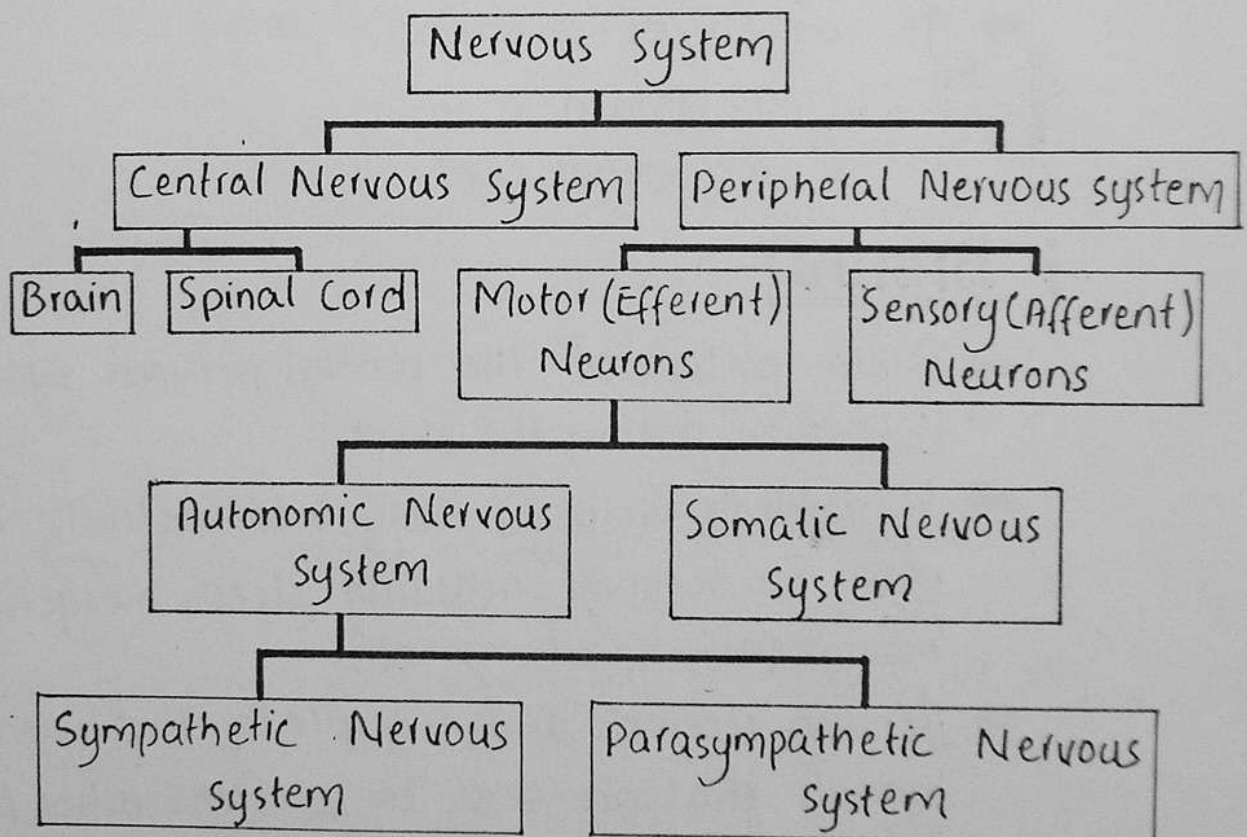


## 5- NERVOUS SYSTEM:

- ➔ It is the central system of a body which controls and co-ordinates all the organs and their functions.
- ➔ It connects the organism with its environment (somatic nervous system) and its internal organs (autonomic or vegetative nervous system).



➔ Nervous system is divided into 2 categories:

A- Central Nervous System (CNS)

B- Peripheral Nervous system (PNS)

## A- CENTRAL NERVOUS SYSTEM:

➔ It is the part of the nervous system that controls and co-ordinates most functions of the body and mind.

➔ It consists of 2 parts:

i- Brain

ii- Spinal Cord

### i- BRAIN:

➔ Brain, portion of the central nervous system contained within the skull.

➔ It controls virtually every vital activity necessary to survival including sleep, hunger, thirst, movement, emotions etc.

➔ It also receives and interprets the countless signals that are sent to it from other parts of the body and from the external environment.

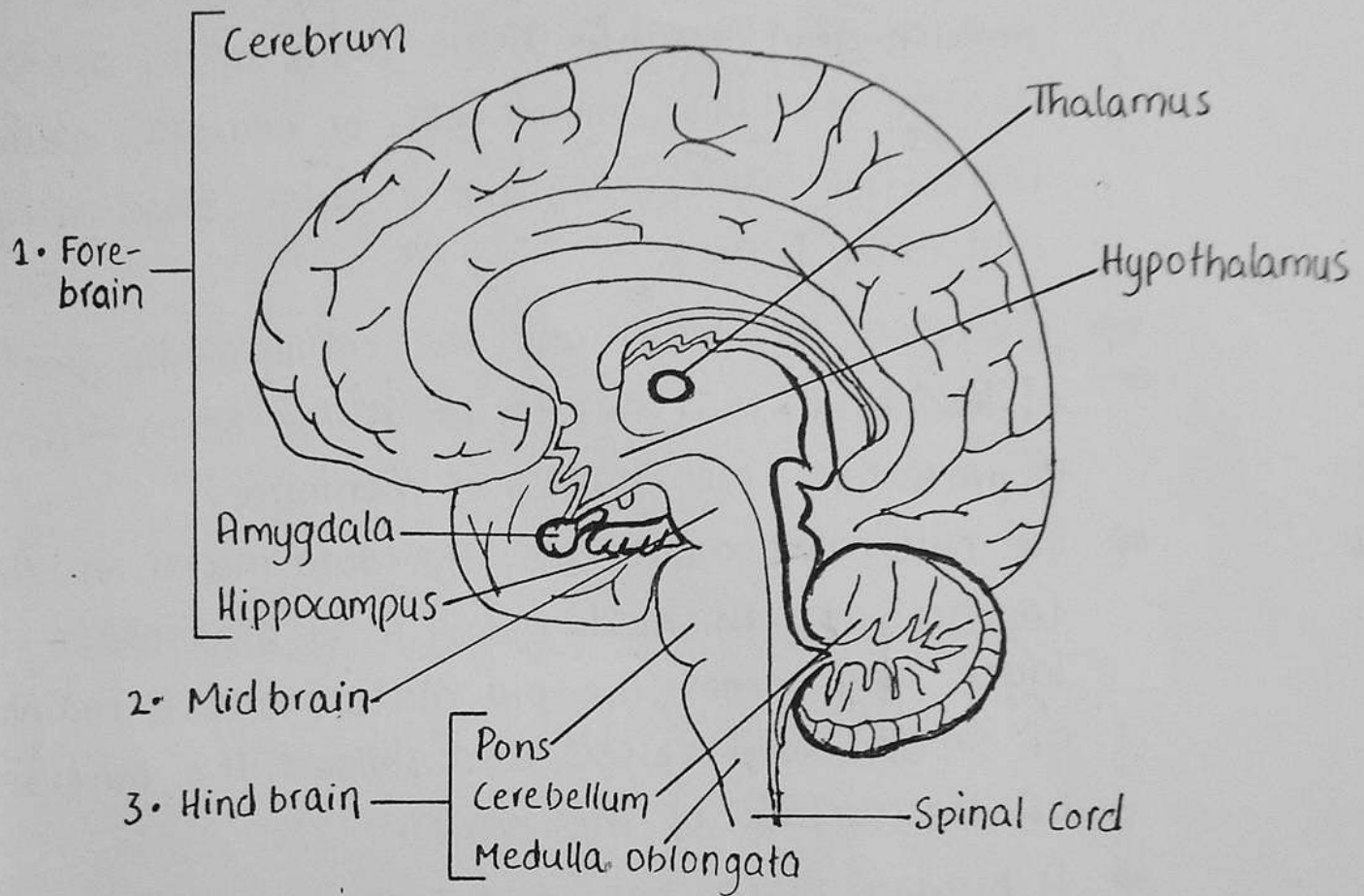


Fig: Human brain with its 3 sections:

1- Forebrain — Cerebrum, Thalamus, Hypothalamus, Amygdala and Hippocampus.

2- Mid brain

3- Hind brain — Pons, Cerebellum and Medulla oblongata

- ➔ There are two hemispheres of the brain, the left hemisphere and the right hemisphere.
- ➔ The left side of the brain usually controls logic while right side is more active in creative pursuits.



- ➔ The adult human brain is 1.3 kg mass of pinkish-gray jellylike tissue made up of approximately 100 billion nerve cells, or neurons; neuroglia (supporting tissue) cells; and vascular (blood-carrying) and other tissues.
- ➔ Between the brain and the cranium—the part of the skull that directly covers the brain—are 3 protective membranes, or meninges.
- ➔ The outermost membrane, the dura mater, is the toughest and thickest. Below it is arachnoid layer. Then comes the pia mater, consists mainly of small blood vessels and follows the contours of the surface of the brain.
- ➔ A human brain has 3 regions :
  - a- Fore-brain (prosencephalon)
  - b- Mid-brain (mesencephalon)
  - c- Hind-brain (rhombencephalon)

### a- FORE BRAIN:

- ➔ The forebrain region has 5 main parts:
  - Cerebrum
  - Thalamus
  - Hypothalamus
  - Amygdala
  - Hippocampus



## • CEREBRUM:

- ➔ The front part of the brain.
- ➔ Divided into two symmetrical halves, cerebral hemispheres.
- ➔ In humans, it is where activities including reasoning, learning, sensory perception and emotional responses take place.

## •• THALAMUS:

- ➔ Thalamus (plural: thalami) is egg-shaped mass of gray matter.
- ➔ There are two thalami, each lying beneath a cerebral hemisphere. They exist in pair.
- ➔ They relay sensory information to the cerebral cortex.
- ➔ They are concerned with awareness of all the main senses except for smell.

## •• HYPOTHALAMUS:

- ➔ It is a central area that lies on the underside of the brain.
- ➔ It controls involuntary functions such as body temperature and the release of hormones.

## :: AMYGDALA:

- ➔ Amygdala is an almond-shaped mass of gray matter, one in each hemisphere of the brain.
- ➔ Amygdalae (plural) are associated with feelings of fear and aggression and are important for visual learning and memory.

## :: HIPPOCAMPUS:

- ➔ Hippocampus (plural hippocampi) is a curved ridge of tissue in each cerebral hemisphere of the brain.
- ➔ Hippocampi are concerned with basic drives, emotions and short term memory.
- ➔ They are also included in limbic system.

## b- MIDBRAIN:

- ➔ The topmost structure of the brain stem is the mid-brain.
- ➔ It contains major relay stations for neurons transmitting signals to the cerebral cortex, as well as many reflex centers (pathways carrying sensory (input) information and motor

(output)

- ➔ Relay and reflex centers for visual and auditory (hearing) functions are located in the top portion of the midbrain.
- ➔ A pair of nuclei called the 'superior colliculus' control reflex actions of the eye, such as blinking, opening and closing the pupil, and focusing the lens.
- ➔ A second pair of nuclei, called the inferior colliculus, control auditory reflexes, such as adjusting the ear to the volume of sound.
- ➔ At the bottom of the midbrain are reflex and relay centers relating to pain, temperature, and touch, as well as several regions associated with the control of movement.

### C- HINDBRAIN:

➔ This region of the brain has 3 main parts:

- Pons
- Cerebellum
- Medulla Oblongata



## • PONS:

- ➔ It is a prominent bulge which is continuous with and below the midbrain.
- ➔ The pons consists of large bundles of nerve fibers that connect the 2 halves of the cerebellum and also connect each side of the cerebellum with the opposite-side cerebral hemisphere.
- ➔ The pons serve mainly as a relay station linking the cerebral cortex and medulla oblongata.

## •• CEREBELLUM:

- ➔ It is the rear part of the brain typically consisting of 2 hemispheres connected by a thin central region, and serving to control and coordinate muscular activity and maintain balance.

## •• MEDULLA OBLONGATA:

- ➔ It is the lowermost part of the brain in vertebrates.
- ➔ It is continuous with the spinal cord and controls involuntary vital functions, such as those involved with the heart and lungs.

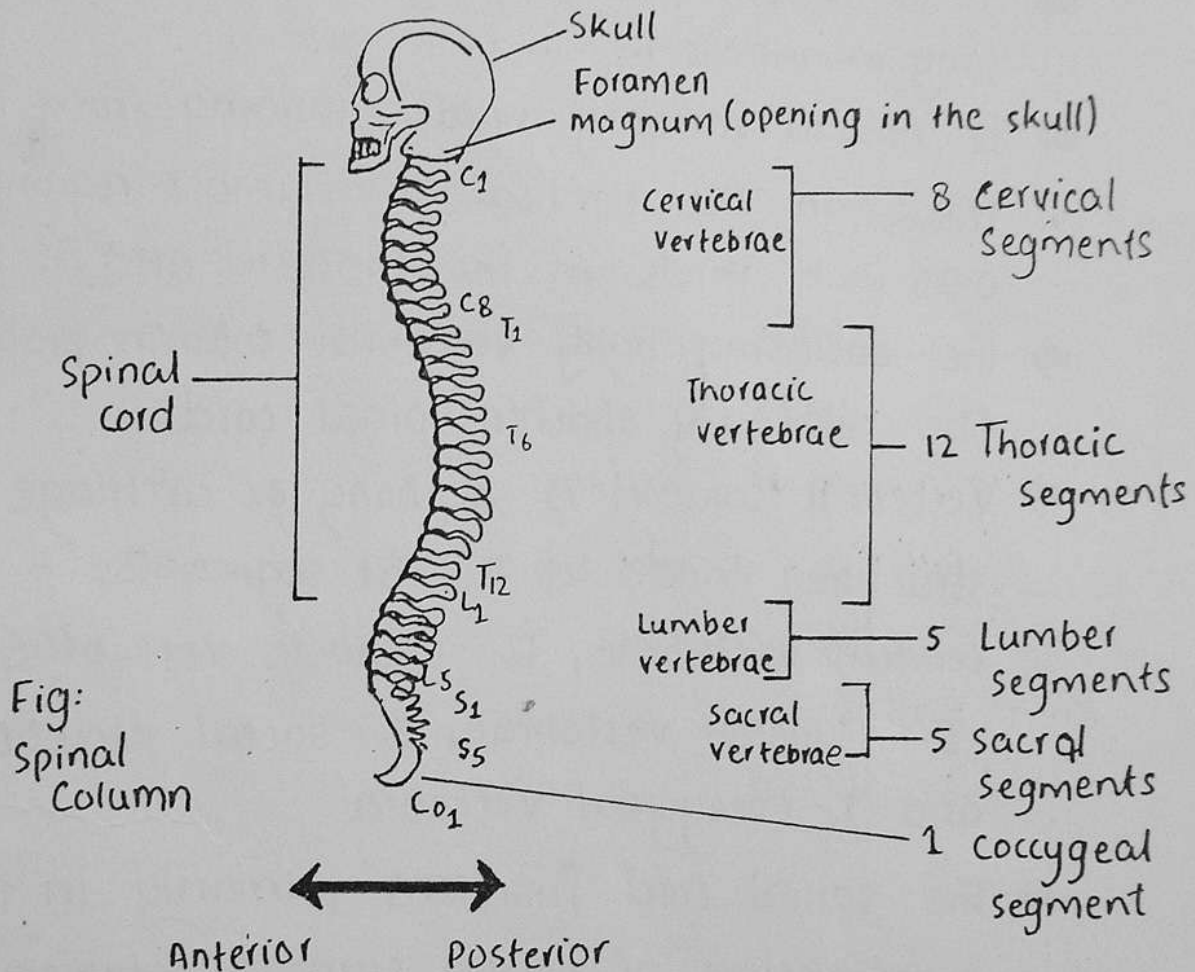
## FAST FACTS: (Just For Knowledge)

- ➔ About 0.85 litres of blood pass through the brain every minute.
- ➔ Brain activity uses up one fifth of the body's energy supply.
- ➔ The longest nerve, the sciatic, runs from the base of the spine to the knee.
- ➔ Meningitis is the inflammation of the meninges, Encephalitis is inflammation of the brain.
- ➔ Retrieving a memory takes 0.0004 seconds.
- ➔ Each nerve cell in brain can receive over 100,000 messages a second.
- ➔ Skull is made up of 22 bones.
- ➔ Someone who forgets a word or name during conversation is suffering from 'Lethologica'.
- ➔ Your brain was as big as an adult's when you were just 6 years old.
- ➔ A human body produces "cerebrospinal fluid" all the time, the fluid acts as a cushion to protect the brain and constantly needs replacing.
- ➔ Men have larger brains than women, but women have more brain cells.
- ➔ Brain can not sense touch or pain, so brain surgery can be done while the patient is still awake.

- ➔ There are two main types of brain cells;
  - i- Neurons : responsible for the transmission and analysis of all the electrochemical communication within the brain and other parts of the nervous system.
  - ii- Neuroglia : neuroglial cells are twice as numerous as neurons and account for half of the brain's weight. Neuroglia (Greek 'glia', "glue") provide structural support to neurons.
- ➔ Speaking and writing problem is called 'Broca's aphasia'. Inability to comprehend spoken language is called 'Wernicke's aphasia'.
- ➔ In humans, left side of the brain controls right side of the body and vice versa.



## ii- SPINAL CORD:



- ➔ Spinal cord is a long, thin, tubular bundle of nervous tissue and supporting cells that extends from the brain (medulla oblongata).
- ➔ It begins at the foramen magnum and extends down to the space between 1<sup>st</sup> and 2<sup>nd</sup> lumbar vertebrae.

- ➔ It does not extend to the entire vertebral column (or spinal column).
- ➔ It is about 45 cm long in men and 43 cm long in women.
- ➔ It has a varying width ranging from 0.5 inch thick in the cervical and lumbar regions to 0.25 inch thick in the thoracic area.
- ➔ The enclosing bony vertebral column protects the relatively shorter spinal cord.
- ➔ Vertebral column is a bony or cartilage structure made up of 31 segments; 8 cervical vertebrae, 12 thoracic vertebrae, 5 lumbar vertebrae, 5 sacral vertebrae and 1 coccygeal vertebra.
- ➔ The spinal cord functions primarily in the transmission of neural signals between the brain and rest of the body but also contains neural circuits that can independently control numerous reflexes and central pattern generators.
- ➔ Spinal cord has 3 major functions:
  - a- Serve as a conduit for motor information, which travels down the spinal cord.

- b- Serve as a conduit for sensory information, which travels up the spinal cord.
- c- Serve as a center for coordinating certain reflexes.

### FAST FACTS: (Just For Knowledge)

- ➔ Just like brain, the spinal cord is also encased in a triple sheath of membranes and is partially divided into 2 lateral halves by a median fissure toward the front and the median partition toward the rear; 31 pairs of spinal nerves arise, each by an anterior and posterior root, from each side of the cord.
- ➔ Collection of nerves from lumbar and sacral levels in the vertebral column is called the 'cauda equina' (horse tail)
- ➔ Spinal column is somewhat flexible, some of the vertebrae in the lower parts of the spinal column become fused.
- ➔ The first cervical vertebra is also called the 'Atlas'.



## B - PERIPHERAL NERVOUS SYSTEM:

- ➔ Peripheral nervous system includes all neural tissue outside the central nervous system.
- ➔ It is further divided into two systems.
  - i- Motor system or Efferent neurons
  - ii- Sensory system or Afferent neurons.

### i- MOTOR NEURONS:

- ➔ Motor neuron is also called efferent neuron and the system is called motor system.
- ➔ It is a nerve cell neuron that conveys nerve impulses from the spinal cord or brain-stem away from the central nervous system towards a muscle or gland.
- ➔ It is further divided into 2 systems:
  - a- Somatic Nervous system
  - b- Autonomic Nervous system

### a- SOMATIC NERVOUS SYSTEM:

- ➔ It is the part of nervous system that serves the sense organs and muscle of the body wall and limbs, and brings about voluntary muscle activity.

## b- AUTONOMIC NERVOUS SYSTEM:

- ➔ It is the part of the nervous system that controls involuntary activity such as the action of the heart and glands, breathing, digestive processes, and reflex actions.
- ➔ It is further divided into 2 systems:
  - Sympathetic nervous system
  - Parasympathetic nervous system

### • SYMPATHETIC NERVOUS SYSTEM:

- ➔ It is the part of autonomic nervous system that is active during stress or danger.
- ➔ It is involved in regulating pulse and blood pressure, dilating pupils and changing muscle tone.

### •• PARASYMPATHETIC NERVOUS SYSTEM:

- ➔ It is the part of autonomic nervous system that controls involuntary and unconscious bodily functions.
- ➔ Its actions include slowing the heart, constricting the pupils, and relaxing the bowels.

## ii- SENSORY NEURONS:

- ➡ Sensory neuron is also called afferent neuron and the system is called sensory system.
- ➡ It is a nerve cell neuron that conveys nerve impulses from a muscle or gland towards the spinal cord or brainstem.



# NEURON: (Just For knowledge)

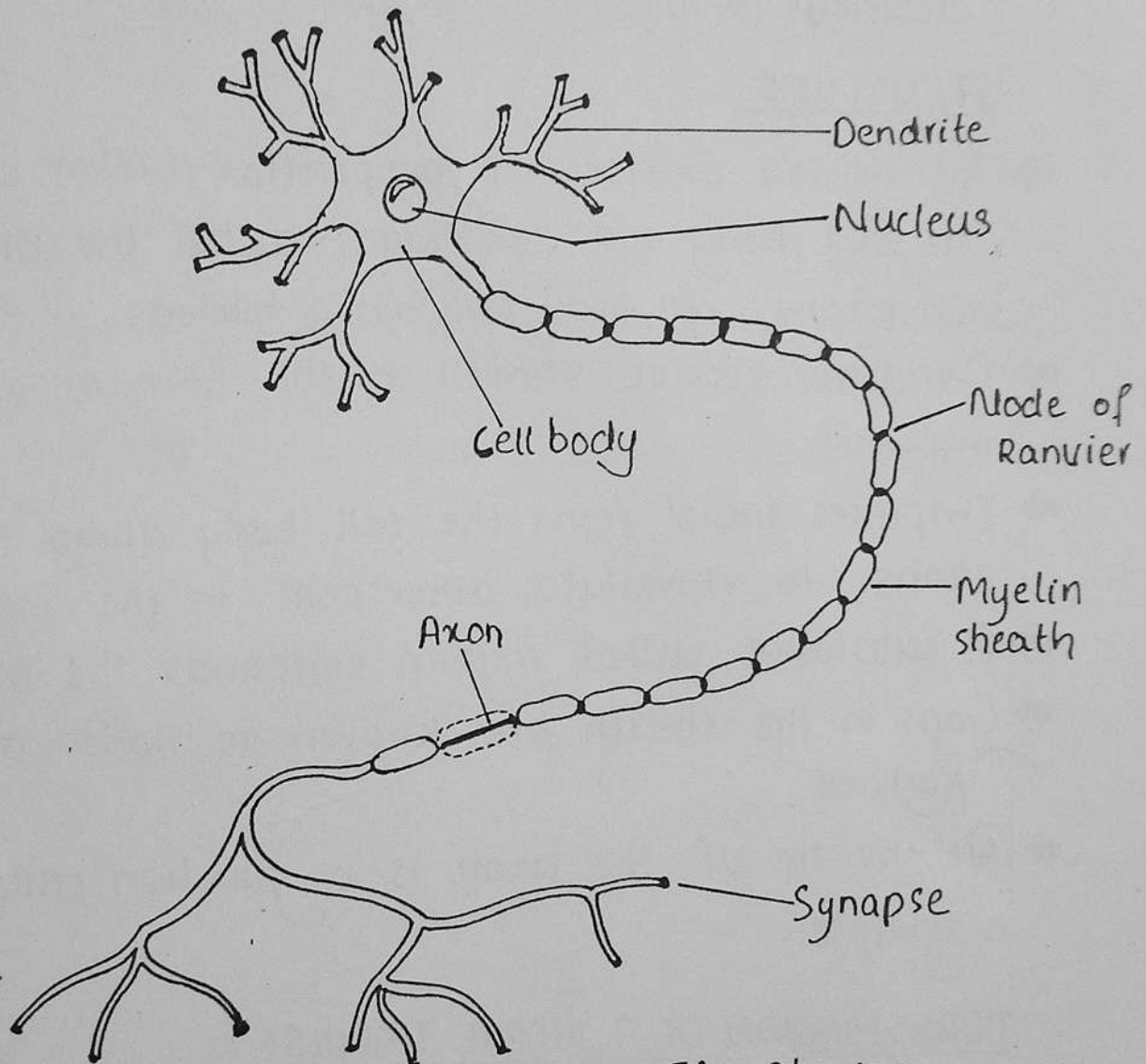


Fig: Neuron

- ➔ A neuron is the functional unit of nervous system.
- ➔ A network of billions of neurons make up the human nervous system.

- ➔ Neurons relay information to and from the central nervous system in the form of electrical impulses.

### STRUCTURE:

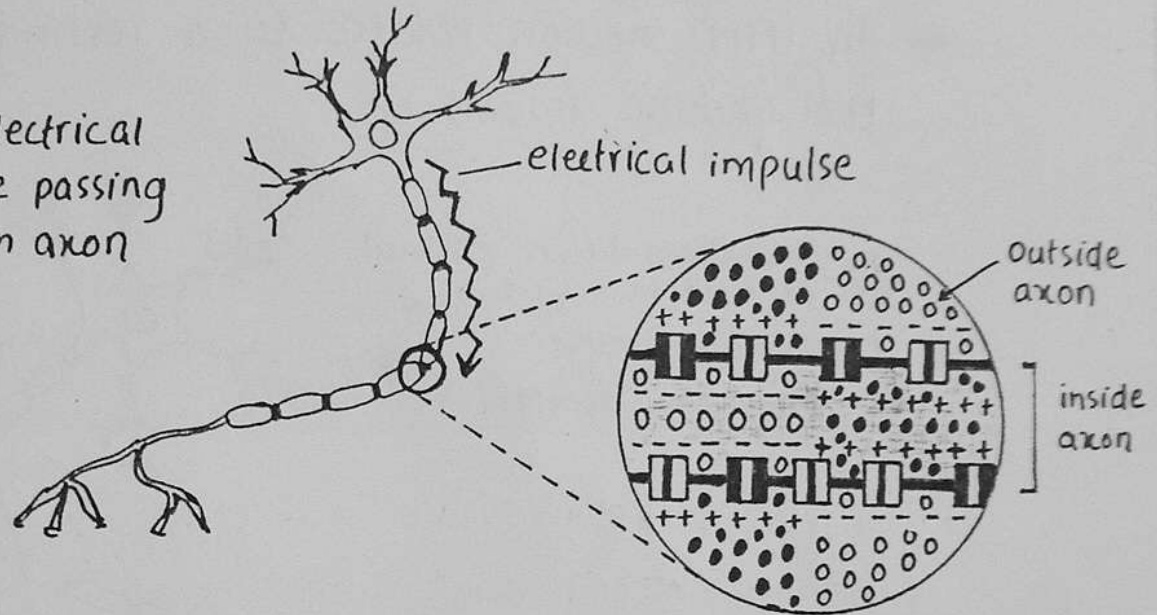
- ➔ The neuron consists of a central portion called the cell body and extensions called the dendrites and axons, cell body also has a nucleus.
- ➔ Dendrites receive stimuli in the form of electrical impulses.
- ➔ Impulses travel from the cell body along the axons to stimulate other cells in the body.
- ➔ A substance called myelin surrounds the axon.
- ➔ Gaps in the sheath are known as nodes of Ranvier.
- ➔ At the tip of the axon is a junction called a synapse.

### TRANSMISSION OF A NERVE IMPULSE:

- ➔ When the neuron is at rest, the axon maintains a chemical balance by keeping more potassium ions inside the cell and more sodium ions outside.
- ➔ When a signal is transmitted, the myelin sheath is stimulated at the nodes of Ranvier, allowing the ions to leak through.

- ➔ Potassium and sodium ions change places, creating an electrical signal that travels along the axon.

Fig: Electrical impulse passing through axon



- Sodium ( $\text{Na}^+$ ) ion
- Potassium ( $\text{K}^+$ ) ion
- ▮ Sodium channel (sodium ions move inside from here)
- ▮ Potassium channel (Potassium ions move outside from here)

### FROM ONE NEURON TO ANOTHER:

- ➔ The space between two neurons is called a synapse.
- ➔ Neurons communicate through the synapse, usually by means of chemicals known as neurotransmitters.
- ➔ When the impulse reaches the synapse, chemical



Transmitters ferry the impulse from the presynaptic side to receptors on the postsynaptic side, and the signal reaches the next neuron.

➔ The first neuron returns to a resting state, and the impulse travels on.

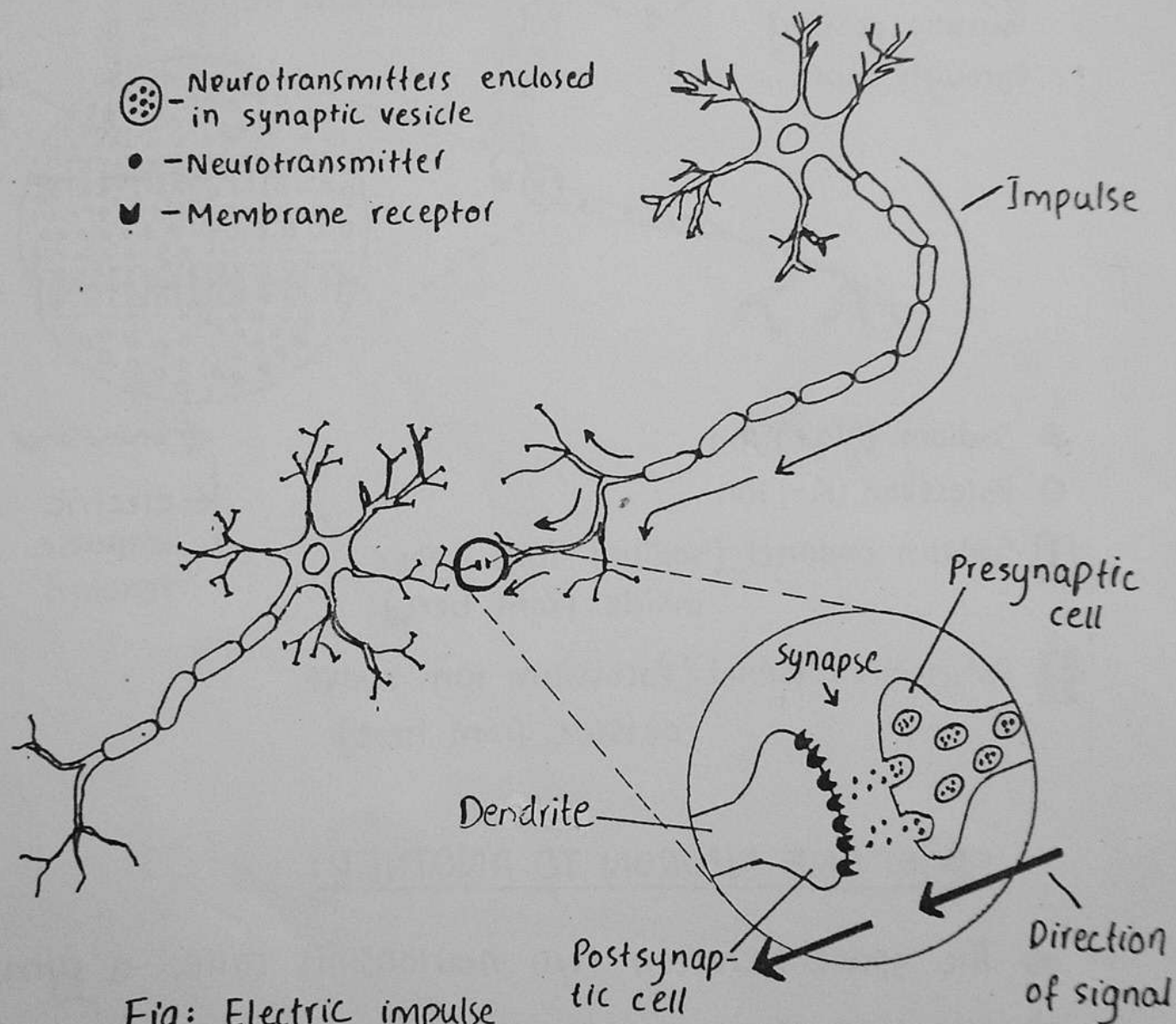


Fig: Electric impulse passing from one neuron to another with the help of neurotransmitters.

## 6- SKELETAL SYSTEM:

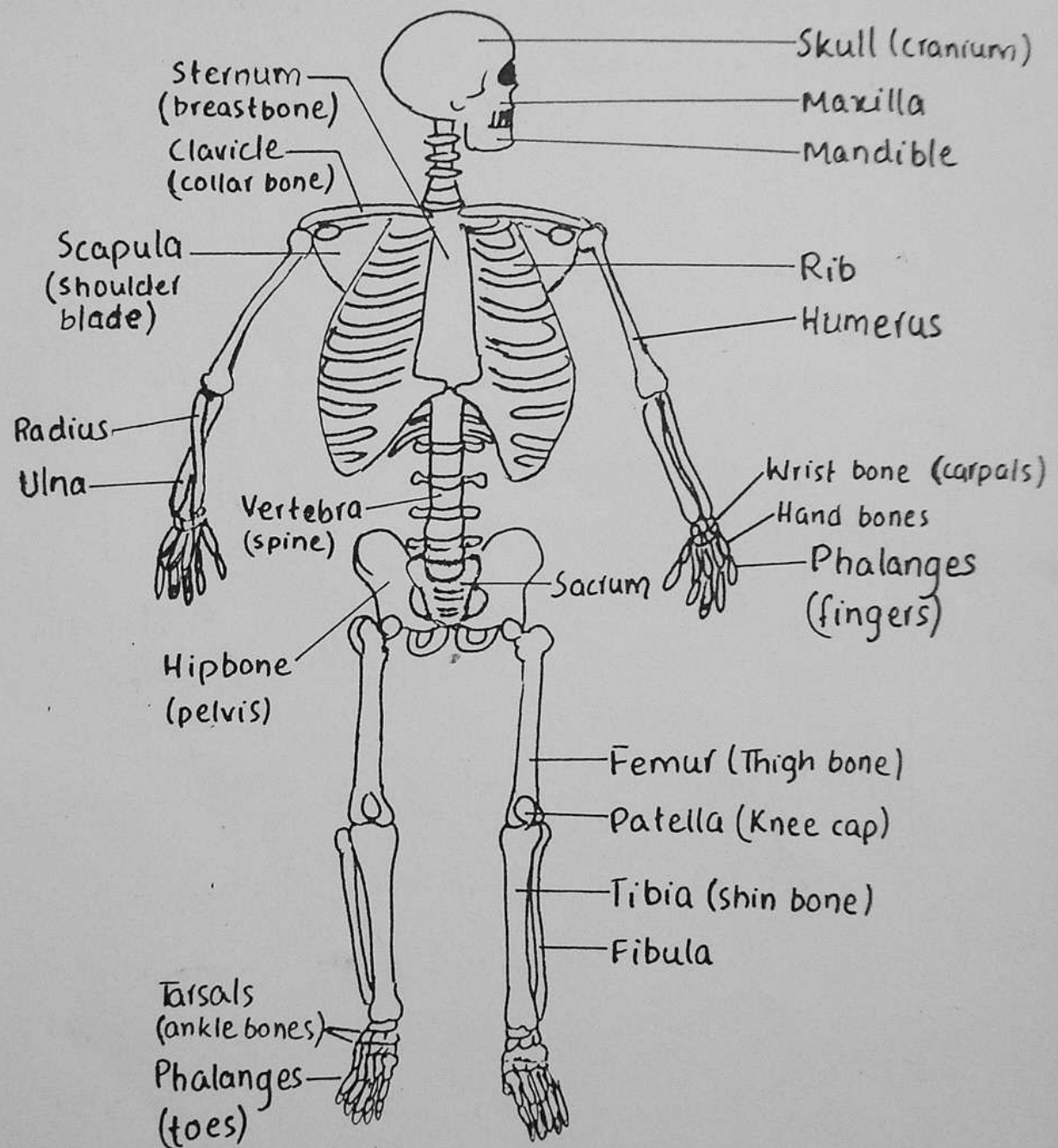


Fig: Rough sketch of Human skeleton

- ➔ Human skeleton is a strong framework of more than 200 bones which gives the body, shape, support and protection, and allows it to move. On average an adult human has 206 bones.
- ➔ It consists of both fused and individual bones supported and segmented by ligaments, tendons, muscles and cartilage.
- ➔ The biggest bone in the body is the femur in the thigh, and the smallest bone is stapes in the middle ear.
- ➔ The skeleton has two main parts :
  - i- Axial (central) skeleton
  - ii- Appendicular skeleton

### i- AXIAL SKELETON :

- ➔ The axial skeleton (80 bones) is formed by the vertebral column (26), the rib cage (12 pairs of ribs and the sternum), and the skull (22 bones and 7 associated bones)
- ➔ It transmits the weight from the head, the trunk, and the upper extremities down to the lower extremities at the hip joints,



it is responsible for upright position of the human body.

- ➔ The 366 skeletal muscles acting on axial skeleton position the spine, allowing for big movements in the thoracic cage for breathing, and the head.

## ii- APPENDICULAR SKELETON:

- ➔ The appendicular skeleton (126 bones) is formed by the pectoral girdles (4), the upper limbs (60), the pelvic girdle (2), and the lower limbs (60).
- ➔ Its function is to make locomotion possible and to protect the major organs of locomotion, digestion, excretion and reproduction.

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Pectoral girdle — part of the skeleton of human beings that provide attachment points and support for the arms.

Pelvic girdle — Part of the skeleton of human beings that provide attachment points and support for the legs.

## 6.1 - FUNCTIONS OF SKELETON :

➔ The skeleton serves 6 major functions:

- i- support
- ii- Movement
- iii- Protection
- iv- Blood cell production
- v- Storage
- vi- Endocrine regulation.

### i- SUPPORT :

➔ Skeleton provides the framework which supports the body and maintains its shape.

### ii- MOVEMENT :

- ➔ The joints between the bones permit movement.
- ➔ Movement is powered by skeletal muscles which are attached to the skeleton at various sites on bones.

### iii- PROTECTION :

- ➔ Skeleton protects many vital organs.
  - Skull protects the brain, the eyes, and the inner and middle ear.
  - Vertebrae protects the spinal cord.
  - Rib cage, spine and sternum protect the

lungs, heart and major blood vessels.

- The clavicle and scapula protect the shoulder.
- Ilium and spine protect the digestive ~~the digestive~~ and urogenital systems and the hip.
- Patella and ulna protect the knee and the elbow respectively.
- Carpals and tarsals protect the wrist and the ankle respectively.

#### IV- BLOOD CELL PRODUCTION:

- ➔ The skeleton is the site of haematopoiesis (red blood cell formation), which takes place in yellow bone marrow.
- ➔ Marrow is found in the center of long bones.

#### V- STORAGE:

- ➔ Bone matrix can store calcium and is involved in calcium metabolism, and bone marrow can store iron in ferritin (iron-containing protein) and is involved in iron metabolism.



- ➔ However, bones are not entirely made of calcium, but a mixture of chondroitin sulfate and hydroxyapatite, the latter making up 70% of a bone.
- 

Chondroitin sulfate: a sulfur-rich compound that is a component of cartilage and is taken as a dietary supplement to relieve arthritis and other conditions.

Hydroxyapatite: a hydrated calcium phosphate mineral.

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## vi- ENDOCRINE REGULATION:

- ➔ Bone cells release a hormone called 'osteocalcin', which contributes to the regulation of blood sugar (glucose) and fat deposition.
- ➔ Osteocalcin increases both the insulin secretion and sensitivity, in addition to boosting the number of insulin-producing cells and reducing stores of fat.

## 6.2- SEX-BASED DIFFERENCES:

- ➔ There are many differences between the male and female skeletons, most prominent is the difference in the pelvis.
- ➔ Owing to characteristics required for the processes of childbirth, the shape of a female pelvis is flatter, more rounded and proportionally larger to allow the head of a fetus to pass.
- ➔ Also, coccyx of a female is oriented more inferiorly whereas the male's coccyx is usually oriented more anteriorly, this difference allows more room for a developing fetus.
- ➔ Men tend to have slightly thicker and longer limbs and digit bones (phalanges) than those of women.
- ➔ Women tend to have narrower rib cages, smaller teeth, less angular mandibles, less pronounced (noticeable) cranial features and the carrying angle of the forearm is more pronounced in females.
- ➔ Females also tend to have more rounded shoulder blades.

**FAST FACTS:** (Just For Knowledge)

- ➔ Osteoporosis is a disease of bone, which leads to an increased risk of fracture.
- ➔ At birth, a newborn baby has over 300 bones, whereas on average an adult human has 206 bones. This difference comes from a number of small bones that fuse together during growth, such as the sacrum and coccyx of the vertebral column.
- ➔ All of a baby's bones contain marrow.
- ➔ American Society for Bone Mineral Research (ASBMR) demonstrates that weight-bearing exercise stimulates bone growth. Only the parts of the skeleton that are directly affected by the exercise will benefit. Non-weight-bearing activity, including swimming and cycling, has no effect on bone growth.

**CARTILAGE:** (Just For Knowledge)

- ➔ Cartilage, or gristle, fibrous connective tissue found in humans and vertebrate animals that provide support to the skeleton at specific sites throughout the body.
- ➔ It is composed of specialized cells, called chondrocytes, surrounded by a gelatinous matrix of collagen, a tough protein.



- ➔ The cartilage surface is covered by a membrane known as the perichondrium.
- ➔ The skeleton of vertebrate fetuses is composed largely of cartilage, which is eventually replaced by bone.
- ➔ Some cartilage persists into adulthood.
- ➔ It is fibrous and rubbery, providing support, flexibility to the ends of bone tissue and to the nose, ears, breastbone, trachea, larynx, joints and other parts of the body.
- ➔ Some animal skeletons, such as that of the shark, are completely cartilaginous.

### **BONE:** (Just For Knowledge)

- ➔ Bones are pale yellow and have their own blood vessels and nerves.
- ➔ They are a combination of living cells and minerals.
- ➔ Bone cells, called osteocytes, produce tiny rod-like structures of bone minerals, called osteons (Haversians systems).
- ➔ Bones are stiff because they contain crystals of minerals such as calcium and phosphate.
- ➔ They are also slightly flexible, because they contain fibres of the body protein, collagen,

so that they bend slightly under stress, rather than crack.

- ➔ In the middle of some bones is jelly-like marrow. This makes new cells for the blood, producing millions every second.
- ➔ All of a baby's bones contain marrow, but by adulthood, marrow is found mainly in the breast bone, backbone, ribs, thigh bone and skull.

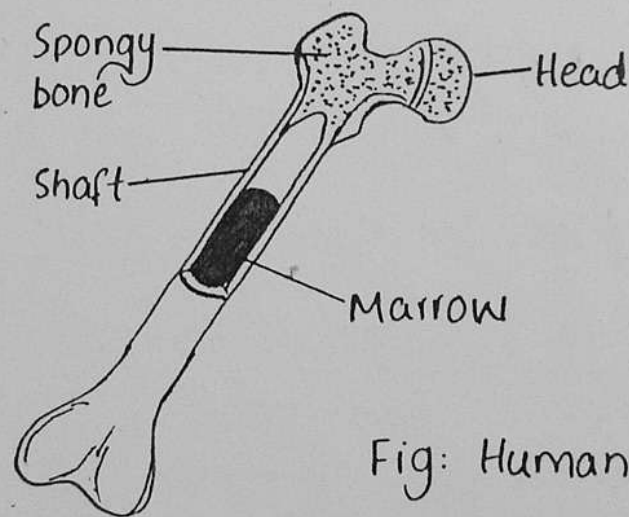
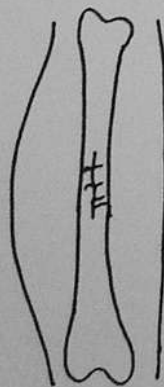
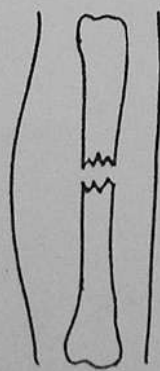


Fig: Human thigh bone

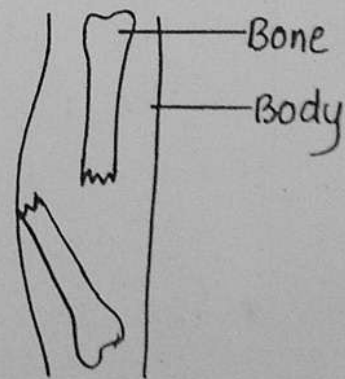
### TYPES OF FRACTURE :



Greenstick Fracture



Simple Fracture



Compound Fracture

## CHAPTER

## 4

## MISCELLANEOUS

1- CERAMICS:

- ➔ Ceramics (Greek 'keramos', "potter's clay"), originally the art of making pottery, now a general term for the science of manufacturing articles prepared from pliable, earthy materials that are made rigid by exposure to heat.
- ➔ Ceramic materials are nonmetallic, inorganic compounds—primarily compounds of oxygen, but also compounds of carbon, nitrogen, boron and silicon.
- ➔ Ceramics includes the manufacture of earthenware, porcelain, bricks and some kind of tile and stoneware.

A- PROPERTIES:

- ➔ Ceramics possess chemical, mechanical, physical, thermal, electrical and magnetic properties that distinguish them from other materials, such as metals and plastics.



#### a- CHEMICAL PROPERTIES:

- ➔ Industrial ceramics are primarily oxides (compounds of oxygen), but some are carbides (compounds of carbon and heavy metals), nitrides (compounds of nitrogen), borides (compounds of boron) and silicides (compounds of silicon).
- ➔ Ceramics are more resistant to corrosion than plastics and metals.
- ➔ Ceramics generally do not react with most liquids, gases, alkalis and acids.
- ➔ Most ceramics have very high melting points, and certain ceramics can be used up to temperatures approaching their melting points.
- ➔ Ceramics also remain stable over long periods.

#### b- MECHANICAL PROPERTIES:

- ➔ Ceramics are extremely strong, showing considerable stiffness under compression and bending.
- ➔ Bend strength, the amount of pressure required to bend a material, is often used to determine the strength of a ceramic.
- ➔ One of the strongest ceramics, zirconium dioxide ( $ZrO_2$ ) has a bend strength similar to that of steel.

- ➔ Zirconias retain their strength up to the temperatures of  $900^{\circ}\text{C}$ .
- ➔ Silicon carbides and silicon nitrides retain their strength up to the temperatures of  $1400^{\circ}\text{C}$ .
- ➔ Although ceramics are strong, temperature-resistant and resilient, these materials are brittle and may break when dropped or when quickly heated or cooled.

#### c- PHYSICAL PROPERTIES:

- ➔ Ceramics are less dense than most metals.
- ➔ Ceramics are also extremely hard, resisting wear and abrasion.
- ➔ Aluminum oxide and silicon carbide are extremely hard materials that are often used to cut, grind, sand and polish metals and other hard materials.

#### d- THERMAL PROPERTIES:

- ➔ Most ceramics have high melting points, meaning that even at high temperatures, ceramics resist deformation and retain strength under pressure.
- ➔ Silicon nitride and silicon carbide for example, withstand temperature changes better than most metals do.
- ➔ Large and sudden changes in temperature, however, can weaken ceramics.

- ➔ Materials that undergo less expansion or contraction per degree of temperature change can withstand sudden changes in temperature better than materials that undergo greater deformation.
- ➔ Silicon carbide and silicon nitride expand and contract less during temperature changes than most ceramics do.

#### e- ELECTRICAL PROPERTIES:

- ➔ Certain ceramics conduct electricity, e.g. chromium dioxide.
- ➔ Some ceramics may act as a semiconductor, e.g. silicon carbide.
- ➔ Other ceramics such as aluminum oxide, do not conduct electricity at all.
- ➔ So, ceramics can be used in electrical circuits according to their electrical properties.

#### f MAGNETIC PROPERTIES:

- ➔ Ceramics containing iron oxide ( $\text{Fe}_2\text{O}_3$ ) can have magnetic properties similar to those of iron, nickel and cobalt magnets.
- ➔ These iron oxide-based ceramics are called ferrites.
- ➔ Other magnetic ceramics include oxides of nickel, manganese and barium.



- ➔ Ceramic magnets, used in electric motors and electronic circuits.

## **B - MANUFACTURE:**

- ➔ The minerals used to make ceramics are dug from the earth and are then crushed and ground into fine powder.
- ➔ Industrial ceramics are produced from powders that have been tightly squeezed and then heated to high temperatures.
- ➔ Traditional ceramics, such as porcelain, tiles and pottery are formed from powders made from minerals such as clay, talc, silica and feldspar.
- ➔ Most industrial ceramics, however are formed from highly pure powders of specialty chemicals such as silicon carbide, alumina and barium titanate.
- ➔ The powder is first purified and then passes through molding process and densification process.

### **i- MOLDING:**

- ➔ The purified powder is added with small amount of wax and plastics to make it more workable and to give it desired pliability and softness.

➔ The powder can be shaped into different objects by various molding processes.

- SLIP CASTING: It is used to form hollow ceramic objects. The powder is poured into a mold that has porous walls, and then the mold is filled with water. The capillary action (forces created by surface tension and by wetting the sides of a tube) of the porous walls drains the water through the powder and the mold, leaving a solid layer of ceramic inside.
- PRESSURE CASTING: Ceramic is poured into a mold, and pressure is applied to the powder. The pressure condenses the powder into a solid layer of ceramic that is shaped to the inside of the mold.
- INJECTION MOLDING: It is used to make small intricate objects. It uses a piston to force the ceramic powder through a heated tube into a mold, where the powder cools, hardening to the shape of the mold. When the object has solidified, the mold is opened and the ceramic piece is removed.

❖ EXTRUSION: Extrusion is used to make products such as ceramic pipe, tiles and brick. It is a continuous process in which ceramic powder is heated in a long barrel. A rotating screw then forces the heated material through an opening of the desired shape. As the continuous form emerges from the die opening, the form cools, solidifies and is cut to the desired length.

## ii- DENSIFICATION:

- ➔ After being molded, the ceramic object is heated in an electric furnace to temperatures between  $1000^{\circ}\text{C}$  and  $1700^{\circ}\text{C}$ .
- ➔ As a result, ceramic particles merge, the object becomes increasingly dense, shrinking by up to 20% of its original size.
- ➔ The goal of this heating process is to maximize the ceramic's strength.

## C- APPLICATIONS:

- ➔ Ceramics are valued for their mechanical properties, including strength, durability and hardness.
- ➔ Their electrical and magnetic properties make them valuable in electronic applications, where they are used as insulators, semiconductors, conductors and magnets.



- ➔ Ceramics also have important uses in the aerospace, biomedical, construction and nuclear industries.

## 2- PLASTICS:

- ➔ The word 'plastic' is derived from the words "plasticus" (Latin for "capable of molding") and "plastikos" (Greek for "to mold")
- ➔ Plastics are materials made of large, organic molecules that can be formed into a variety of products.
- ➔ The molecules that compose plastics are long carbon chains (polymers) that give plastics many of their useful properties.
- ➔ Plastic can be made hard as stone, strong as steel, transparent as glass, light as wood and elastic as rubber.
- ➔ More than 50 families of plastics have been produced, and new types are currently under development.
- ➔ Most plastics are made from the chemicals obtained from petroleum oil.

## A- USES OF PLASTIC :

- ➔ Plastic replaces many metal and ceramic items because it is light but durable, e.g: bathtub.
- ➔ Many items are wrapped and sealed in plastic rather than paper bags.
- ➔ Polyester is a plastic that is widely used in clothing manufacture.
- ➔ Instead of wood, boats today are often made of strong, lightweight plastic.
- ➔ Plastic is used for replacement body parts, such as false teeth.
- ➔ Aerospace industry uses plastics to make strategic military parts for missiles, rockets and aircraft.
- ➔ Nearly 12% of a vehicle's overall weight comprises of plastic materials.

## B- TYPES OF PLASTICS:

- ➔ All plastics, whether made by addition or condensation polymerization, can be divided into two groups:
  - i- Thermoplastics
  - ii- Thermosetting plastics
- ➔ These terms refer to the different ways these types of plastics respond to heat.

## i- THERMOPLASTICS:

- ➔ Thermoplastics can be repeatedly softened by heating and hardened by cooling.
- ➔ Its molecules, which are linear or slightly branched, do not chemically bond with each other when heated.
- ➔ Instead, thermoplastic chains are held together by weak 'van der Waal forces' (weak attractions between the molecules) that cause the long molecular chains to clump together like piles of entangled spaghetti.
- ➔ That's the reason why thermoplastics can be heated and cooled, and consequently softened and hardened, repeatedly, like candle wax.
- ➔ For this reason, they can be remolded and reused almost indefinitely.

## ii- THERMOSETTING PLASTICS:

- ➔ Thermosetting plastics harden permanently after being heated once.
- ➔ These plastics consist of chain molecules that chemically bond or cross-link, with each other when heated.
- ➔ When thermosetting plastics cross-link, the molecules create a permanent, three-dimensional



- network that can be considered one giant molecule.
- ➔ Once cured, thermosetting plastics can not be remelted, in the same way that cured concrete can not be reset.
  - ➔ Consequently, these are often used to make heat-resistant products, because these plastics can be heated to temperatures of  $260^{\circ}\text{C}$  without melting.

### C- EXAMPLES:

#### i- Thermoplastics:

Polyethylene, Polyvinyl Chloride, Polypropylene, Polystyrene, Polyethylene Terephthalate and Polyamide etc.

#### ii- Thermosetting Materials:

Polyurethane, Phenolics, Epoxy, Reinforced plastics, Unsaturated polyesters, Melamine-formaldehyde, Urea-formaldehyde etc.

### D- LIMITATIONS OF PLASTICS:

- ➔ When burned, some plastics produce poisonous fumes.
- ➔ Due to their molecular stability, plastics do not easily break down into simpler components, as a result, disposal of plastics create a solid waste problem. Plastics are therefore not considered biodegradable.

### 3- SEMICONDUCTOR:

- ➔ Semiconductor is a solid or liquid material, able to conduct electricity at room temperature more readily than an insulator, but less easily than a metal. e.g: silicon, germanium etc.

#### A- EXPLANATION:

- ➔ A semiconductor's ability to conduct electricity is in between that of a conductor and insulator.
- ➔ However, at low temperatures, pure semiconductors behave like insulators, and under higher temperatures or light or with the addition of impurities, the conductivity of semiconductors can be increased dramatically.
- ➔ The physical properties of semiconductors are studied in solid-state physics.
- ➔ The increase in conductivity with temperature, light or impurities arises from an increase in the number of conduction electrons, which are the carriers of the electrical current.
- ➔ In a pure, or intrinsic semiconductor such as silicon, the valence electrons, or outer electrons, of an atom are paired and shared between atoms to make a covalent bond that holds the crystal together.

- ➔ These valence electrons are not free to carry electrical current.
- ➔ To produce conduction electrons, temperature or light is used to excite the valence electrons out of their bonds, leaving them free to conduct current.
- ➔ Deficiencies, or "holes" are left behind that contribute to the flow of electricity. (These holes are said to be carriers of positive electricity.)
- ➔ This is the physical origin of the increase in the electrical conductivity of semiconductors with temperature.
- ➔ The energy required to excite the electron and hole is called the energy gap.

### B- DOPING:

- ➔ A method to produce free carriers of electricity is to add impurities to, or to "dope," the semiconductor.
- ➔ The difference in the number of valence electrons between the doping material or dopant (either donors or acceptors of electrons) and host, gives rise to negative (n-type) or positive (p-type) carriers of electricity.



## i- n-TYPE SEMICONDUCTOR :

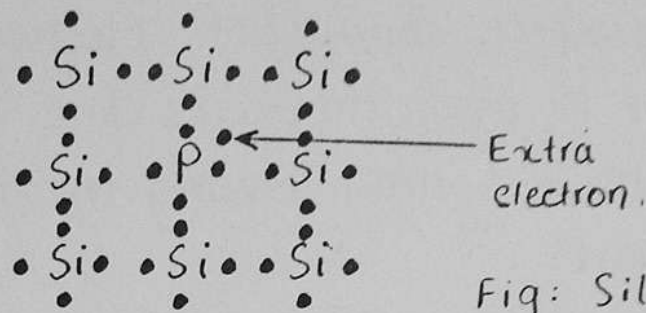


Fig: Silicon doped with phosphorus

- ➔ In the above diagram, each silicon atom has 4 valence electrons (represented by dots); two are required to form a covalent bond.
- ➔ In n-type silicon, atoms such as phosphorus (P) with 5 valence electrons replace some silicon and provide extra negative electrons for the conduction of electricity.

## ii- p-TYPE SEMICONDUCTOR:

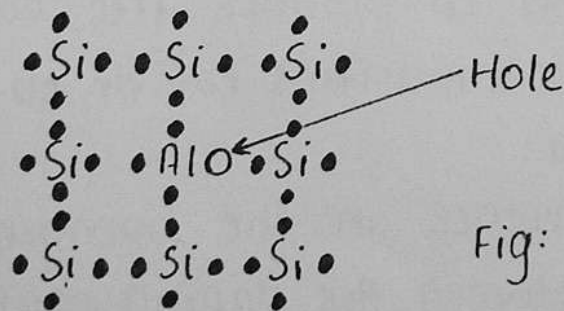


Fig: Silicon doped with aluminum

- ➔ In the above diagram, each silicon atom has 4 valence electrons (represented by dots); two are required to form a covalent bond.

- ➔ In p-type silicon, atoms with 3 valence electrons such as aluminum (Al) lead to a deficiency of electrons, or to holes, which act as positive electrons, which conduct electricity.

### C- SEMICONDUCTOR DIODE:

- ➔ When p-type and n-type semiconductor regions are adjacent to each other, they form a semiconductor diode.
- ➔ The region of contact of both the types is called a 'p-n junction'.
- ➔ A diode is a two terminal device that has a high resistance to electric current in one direction but low resistance in the other direction.
- ➔ The conductance properties of p-n junction depend on the direction of voltage, which can, in turn, be used to control the electrical nature of the device.
- ➔ Series of such junctions are used to make transistors and other semiconductor devices such as solar cells, p-n junction lasers, rectifiers etc.

#### 4- RADIO (RECEIVER):

- ➔ A conventional radio is a device used at homes that extracts information (sound) from radio-frequency (rf) energy received at antenna.
- ➔ Technically, it is an electronic circuit that receives its input from an antenna, uses electronic filters to separate a wanted radio signal from all other signals picked up by this antenna, amplifies it to a level suitable for further processing, demodulates and decodes the original information signal, and gives its output in the form of sound or pictures etc.

#### A-CONSTRUCTION:

- ➔ The essential components of a radio receiver are:
  - i- An 'antenna' for receiving the electromagnetic waves and converting them into electrical oscillations.
  - ii- 'Amplifiers' for increasing the intensity of these oscillations.
  - iii- 'Demodulator' to separate original information (base-band) frequency from carrier frequency.



- iv- A 'speaker' for converting the impulses into sound waves audible by the human ear.
- v- In most radio receivers, 'oscillators' to generate radio-frequency waves that can be "mixed" with the incoming waves.

### B-WORKING:

- ➔ Most modern radio receivers are of the 'super-heterodyne' type in which an oscillator generates a radio frequency wave that is mixed with the incoming wave, thereby producing a radio frequency wave of lower frequency; the latter is called 'intermediate frequency.'
- ➔ To tune the receiver to different frequencies (stations), the frequency of the oscillations is changed, but the intermediate frequency always remains the same (at 455 kHz for most AM receivers and at 10.7 MHz for most FM receivers).
- ➔ The oscillator is tuned by altering the capacity of the capacitor in its 'tank-circuit'; the antenna is similarly tuned by a capacitor.
- ➔ The radio-frequency received by antenna is then fed to voltage amplifiers for amplification of signals.

- ➔ The amplified radio frequency then reaches the detector (second detector) and the mixer (first detector). These detectors are simply diodes acting as rectifiers that produce an audio-frequency signal from radio-frequency signal.
- ➔ FM waves are demodulated or detected by circuits known as 'discriminators' or 'radio-detectors' that translate the varying frequencies into varying signal amplitudes.
- ➔ In the end, the audio-frequency signal or the information signal is converted into audible sound with the help of speakers.

## 5- LASER:

- ➔ A laser is a machine/device that produces a powerful beam of light.
- ➔ The word 'laser' is short for 'Light Amplification by Stimulated Emission of Radiation'.
- ➔ A laser light has all waves of same wavelength, same energy and more is same direction.
- ➔ It is an organized and coherent light.
- ➔ Albert Einstein first proposed stimulated emission, the underlying process for laser action, in 1917.
- ➔ Theodore Maiman of Hughes Aircraft Corporation constructed the first working laser from a ruby rod in 1960.

### A-TYPES:

- ➔ Lasers are generally classified according to the material, called the medium, they use to produce the laser light.

i- SOLID-STATE LASERS: They produce light by means of a solid-medium, mostly rods of ruby crystal.



ii- GAS LASERS: Their lasing medium can be a pure gas, a mixture of gases, or even metal vapour.

iii- LIQUID LASERS: Most common lasing medium are inorganic dyes contained in glass vessels.

iv- SEMICONDUCTOR LASERS: Most compact lasers. Lasing medium are layers of semiconductor, typically gallium arsenide.

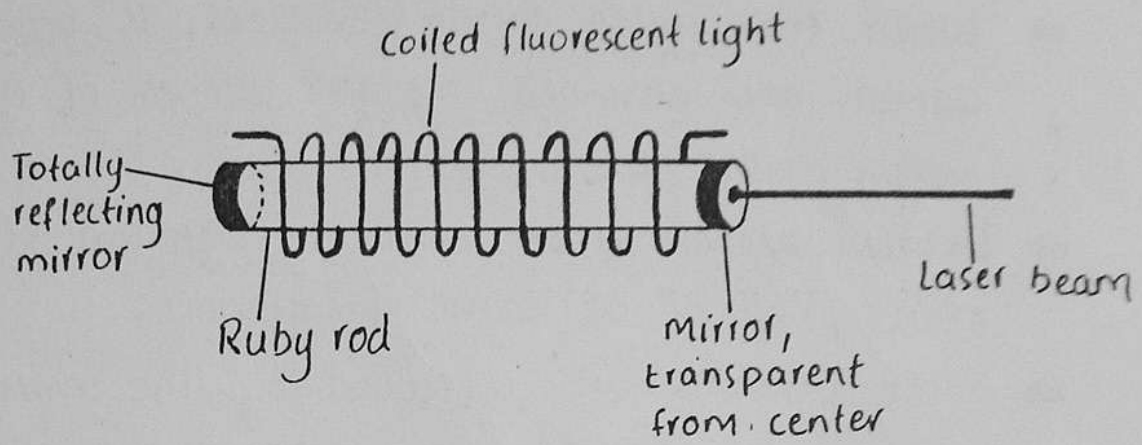
v- FREE ELECTRON LASERS: These employ an array of magnets to excite free electrons (electrons not bound to atoms).

### B-COMPONENTS OF SOLID-STATE LASER:

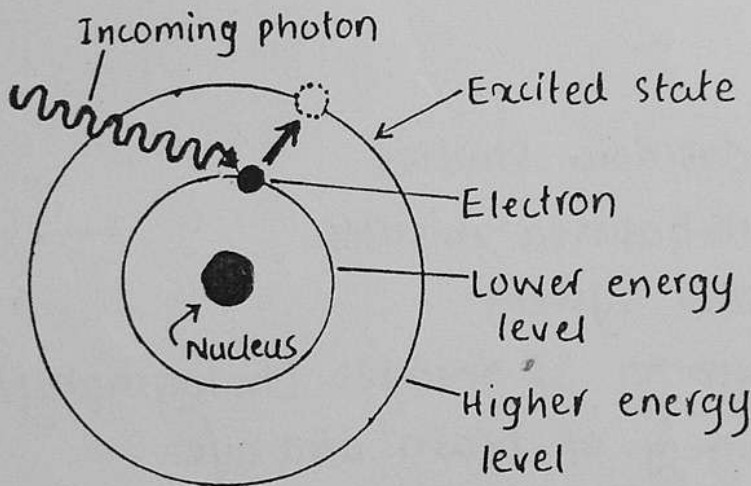
i- Active medium or Lasing medium  $\longrightarrow$  Ruby rod

ii- A source of energy  $\longrightarrow$  A coiled fluorescent light.

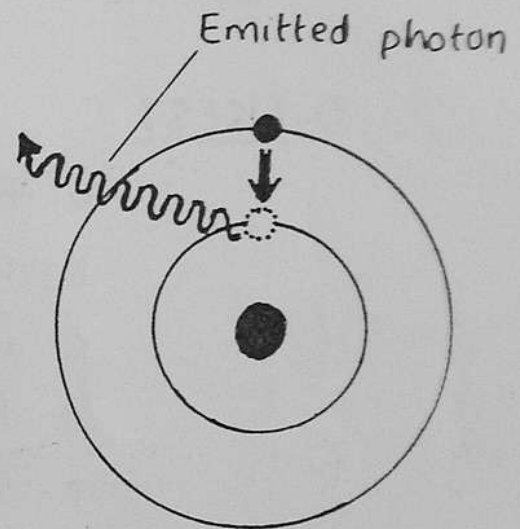
iii- A pair of silvered mirrors, one slightly transparent from center.



### C- MECHANISM:



A: Absorption



B: Emission

Fig: A: Absorption:

When a photon is absorbed by an atom, the atom gains the energy, and one of the atom's electrons may jump to the higher energy level, the atom is said to be excited.

B: Emission:

When an electron of an excited atom falls to a lower energy level, it emits the excess energy in the form of photon and comes to ground state.

- ➔ When the coiled lamp energizes, it emits photons which are absorbed by the atoms of the ruby which makes them excited
- ➔ Excited atoms when come to ground state, they emit photons of same frequencies.
- ➔ These photons are reflected by the mirrors, till a beam of light escapes from hole of one of the mirrors as a laser beam.

#### D-USES:

- a- Endoscopic studies
- b- Anti-ballistic missiles
- c- Radar system
- d- Forming 3-D images (holography)
- e- Surgery of brain and eye
- f- Removing decay from tooth
- g- Cutting hard materials
- h- Detecting flaws in fabrics, etc



## 6- SATELLITE (ARTIFICIAL)

- ➔ Satellites are objects that move in orbit around other objects of greater mass.
- ➔ A satellite may be natural, like the moon, or artificial, like an orbiting aircraft.
- ➔ Artificial satellite is any object purposely placed into orbit around Earth, other planets or the Sun.
- ➔ Sputnik 1 is the world's first artificial satellite launched by Russia on Oct 4, 1957, it was used to broadcast scientific data and orbited the Earth for 6 months.

### A- TYPES OF SATELLITES:

- ➔ Engineers have designed many kinds of satellites, each designed to serve a specific purpose or mission.

- i- Communications satellites
- ii- Navigation satellites
- iii- Weather satellites
- iv- Military satellites
- v- Scientific satellites

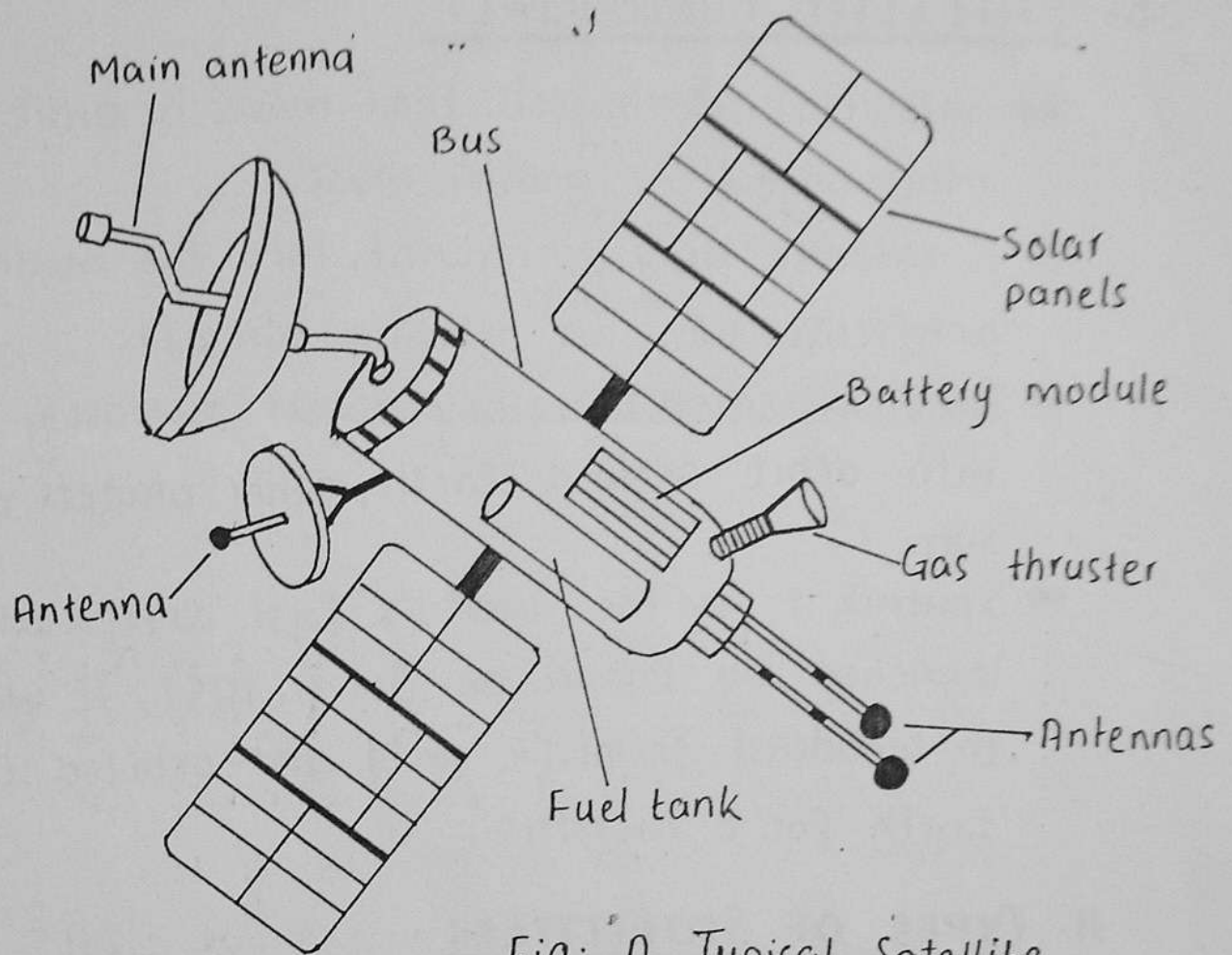


Fig: A Typical Satellite

### i- COMMUNICATIONS SATELLITES:

- ➔ Communications satellites are used by the telecommunications and broadcasting industries to carry radio, television and telephone signals over long distances without the need for cables or microwave relays.
- ➔ Almost all of the previous satellites were communications satellites.
- ➔ NASA launched the first telephone and television satellite, "AT&T's Telstar 1", in 1962.

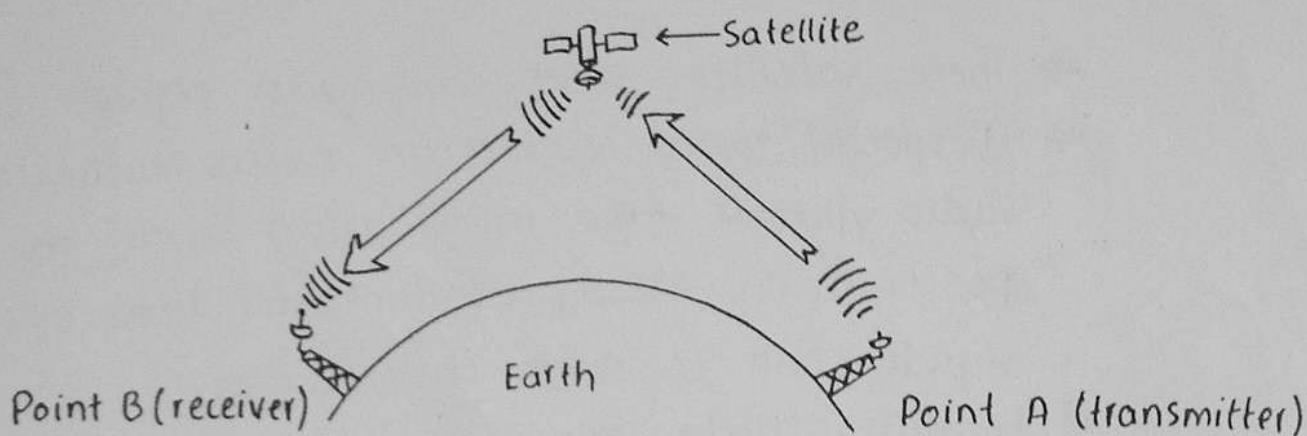


Fig: Communication between point A and B through satellite.

- ➔ Modern communications satellites receive, amplify and retransmit information back to earth, providing television, telefax, telephone, radio and digital data links around the world.
- ➔ Syncom 4 follows a 'geosynchronous orbit'— that is, it orbits at the same speed as the Earth spins, keeping the satellite in a fixed position above Earth. This type of orbit enables uninterrupted communication links between ground stations.

## ii- NAVIGATION SATELLITES:

- ➔ Navigation satellites help locate the position of ships, aircraft, and even automobiles that are equipped with special radio receivers.



- ➔ These satellites send continuous signals to Earth.
- ➔ A special radio receiver on Earth translates these radio signals into information about the satellite's position, its speed, direction and how long the signal took to reach the receiver.
- ➔ From this data, the receiver can calculate its own location.
- ➔ Some navigation satellite systems use signals from several satellites at once to provide even more exact location information by using the method known as "triangulation".
- ➔ The U.S. Navy launched the first navigation satellite, "Transit 1B", in 1960.

#### MODERN NAVIGATION SATELLITE SYSTEMS:

GPS - The U.S. Air Force operates a system, called the NAVSTAR Global Positioning System (GPS), that consists of a network of 24 satellites orbiting the Earth. Its location information accuracy varies from 100 metre to 1 cm depending upon the receiver and method used.

GLONASS - The Global Orbiting Navigation Satellite System (GLONASS) of the Russian Federation consists of a network of 24 satellites, with accuracy similar to GPS.

### iii- WEATHER SATELLITES:

- ➔ Weather satellites carry cameras and other instruments pointed towards Earth's atmosphere.
- ➔ They can provide advance warning of severe weather and are a great aid to weather forecasting.
- ➔ National Aeronautics and Space Administration (NASA) launched the first weather satellite, Television Infrared Observation Satellite 1 (TIROS 1), in 1960, which transmitted almost 23000 photographs of Earth and its atmosphere.

### iv- MILITARY SATELLITES:

- ➔ Many military satellites are similar to commercial ones, but they send encrypted data that only a special receiver can decipher (decode).
- ➔ Military surveillance satellites take pictures just as other earth-imaging satellites do, but cameras on military satellites usually have a higher resolution.
- ➔ The U.S. Military's "Defense Satellite Communication System" (DSCS) consists of 5 spacecraft in geostationary orbit that transmit voice, data and television signals between military sites.

- Some military satellites provide data that is available to the public. For instance, the satellites of the Defense Meteorological Satellite Program (DMSP) collect and disseminate global weather information.

## V- SCIENTIFIC SATELLITES:

- Scientific satellites provide data to map Earth, determine the size and shape of Earth and study the dynamics of oceans and atmosphere.
- These satellites are also used to observe the Sun, the Moon, other planets and their moons, comets, stars, galaxies etc.
- The Hubble Space Telescope (HST) is a general-purpose observatory launched in 1990.
- Some scientific satellites orbit bodies other than the Earth. The Mars Global Surveyor (MGS), for example, orbits the planet Mars.

## B- SATELLITE ORBITS:

- A satellite's controllers choose an orbit with a particular combination of shape, altitude and angle (with Earth's equator) that will best serve the satellite's mission.



- ➔ Most orbits are circular, but some are elliptical.
- ➔ Some satellites move clockwise around Earth (as seen from the North Pole), but most satellites move counter-clockwise.
- ➔ Five orbits are important:
  - i- Geostationary Equatorial Orbit
  - ii- Low Earth Orbit
  - iii- Medium Earth Orbit
  - iv- Polar Orbits
  - v- Sun-Synchronous Orbits

### i- GEOSTATIONARY EQUATORIAL ORBIT:

- ➔ Satellites in Geostationary Equatorial Orbit (GEO) are called geosynchronous or Earth-synchronous satellites.
- ➔ Its altitude is 38,500 km.
- ➔ Satellites in GEO orbit Earth around the equator in the same amount of time that it takes Earth to rotate once.
- ➔ These satellites stay above one point on Earth's equator at all times.
- ➔ Direct-broadcast television satellites (DBS), Earth surveillance satellites etc are all in GEO.

## ii- LOW EARTH ORBIT :

- ➔ Low Earth Orbit (LEO) has an altitude of 2000 km or less.
- ➔ Lesser fuel is needed to reach LEO.
- ➔ A satellite in LEO can obtain clearer images of the Earth due to lesser altitude.
- ➔ It can avoid Van Allen Radiation Belts, which contain harmful high-energy particles.
- ➔ It needs less powerful signals to communicate with Earth than satellites with higher orbits.
- ➔ Data transmission is quicker due to lesser altitude.

## iii- MEDIUM EARTH ORBIT:

- ➔ Medium Earth Orbit (MEO) satellites orbit the Earth at an altitude about 10,000 km.
- ➔ MEO satellites balance the benefits and problems between LEO and GEO.
- ➔ The most common uses of MEO are navigation and communication satellites.
- ➔ The U.S. NAVSTAR GPS, the Russian GLONASS and Odyssey, a private U.S. communication satellite program, all use MEO.

#### IV- POLAR ORBITS:

- ➔ Satellites in polar orbits, orbit around Earth at right angles to the equator over both the North and South poles.
- ➔ Polar orbits can occur at any altitude, but most satellites in polar orbits use LEOs.
- ➔ Two satellites belonging to the U.S. National Oceanic and Atmospheric Administration provide weather information for all areas of the world every 6 hours.
- ➔ The purposes of polar orbit satellites include observing poles, mapping ozone levels, in the atmosphere, navigation in polar regions etc.

#### V- SUN-SYNCHRONOUS ORBITS:

- ➔ A satellite in a Sun-synchronous orbit is called a Sun-synchronous satellite, and it is synchronous with the Sun with respect to Earth.
- ➔ This satellite always passes over a certain point of Earth when the Sun is at the same position in Earth's sky.
- ➔ A Sun-synchronous satellite has a retrograde orbit (it moves clockwise around Earth),



orbits in LEO and orbits at a specific angle with respect to equator (about  $98^\circ$ ).

→ These satellites are useful for photographing Earth, because the Sun will be at the same angle each time the satellite passes over a point on Earth.

## DIFFERENCE BETWEEN: (CSS-1996 — CSS-2010)

1 HYDROMETER	HYGROMETER
(2010)(i) An instrument used to measure either specific gravity or density of a liquid.	Any of various types of instruments used to measure atmospheric humidity.
(ii) It is based on the hydrostatic principle of Archimedes.	A simple form of hygrometer utilizes the change in length in an organic fiber (often a single human hair) brought about by the absorption of moisture.
(iii) It works at standard temperature, usually $4^{\circ}\text{C}$ .	Standard temperature is not necessary.
2 PERIMETER	TELEMETER
(2010)(i) It is a boundary line drawn around the edge of an area or shape, e.g. perimeter of a square is the sum of its 4 sides.	It is a device used for measuring distances directly that does not use rods or chains across the distance to be measured.

3

**ISOTOPE**

(2010) (i) One of two or more species of an atom having same atomic number but different mass number.

**ISOMER**

One of two or more molecules that contain the same atoms but have different arrangements of those atoms.

(ii) Isotopes of same element differ from one another only in the number of neutrons in their nucleus.

Isomers of the same atoms differ from one another only in the arrangement of atoms.

**4 FLYING MAMMALS**

(2010) (i) They give birth to their young.

**BIRDS**

All birds lay eggs.

(ii) They nourish their young with milk.

Birds do not.

(iii) They have small but solid bones.

Have mostly thin, hollow bones.

(iv) X and Y chromosomes to determine sex.

Z and W chromosomes to determine sex.

(v) Only 1 species is known yet i.e. bat.

There are many species of birds e.g. crow, ostrich, kingfisher etc.



5

**VERTEBRATES**

(2010  
2005) (i) They have spinal cord.

(ii) They have endoskeleton.  
e.g human, cats, snakes etc.

**INVERTEBRATES**

They do not have spinal cord.

Many of them have exoskeleton e.g: cockroach, spiders. while others do not have skeleton at all e.g sponge, jellyfish etc.

6

**UMBRA**

(2009  
2005  
2002) (i) The darkest portion of the shadow cast by an astronomical object during an eclipse.

**PENUMBRA**

A partial outer shadow that is lighter, and lies between complete darkness (umbra) and complete light in an eclipse.

7

**HEAVY WATER**

(2009  
2002  
1999) (i) Water that has had its hydrogen atoms replaced with the hydrogen isotope 'deuterium'.

**HARD WATER**

Natural water, containing calcium and magnesium salts and to a small extent, iron, aluminum and other metals.

(ii)	Harmful to one's health if consumed in large amount.	Not harmful to one's health.
(iii)	Used in nuclear reactors.	Can pose serious problems in industrial settings.

8

## SMOG

(2009) (i) A mixture of fog and smoke or other airborne pollutants such as exhaust fumes.

(ii) It is formed when humidity is high, and the air so calm that smoke and fumes accumulate near their source.

## SMOKE

A mass of tiny particles in the air that rises up from something burning.

It is usually produced by combustion process.

9

## MYOPIA

(2009) (i) Distant objects are not clear.

(ii) Eye lens becomes harder and convergence takes place before retina.

## HYPEROPIA

Near objects are not clear.

Eye lens becomes weak and convergence takes place after retina.

(iii) For rectification, concave lens is used.

For rectification, convex lens is used.

10

**MAGMA**

(2009, 2003) (i) Molten or partially molten rock beneath the earth's surface.

**LAVA**

Molten or partially molten rock that erupts at the earth's surface.

OR

Magma that erupts is called lava.

11

**PERISCOPE**

(2009) (i) A long tubular optical instrument, (e.g. on a submarine) that allows a viewer to see objects not in a direct line of sight.

**PERIMETER**

A boundary line that encloses an area.

12

**X-RAYS**

(2009) (i) X-rays are emitted by electrons outside the nucleus.

**GAMMA RAYS**

Gamma-rays are emitted by excited nucleus itself.



(ii) Frequencies vary from 30 petahertz ( $10^{15}$  hertz) to 30 exahertz ( $10^{18}$  hertz).

Frequencies are above  $10^{19}$  Hz.

(iii) Not much dangerous to human health.

A lot more dangerous and hazardous to human health.

(iv) can not be produced along with alpha and beta rays.

Can be produced along with alpha and beta rays.

13

### FISSION

### FUSION

2008 (i) An energy releasing process in which an atom is split into two or more smaller particles.  
1996)

An energy releasing process in which two or more smaller atoms are fused together to form a larger atom.

(ii) It normally does not occur in nature.

It takes place in nature like stars.

(iii) Fission only needs a low energy for splitting the atom.

Fusion takes place only under massive energy.

(iv) It is not environment friendly.	It is more environment friendly.
(v) It happens because of chain reaction .	No chain reaction happens in it.
(vi) Energy from fission can be controlled.	Energy can not be controlled.
(vii) Fission reactors are developed.	Fusion reactors are yet to be developed.

## 14 STAR

(2008  
1996) (i) Stars are large balls of hot gases (mostly hydrogen and helium).

(i) Stars appear to be still.

(ii) stars produce their own light and heat through nuclear reactions.

(iii) Stars are much more heavier and larger than planets.

## PLANET

Planets may be rocky, like the Earth, or made mostly of gas and liquid, like Jupiter.

Planet orbits a star .

Planets rely on light and heat obtained from star.

Planets are much more smaller than stars.

15

**POLLINATION**

(2008) (i) It is the transfer of pollen grains from the male structure of a plant to the female structure of a plant.

(ii) It occurs only in plants.

(iii) Pollination prepares the plant for fertilization.

**FERTILIZATION**

It is the process in which gametes—a male's sperm and a female's egg or ovum fuse together, producing a single cell that develops into an adult organism.

It occurs in both animals and plants that reproduce sexually.

Fertilization prepares the organism for reproduction.

16

**TELESCOPE**

(2008) (i) An optical instrument used to view distant objects.

(ii) By means of compound lenses or concave mirrors, it makes distant objects appear nearer and larger.

**MICROSCOPE**

An optical instrument used to view extremely small objects.

It makes use of a system of lenses to produce a greatly magnified image of an object.



17

## ANTIBIOTIC

(2008)(i) A compound or a substance that kills or inhibits the growth of bacteria.

(ii) Antibiotics work during the time of disease.

(iii) Antibiotics are taken after getting infected.

(iv) It kills bacteria.

(v) Available in different forms like tablets, capsules, drops or ointments.

## VACCINE

Vaccine is a preparation that improves the immunity to a particular disease.

Vaccine is taken once and has permanent effect, as it becomes part of the immune system.

Vaccines are preventive method that is taken before getting infected.

It kills virus.

can be given orally or through injection.

18

## BIT

(2007  
1997)(i) A bit is one binary digit (either '0' or '1').

(ii) It stores a single numeric value, either '0' or '1'.

## BYTE

A byte is collection of 8 bits.

It stores a single character e.g 'A', 'B', 'X' etc.

19

**ROM****RAM**(2007  
1997)

(i) Acronym for "read-only memory".

Acronym for "random access memory."

(ii) It is slower.

It is faster.

(iii) It is non-volatile memory.

It is volatile memory.

(iv) In most systems it comes in the form of hard drive.

It exists in the form of chips.

(v) ROM can be used as virtual RAM.

RAM can't be used as virtual ROM.

20

**EPIDEMIC****ENDEMIC**

(2007)

(i) An outbreak of a disease that spreads more quickly and more extensively among a group of people than would normally be expected.

Describes a disease occurring within a particular area.

21

**PHOTOSYNTHESIS****RESPIRATION**

(2007)(i) Occurs only in plants.

Occurs in both animals and plants.

(ii) Involves the production of carbohydrates.Involves the use of carbohydrates.(iii) It captures light energy and converts it to chemical energy.

It takes chemical energy and breaks it down, releasing energy.

(iv) Sunlight is required.Sunlight is not required.

(v) It uses carbon dioxide and water to make sugar and release oxygen as a by product.

It uses sugar and oxygen to produce energy and release carbon dioxide as waste.

22

**HERBIVORES****CARNIVORES**

(2007)(i) Refers to animals that consume only plant products, for food.

Refers to animals that consume the flesh and meat of other animals, for food.

(ii) They have flat, spade-shaped canines and dull, short incisors, to help them grind food.

They have sharp incisors and canines, to help them tear their prey's flesh.



(iii). They merely utilize their mouths for consuming food which is why they only have small mouth openings.

They use their teeth as a weapon, making it necessary for their mouth openings to be relatively larger.

## 23 **RADIOTHERAPY**

(2005)(i) Also called radiation therapy.

(ii) It is the use of targeted radiation to destroy tumor cells.

(iii) It targets only the cancer cells.

(iv) It is roughly used for local cancer.

## **CHEMOTHERAPY**

Also called chemical therapy.

It is the use of drugs to destroy rapidly dividing cells.

It affects both cancerous and non-cancerous cells.

It is a "full body" therapy.

## 24 **SPRINGTIDE**

(2005)(i) The season of spring between winter and summer.

## **NEAP TIDE**

A tide that shows the least range between high and low.

(ii) It occurs once in a year.

It occurs twice a month between the first and third quarters of the moon.

25

### FLUORESCENT LIGHT

### NEON SIGN

(2005)(i) It produces light by causing a substance called a phosphor to emit light.

Neon signs are made up of neon light that use neon gas to emit light.

(ii) It emits white light.

Neon signs could be colourful.

(iii) It comes in long tubular shape and can not be bent.

It can be bent into many shapes.

(iv) It is used in houses and offices etc, for lighting purpose.

Neon signs are used in advertisement of products and stores etc.

26

### ULTRAVIOLET

### INFRARED

(2003)(i) Its wavelength is about hundred thousandth of a millimeter.

Its wavelength is about hundredth of a millimeter.

(ii) Higher energy, higher frequency waves, just above the visible spectrum.

Relatively lower energy, lower frequency waves, just below the visible spectrum.

(iii) Ultraviolet tends to affect the microscopic, affecting individual molecules and atoms.

Infrared tends to affect things macroscopically, eg. heating the object as a whole.

27

## FAULT

(2003)(i) It is the crack in the crust of the Earth along which there has been movement of the rocks on either side of the crack.

(ii) A fault zone is where the sides of the broken rock have moved relative to each other.

## FOLD

It is a bend in a rock layer caused by forces within the crust of the Earth.

Folds usually occur in a series and look like waves in the rock.



**28 CAUSTIC SODA**

(2003)(i) chemical name is sodium hydroxide ( $\text{NaOH}$ ).

(ii) A brittle white alkaline solid.

(iii) Used in the manufacture of paper, rayon, soap, pharmaceuticals.

**CAUSTIC POTASH**

Chemical name is potassium hydroxide ( $\text{KOH}$ ).

A caustic toxic white solid.

Used in the manufacture of soap, detergents, matches, liquid shampoos, etc.

**29 SEM**

(2003)(i) Acronym for "scanning electron microscope."

(ii) Electron beam scans over surface of sample.

(iii) Image is shown on TV monitor.

(iv) It can magnify upto about 200,000 times.

(v) Its resolution or resolving power is about  $\pm 2 \text{ nm}$ .

**TEM**

Acronym for "transmission electron microscope."

Electron beam passes through thin sample.

Image is shown on fluorescent screen.

It can magnify up to about 500,000 times.

Its resolution or resolving power is about  $\pm 0.2 \text{ nm}$ .

### 30 ROTATION OF EARTH

(2002)(i) Rotation of Earth takes place on its axis.

(ii) It causes days and nights to vary.

(iii) It takes approx: 24 hours to rotate once.

### REVOLUTION OF EARTH

Revolution is its motion around Sun.

It causes the variation of seasons.

It takes about 365.25 days to revolve once.

### 31 MONOCOT PLANTS

(2002)(i) Their seeds are in one piece e.g corn.

(ii) They have flower parts (like petals) in multiples of 3.

(iii) They have veins branching up and down the leaf.

### DICOT PLANTS

Their seeds can easily be split in half e.g pea.

They usually have them in multiples of 4 or 5.

They have veins branching from a thick, central midrib.

32

**NUCLEUS**

(2002) (i) It is a membrane-bound organelle found in all eukaryotic cells.

(ii) It contains most of the cell's genetic material and is involved in protein synthesis.

(iii) It is typically round and occupies about 10% of the cell's total volume.

**NUCLEOLUS**

It is a non-membrane bound structure found within the nucleus.

It is composed of protein and nucleic acids and is involved in the manufacture of ribosomes.

It appears as irregularly shaped fibers and granules.

33

**DNA**

(2001) (i) It stands for deoxyribonucleic acid.

(ii) Found in nucleus.

(iii) Sugar is deoxyribose.

(iv) Bases are adenine, thymine, cytosine and guanine.

(v) It contains genetic instructions.

**RNA**

It stands for ribonucleic acid.

Found in nucleus and cytoplasm.

Sugar is ribose.

Bases are adenine, uracil, cytosine and guanine.

It translates the instructions of DNA and synthesizes protein.



(vi) Typically a double-stranded molecule with long chain of <u>nucleotides</u> .	Mostly, a single-stranded molecule with shorter chain of <u>nucleotides</u> .
(vii) Helix geometry of DNA is of <u>B-form</u> .	Helix geometry of RNA is of <u>A-form</u> .
(viii) DNA is completely protected by the body i.e., the body destroys enzymes that cleave DNA.	RNA strands are continually made, broken and reused.
(ix) Can be damaged by exposure to UV rays.	More resistant to damage by UV rays.

34 (2001)	<b>BRASS</b>	<b>BRONZE</b>
(i)	It is a combination of copper and zinc.	It is a combination of copper and tin.
(ii)	It is more greyish greenish, bluish in colour.	It is brownish in colour.
(iii)	Less expensive.	Almost 4 times more expensive than brass.
(iv)	Softer and weaker.	Harder and stronger.
(v)	Less corrosion and abrasion resistant.	More corrosion and abrasion resistant.

(vi) It melts at lower temperature and is polished easily.

Its melting point is much higher than brass and is polished with difficulty.

35

**BLOOD****LYMPH**

(2001)<sub>(i)</sub> It contains red blood cells, white blood cells, plasma and platelets.

It is diluted blood plasma containing large numbers of white blood cells.

(ii) Red in colour.

Milky in colour.

(iii) It is pumped by heart.

It mobilizes by the normal movement of the body.

(iv) It is associated with the circulation of oxygen and carbon dioxide.

Its function is entirely defensive and it forms a part of ~~a part of~~ immune system.

(v) It is purified in the kidneys.

It is purified in lymph nodes.

(vi) It flows through the body in circular motion.

It moves in single direction.

36

**SMALLPOX**

(2001)(i) characterized by the appearance of numerous vesicles on face, trunk and limbs.

(ii) Today it is almost eradicated by vaccination.

**MEASLES**

characterized by red spots on skin, fever, malaise (illness) and enlarged lymph nodes.

It is not eradicated yet.

37

**PIG IRON**

(2001)(i) Iron with about 2-4% carbon is called pig iron.

(ii) It is crude form of iron and is processed further to form steel, other alloys etc.

(iii) It can not be used to make products directly.

(iv) It is not durable and can rust easily.

**STAINLESS STEEL**

Iron with less than 2% carbon, and chromium is called stainless steel.

It is an end product after addition of chromium in steel.

It can be used to make products directly.

It is durable and do not rust easily.



38

**ALLOY**

- (2001) (ii) A substance that is a mixture of two or more metals, or of a metal with a nonmetallic material.

**AMALGAM**

An alloy composed by mercury and other metal is called amalgam.

39

**ISOTOPES**

- (2001 1999 1998) (ii) Isotopes are elements with different mass numbers (atomic mass) and same atomic number (number of proton or electron).

**ISOBARS**

Isobars are elements with same mass number (atomic mass) and different atomic numbers (protons or electrons).

40

**ARTERY**

- (2001 1998) (ii) Arteries carry purified blood from heart to different parts of the body.

**VEIN**

Veins carry impure blood from the body to the heart.

41

**BARRAGE**

(2001/1998) (i) In barrage, entire length across the river i.e. between the banks is provided with gates having their bottom near the river-bed.

(ii) The storage behind barrage is solely created by the height of the gates.

**DAM**

Dam has spillway gates almost near its top level.

Storage behind the dam is mainly due to the height of concrete structure and partially due to the gate height.

42

**CARDIAC MUSCLES**

(2000) (i) They are controlled by involuntary nervous system.

(ii) Found in heart.

(iii) Their cells are semi-spindle in shape.

(iv) cells are shorter.

(v) There are only 1 or 2 nuclei in their cells.

**SKELETAL MUSCLES**

They are controlled by somatic nervous system.

Attached to bones.

Their cells are cylindrical in shape.

cells are longer than cardiac muscles cells.

They have multi-nucleated cells.

43

**HAZE**

(2000)(i) It is mist, cloud, or smoke suspended in the atmosphere and obscuring or obstructing the view.

**SMOG**

It is the mixture of fog and smoke or other airborne pollutants such as exhaust fumes.

44

**HORMONE**

(2000)(i) Hormones travel through the body to initiate a process.

(ii) Hormones act indirectly through cells, e.g: insulin causes cells to convert glucose to glycogen.

(iii) Hormones control aspects of growth and metabolism such as changing of voice, development of musculature during puberty in males.

**ENZYME**

Enzymes are catalysts, and speed reactions up.

Enzymes act directly on the things they are going to effect, e.g: amylase (an enzyme in saliva) directly breaks down starch to sugars.

Enzymes mediate all reactions in cells, their structure and synthesis being determined by DNA.



45

**SEDIMENTARY ROCK**

(2000) (i) Formed by the accumulation of other eroded material.

(ii) Usually found in water bodies i.e sea, oceans etc.

(iii) sedimentary rocks include shale, limestone, sandstone etc.

**IGNEOUS ROCK**

Formed when magma (molten rock) have cooled down and solidified.

Commonly found inside the Earth's crust or mantle.

Igneous rocks include granite, basalt etc.

46

**PRODUCERS**

(2000) (i) Producers are the organisms that manufacture their own food from simple inorganic substances, e.g: a green plant.

**CONSUMERS**

Consumers are the organisms that feed on other organisms, or on material derived from them, e.g: herbivores, carnivores, worms, fungi, bacteria, etc.

47 ANIMAL CELL	PLANT CELL
(i) Irregular round shape due to the absence of cell wall.	Fixed (rectangular) shape due to the presence of cell wall.
(ii) Plastids and chloroplast are absent.	Plastids and chloroplast are present.
(iii) Centrioles are present.	centrioles are present only in lower plants e.g. alga.
(iv) One or more small vacuoles are present.	One, large central vacuole, taking up to 90% of cell volume is present.
(v) It turns sugar into carbon dioxide to make energy (respiration).	It turns carbon dioxide into sugar (photosynthesis).

48 PROKARYOTIC CELLS	EUKARYOTIC CELLS
(i) No pre-defined nucleus. contain no membrane-bound organelles	Pre-defined nucleus is found. contain membrane bound organelles.
(ii) Chromosomes are dispersed in the cytoplasm.	Chromosomes are found in nucleus.
(iii) Smaller—typically 0.2-2 micrometer in diameter.	larger—typically 10-100 micrometers in diameter.
(iv) Have circular chromosomes and lack histone proteins.	Have linear DNA and contain histone proteins.

49

**NEURON**

(1999)(i) A cell, usually consisting of a cell body, axon and dendrites, that transmits nerve impulses and is the basic unit of nervous system.

(ii) Found in nervous system.

**NEUTRON**

A neutral elementary particle with a zero electrical charge and a mass approximately equal to that of a proton.

Found in nucleus of atoms.

50

**MITOSIS**

(1999)(i) It occurs in somatic cells.

(ii) It produces 2 daughter cells.

(iii) DNA replicates once.

(iv) There is no crossing over involved.

(v) Cell divides once.

Number of chromosomes are same in both parent and daughter cells.

**MEIOSIS**

It occurs in sex cells.

It produces 4 daughter cells.

DNA replicates twice.

Cross over is involved, which results in different genetic features in all daughter cells.

Cell divides twice.

Number of chromosomes is half in daughter cells as compared to parent cell.



51

**CLIMATE**

(1999)(i) It defines the conditions of atmosphere over longer periods like an entire year or decade.

(ii) Elements of climate are temperature, humidity, precipitation, cloudiness, brightness of the sun, visibility, wind and atmospheric pressure.

(iii) climate is what you expect according to averages of atmospheric conditions collected over several years at a place, e.g: "a very cold winter".

**WEATHER**

It defines the conditions of the atmosphere over a short period e.g, a day, or week or month.

Its elements, along with all those of climate, also include rain, hail, thunderstorm, and floods etc, which are short term events.

Weather is what you get on a particular day—whether in accordance or not with the forecast of the day, e.g: "a very cold day".

52

**HARD WATER**

(1998)(i) Hard water contains minerals - magnesium and calcium.

**SOFT WATER**

Soft water has minimum or no mineral content.

(ii) It passes through soft rocks thereby collecting minerals, before reaching the pipes for supply.

It passes through hard rocks like granite and hence gathers minimum or no minerals.

(iii) It has health benefits eg. prevents heart diseases, lowers blood pressure, good for bones.

It is good for washing and bathing purposes, good for skin.

### 53 E-MAIL

(1998)(i) Also called electronic mail.

### SNAIL MAIL

Also called ordinary mail or postal mail.

(ii) It is faster.

It is slower.

(iii) Being a soft copy, it is less reliable.

Being a hard copy, it is more reliable.

(iv) Electronic devices (e.g: computer) are required on both ends along with connectivity.

No such things are required.

(v) Mostly it is a typed mail.

Mostly it is a hand-written mail.

54

## APES

## MONKEYS

(1998)(i) The ape family consists of chimpanzees, orangutans, and gorillas.

The monkey family consists of old and new monkeys.

(ii) Apes are more intelligent.

Less intelligent than apes.

(iii) Larger brains and bodies than monkeys.

They have smaller brains and bodies.

(iv) Broad back and arms longer than the legs.

Slender, long chest and length of arms is either equal or shorter than length of legs.

(v) Apes live more comfortably on ground.

Monkeys are more used to the life on trees.

(vi) Not found all over the world.

Found all over the world.

(vii) Nasal openings are rounded.

Nasal openings are slanted.

(viii) Do not have webbed feet.

Do have webbed feet.

(ix) They have opposable thumbs like humans.

Do not have opposable thumbs.



55

**HYDROSTATICS**

(1998) (i) It is the scientific study of the equilibrium of liquids at rest and the forces and pressure exerted by them.

(ii) It involves problems like buoyancy and flotation, pressure on dams and submerged devices and hydraulic presses etc.

**HYDRODYNAMICS**

It is the area of fluid dynamics and deals with the study of liquids in motion.

It is concerned with such matters as friction and turbulence generated in pipes by flowing liquids etc.

56

**COMET**

(1998) (i) An astronomical object that is composed of a mass of ice and space dust and has a long luminous tail produced by vaporization when it passes close to a star.

(ii) It has an orbit.

**METEOR**

A mass of rock from space that burns up after entering the Earth's atmosphere.

It does not have any orbit.

57

**ELECTRON**

(1998)(i) It is an elementary particle of atom that revolves around nucleus.

(ii) It is negatively charged.

(iii) It is real.

**HOLE**

A hole is the lack of an electron at a position where one could exist in an atom.

It can act as a carrier of a positive charge. (It is different from positron).

It is conceptual.

58

**AUTOPSY**

(1998)(i) It is the medical examination of a dead body in order to establish the cause and circumstances of death.

**BIOPSY**

It is the removal of a sample of tissue from a living person for laboratory examination.

59

**C.U.**

(1997)(i) Short for control unit.

**A.L.U**

Short for arithmetic and logic unit.

(ii) It is the most important part of C.P.U (central processing unit) as it controls and coordinates the activities of all other units i.e A.L.U, memory unit, input and output units.

It is the part of C.P.U where the actual data processing takes place.

(iii) It interprets instructions and transfers data from the main memory to the A.L.U for processing.

It carries out arithmetic operations such as addition, subtraction, multiplication and division; and performs certain logical operations of selecting, sorting and comparing.

60

## HARDWARE

(1997)(i) It is the equipment involved in the function of a computer.

(ii) Hardware is tangible.

(iii) Hardware is of 3 types:  
a- Input - keyboard, mouse etc  
b- Output - monitor, printer etc  
c- Storage - USB drive, hard disk etc.

## SOFTWARE

It is the set of instructions that causes the hardware to do work.

Software is intangible.

Software is of 2 types:  
a- System software - unix, linux, windows etc.  
b- Application software - ms office, photoshop etc.



**61 PERSONAL COMPUTER**

(1997)(i) PC is meant for 1 user at a time.

(ii) It is also called "micro computer" and is very smaller than mainframe.

(iii) For 1 user, it provides good processing speed.

(iv) On average, it processes 30 mn instructions per sec.

(v) It is very cheap nowadays

**MAINFRAME**

Mainframe is designed for multiple users.

It is bigger than PC and could be of the size of a refrigerator.

For individual users, it provides a fairly decent speed.

On average, it processes 250 mn instructions per second.

It is much more costly than PC.

**62 THERMOPLASTIC**

(1996)(i) Thermoplastics can be repeatedly softened by heating and hardened by cooling.

**THERMOSETTING PLASTIC**

Thermosetting plastics harden permanently after being heated once.

(ii) Chains of thermoplastic are held together by weak van der Waal forces which repeatedly loosen and tighten when heated and cooled respectively.

Thermosetting plastic when heated once, its chains chemically bond, or cross-link with each other which create a permanent, three-dimensional network.

(iii) Examples: polyethylene, polystyrene, polyamide, polypropylene etc.

Examples: polyurethane, phenolics, epoxy, etc.

### 63 LUNAR ECLIPSE

(1996)(i) It occurs when Earth comes between Sun and Moon.

(ii) It is visible on the entire night side of the Earth.

(iii) Watching it with naked eyes is absolutely safe.

(iv) Its duration may last for an hour.

(v) It generally occurs twice a year.

### SOLAR ECLIPSE

It occurs when Moon comes between Sun and Earth.

It is only visible in very small portions.

Watching it with naked eyes is very dangerous.

It can be from six to seven minutes at best.

It occurs once every 18 months.

replace (v)

64

**ASTEROID**

(1996)(i) An irregularly shaped rock that orbits the Sun, mostly occurring in a band asteroid belt between the orbits of Mars and Jupiter.

**METEORITE**

An object from outer space that impacts the Earth and survives in some form.

65

**RENEWABLE ENERGY RESOURCES**

(1996)(i) These are the sources of energy which do not deplete with time, e.g: solar energy, wind energy etc

**NON-RENEWABLE ENERGY RESOURCES**

These are the sources of energy which either deplete or their rate of consumption is faster than rate of production, e.g: fossil fuels etc.

(ii) To produce energy, their plants need larger area and no input, but maintenance.

To produce energy, their plants need smaller area and continuous input and maintenance.

(iii) They are non-pollutant.

They are pollutant.

(iv) They yield comparatively lesser energy.

They yield more energy.

(v) They are environment-friendly.

They are not environment-friendly.



## 66 EXOTHERMIC REACTIONS

(1996)(i) In these reactions heat is produced as one of the end products.

(ii) Enthalpy (thermodynamic property) change is always negative.

(iii) The end products are stable.

(iv) Most exothermic reactions are spontaneous.

(v) Examples: burning of candle, wood and neutralization reactions etc.

## ENDOTHERMIC REACTIONS

In these reactions heat is absorbed.

Enthalpy change is always positive.

The end products are less stable.

Most endothermic reactions are not spontaneous.

Examples: Melting of ice, photosynthesis etc.

— END —