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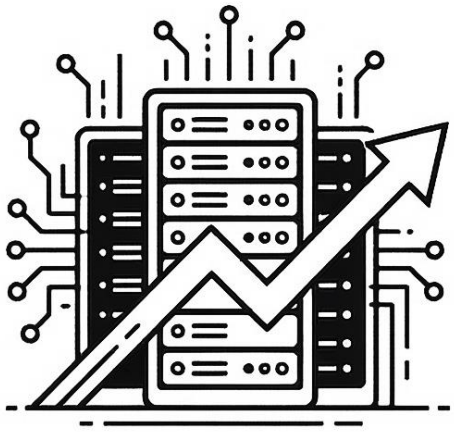
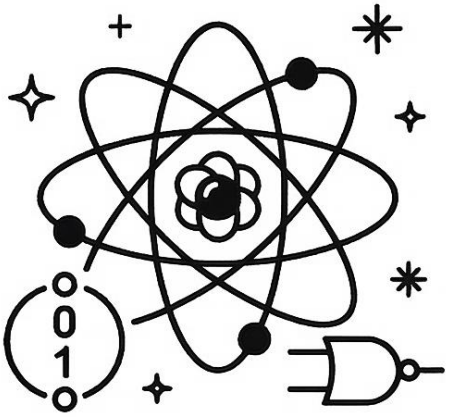
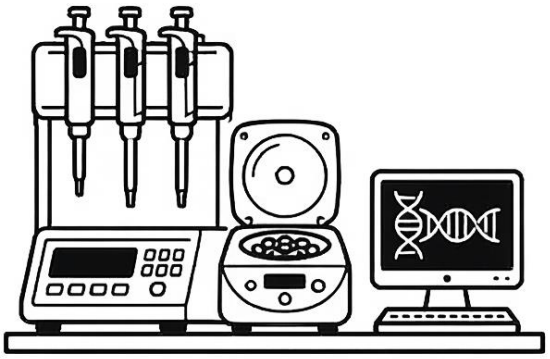
FREE NOTES

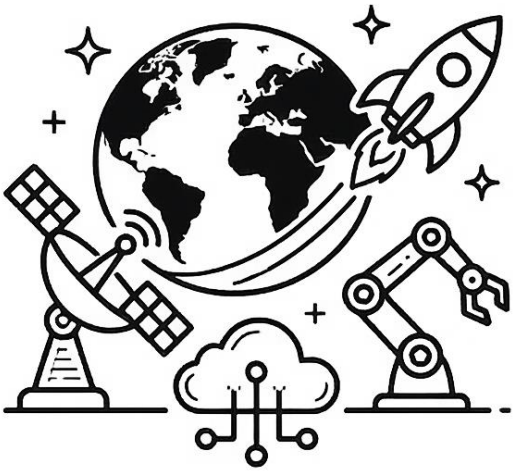
SCIENCE & TECHNOLOGY (212)

CHAPTERWISE NOTES









SCIENCE AND TECHNOLOGY

Sl. No.	Module	Chapters (Public Examination)	Marks
1	Module 1: Measurement	L-1 Measurement in Science	4
2	Module 5: The Living World	L-22 Life Processes I (Nutrition, Respiration) L-23 Life Processes II (Control) L-24 Life Processes III (Reproduction) L-25 Heredity	15
3	Module 6: Natural Resources	L-27 Metals and Non-metals L-28 Carbon and Its Compounds	10
4	Module 7: Humans and Environment	L-29 Natural Environment L-30 Human Impact on Environment	12

Component	Details	Marks
Public Exam (Selected Modules 1,5,6,7)	Total Chapters : 9	41
Practical Exam	Practical	15
TMA	Tutor Marked Assignment	17
Final Possible Marks		**73 Marks**

Table of Content

1

Measurement in Science

Introduction

Measurement is an integral part of our daily life and science. It is impossible to obtain accurate information without it. In this chapter **'Measurement in Science and Technology'**, we will study the need for measurement, various units (especially SI units) and the rules of measurement so that physical quantities can be measured correctly.

What is measurement?

- Measurement is the process of expressing an object by a **number** so that we can know how much the object is.
- Measurement is done to know the distance, time, and weight etc. (like: measuring the length of a playground).

Why do we need to make a measurement?

- For **accurate information**, so that there is no dispute in buying and selling (like: buying 50 Rs per kg mangoes).
- **Precise measurement** is necessary for the accurate calculation of spacecrafts and for daily tasks.

What is a unit?

- **Unit:** It is a measure, device or scale with the help of which we measure a physical quantity.
- Value of a physical quantity = **Numerical quantity × Unit**.
- Example: The distance between two trees is **100 meters** (m), then 100 is the number and meter is the unit.

Characteristics of a unit

- A good unit should have the following characteristics:
- **Relevant:** It should be suitable for the quantity to be measured (distance cannot be measured in kilograms).
- **Convenient:** It should be easy to use (like the distance between two cities in kilometres instead of inches).

- **Well-defined:** Its meaning should be the same for everyone.

How did our ancestors make measurements?

- In ancient times, measurement was done with **human body parts** like: width of a finger (digit), length of a foot (foot), length of a hand (cubit), and hand span.
- Romans used to call one thousand paces a **mile**.

Need for standard units

- Units based on body parts are **arbitrary and inaccurate** because the measurement of every person is different.
- To bring uniformity in measurement, the people of Egypt created the **standard cubit** (the distance from the elbow to the tip of the middle finger).

Indian measurement system

(a) Indian measurement system in ancient period: The ratio of bricks during Chandragupta Maurya's period was 4:2:1. The smallest unit of length was **'1 Parmanu'**, and long distances were measured in **'Yojan'**.

(b) Indian measurement system in medieval period: Gaj was used to measure length during Akbar's period.

(c) Indian measurement system in British period: Inch, foot, yard were used for length and grain, ounce, pound were used for mass. In India, **Ratti**, Masa, Tola, Seer and Maund were used for mass.

The modern measurement systems

- In 1790, French scientists developed a new system of weights and measures based on the **decimal system**.
- There were two main systems: **cgs** (centimeter, gram, second) and **mks** (meter, kilogram, second).

SI units

- In 1960, the international system of weights and measures was accepted which is called **SI units**.
- It has **seven basic (fundamental) units**: length (meter, m), mass (kilogram, kg), time (second, s), electric current (ampere, A), thermodynamic temperature (kelvin, K), amount of substance (mole, mol), luminous intensity (candela, cd).

Derived units

- **Derived units:** The units which are obtained (derived) from fundamental SI units.
- **Area** = length × width = m^2 (square meter).
- **Volume** = length × length × length = m^3 (cubic meter).
- **Force** = mass × acceleration = kg × ms^{-2} (Newton, N).

SI prefixes

- **SI prefixes** are used to write very large or small quantities easily.
- Examples of prefixes: Kilo (10^3), Mega (10^6), Micro (10^{-6}), Nano (10^{-9}).

How will you use SI prefixes?

- Rule: Choose a prefix such that the value remains between **0.1 and 1000.**
- Do not leave space between the prefix and the symbol (ng is correct).
- Use only one prefix at a time (1 mmg is incorrect).

Rules for representing SI units

- Leave a **blank space** between the number and the unit (10 kg is correct).
- Do not change the symbol of the unit into **plural** (10 kgs is incorrect).
- Do not put a **full stop (.)** after the unit, unless the sentence ends.
- Write the symbol of units based on a person's name in a capital English letter (like for Joule).

TOP 5 QUESTIONS

Q1. What is called a unit and what should be its characteristics?

Answer- A unit is that standard measure by which a physical quantity is measured. It should be relevant, convenient and well-defined so that everyone can understand its meaning equally.

Q2. Why was measurement with human body parts inaccurate in ancient times?

Answer- Measurement with body parts was inaccurate because the size of body parts (like hands, feet) of every person is different, due to which the results of measurement change.

Q3. What is the difference between fundamental units and derived units?

Answer- Fundamental units (like meter, kilogram) do not depend on any other unit. Whereas derived units (like square meter, Newton) are obtained with the help of fundamental units.

Q4. How many fundamental units are there in the SI system? Write the names of any three.

Answer- There are seven fundamental units in the SI system. Three examples are: Length (meter), Mass (kilogram), and Time (second).

Q5. State any two main rules to keep in mind while writing SI units.

Answer- 1) There should be a blank space between the number and the unit (like 10 kg).

2) The symbol of the unit should never be written in plural (like 10 kgs is incorrect).

2

Life Processes-I

Introduction

Living beings continuously need some fundamental processes to stay alive, obtain energy and excrete waste materials, which are called life processes. In this chapter, we will do a detailed study of important life-saving processes like nutrition, respiration, transportation of substances and excretion.

Why is food needed?

- We get energy, raw material for growth and the ability to fight against diseases from food.
- It is helpful in repairing the damaged cells of the body.

Nutrition

- **Nutrition:** The process by which organisms ingest food and convert it into a simple form suitable for the body's use.

Types of nutrition

(a) Autotrophic nutrition: Organisms (green plants) make their own food by photosynthesis.

(b) Heterotrophic nutrition: Organisms depend on others for their food.

- **Holozoic:** Ingestion, digestion and absorption of food takes place (like humans).
- **Parasitic:** Take food from the body of other organisms without killing them (like amarbel).
- **Saprophytic:** Take nutrition from rotten dead materials (like fungi).

Nutrition in plants - Photosynthesis

- **Photosynthesis:** Green plants make food (glucose) from carbon dioxide and water in the presence of sunlight and chlorophyll.
- **Formula**: $CO_2 + 12H_2O \longrightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

Raw materials required for photosynthesis

- **Chlorophyll:** Absorbs solar energy.
- **Sunlight:** Main source of energy.
- **Carbon dioxide and water:** Together they form sugar.

Process of photosynthesis

- **Light reaction:** Light energy is absorbed.
- **Dark reaction:** Glucose is formed without light.

Significance of photosynthesis

- Provides food to all organisms.
- Maintains the balance of O_2 and CO_2 in the atmosphere.

Nutrition process in human body

(a) Carbohydrates: Main source of energy.

(b) Fats: Keep the body warm and provide energy.

(c) Proteins: Do the growth of the body and tissues.

(d) Vitamins: For the maintenance of the body and protection from diseases.

(e) Minerals: Iron (for hemoglobin), Calcium (for bones).

(f) Water: Controls the temperature of the body.

(g) Raw vegetables: Make roughage.

Balanced diet

- **Balanced diet:** In which all nutrients (carbohydrates, fats, proteins etc.) are present in the right quantity.

Digestion

- **Digestion:** Breakdown of complex food substances into simple and absorbable forms.

Digestive system

- It includes the alimentary canal (mouth, oesophagus, stomach, intestine) and digestive glands (liver, pancreas).

Enzymes

- **Enzymes:** Proteins that accelerate chemical reactions, which digest food.

Steps of nutrition process

(a) Ingestion and digestion:

- **Mouth:** Salivary amylase digests starch.
- **Oesophagus:** Takes food to the stomach.
- **Stomach:** Gastric juice (HCl and pepsin) digests protein.
- **Small intestine:** Complete digestion is done by liver (bile juice) and pancreatic juice.
- **Large intestine:** Absorption of water takes place.

(b) Absorption: Villi of the small intestine mix digested food into the blood.

(c) Assimilation: Generation of energy from food by cells.

(d) Egestion: Excretion of undigested waste.

Deficiency diseases or nutritional disorders

(a) Protein energy malnutrition: Marasmus (up to 1 year) and Kwashiorkor (1-5 years).

(b) Mineral deficiency diseases: Goiter (iodine deficiency) and anemia (iron deficiency).

(c) Vitamin deficiency diseases: Night blindness (Vit A), Beri-beri (Vit B), Scurvy (Vit C).

Food adulteration

- **Food adulteration:** Mixing inferior or inedible substances in pure food.

Transportation

- **Transportation:** Movement of food, oxygen and waste materials from one place to another in the body.

Transportation of substances in plants

- **Xylem:** Takes water from roots to the leaves.
- **Phloem:** Takes food from leaves to other parts.

Transportation of substances in humans

- It includes the heart and blood vessels.

Heart

- It is a muscular pump with four chambers (two auricles, two ventricles) that sends blood to the body.

Circulatory medium

- Blood: Composed of red blood cells (O_2 transport), white blood cells (protection from pathogens) and platelets (blood clotting).

Blood groups and blood transfusion

- There are four blood groups: A, B, AB, O. 'O' is the universal donor and 'AB' is the universal recipient.

Lymphatic system

- **Lymph:** A pale yellow fluid that prevents infection.

Disorders related to the circulatory system

- Heart attack, anaemia, leukaemia (blood cancer) and high blood pressure.

Respiration

- **Respiration:** Taking oxygen to oxidize food and generate energy.

Respiration in plants

- Roots, leaves (stomata) and stems exchange gases.

Breathing and respiration in humans

- Breathing: Only in and out of gases (O_2 and CO_2).

Respiratory system in humans

- Nostril → Pharynx → Trachea → Lungs (alveoli).

Mechanism of breathing

- Air fills and exits the lungs by the movement of the diaphragm and ribs.

Breathing rate

- Normal rate is 16-18 times per minute.

Exchange of gases between blood and tissues

- O_2 comes into the blood from the alveoli of the lungs and CO_2 comes out from the blood.

Cellular respiration

- Formation of energy (ATP) in the mitochondria of cells.

Excretion

- **Excretion:** Removal of harmful nitrogenous waste (urea) from the body.

Human excretory system

- It consists of two kidneys, ureters, urinary bladder and urethra.

Structural and functional unit of kidney: Nephron

- **Nephron:** It is the filtering unit of the kidney.

Process of excretion

- Blood is filtered in the nephron, beneficial substances go back into the blood and urea becomes urine.

Other organs that excrete waste from the body

- Skin (sweat) and lungs (CO_2).

Maintaining the internal environment

- The kidney maintains the balance of water and minerals in the body.

Kidney failure, dialysis and kidney transplant

- Cleaning blood with an artificial machine is called **dialysis**.

TOP 5 QUESTIONS

Q1. What is the difference between autotrophic and heterotrophic nutrition?

Answer- In autotrophic nutrition, organisms make their own food (like green plants). Whereas in heterotrophic nutrition, organisms cannot make their own food and depend directly or indirectly on plants or other organisms.

Q2. Write the formula of photosynthesis.

Answer- The chemical formula of photosynthesis is: $CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$ (in the presence of chlorophyll and sunlight). In this, glucose is formed and oxygen gas is released.

Q3. What is the function of xylem and phloem?

Answer- Xylem tissue transports water and minerals absorbed by the roots to the leaves. Phloem tissue transports the food materials made by the leaves to other parts of the plant.

Q4. What is the difference between breathing and respiration?

Answer- Breathing is merely the physical exchange of gases (taking in O_2 and releasing CO_2). Respiration is a cellular chemical process in which oxidation of glucose takes place inside the cells and energy is generated.

Q5. What is the function of the nephron?

Answer- Nephron is the filtering unit of the human kidney. It filters the blood to separate harmful waste materials like urea and reabsorbs the beneficial substances to form urine.

3

Life Processes-II

Introduction

Various organs in our body work together, which is called **coordination**. Control over organs is necessary to give the right response to changes (stimuli) happening in the environment. In this chapter, we will study control by the **nervous system** and **plant hormones**.

Response to stimuli

- **Stimulus:** That change happening in the environment to which organisms react (like light, heat, pain).
- **Response:** The reaction given by the body of the organism to the stimulus.

Coordination in animals: Nervous system

- Control and coordination in animals is done by the nervous system and the endocrine system (hormones).

Nerve cell

- **Nerve cell:** It is the structural and functional unit of the nervous system.
- It has three main parts: **cell body, dendrite** and **axon**.
- **Synapse:** The empty space between two nerve cells is called synapse, from where the impulse moves forward through chemicals.

Central nervous system

- It includes the **brain** and the **spinal cord**.
- The **brain** has three parts: forebrain (thinking and remembering), midbrain, and hindbrain (making body balance).

Peripheral nervous system

- It is made up of cranial nerves emerging from the brain and spinal nerves emerging from the spinal cord. It connects the body and the central nervous system.

Autonomic nervous system

- It controls the **involuntary actions** of the body (like heartbeat, digestion).

Reflex action

- **Reflex action:** A sudden and involuntary response of the body to an external stimulus (like removing hand immediately on touching a hot object).
- It is controlled directly by the **spinal cord** instead of the brain.
- **Path of reflex arc:**

$$Stimulus \rightarrow Receptor\ organ \rightarrow Sensory\ nerve \rightarrow Spinal\ cord \rightarrow Motor\ nerve \rightarrow Effector\ organ\ (muscle) \rightarrow Response$$

Chemical coordination in animals: Endocrine system

- This system is made up of glands that secrete chemicals directly into the blood.

What are hormones?

- **Hormones:** Chemical messengers secreted by endocrine glands that control the growth and functions of the body.

Major endocrine glands of human

- **Pituitary gland:** It is called the **'master gland'** because it controls other glands. It makes growth hormone.
- **Thyroid gland:** It is in the neck and makes thyroxine hormone (iodine is necessary for this).
- **Pancreas:** Makes insulin hormone which controls sugar in the blood.
- **Adrenal:** Secretes adrenaline which prepares the body for emergency situations (fight or flight).
- **Testis:** Make testosterone hormone in males.
- **Ovary:** Make estrogen and progesterone in females.

Control and coordination in plants

- Plants do not have a nervous system, they coordinate only through chemicals (plant hormones).

Tropic movements

- **Tropic movement:** The movement of plant parts according to the direction of the external stimulus.
- **Phototropism:** Movement of the stem towards light.
- **Geotropism:** Movement of roots towards gravity (downwards).
- **Hydrotropism:** Movement of roots towards water.

Plant hormones

- **Auxin:** Increases cell length and is helpful in bending the stem towards light.
- **Gibberellin:** Helpful in the growth of the stem.
- **Cytokinin:** Accelerates cell division.
- **Abscisic acid (ABA):** It inhibits growth and causes falling or wilting of leaves.

TOP 5 QUESTIONS

Q1. What is called a synapse?

Answer- The small empty space between two nerve cells (neurons) is called a synapse. Here the transmission of nerve impulse from one nerve cell to another takes place through chemicals.

Q2. What is reflex action? Give an example.

Answer- A sudden and involuntary response of the body to an external stimulus is called reflex action. It is controlled by the spinal cord. Example: Immediate withdrawal of hand on touching a hot object.

Q3. Why is the pituitary gland called the master gland?

Answer- The pituitary gland is called the master gland because it controls and directs the secretion and functions of all other endocrine glands (like thyroid, adrenal etc.) of our body.

Q4. Why is it advised to eat iodine-containing salt?

Answer- The thyroid gland requires iodine to make thyroxine hormone. Deficiency of iodine can cause goiter disease in which the neck swells, hence iodine-containing salt should be eaten.

Q5. What is the function of auxin hormone in plants?

Answer- Auxin is an important plant hormone that is formed in the tip of the stem. It helps in increasing the length of cells and in bending the stem of the plant in the direction of light (phototropism).

4

Life Processes-III

Introduction

The ability of living beings to produce new offspring similar to themselves is called **reproduction**. This is a very essential process to maintain the existence and continuity of a species. In this chapter, we will study different methods of reproduction in plants and animals and the human reproductive system.

What is reproduction

- **Reproduction:** It is the biological process by which organisms produce new offspring similar to themselves, so that their species does not perish.

Types of reproduction

Reproduction is mainly of two types:

- Asexual reproduction,
- Sexual reproduction.

Asexual reproduction

- **Asexual reproduction:** The process of reproduction in which only a single parent participates and gametes are not formed.
- **Fission:** Breaking of one cell into two or more parts (like: binary fission in Amoeba).
- **Budding:** An outgrowth (bud) is formed on the body of the organism which detaches to form a new organism (like: Yeast, Hydra).
- **Fragmentation:** The body of the organism breaks into pieces and each piece becomes a new organism (like: Spirogyra).
- **Spore formation:** Under unfavourable conditions, microscopic spores are formed which form new organisms when favourable (like: Rhizopus/fungi).

- **Vegetative propagation:** Formation of a new plant from root, stem or leaf of a plant (like: stem of potato, leaf of Bryophyllum).

Sexual reproduction

- **Sexual reproduction:** It requires two parents (male and female) and fusion of male and female gametes takes place.

Sexual reproduction in flowering plants

1. Flower is the reproductive organ of a plant. It has four main parts:

- Sepal,
- Petal,
- **Stamen** (male part),
- **Pistil** (female part)

2. **Pollination:** Transfer of pollen grains from stamen (anther) to stigma of pistil (by wind, water or insects).

3. **Fertilization:** The process of fusion of male and female gametes, which forms a **zygote**.

4. After fertilization, the ovary turns into a **fruit** and the ovule turns into a **seed**.

Reproduction in humans

- Humans have only sexual reproduction and fertilization takes place inside the body (internal fertilization).

Male reproductive system

- It has a pair of **testes** which make sperms (male gametes) and testosterone hormone.
- Vas deferens tube carries sperms to the penis.

Female reproductive system

- It has a pair of **ovaries** which make ova (female gametes) and estrogen hormone.
- Fertilization occurs in the **Fallopian tube** and the development of the embryo takes place in the **uterus**.

Puberty and adolescence

- **Puberty:** The age when the reproductive organs of boys and girls mature and start producing gametes (10-12 years in girls, 13-14 years in boys).

Menstrual cycle

- **Menstrual cycle:** If the ovum is not fertilized, the thick lining of the uterus comes out through the vagina as blood. It is a 28-day cycle.

Family planning and contraception

- Contraceptive methods are used to keep a proper gap in the birth of children.
- **Methods:** Physical barrier (condom), chemical (contraceptive pills), intra-uterine device (Copper-T), and surgical (vasectomy in males, tubectomy in females).

Sexually transmitted diseases (STDs)

- Diseases spread by unsafe sexual intercourse (like: Syphilis, Gonorrhoea, and HIV/AIDS).
- These can be avoided by the use of condoms.

TOP 5 QUESTIONS

Q1. What is a main difference between asexual and sexual reproduction?

Answer- In asexual reproduction, only a single parent is required and gametes are not formed in it. Whereas in sexual reproduction, two parents (male and female) are required and fusion of gametes (fertilization) takes place in it.

Q2. What is called pollination?

Answer- The process of transfer of pollen grains from the anther (male part) of a flower to the stigma (female part) of the same flower or another flower is called pollination. It occurs by wind, water or insects.

Q3. Where does fertilization occur in a human female and what is its result?

Answer- The process of fertilization in a human female takes place in the Fallopian tube. As a result of fertilization, the fusion of male and female gametes leads to the formation of a zygote which goes into the uterus and develops as an embryo.

Q4. What is vegetative propagation? Give an example.

Answer- When a new plant is developed from other vegetative parts (like root, stem or leaf) of a plant other than seeds, it is called vegetative propagation. Example: Growing a new plant from a potato tuber (stem) or a leaf of Bryophyllum.

Q5. Write the names of any two methods of family planning.

Answer- Two main methods of family planning are:

Physical barrier method (like use of condom)

Surgical method (like vasectomy in men or tubectomy in women for permanent block).

5

Heredity

Introduction

Every organism is born with traits similar to its parents. The process of transfer of these traits from one generation to another is called **heredity**. In this chapter, we will study important concepts like Mendel's experiments, laws of heredity, DNA, genes and sex determination in humans.

Heredity and Variation

- **Heredity:** The transfer of physical and mental traits from parents to offspring is called heredity.
- **Variation:** The differences found between organisms of the same species or offspring of the same parents are called variation.

Gregor Johann Mendel and his experiments

- Gregor Johann Mendel is called the **'Father of Genetics'**.
- **Selection of pea plant:** Mendel chose the garden pea (Pisum sativum) for his experiments because its life cycle is short and many clear contrasting traits (like: tall/dwarf, round/wrinkled seeds) can be easily seen in it.

Monohybrid Cross

- **Monohybrid cross:** When a cross is made keeping only one trait (like the height of the plant) in mind.
- Mendel crossed pure tall (TT) and pure dwarf (tt) plants.
- **F1 generation:** All plants obtained in this generation were tall (Tt).
- **F2 generation:** On self-pollination in F1 plants, tall and dwarf plants were obtained in the ratio of 3:1.

Dihybrid Cross

- **Dihybrid cross:** When a cross is made keeping two traits (like color of the seed and shape of the seed) in mind together.

- In the F2 generation, its phenotype ratio is obtained as 9:3:3:1.

Mendel's laws of inheritance

(a) Law of Dominance: The trait that appears in the F1 generation is called the **dominant** trait and the one that gets hidden is called the **recessive** trait.

(b) Law of Segregation: At the time of gamete formation, the genes (alleles) of a pair separate from each other and only one gene goes into each gamete. It is also called the law of purity of gametes.

(c) Law of Independent Assortment: The inheritance of two or more traits is completely independent of each other.

Chromosomes, DNA and Genes

- **Chromosomes:** There are thread-like structures in the nucleus of the cell which carry genetic information. There are a total of 46 (23 pairs) chromosomes in humans.
- **DNA:** It is the main component of chromosomes and is the main genetic material which stores information.
- **Gene:** That small segment of DNA which determines a specific trait is called a gene. It is the fundamental unit of heredity.

Sex determination in humans

- In humans, the chromosomes of the 23rd pair determine the sex, which are called **sex chromosomes**.
- Males have **XY** chromosomes whereas females have **XX** chromosomes.
- If X chromosome is received from the father then the offspring will be a **girl (XX)**, and if Y chromosome is received then the offspring will be a **boy (XY)**.
- Therefore, the sex determination of the child depends entirely on the chromosome of the father.

Inheritance of blood groups

- There are 4 blood groups in humans: **A, B, AB, and O**.
- Their determination is done by three genes (alleles): I^A, I^B, i
- I^A and I^B are dominant genes, whereas i is a recessive gene. The blood group of the offspring is determined by the combination of the blood groups of the parents.

Genetic disorders

- **Genetic disorders:** Those diseases which are transferred from generation to generation from parents to offspring due to disturbance in genes or chromosomes.
- **Colour blindness:** Inability to distinguish between red and green color (it is a disease linked to the X chromosome).
- **Haemophilia:** Blood does not clot when injured, due to which bleeding continues continuously.
- **Thalassemia:** Due to the formation of defective haemoglobin, the patient gets severe anaemia.

TOP 5 QUESTIONS

Q1. Who is called the father of genetics and which plant did he choose for his experiment?

Answer- Gregor Johann Mendel is called the **'father of genetics'**. He chose the 'garden pea' (Pisum sativum) plant to discover the laws of heredity.

Q2. What is the difference between a monohybrid and a dihybrid cross?

Answer- When a cross is made keeping only one trait (like the height of the plant) in mind for the study of inheritance, it is called a monohybrid cross. When two traits (like the color and shape of the seed) are taken together, it is called a dihybrid cross.

Q3. What is a gene?

Answer- A gene is a specific and small segment of DNA. It is the fundamental unit of heredity which determines any specific physical or mental trait from parents to offspring.

Q4. How is the sex of a child determined in humans?

Answer- The sex determination of a child depends entirely on the chromosome of the father. If an X chromosome is received from the father at the time of fertilization, the offspring is a girl (XX), and if a Y chromosome is received, the offspring is a boy (XY).

Q5. Name any two genetic disorders and state their main symptoms.

Answer- 1) Colour blindness: In this, the patient cannot distinguish between red and green colors.

2) Haemophilia: In this, blood does not clot when injured and bleeding does not stop.

6

Metals and Non-metals

Introduction

Most of the objects in our daily life are made of **metals** (like iron, copper) or **non-metals** (like oxygen, carbon). In this chapter, we will do a detailed study of the physical and chemical properties of metals and non-metals, their reactivity series, chemical bonds, extraction of metals (metallurgy) and protection from corrosion (rust).

Physical properties of metals and non-metals

Metals:

- These are solid, lustrous (metallic luster), hard, **malleable** (capable of being made into sheets) and **ductile** (capable of being drawn into wires).
- Metals are **good conductors** of heat and electricity (like: silver and copper).

  (Exception: Mercury is liquid at room temperature, lead is a poor conductor of heat).

Non-metals:

- These can be solid, liquid or gas. They do not have luster and they are **poor conductors** of electricity.
- Non-metals are brittle (breakable) and are not malleable or ductile.

  (Exception: Iodine is lustrous, and graphite is a good conductor of electricity).

Chemical properties of metals

1. Reaction with air (oxygen): Metals burn with oxygen to form basic metal oxides.

- **Formula**: $2Cu + O_2 \longrightarrow 2CuO\ (Copper\ oxide)$

Oxides of aluminum and zinc are **amphoteric**.

- **Amphoteric** react with both acids and bases.

2. Reaction with water: Active metals react with water to form metal hydroxide and hydrogen gas.

- **Formula**: $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

3. Reaction with acids: Metals react with dilute acid to give salt and hydrogen gas.

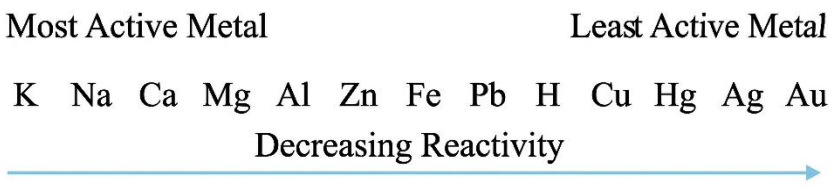
- **Formula**: $Mg + 2HCl \longrightarrow MgCl_2 + H_2$

4. Reaction with solutions of other metal salts: A more reactive metal displaces a less reactive metal from its salt (displacement reaction).

- **Formula**: $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

Reactivity series

- **Reactivity series:** A list arranging metals in the decreasing order of their reactivity.
- **Most reactive:** K (Potassium), Na (Sodium), Ca, Mg.
- **Moderately reactive:** Zn, Fe, Pb, Cu.
- **Least reactive:** Ag (Silver), Au (Gold).



How do metals and non-metals react?

- Metals lose electrons to form **cations**, whereas non-metals gain electrons to form **anions**.
- An **ionic bond** is formed by the strong electrostatic force of attraction between these oppositely charged ions (like NaCl).

Properties of ionic compounds

- **Physical nature:** These are solid and hard.
- **Melting and boiling points:** Due to strong attraction between ions, their melting and boiling points are very high.
- **Solubility:** These are soluble in water, but insoluble in kerosene or petrol.

- **Electrical conductivity:** Poor conductors in solid state, but are **good conductors** in aqueous solution or molten state.

Occurrence of metals

- **Minerals:** Elements or compounds occurring naturally in the earth's crust.
- **Ores:** Those minerals from which metals can be extracted easily and profitably.

Extraction of metals (Metallurgy)

The process of obtaining pure metal from ore is called **metallurgy**.

(a) Enrichment of ores: Removing impurities like soil, sand (gangue) from the ore.

(b) Extraction of metals of low reactivity: These are obtained by merely heating (by roasting).

(c) Extraction of metals of medium reactivity:

- **Roasting:** Heating sulphide ore in the presence of air.
- **Calcination:** Heating carbonate ore in limited air.
- After obtaining the oxide, it is **reduced** by carbon (coke).

(d) Extraction of metals of high reactivity: These are extracted by electrolytic reduction (Electrolysis).

Refining of metals

- **Electrolytic refining** is used to purify impure metal, in which the anode is made of impure metal and the cathode is made of pure metal.

Corrosion

- **Corrosion:** The gradual destruction of the surface of a metal when it comes in contact with air (oxygen) and moisture.
- Example: Rusting of iron, blackening of silver, formation of a green layer on copper.

Protection from corrosion

- Metals can be protected from corrosion by painting, applying oil or grease.

- **Galvanization:** Coating a thin layer of zinc on iron or steel so that it does not rust.

Alloys

Alloy: A homogeneous mixture of two or more metals (or a metal and a non-metal) is called an alloy.

It increases the hardness and rust resistance of metals. Example:

1. **Steel (Iron + Carbon),**
2. **Brass (Copper + Zinc),**
3. **Bronze (Copper + Tin),**
4. **Solder (Lead + Tin).**

TOP 5 QUESTIONS

Q1. What is the difference between roasting and calcination?

Answer- The process of heating sulphide ore at a high temperature in the presence of excess air is called roasting. Whereas the process of converting carbonate ore into oxide by heating it in the presence of limited air is called calcination.

Q2. Why is the melting point of ionic compounds high?

Answer- There is a very strong electrostatic force of attraction between the cations and anions in ionic compounds. A very high amount of energy (heat) is required to break this strong inter-ionic force of attraction, hence their melting point is high.

Q3. What are amphoteric oxides? Give an example.

Answer- Those metal oxides which react with both acids and bases to form salt and water are called amphoteric oxides. Example: Aluminum oxide (Al_2O_3) and Zinc oxide (ZnO).

Q4. What is called galvanization?

Answer- The process of coating a thin layer of zinc metal over the objects of iron and steel to protect them from rust (corrosion) is called galvanization.

Q5. What is an alloy? Which metals is brass made of?

Answer- A homogeneous mixture of two or more metals, or a metal and a non-metal is called an alloy. Brass is a major alloy which is made of copper and zinc.

7

Carbon and Its Compounds

Introduction

Carbon is a unique element which is the main basis of our life and the structure of living beings. In this chapter, we will do a detailed study of the nature of carbon, allotropes, important oxides of carbon, hydrocarbons, functional groups and compounds of daily life like soaps and detergents.

Versatile nature of carbon

- **Tetravalency:** The valency of carbon is 4. It forms covalent bonds by sharing electrons with 4 other atoms.
- **Catenation:** The atoms of carbon have a unique property of joining together to form long, branched or ring (circular) chains.
- **Multiple bonding:** Carbon can form single, double or triple bonds with itself or other elements.

Allotropes of carbon

Allotropy: Different forms of an element whose physical properties are different but chemical properties are the same.

(a) Crystalline allotropes:

- **Diamond:** Hardest natural substance, is a **poor conductor** of electricity.
- **Graphite:** Soft and slippery, is a **good conductor** of electricity (due to free electrons).
- **Fullerene:** Carbon atoms are arranged in the shape of a football (like C_{60}).

(b) Non-crystalline allotropes: Coal, coke, charcoal and carbon black.

Compounds of carbon

- Carbon combines with other elements (like hydrogen, oxygen, nitrogen, halogens) to form a large number of compounds.
- These are mainly classified into organic and inorganic compounds.

Oxides of carbon

Carbon monoxide (CO):

- It is formed by the incomplete combustion of carbon or carbon-containing fuels ($2C + O_2 \longrightarrow 2CO$).
- It is a colourless, odourless and **highly poisonous gas**. It binds with the haemoglobin of the blood and stops the flow of oxygen.

Carbon dioxide (CO_2):

- It is formed by the complete combustion of carbon ($C + O_2 \longrightarrow CO_2$).
- It is necessary for photosynthesis and is the main cause of the **greenhouse effect**.
- Solid CO_2 is called Dry Ice, which is used as a refrigerant.

Hydrocarbons

Hydrocarbons: Those compounds which are made up of only carbon (C) and hydrogen (H).

(a) Saturated hydrocarbons:

- **Alkane:** There is only a **single bond** between carbon atoms.

  Formula: C_nH_{2n+2} (Example: Methane CH_4)

(b) Unsaturated hydrocarbons:

- **Alkene:** Having double bond between carbon atoms.

  Formula: C_nH_{2n} (Example: Ethene C_2H_4)

- **Alkyne:** Having triple bond between carbon atoms.

  Formula: C_nH_{2n-2} (Example: Ethyne C_2H_2)

Isomerism

- **Isomers:** Those compounds whose molecular formula is the same but structural formula is different.
- Example: Butane (C_4H_{10}) has two isomers (normal-butane and iso-butane).

Functional groups

- **Functional group:** The group of atoms which joins the carbon chain and determines the specific chemical properties of the compound.
- **Halogen**: $-Cl, -Br, -I$
- **Alcohol**: $-OH$
- **Aldehyde**: $-CHO$
- **Ketone**: $-CO-$
- **Carboxylic acid**: $-COOH$

Homologous series

- It is a series of organic compounds in which all members have the same functional group.
- There is a fixed difference of a $-\boldsymbol{CH_2}-$ unit and **14 u** mass between any two consecutive members.

Nomenclature system of carbon compounds (IUPAC)

- The name of the compound is formed by adding the number of carbon atoms (Meth, Eth, Prop) and the suffix of the functional group.

Chemical properties of carbon compounds

- **Combustion:** Burn in oxygen to give heat, light and CO_2 ($CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + Heat$).
- **Oxidation:** On heating ethanol with alkaline $KMnO_4$, ethanoic acid is formed.
- **Addition:** Adding hydrogen in unsaturated hydrocarbons in the presence of nickel catalyst (making vegetable ghee from vegetable oil).
- **Substitution:** Removing hydrogen of methane by chlorine in sunlight ($CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$).

Some important carbon compounds

(a) Ethanol (C_2H_5OH): It is a good solvent and is used in liquor and cough syrup. Reacts with sodium to give hydrogen gas.

(b) Ethanoic acid (CH_3COOH): It is also called acetic acid. Its 3-4% aqueous solution is called vinegar. It reacts with ethanol to form a sweet-smelling ester.

Soaps and detergents

- **Soap:** Sodium/potassium salts of long chain carboxylic acids. They give lather only in soft water.
- **Detergent:** Salts of long chain sulfonic acids. They work in both hard and soft water.
- **Micelle:** Soap molecules surround the dirt to form a 'micelle' due to which the dirt of the clothes comes into the water.

TOP 5 QUESTIONS

Q1. Why is carbon monoxide considered a poisonous gas?

Answer- Carbon monoxide binds very rapidly with the hemoglobin of the blood to form carboxyhemoglobin. It stops oxygen from reaching the cells of the body, due to which a person can die of suffocation.

Q2. What is called dry ice?

Answer- Solid carbon dioxide (CO_2) is called dry ice. It is mainly used as a refrigerant to keep things extremely cold.

Q3. What are isomers? Give an example.

Answer- Those organic compounds whose molecular formula is the same, but their structural formula (structure) is different, are called isomers. Example: Butane (C_4H_{10}) has two isomers (normal and iso-butane).

Q4. What is the difference between the members of a homologous series?

Answer- There is always a fixed difference of one $-CH_2-$ unit in the chemical formula and 14 u (unit) in their molecular mass between any two consecutive members of a homologous series.

Q5. What is a main difference between soap and detergent?

Answer- Soap can clean by forming lather only in soft (sweet) water, whereas detergent can clean clothes by easily forming lather even with the calcium ions present in hard water.

8

Natural Environment

Introduction

All living and non-living things present around us together make the **natural environment**. All organisms depend on the environment to stay alive and affect each other. In this chapter, we will do a detailed study of ecosystem, biotic community, food chain, various adaptations and population growth.

Ecosystem and its components

- **Ecosystem:** It is such an environment under which all the organisms of a particular area and those non-living physical factors come, with which the organisms interact.
- In 1935, A. G. Tansley coined the term 'Ecosystem'.
- It can be **natural** (forests, deserts, rivers) or **man-made** (fields, gardens, aquariums).

Components of ecosystem and their relationship

- **Abiotic factors:** Non-living physical and chemical factors of the environment (like- sunlight, temperature, rainfall, moisture and soil).
- **Biotic factors:** Living components of the ecosystem (like- plants, animals and microorganisms).

Biotic community

- **Biotic community:** A community of different types of organisms living together in the same habitat.
- **Autotrophs (Producers):** Green plants which make their own food by photosynthesis.
- **Heterotrophs (Consumers):** Those organisms which eat plants or other animals for food (like herbivores and carnivores).
- **Saprotrophs (Decomposers):** Those bacteria and fungi which decompose rotten dead organic materials and convert them into simple forms.

Food chain and food web

(a) Food chain: That sequence of organisms in a community which transfers the energy of food from one organism to another.

- **Grazing food chain:** It starts from plants ($Grass \rightarrow Rabbit \rightarrow Wolf \rightarrow Cheetah$).
- **Detritus food chain:** It starts from dead organic materials and goes up to decomposers and carnivores. $Microbes \rightarrow Earthworm \rightarrow Frog \rightarrow Snake$.

(b) Food web: Many interconnected food chains in an ecosystem together form a 'food web'.

Energy flow in ecosystem

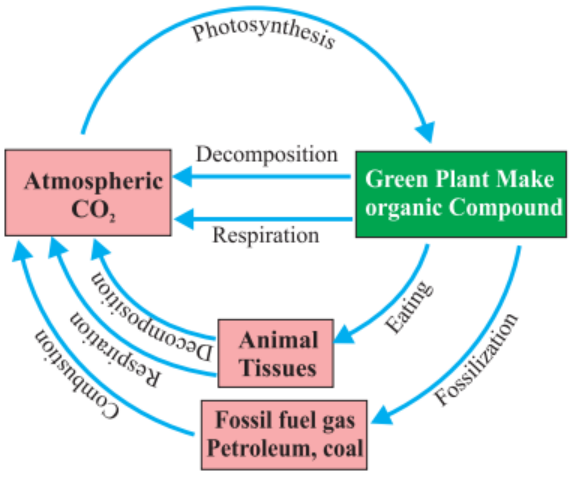
- The flow of energy is always **unidirectional**, meaning the transferred energy does not return.
- Most of the energy (90%) is lost in heat and biological processes, hence energy goes on decreasing on moving up in the food chain.

Biogeochemical or nutrient cycles

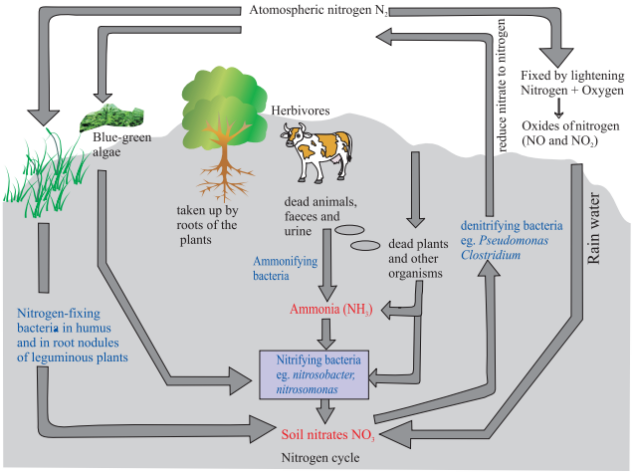
Biogeochemical cycle: That circular path in which nutrients flow from the environment to the organisms and back from the organisms to the environment.

1. Carbon cycle:

Exchange of carbon between atmosphere, water and soil. Plants take CO_2, while organisms release it back into the atmosphere by respiration and burning of fossil fuels.



2. Nitrogen cycle:



It has 5 main steps:

1. **Nitrogen fixation**: Conversion of atmospheric N_2 into nitrate by lightning or bacteria (blue-green algae, Rhizobium).

2. **Nitrogen assimilation**: Absorption of nitrate by plants and eating it as protein by animals.

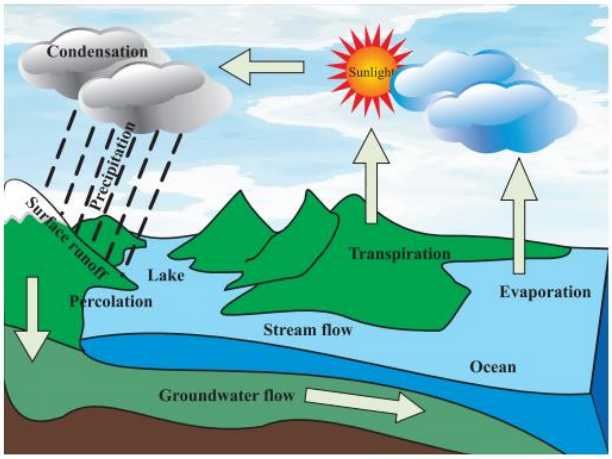
3. **Ammonification**: Decomposition of dead organisms into ammonia by ammonifying bacteria.

4. **Nitrification**: Conversion of ammonia back into nitrate by Nitrobacter bacteria.

5. **Denitrification**: Conversion of nitrate back into nitrogen gas by Pseudomonas bacteria.

3. Water cycle:

Continuous circulation of water between the earth and the atmosphere through evaporation, condensation and precipitation (rain).



Ecosystem services

- Environment gives us oxygen, food, water, fuel (wood) for free and controls climate and diseases.

Adaptations in animals

Adaptation: Those specific traits which help a plant or animal to survive in its specific habitat.

1. **Aquatic adaptations in plants (Hydrophytes)**: Roots are poorly developed. Stem is spongy. Leaves are ribbon-like or with a waxy coating (water repellent) (like lotus, Hydrilla).

2. **Aquatic adaptations in animals**: Body is streamlined and smooth. Fishes have fins and gills to swim. Duck has webbed feet and whale has flippers.

3. **Terrestrial adaptations in plants:**

- **Mesophytes**: Plants of normal environment, leaves are broad and bear stomata.
- **Xerophytes**: Desert plants (Cactus). They have fleshy stems for water storage and leaves are modified into spines.

4. **Adaptations in xerophytic animals**: Desert animals live in burrows to escape the heat. Camel's skin is scaly and has a hump for fat storage. They excrete concentrated urine.

5. **Adaptations to survive in extreme cold and water scarcity**: Polar bear and penguin have thick fur and a layer of fat on their body which keeps the body warm.

6. **Aerial adaptations in organisms**: The body of flying organisms (birds, bats) is streamlined and bones are hollow. Forelimbs are modified into wings.

Population interactions

Population: A group of similar organisms (species) in a specific geographical area.

1. Mutualism: Relationship between two different organisms in which both are benefited (like algae and fungus in lichen).

2. Commensalism: One organism is benefited and the other is neither benefited nor harmed (like shark and sucker fish).

3. Parasitism: One organism (parasite) takes nutrition from the body of another and harms it (like tapeworm of intestine).

4. Symbiosis: An intimately connected close relationship between two organisms (like pollination between flowers and honeybee).

Population growth

Population growth: The change in the number of members in a population over time. When the birth rate becomes more than the death rate, the population increases.

1. **Population distribution**: Settling of organisms in new places.

- **Emigration**: Migration of animals out of the population (population decreases).
- **Immigration:** Arrival of animals into the population from outside (population increases).

2. **Environmental resistance**: Prevention of maximum reproduction of a species by the environment (food, space, predators). The maximum 'carrying capacity' of the environment is fixed.

3. **Growth curve**: When population growth is shown on a graph, it is called a growth curve.

- **S-shaped growth curve**: In this, the growth is slow at first (lag phase), then increases rapidly (growth phase) and finally stabilizes due to environmental resistance (stable phase).
- **J-shaped growth curve**: In this, the population increases very rapidly exponentially and as soon as environmental resistance arrives, the death rate suddenly increases causing a 'population crash'.

TOP 5 QUESTIONS

Q1. What is called an ecosystem?

Answer- An ecosystem is such an environment under which all the living organisms of a particular area and those non-living physical factors come, with which these organisms interact. It can be natural or man-made.

Question 2. What is the difference between grazing and detritus food chains?

Answer- Grazing food chain starts from plants (producers) and goes to herbivores and then to carnivores. Whereas detritus food chain starts from dead organic materials (rotten organisms) and goes to decomposers (bacteria/fungi) and small carnivores.

Question 3. What adaptations are there in xerophytic plants (like cactus) for water conservation?

Answer- In xerophytic plants, the stems become thick and fleshy for water storage. To prevent water loss from transpiration, their leaves are modified into spines and the number of stomata is very low.

Question 4. What is Commensalism? Give an example.

Answer- Commensalism is such a mutual relationship between two different species in which one organism is benefited, whereas the other organism is neither benefited nor harmed. Example: Sucker fish remaining attached to the body of a shark.

Question 5. What is the difference between Emigration and Immigration in population growth?

Answer- Emigration means the permanent migration of animals outwards from their population, due to which the population size decreases. Immigration means the arrival of animals into a population from outside, due to which the population increases.

9

Human Impact on Environment

Introduction

Many environmental problems have arisen due to natural processes and human activities which adversely affect humans and other organisms. In this chapter, we will do a detailed study of natural disasters, impact of growing population on the environment, pollution, waste management and global environmental problems.

Environmental problems- a cause of concern

- Due to the growing population in the world, advancement in technology and apathy towards the environment, the depletion of natural resources and pollution have increased continuously.
- The environment has been polluted due to human development activities, hence it is very important to be aware of its conservation.

Environmental problems

- Environmental problems are caused by natural forces or human activities, which have been divided into two parts:
- **Natural disasters**: Flood, cyclone, earthquake, tsunami, landslide and forest fire.
- **Man-made disasters**: Deforestation, air/water/soil pollution, depletion of fossil fuels, biomagnification, ozone depletion and global warming.

Natural disasters and their impact on environment

1. **Flood**: A flood occurs when the water level of a river goes beyond the capacity of its banks due to torrential rain. It destroys crops, houses and life, but improves soil quality.
2. **Cyclone**: These are areas of extremely low pressure originating in the sea which come with fierce storms and strong winds (like the 1999 Orissa super cyclone).
3. **Earthquake**: A sudden tremor occurring in the surface of the earth is called an **earthquake**. It is measured on the **Richter scale** with a 'seismograph' instrument.

4. **Forest fire (Wild fire)**: The fire that breaks out in forests due to heat, natural causes (lightning strike) or human negligence which destroys biodiversity, plants and valuable wood.

5. **Tsunami (Harbor wave)**: The huge and destructive ocean waves rising due to an earthquake, landslide or volcanic eruption under the sea are called **tsunami** (Harbor wave).

6. **Landslide**: The sliding of rocks, soil or debris from hill slopes is called **landslide**. It happens due to heavy rain, soil erosion or dynamite explosion.

7. **Cloud burst**: Occurrence of a huge amount of torrential rain (with hail and thunder) in just a few minutes, which causes a sudden flood.

Impact of human population on environment

- Due to overpopulation, the demand for food, water, land and energy increases, causing rapid overexploitation of natural resources and heavy damage to the environment.

Deforestation

- The cutting down of natural forest cover for agriculture, industries and housing is called **deforestation**.
- **Impact**: Extinction of species, decrease in rainfall, fall in groundwater level, soil erosion and global warming.
- **Prevention**: Adopting **reforestation** (planting new saplings in place of cut trees), silviculture (growing woody plants) and social forestry.

Pollution

The undesirable change occurring in the physical, chemical and biological properties of the environment due to human activities is called **pollution**.

a. Air pollution: Mixing of undesirable gases (CO_2, SO_2) and suspended particulate matter (SPM) in the air.

b. Water pollution: Mixing of pollutants into water bodies.

- **Eutrophication**: With the mixing of fertilizers in water, nutrients increase, due to which algae grow rapidly and aquatic organisms die due to lack of oxygen.
- **Biomagnification**: Entry of harmful chemicals (like DDT) into the food chain and getting accumulated in the top consumers.

c. Soil pollution and land pollution: Mixing of domestic waste, plastic and agricultural chemicals in the soil due to which its quality decreases.

d. Noise pollution: Unwanted and loud sound which is painful. It is measured in **decibels (dB)**. It increases deafness, irritability, and blood pressure.

Waste and its management

- **Biodegradable waste**: Substances decomposable by bacteria (like- leaves, cow dung, paper).
- **Non-biodegradable waste**: Substances not easily decomposable (like- plastic, glass, nuclear waste).
- **Management**: Burying in landfill, incineration (burning the garbage) and following **4R** (reduce, reuse, repair, recycle).

Global environmental problems

- **Ozone hole: Depletion of ozone layer**: The thinning of the ozone layer of the atmosphere due to chlorofluorocarbons (CFCs) is called ozone hole. It causes skin cancer and cataract.
- **Global warming- Green house effect:** Inability of the sun's heat to go back due to the excess of gases like CO_2 and methane in the atmosphere, due to which the average temperature of the earth is increasing.
- **Photochemical Smog**: A toxic mixture of smoke and fog formed by the reaction of hydrocarbons and nitrogen oxides in sunlight.
- **Acid rain:** The combination of SO_2 and nitrogen oxides present in the atmosphere with rainwater to form acids (H_2SO_4, HNO_3). It destroys aquatic organisms, soil and monuments (Taj Mahal).

TOP 5 QUESTIONS

Q1. Give two examples each of natural and man-made disasters.

Answer- Examples of natural disasters are earthquakes and tsunamis. Examples of man-made disasters are large scale deforestation (cutting of forests) and air or water pollution.

Q2. What is eutrophication and what is its effect on aquatic organisms?

Answer- The increase of nutrients due to the flowing of agricultural fertilizers into water bodies is called eutrophication. Due to this, algae grow rapidly in water and there is a lack of oxygen, due to which fishes and other aquatic organisms die.

Q3. What is called biomagnification?

Answer- The entering of harmful non-biodegradable chemicals (like DDT) into the food chain and the continuous increase of their concentration (amount) in the body with each trophic level is called biomagnification.

Q4. What is the main cause of depletion of the ozone layer and what is its harm?

Answer- The main cause of depletion of the ozone layer is chlorofluorocarbons (CFCs) chemicals used in air conditioning and refrigerators. Due to its thinning, the ultraviolet rays of the sun reach the earth, which causes skin cancer and cataract.

Q5. How is acid rain formed?

Answer- Pollutants emerging from factories and vehicles like sulfur dioxide (SO_2) and nitrogen oxides go into the atmosphere and chemically react with rainwater and form acids (sulfuric and nitric acid), which is called acid rain.