gravitation) ...(iii)

From (ii) and (iii)

$\therefore \quad mg = G\frac{Mm}{d^2}$

$\therefore \quad g = \frac{GM}{d^2}$

M = Mass of the earth

d = Distance between the object and the earth

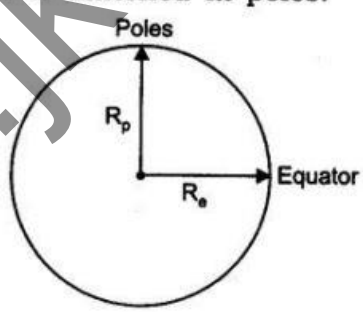
G = Gravitational constant

If the object is placed on the earth then $d = R$

(R = radius of the earth)

$\therefore \quad g = \frac{GM}{R^2}$

Earth is not a sphere it is flattened at poles.



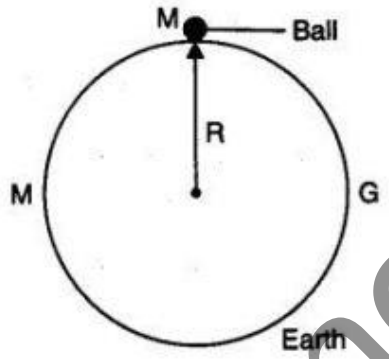
Hence R_p – Radius at pole and R_e – Radius at equator

$$R_e > R_p$$

$$g \propto \frac{1}{R}$$

∴ The value of 'g' is more at poles = (9.9 m/s^2)
and less at equator = (9.8 m/s^2)

Calculation of value of g



$$g = G\frac{M}{R^2}$$

$G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

$M = 6 \times 10^{24}$ kg (Mass of the earth)

$R = 6.4 \times 10^6$ m

On substituting the given values

$$g = \frac{6.7\times10^{-11}Nm^2\ kg^{-2}\times6\times10^{24}kg}{(6.4\times10^6m)^2}$$

$g = 9.8\ m/s^2$.

The motion of objects under the influence of gravity 'g' does not depend on the mass of the body. All objects small, big, heavy, light, hollow or solid fall at the same rate.

Th three equation of motion viz.

(i) $v = u + at$ (ii) $s = ut + \frac{1}{2}at^2$ (iii) $v^2 - u^2 = 2as$ are true for motion of objects under gravity. For free fall, value of acceleration $a = g = 9.8\ ms^{-2}$.

If an object is just let fall from a height then in that as u = 0 and a = g = 9.8 m/s^{-2}.

If an object is projected vertically upward with an initial velocity u, then a = – g = – 9.8 ms^{-2} and the object will go to a maximum height h where its final velocity becomes zero (i.e., v = 0).

Mass: Mass of an object is the measure of its inertia. It is the matter present in it. It remains the same everywhere in the universe.

Weight: The force of attraction of the earth on the object is known as the weight of the object. It's S.I. unit is Newton.

W = m x g

$$W_m = \frac{GM_m \times m}{R_m^2}$$

W_m = weight of an object on moon

M_m = mass of the moon = 7.36×10^{22}

R_m = radius of the moon = 1.74×10^6

G = 6.67×10^{-11} Nm^2/kg^2

$$\therefore \quad W_m = G\,\frac{7.36 \times 10^{22}\text{kg} \times \text{m}}{(1.74 \times 10^6\text{m})^2}$$

$$W_m = 2.431 \times 10^{10}\ G \times m$$

and $$W_e = 1.474 \times 10^{11}\ G \times m$$

$$\therefore \quad \frac{W_m}{W_e} = \frac{\text{Weight of object on moon}}{\text{Weight of object on earth}} = \frac{2.431 \times 10^{10} Gm}{1.474 \times 10^{11} Gm} = \frac{1}{6}.$$

∴ Weight of an object on moon = $\frac{1}{6}$ th the weight of an object on the earth.

Chapter 11

Work, Power and Energy

Facts that Matter

Work: When a force acts on an object and the object shows displacement, the force has done work on the object.

Two conditions need to be satisfied for work to be done:

(i) A force should act on object

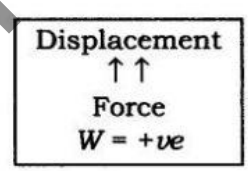
(a) The object must be displaced

Work = Force x Displacement Unit of workdone = Joule = Newton x metre 1 Joule work is said to be done when 1 Newton force is applied on an object and it shows the displacement by 1 meter.

(Case I)

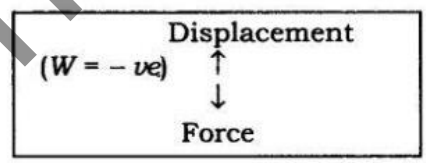
If displacement is in the direction of the force

$W = F \times s$



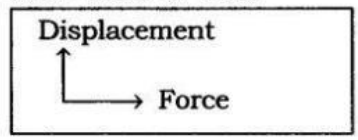
If displacement is in the direction opposite to the force

$W = -F \times s$



(Case II)

If displacement is perpendicular to the force work done is zero.



Energy

The capacity of a body to do work is called the energy of the body.

Unit of energy = Joules 1KJ = 1000 J

Forms of Energy: The various forms of energy are potential energy, kinetic energy, heat energy, chemical energy, electrical energy and light energy.

Kinetic Energy: Energy possessed by a body due to its motion. Kinetic energy of an object increases with its speed.

Kinetic energy of body moving with a certain velocity = work done on it to make it acquire that velocity

Derivation

Let an object of mass m, move with uniform velocity u, let us displace it by s, due to constant force F, acting on it

$\therefore$ Work done $\rightarrow$ $W = F \times s$ ... (i)

due to force the velocity changes to v, and the acceleration produced is a

$\therefore$ relationship between v, u, a and s = $v^2 - u^2 = 2as$

$$\therefore \quad s = \frac{v^2 - u^2}{2a} \quad \text{... (ii)}$$

$$F = ma \quad \text{... (iii)}$$

Substitute (ii) and (iii) in (i) we get

$$W = F \times s$$

$$= ma \times \frac{v^2 - u^2}{2a}$$

$$W = \frac{1}{2} m(v^2 - u^2)$$

if $u = 0$, (object starts at rest)

$$\therefore \quad W = \frac{1}{2} mv^2$$

Work done = Change in kinetic energy

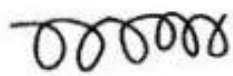
$$\therefore \quad E_k = \frac{1}{2} mv^2$$

Potential Energy

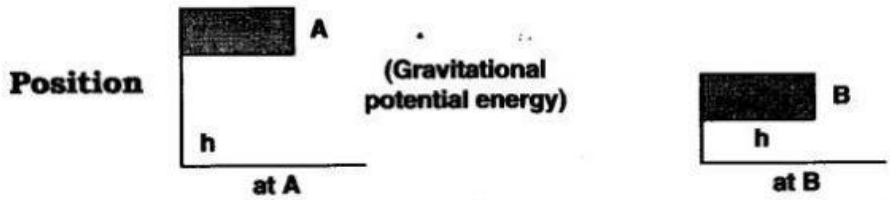
The energy possessed by a body due to its position or shape is called its potential energy.

shape

Coiled spring (Elastic potential energy)



Uncoiled spring



Greater energy due to compression in spring and due to greater height of the object.

Less energy due to less compression in spring and due to less height of the object.

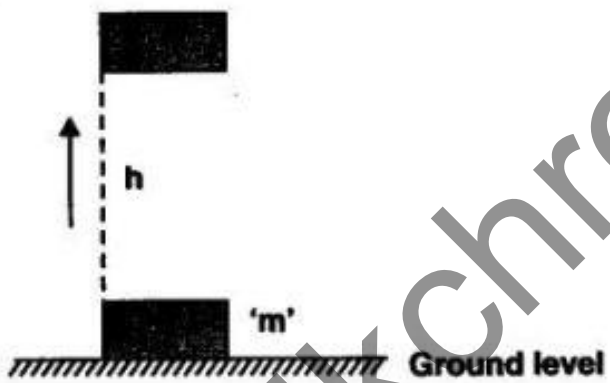
Gravitational Potential Energy: (GP)

When an object is raised through a height, work is said to be done on it against gravity.

The energy possessed by such an object is called the gravitational potential energy.

GPE = work is done in raising a body from the ground to a point against gravity.

Derivation



Consider a body with mass m, raised through a height h, from the ground,

Force required to raise the object = weight of object mg.

The object gains energy to the work done on it.

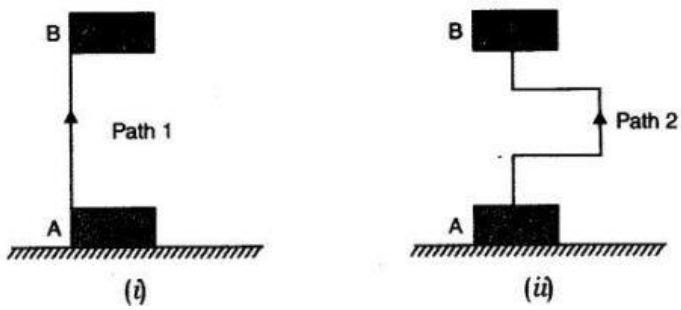
∴ Work done on the object against gravity is W.

∴ W = force × displacement

$= mg \times h$

$W = mgh$

∴ $P_E = mgh$



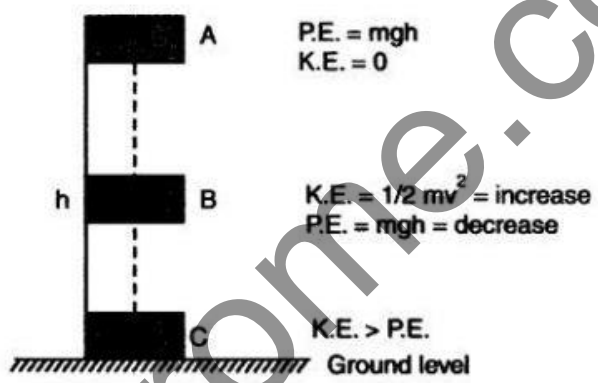
Work done in both the cases (i) and (ii) is same as a body is raised from

position A to B, even if the path taken is different but the height attained is the same.

Mechanical Energy: The sum of kinetic energy and potential energy is called mechanical energy.

Law of Conservation of Energy:
Energy can neither be created nor destroyed, it can only be transformed from one form to another. The total energy before and after transformation remains the same.

Case (i)



Potential energy + Kinetic energy = Constant (Mechanical energy)

Potential energy + Kinetic energy = Constant (Mechanical energy)
A body of mass 'm' is raised to height 'h' at A its potential energy is maximum and kinetic en rgy is 0 as it is stationary.
When body falls at B, h is decreasing hence potential energy decreases and V is increasing hence kinetic energy is increasing.
When the body is about to reach the ground level, h = 0, v will be maximum hence kinetic energy –> potential energy
Decrea e in potential energy = Increase in kinetic energy
This shows the continual transformation of gravitational potential energy into kinetic energy.

Power

$$\text{Power} = \frac{\text{Work}}{\text{Time}} \qquad \therefore \; P = \frac{W}{t}$$

$$\text{Watt} = \frac{\text{Joules}}{\text{Second}}$$

1 kilowatt = 1000 watts

1 kilowatt = 1000 J/s

Commercial Unit of Energy

Commercial unit of energy = 1 kilowatt hour (kwh)

$\therefore$ 1 kWh = 1 kilowatt × 1 hour

= 1000 watt × 3600 seconds

= 3600000 Joule (watt × second)

1 kWh = 3.6×10^6 J.

$\therefore$ 1 kWh = 1 unit

The energy used in one hour at the rate of 1 kW is called 1 kWh.

Chapter 12

Sound

Facts that Matter

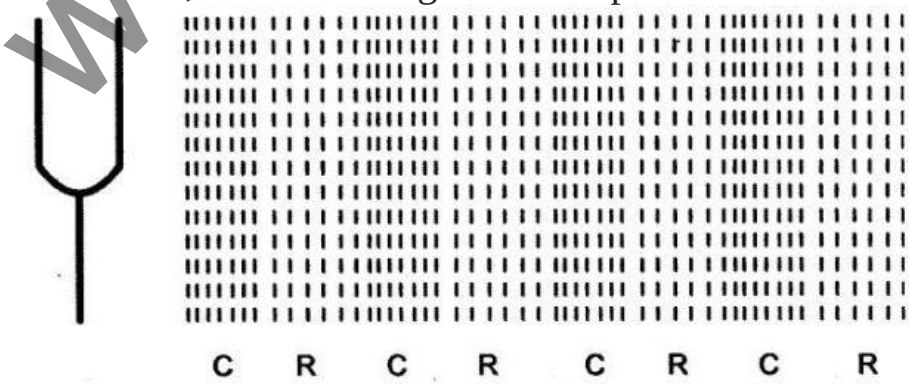
A sound is a form of energy which produces a sensation of hearing in our ears.

Propagation of Sound: Sound is produced by vibrating objects.

Medium: The matter or substance through which sound is transmitted is called a medium. It can be solid, liquid or gas. Air is the most common medium for sound propagation.

Wave: A wave is a disturbance that moves through a medium when the particles of the medium set neighbouring particles into motion. They in turn produce similar motion in others. The particles of the medium do not move forward themselves, but the disturbance is carried forward. This is what happens during propagation of sound in a medium, hence sound can be visualised as a wave. Sound waves are characterised by the motion of particles in the medium and are called mechanical waves.

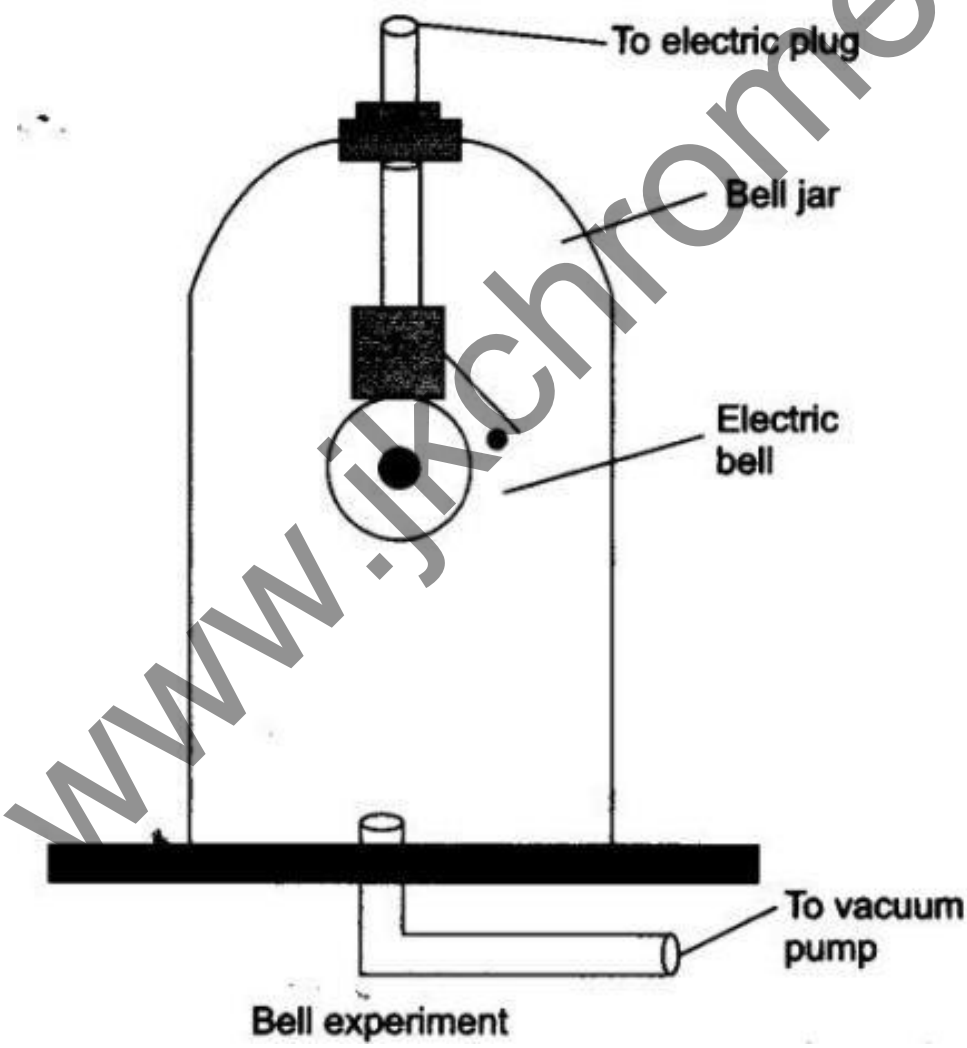
When a vibrating object moves forward, it pushes and compresses the air in front of it creating a region of high pressure. This region is called a compression (C), as shown in following figure. This compression starts to move away from the vibrating object. When the vibrating object moves backwards, it creates a region of low pressure called rarefaction (R).



As the object moves back and forth rapidly, a series of compressions and rarefactions is created in the air. These make the sound wave that propagates through the medium. Compression is the region of high pressure and rarefaction is the region of low pressure.

Experiment to show Sound needs a medium:
Activity:

- Take and electric bell and airtight jar.
- Fit the bell inside the jar and attach to battery.
- With air still in jar ring the bell.
- Now take out air by vaccumization.
- Ring the bell again.

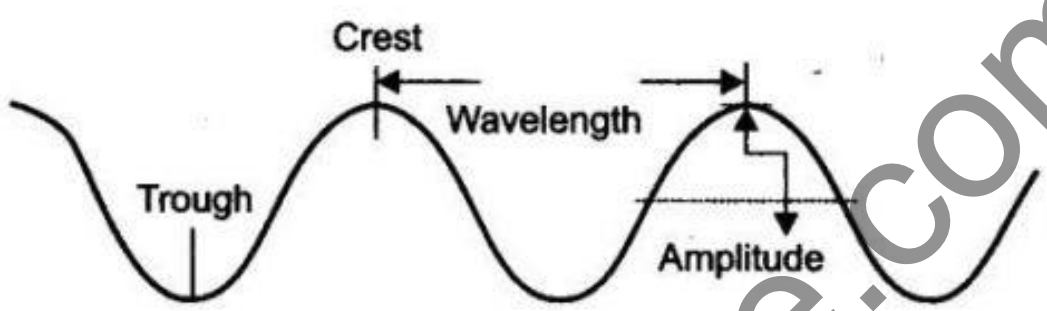


Bell experiment

Observation: Sound of bell can be heard when air is inside the jar. When air is taken out then sound cannot be heard.

Conclusion: This shows that presence of medium is necessary for propagation of sound waves.

Properties of Sound Waves:



Frequency: Number of oscillations of sound waves is called its frequency. The number of peak and troughs per unit of time will give frequency. It is represented by v (nu) and its SI unit is Hertz (Hz)
Time Period: The time taken to complete one oscillation is called its time period. Its unit is second and is represented by T.

Relation of frequency and time period:
$v = 1/T$

Amplitude: The magnitude of the maximum disturbance in the medium on either side of the mean value is called the amplitude of the wave. It is usually represented by the letter A. Its unit is meter.

Softness or Loudness of Sound: If the amplitude is smaller then the sound will be softer and if it is larger then sound will be louder. Higher amplitude helps the sound wave is travelling faster.

Speed of sound: It is the distance which compression or a rarefaction travels per unit of time.

$$\text{Speed of sound} = v = \frac{\lambda}{T} = \frac{\text{Wavelength}}{\text{Time}}$$

$$\text{Or, } v = \nu\lambda \text{ (because } \frac{1}{T} = \nu)$$

So, Speed = Wavelength × Frequency

So, Speed = Wavelength Frequency

The speed of the sound remains almost the same for all frequencies in a given medium under the same physical condition.

Speed of Sound in Different Media at 25° C.

State	Substance	Speed in m/s
Solids	Aluminium	6420
	Nickel	6040
	Steel	5960
	Iron	5950
	Brass	4700
	Glass (flint)	3980
Liquids	Water (sea)	1531
	Water (distilled)	1498
	Ethanol	1207
	Methanol	1103
Gases	Hydrogen	1284
	Helium	965
	Air	346
	Oxygen	316
	Sulphur dioxide	213

Reflection of Sound: Sound reflects off a surface in the same way as light reflects and follows same rules of reflection. The incident sound and the reflected sound make equal angles with the normal and all three are in the same plane.

Echo: In bigger monuments and in large empty halls you can hear reflections of your sound after you speak something. This effect is known as echo. The sensation of sound persists in our brain for 0.1 seconds, so to hear echo the time difference between original sound and reflected sound should be more than that.

As you know speed of sound in air is = 344 m/s And 344 x 0.1 = 34.4 metre

So, the minimum distance required to hear an echo from a reflecting wall or surface should be half of 34.4, means it should be 17.2 metres.

Reverberation: Repeated reflections of sound results in persistence of sound and is called reverberation.

Use of Reverberation of Sound: Following instruments use this property of sound:

1. Megaphones, Shehanais, Trumpets
2. Stethoscope
3. Curved dome of concert halls

Range of Hearing in humans:
From 20 Hz to 20000 Hz
Sounds below 20 Hz are called infrasonic.
Sounds above 20000 Hz are called ultrasonic

Chapter 13

Why Do we Fall ill

Facts that Matter

Introduction
Health is a state of complete physical, mental and social well-being.

Basic conditions for good health:

- Proper balanced and nutritious diet.
- Personal hygiene.
- Clean environment and surroundings.
- Healthy air, no pollution in the surrounding
- Regular exercise.
- Proper rest.
- Good standard of living and economic status.

Disease: when the body is not at ease i.e., comfortable then it is said to have a disease.
When there is a disease the functioning or appearance of one or more systems of the body changes.
Depending on the duration—disease is classified as acute or chronic.

Acute disease: Diseases that last for only short period of time, e.g., headache common cold etc.

Chronic disease: Diseases that last for long time,' are called chronic diseases, e.g., elephantiasis, tuberculosis, etc.

Causes of diseases: Immediate cause and contributory cause.

Immediate cause: The organisms that enter our body and causes disease is called immediate cause. For example, virus, bacteria, protozoa etc.

Contributory cause: The secondary factors which led these organisms enter our body are called as contributory cause. For example, dirty water, unclear
surroundings, contaminated food, improper nourishment, poverty, poor standard of living etc.
Diseases may be due to infectious and non-infectious causes.

(a) Infectious causes: Diseases where microbes are the immediate causes are called infections diseases. The infection spreads from one person to another.

(b) Non-infectious causes: Some diseases that do not spread in the community, but remains internal are called non-infectious diseases. Example, cancer, genetic abnormalities, high blood pressure etc.

Infectious diseases (Communicable diseases): When a disease causing organism enters our body it causes infection, it multiplies and grows in the body called host and micro-organisms multiplies in the host body.

Causes of Infections	Diseases
Bacteria	Tuberculosis, tetanus, typhoid, cholera
Virus	AIDS, polio, chickenpox, rabies, measles
Fungi	Skin diseases, food poisoning
Protozoan	Malaria, amoebiasis, kala-azar
Worm	Filariasis

Infectious diseases spread through:

- **Air:** Causes air-borne diseases due to bacteria, virus e.g., common cold, influenza, measles, tuberculosis.
- **Food and water:** Is caused due to contaminated food and water that contains bacteria, virus, worm etc. Example, cholera, typhoid and hepatitis.
- **Contact:** Many diseases spread by contact of infected person with the healthy person. Examples, fungal infection, scabies etc.
  AIDS and syphilis spread due to sexual contact.
- **Body fluids:** Body fluids like blood, semen, mother milk when infected can also cause disease. Example, AIDS.

Antibiotics: These are the chemicals (medicine, drugs) that block biochemical pathways important for bacteria. They are used for diseases caused by bacteria.

Inflammation: When an active immune system release many cells to the affected tissue to heat-off the disease-causing microbes it is called inflammation. Local effects caused on body due to inflammation are—swelling, pain, fever and redness.

Principles of treatment

- To reduce the effects of the diseases.
- To kill the cause of the disease i.e., to kill the microbes like bacteria fungi, protozoa.

Principles of Prevention

- General method
- Specific method

General ways of preventing infections relate to preventing exposure.

Prevention of exposure can be done tin following ways:

- For air borne infections—valid -visiting public place, cover your nose and mouth while coughing.
- for water borne infections- Drink, clean and boiled thinking water.
- For vector borne infections Keep the surroundings clean, do not keep any puddle of water open in the surrounding as it allows the breeding of mosquitoes.
- Self immune system that can (fight off and kill microbes when it enters our body.
- Availability of proper and sufficient -food for everyone.

Specific ways: 1% (giving vaccines, a childhood immunisation that its given to the children for (preventing infectious diseases.

Chapter 14

Natural Resources

Facts that Matter

Life exists on earth due to its ambient temperature, water, food and energy from the sun.

Lithosphere: The outer crust of the earth is called the lithosphere.

Hydrosphere: Sum of all water bodies is called hydrosphere.

Atmosphere: Air that covers the earth is called the atmosphere.

Biosphere: The life-supporting zone of the earth where the atmosphere, hydrosphere and lithosphere interact and make life possible is called biosphere.
It consists of biotic components-living things and abiotic components-non-living things like air, water and soil

Air: It is a mixture of many gases like oxygen, nitrogen, carbon-dioxide, water vapour and other gases.

- Nitrogen is used by plants for protein synthesis.
- Oxygen sustains life used for respiration, combustion.
- Carbon-dioxide used by plants for preparing food by photosynthesis.

Water vapour: provides moisture.

Atmosphere: Acts as a protective blanket around the earth. Maintains the temperature on the surface of earth. Winds are caused due to uneven heating of atmosphere, these winds maintains the pressure difference and causes cold and hot air, sea and land breeze, brings rain etc.

Rain: The clouds formed due to the evaporation of water condenses and precipitates as rain.

Water: Various sources of water are available i.e., surface water, underground water, snow, ice-bergs, water vapour in the atmosphere.

Use of Water

- Water is used for transportation.
- Sustain life
- Used by plants and animals for life-processes. Water available for drinking should be conserved and used wisely.

Soil: Soil is formed by a very slow process i.e., by weathering of rocks. It consists of various nutrients. Plants grow in the soil, many microbe's homes is soil.

Varieties of soil types are available

- Sandy soil
- Loamy Soil
- Clayey Soil
- Black soil
- Red soil
- Alluvial soil
- Laterite soil

Temperature: Temperature and light is also required for all biotic components.

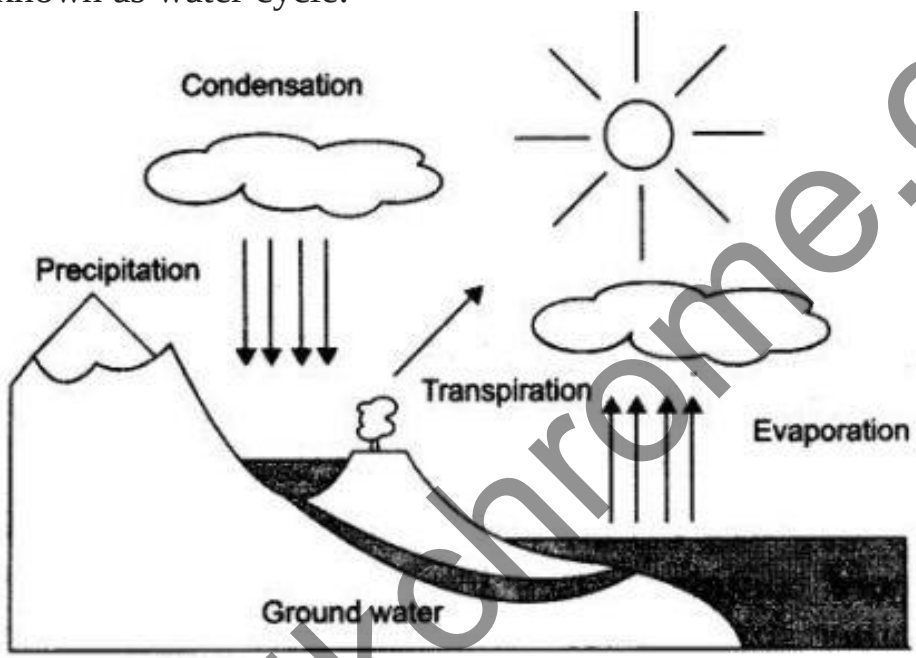
Pollution: Contamination of natural sources with unwanted substances.

- **Air Pollution:** Air contaminated with smoke, fumes, dust, pollen grain, etc.
- **Water Pollution:** Water contaminated by sewage, industrial waste, excreta, chemicals, fertilizers etc.

- **Soil Pollution:** Soil gets contaminated with fertilizers, pesticides, garbage, chemicals etc.

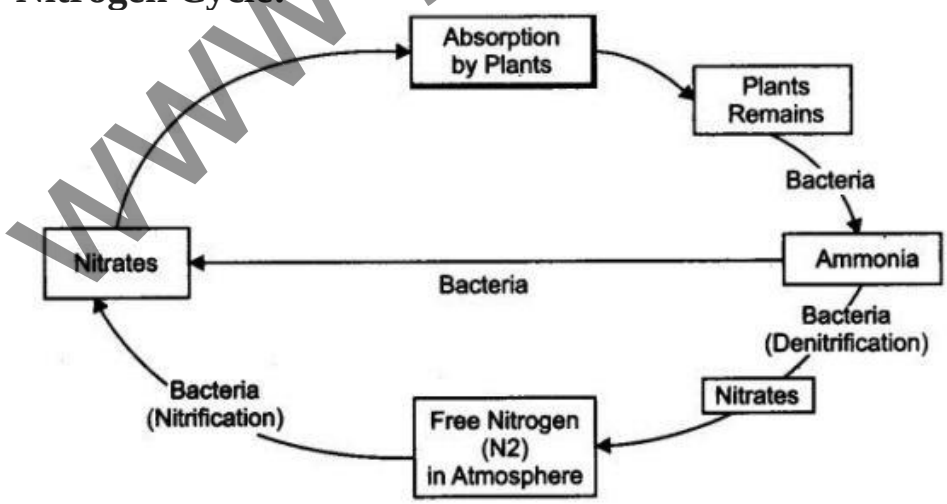
Bio-geo-chemical Cycles: A constant interaction between biotic and abiotic components of the biosphere makes a system and these flow of components form a cycle called bio-geo-chemical cycle.

Water Cycle: Water from various sources evaporates, condenses and again precipitates as rain, falls on the land, flows back in the sea and river is known as water cycle.



Water Cycle

Nitrogen Cycle:



Nitrogen from the atmosphere is fixed by the process of nitrification. Nitrification is done by nitrogen fixing bacteria e.g. Rhizobium present in

soil, these compounds of nitrogen are absorbed by plants. The fixation is also done by atmosphere or industries. In atmosphere, during lightning, high temperatures and pressures created in air converts nitrogen into oxides of nitrogen, which dissolves in water forming nitric and nitrous acids and is then used by life forms.

Plants contain nitrogen in the form of proteins or other complex compounds. Plants are eaten by animals. When die bacteria present in soil act on and convert plants and animals various compounds of nitrogen into nitrites and nitrifies. Another group of bacteria convert these nitrates and nitrites into free, elemental nitrogen, this process is called denitrification.

Carbon Cycle: Carbon is present in the compound form in atmosphere ie., CO_2, carbonates in water which forms limestone.
CO_2 is taken by plants during photosynthesis to form organic compounds like glucose, carbohydrates, these plants are further eaten by animals, and decomposition gives CO_2 back to the atmosphere. Plants and animals which get buried under the earth and does not decompose form coal and petroleum respectively.
Animals and plants also release CO_2 back to the atmosphere during respiration.

Chapter 15

Improvement in Food Resources

Facts that Matter

Food supplies proteins, carbohydrates, fats, vitamins and minerals, all of which we require for body development, growth and health.

Different crops require different climatic conditions, temperature and photoperiods for their growth and completion of their life cycle Photoperiods are related to the duration of sunlight. Growth of plants and flowers are dependent on sunlight.

Successful crop production depends upon many factors such as:

- Understanding how crops grow and develop.
- Effect of various nutrients, climate, water on the growth of the plant.
- Modification and management of each factor for increasing the yield of the crop.

The crops which are grown in rainy season (the kharif season, from June to October) are called s kharif crops.
Example: Paddy, soyabe n, pigeon pea, maize, cotton, green gram and black gram are kharif crops.

The crops which are grown in winter season (the rabi season, from November to April) are called rabi crops.
Example: Wheat grain, peas, mustard and linseed are rabi crops.

Crop variety improvement: It can be done either by hybridisation or by introducing a gene.

- Crop improvement by hybridisation: Hybridisation refers to crossing between genetically dissimilar plants. This crossing may be intervarietal (between different varieties), interspecific (between two

different species of the same genus) or intergeneric (between different genera).

- Crop improvement by introducing a gene: This provides the desired characteristics and results in genetically modified crops.
- Cultivation practices and crop yield are related to weather, soil quality and availability of water. Since weather conditions such as drought and flood situations are unpredictable, varieties that can be grown in diverse climatic conditions are useful.

The factors for which variety of improvement is done are:

- **Higher yield:** To increase the productivity of the crop per acre.
- **Improved quality:** The quality of crop products vary from crop to crop. E.g., the protein quality is important in pulses, oil quality in oilseeds, preserving quality in fruits and vegetable.
- **Biotic and abiotic resistance:** Biotic factors are the diseases, insects and nematodes while abiotic factors are the drought, salinity, waterlogging, heat, cold and frost which affect the crop productivity. Varieties resistant to these factors (stresses) can be improved to increase crop production.
- **Change in maturity duration:** Shorter maturity period of crop reduces the cost of crop production and makes the variety economical. Uniform maturity makes the harvesting process easy and reduces losses during harvesting.
- **Wider adaptability:** It allows the crops to be grown under different climatic conditions in different areas.
- **Desirable agronomic characteristics:** It increases productivity, for example, tall ess and profuse branching are desirable characters for fodder crops; while dwarfness is desired in cereals, so that less nutrients are consumed by these crops.

Plant nutrients: Nutrients are supplied to plants by air, water and soil. There are sixteen nutrients which are essential for plants. Air supplies carbon and oxygen; hydrogen comes from water and soil supplies the other thirteen nutrients to plants. Amongst these thirteen nutrients, six are required in large quantities and are therefore called macro-nutrients. The other seven nutrients are used by plants in small quantities and are therefore called micro-nutrients.

Nutrients supplied by air, water and soil

Source	Nutrients
Air	Carbon, Oxygen
Water	Hydrogen, Oxygen
Soil	(*i*) **Macro-nutrients:** Nitrogen, phosphorus, potassium, calcium and sulphur.
	(*ii*) **Micro-nutrients:** Iron, manganese, boron, zinc, copper, molybdenum and chlorine.

Manure: Manure contains large quantities of organic matter and also supplies small quantities of nutrients to the soil. Manure is prepared by the decomposition of animal excreta and plant waste. Manure helps in enriching soil with nutrients and organic matter and increasing soil fertility. On the basis of the kind of biological waste used to make manure, it can be classified into three types:
(i) Compost (ii) Vermicompost (iii) Green manure.

(i) Compost: It can be farm waste mate ial such as livestock excreta (cow dung etc.), vegetable waste, animal refuse, domestic waste, sewage waste, straw, eradicated weeds,etc. This material is decomposed in pits and this process of decomposition is also called composting. This compost is rich in organic matter and nutrients.

(ii) Vermicompost: The compost which is made by the decomposition of plant
and animal refuse with the help of redworm is called vermicompost.

(iii) Green manure: Prior to the sowing of the crop seeds, some plants like sun hemp or guar are grown and then mulched by ploughing them into the soil. These green plants thus turn into green manure which helps in enrichi g the soil in nitrogen and phosphorus.

Fertilizers: Fertilizers are commercially produced plant nutrients. Fertilizers supply nitrogen, phosphorus and potassium. They are used to ensure good vegetative growth (leaves, branches and flowers), giving rise to healthy plants. Fertilizers are an important factor in the higher yields of high-cost farming.

Organic farming: It is a farming system with minimal or no use of chemicals as fertilizers, herbicides, pesticides, etc. and with a maximum input of organic manures, recycled farm-wastes (straw and livestock excreta), use of bio-agents such as culture of blue-green algae in preparation of biofertilizers, neem leaves or turmeric specifically in grain storage as bio-pesticides with healthy cropping systems [mixed cropping inter-cropping and crop rotation]. These cropping systems are beneficial in insect, pest and weed control besides providing nutrients.

Irrigation: Proper irrigation is very important for the success of crops Ensuring that the crop gets water at the right stages during their growing season, can increase the expected*yield of a crop. Different kinds of irrigation systems include wells, canals, rivers and tanks.

- **Wells:** These are of two types namely dug wel s and tube wells. In a dug well, water is collected from water bearing strata. Tube wells can tap water from the deeper strata. From these wells, water is lifted by pumps for irrigation.
- **River lift system:** In areas where canal flow is insufficient or irregular axle to inadequate reservoir release, the lift system is more rational. Water is directly drawn from the rivers for supplementing irrigation in areas close to rivers.
- **Tanks:** These are small storage reservoirs, which intercept and store the run-off of smal er catchment areas.

Cropping patterns: It includes different ways of growing crops so as to get the maximum benefit. These different ways include the following:
Mixed cropping: Mixed cropping is growing two or more crops simultaneously on the same piece of land, for example, wheat + gram, or wheat + mustard, or groundnut + sunflower. This reduces disease risk and gives some insurance against failure of one of the crops.

Inter-cropping: It involves growing two or more crops simultaneously on the same field in definite proportion or pattern. A few rows of one crop alternate with a few rows of a second crop, for example, soyabean + maize, or finger millet (bajra) + cowpea (lobia). The crops are selected such that their nutrient requirements are different. This ensures maximum utilisation of the nutrients supplied, and also prevents pests and diseases

from spreading to all the plants belonging to one crop in a field. This way, both crops can give better returns.

Crop rotation: The growing of different crops on a piece of land in a pre¬planned succession is known as crop rotation. Depending upon the duration, crop rotation is done for different crop combinations. The availability of moisture and irrigation facilities decide the choice of the crop to be cultivated after one harvest. If crop rotation is done properly then two or three crops can be grown in a,year with good harvest.

The food requirements of dairy animals are of two types: (a) maintenance requirement which is the food required to support the animals to live a healthy life, and (b) milk producing requirement, which is the type of food required during the lactation period.

Weeds: Weeds are unwanted plants in the cultivated field, for example, Xanthium (gokhroo), Parthenium (gazar ghas) and Cyprinus rotundus (motha). They compete for food, space and light. Weeds take up nutrients and reduce the growth of the crop. Therefore, removal of weeds from cultivated fields during the early stages of crop growth is essential for a good harvest.

Methods of weed control: The most effective method is mechanical removal. Preventive methods such as proper seed bed preparation, finely sowing of crops, inter-cropping and crop-rotation also help in weed control.

Insect pests: Generally insect pests attack the plants in three ways:

They cut the root, stem and leaf,
they suck the cell sap from various parts of the plant, and

- They bore into stem and fruits. They thus affect the health of the crop and reduce yields.

Preventive measures against pest include:

- The use of disease resistant varieties.

- Growing two or more crops simultaneously on the same field.
- Summer ploughing: In this method, fields are ploughed deep in summers to destroy both pests as well as weeds.

Animal husbandry is the scientific management of animal livestock. It includes various aspects such as feeding, breeding and disease control. Animal-based farming includes cattle, goat, sheep, poultry and fish farming.

Milk-producing females are called milch animals (dairy animals), while the one used for farm labour are called draught animals.

Animal feed includes:

- Roughage, which is large, fibre and
- Concentration which are low in fibre and contain relatively high levels of protein and other nutrients.

The improved poultry breeds are developed for the following desirable traits:

- Number and quality, f chicks.
- Dwarf broiler parent for commercial chick production.
- Summer adaptation capacity.
- Low maintenance requirements.
- Reduction in the siz of the egg-laying bird with the ability to utilise more fibrous cheaper diets formulated using agricultural by-products.

Production of poultry birds: For good production of poultry birds, good management practices are important. These include maintenance of temperature and hygenic conditions in housing and poultry feed, as well as prevention and control of diseases and pests.

The housing, nutritional and environmental requirements of broilers are somewhere different from those of egg layers. The ration (daily food requirement) for broilers is protein rich with adequate fat. The level of vitamins A and K is kept high in the poultry feeds.

Fish Production: There are two ways of obtaining fish. One is from natural resources, which is called capture fishing. The other way is by fish farming, which is called culture fishery.

Popular marine fish varieties include Pomphret, mackerel, tuna, sardines and Bombay duck. Marine fish of high economic value includes mullets, bhetki pearl spots, prawns, mussels and oysters.

As marine fish stocks get further depleted, the demand for more fish can only be met by culture fisheries, a practice called mariculture.

Fish resources are of two types:

- Freshwater resources such as canals, ponds re ervoirs and rivers.
- Brackish water resources (where sea water and fresh water mix together) such as estuaries and lagoons

More extensive fish farming can be done in composite fish culture systems. Both local and imported fish species are used in such systems.

In such a system, a combination of five or six species is used in a single fish pond. These species are selected so that they do not compete for food among them having diffe ent types of food habits. As a result, the food available in all parts of the pond is used.

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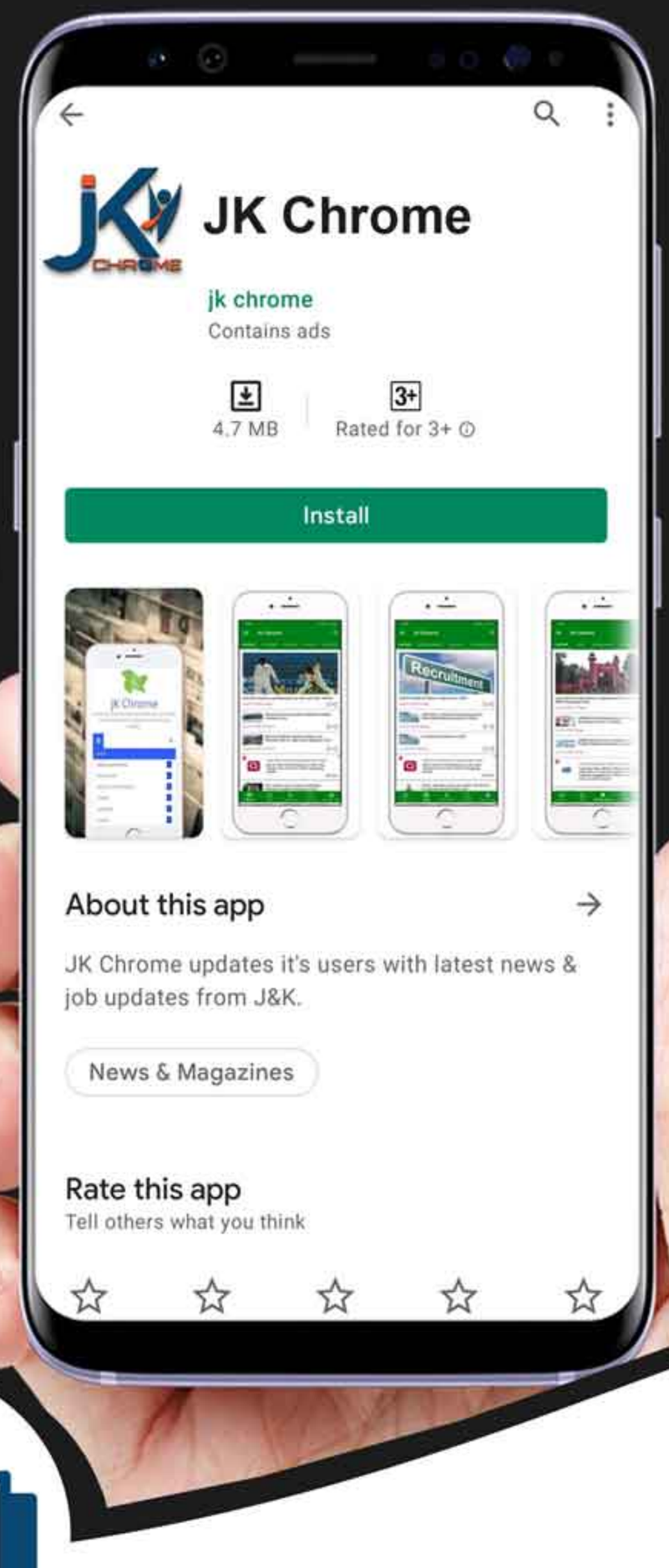

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