

**Branches Of Biology:**

- i) Zoology:** Zoology is that branch of biology which deals with the study of animals.
- ii) Botany:** Botany is that branch of biology which deals with the study of plants.
- iii) Microbiology:** It is the branch of biology which deals with the study of microorganisms such as viruses, bacteria etc.
- iv) Morphology:** It deals with the shape and structure of living organisms.
- v) Histology:** It is the microscopic study of tissues of plants and animals.
- vi) Cytology:** It deals with the structure of cell and organelles present inside the cell.
- vii) Physiology:** It deals with the study of functions of different parts of plants and animals.
- viii) Ecology:** It is the science of ecosystem and explains the relationship between organisms and their environment.
- ix) Taxonomy:** It deals with the naming and classification of organisms.
- x) Genetics:** It deals with the study of heredity and variations.
- xi) Biotechnology:** It deals with the application of biological processes.
- xii) Haematology:** Study of blood and its constituent cells.
- xiii) Geology:** Study of features and properties of earth and its constituents rocks.

**Characteristics Of Living Organisms:**

**Following are the main characteristics of living beings which are not present in non-living organisms.**

- i) Metabolism
- ii) Growth
- iii) Irritability
- iv) Reproduction
- v) Movement
- vi) Nutrition
- vii) Respiration
- viii) Excretion

**Virus:**

- Viruses are the micro-organisms which are strict or obligate parasites of animals or plant cells.
- Many of the viruses are also parasites on bacteria.
- A large number of viruses cause diseases in plants and animals.

**Characteristics Of Virus:**

- A virus consists of two components, a protein coat and a core of nucleic acid which is either DNA or RNA.
- DNA viruses are called adenoviruses and RNA viruses are called retroviruses.
- The shape of a virus is due to its protein coat.
- Viruses are of many shapes i.e. rods, spherical, hexagonal or icosahedral.
- Sometimes their shape is complicated.
- Virus replicate inside a living cell and many viruses are synthesized along with their protein coats and nucleic acid.
- The nucleic acid contains instructions for the shape of the virus.

**Diseases Caused By viruses:**

- i) Polio
- ii) AIDS
- iii) Smallpox
- iv) Measles
- v) Hepatitis

**Bacteria:****Characteristics Of Bacteria:**

- Bacteria are unicellular prokaryotic organisms which generally divide by transverse binary fission.
- They possess rigid cell walls and act as pathogens
- Nucleus is not well organised
- No definite chloroplast, chlorophyll is dissolved in chromoplasm.
- There are three forms of bacteria which are:

- i) Round called Cocci
- ii) Rod like called Bacilli
- iii) Spiral called Spirilla

**Classification Of Bacteria According To Mode Of Nutrition:**

According to mode of nutrition, there are three types of Bacteria:

**a) Parasitic:**

- Devoid of chlorophyll
- Are heterotrophic and get food from living animals and plants

**b) Saprophytic**

- Lack chlorophyll hence cannot prepare their own food.
- Get food from dead organic remains

**c) Autotrophic**

- Contain chlorophyll
- Can synthesis food by photosynthesis
- Few get their food by chemosynthesis

**Reproduction In Bacteria:**

- i) Vegetative: By Binary Fission
- ii) Asexual: By Formation of Endospores
- iii) Sexual: By Conjugation

**Cell:****Definition:**

The smallest structural and functional unit of an organism, typically microscopic and consisting of cytoplasm and a nucleus enclosed in a membrane.

OR

The cell is the functional basic unit of life. It was discovered by Robert Hooke and is the functional unit of all known living organisms. It is the smallest unit of life that is classified as a living thing, and is often called the building block of life.

## **Cell Structure And Functions (Plant & Animal Cell)**

### **1. Cell wall**

- Most commonly found in plant cells
- Controls turgidity
- Extracellular structure surrounding plasma membrane
- Primary cell wall: extremely elastic
- Secondary cell wall: forms around primary cell wall after growth is complete

### **2. Plasma membrane**

- Outer membrane of cell that controls cellular traffic
- Contains proteins (left, gray) that span through the membrane and allow passage of materials
- Proteins are surrounded by a phospholipid bi-layer.

### **3. Protoplasm**

- colourless, semitransparent, viscous granular fluid present inside the cell is called as protoplasm.
- colloidal in nature and considered as physical basis of life.
- exhibits the active streaming movement called cyclosis -it consists of water, protein, lipid or fats, carbohydrates, enzymes, salts, nucleic acid in a fixed proportion.-it is divided into Nucleus and Cytoplasm

### **4. Cytoplasm**

Protoplasm outside the nucleus is called cytoplasm, all the organelles are present in the cytoplasm like;

#### **i) Endoplasmic reticulum**

- Tubular network fused to nuclear membrane
- Goes through cytoplasm onto cell membrane
- Stores, separates, and serves as cell's transport system
- Smooth type: lacks ribosomes
- Rough type (pictured): ribosomes embedded in surface

#### **ii) Golgi apparatus**

- - Composed of numerous layers forming a sac
- Works as the distribution and shipping department of the cell's chemical product.

#### **iii) Lysosome**

- - Digestive 'plant' for proteins, lipids, and carbohydrates
- Transports undigested material to cell membrane for removal
- Vary in shape depending on process being carried out
- Cell breaks down if lysosome explodes

#### **iv) Mitochondria**

- Second largest organelle with unique genetic structure
- Double-layered outer membrane with inner folds called cristae
- Energy-producing chemical reactions take place on cristae
- Controls level of water and other materials in cell
- Recycles and decomposes proteins, fats, and carbohydrates, and forms urea

#### **v) Ribosomes**

- Each cell contains thousands
- Miniature 'protein factories'
- Composes 25% of cell's mass
- Stationary type: embedded in rough endoplasmic reticulum

- Mobile type: injects proteins directly into cytoplasm

#### **vi) Vacuoles**

- Membrane-bound sacs for storage, digestion, and waste removal
- Contains water solution
- Contractile vacuoles for water removal (in unicellular organisms)

#### **vii) Chloroplasts**

- A plastid usually found in plant cells
- Contain green chlorophyll where photosynthesis takes place

#### **viii) Cytoskeleton**

- Composed of microtubules
- Supports cell and provides shape
- Aids movement of materials in and out of cells

#### **ix) Centrioles**

- Paired cylindrical organelles near nucleus
- Composed of nine tubes, each with three tubules
- Involved in cellular division
- Lie at right angles to each other

### **5. Nucleus:**

- Control centre of the cell
- Serves as information processing and administrative centre of the cell
- Performs the following major functions:
  - a) stores the cell's hereditary material, or DNA
  - b) coordinates the activities of the cell, which includes growth, metabolism, protein synthesis, and reproduction or cell division.

#### **i) Nuclear membrane**

- Surrounds nucleus
- Composed of two layers
- Numerous openings for nuclear traffic

#### **ii) Nucleolus**

- Spherical shape
- Visible when cell is not dividing
- Contains RNA for protein manufacture

#### **iii) Chromosomes**

- Usually in the form of chromatin
- Contains genetic information
- Composed of DNA
- Thicken for cellular division
- Set number per species (i.e. 23 pairs for human)

### **Difference Between Animal And Plant Cell:**

#### **1) Cell Wall OR Cell Membrane**

- The outer boundary of plant cells is known as the cell wall, which is mainly composed of cellulose.
- It helps the plant cell to maintain its shape.

- The cell wall is absent in animal cell.
- In animal cell the outer covering is known as cell membrane which is composed of lipid bilayer, proteins and carbohydrates.

#### 2) Plastids

- Plants cells also contain organelles which are known as plastids.
- The most common type of plastid is the chloroplast which contains chlorophyll.
- These organelles or plastids are totally absent in animal cell.

#### 3) Vacuole

- The main difference between the vacuole of animal and plants is their size.
- The vacuole of plant cell is much bigger than that of animal cells.

#### 4) Centrosomes

- In animal cells centrosomes are present, which are responsible for making some protein fibres which help in movement of chromosomes during division of cells.
- Centrioles are absent in the plant cells.

#### 5) Lysosome

- Lysosomes are not evident in plants while they are prominent in animal cells.

### **Cell Division:**

The process in which the cells divide and replicate. This process is the basis for growth and replication.

There are two main types of cell division, which are as under:

- 1) Mitosis
- 2) Meiosis

#### **Mitosis:**

A type of cell division in which a cell divides into two identical daughter cells each having same number of chromosomes as that of parent cell.

#### **Stages Of Mitosis:**

There are four stages of mitosis, which are as under:

- i) Prophase
- ii) Metaphase
- iii) Anaphase
- iv) Telophase

#### **i) Prophase:**

- Prophase is the first phase of mitosis.
- Chromatin material condenses and becomes visible
- The nucleolus of the cell disappears
- The nuclear membrane also disappears
- Centrioles begin to move opposite ends of the cell

#### **ii) Metaphase:**

- Metaphase is the second stage of mitosis.
- Chromosomes line up in the centre of the cell, separate and become a pair of identical chromosomes.
- The chromatids become uncoiled and apart from each other.

#### **iii) Anaphase:**

- It is the third phase of mitosis.
- During this phase each set of chromosomes move towards the opposite end of the cell.

#### **iv) Telophase:**

- The fourth phase of mitosis is known as Telophase.
- During this phase spindle fibres disappear.
- Nuclear membrane appears
- Cell divides into two daughter cells
- Nucleolus re-appear
- The chromosomes disperse and are no longer visible.

#### **Significance Of Mitosis:**

**1. Growth:** The number of cells within an organism increases by mitosis and this is the basis of growth in multicellular organisms.

**2. Cell Replacement:** Cells are constantly sloughed off, dying and being replaced by new ones in the skin and digestive tract. When damaged tissues are repaired, the new cells must be exact copies of the cells being replaced so as to retain normal function of cells.

**3. Regeneration:** Some animals can regenerate parts of the body, and productions of new cells are achieved by mitosis.

**4. Vegetative Reproduction:** Some plants produce offspring which are genetically similar to themselves. These offspring are called clones.

#### **Meiosis:**

A type of cell division in a cell divides into four daughter cells with having half number of chromosomes as compared to parent cell.

#### **Characteristics Of Meiosis:**

- Takes place in sexual reproduction at the time of formation of male and female gametes
- In animals it takes place during the formation of sperms and ova while in plants during spore formation
- Diploid cells reduce to haploid cells
- Consists of two consecutive divisions
- First division is reductional or meiotic and the second is simple mitotic division.

#### **Stages Of Meiotic Division:**

- i) Prophase I
- ii) Metaphase I
- iii) Anaphase I
- iv) Telophase I
- v) Prophase II
- vi) Metaphase II
- vii) Anaphase II
- viii) Telophase II

#### **Prophase I:**

Prophase I consists of 5 sub stages, these are:

##### **a. Leptotene**

- Nucleus increases in size
- Chromosomes become long and uncoiled threads
- They become more visible

**b. Zygotene**

- Homologue (similar) chromosomes attract each other and form pairs.
- This process is called synapses

**c. Pachytene**

- Chromosomes become condensed due to widening of coils
- They form chiasmata i.e. cross each other in double nature or bivalents.

**d. Diplotene**

- Homologous chromosomes go apart from each other except at chiasmata
- Chromosomes become more short and thicker

**e. Diakinesis**

- The bivalents become more apart.
- Chromosomes become deeply stained
- Nucleolus and nuclear membrane disappear and spindles become distinct

**Metaphase I:**

- Chromosomes now rearrange themselves in an equatorial line
- Spindles attach to the centrosome of the chromosomes

**Anaphase I:**

- Spindles start to contract
- Split the tetrahedral chromosomes into two chromatids and drag them to opposite poles
- Here the reduction takes place.

**Telophase I:**

- Spitted chromosomes reach to opposite poles
- Nucleolus and nuclear membrane reappear
- At the end of Telophase I, prophase II starts.

**Prophase II:**

- Chromatin network breaks into bivalent chromosomes
- Nuclear membrane and nucleolus disappear and spindles start to reappear

**Metaphase II:**

- Bivalent chromosomes rearrange themselves at equator
- Spindles attach to the centrosomes of each chromosome

**Anaphase II:**

- Spindles contract and split the chromosomes longitudinally into two chromatids
- Each chromatid travel to opposite pole

**Telophase II:**

- Each chromatid reach to the opposite pole
- Spindles disappear and nuclear membrane and nucleoli reappear
- As a result 4 nuclei are formed

**Significance Of Meiosis:**

- To allow trait inheritance in offspring
- To maintain diploid number in each generation
- To ensure the production of haploid gametes in sexual reproduction
- To produce genetic variations among offspring

**Classification Of Plants:**

Plants are those organisms which contain chlorophyll and synthesize their own food through photosynthesis. Plants are divided into:

- 1) Flowering Plants OR Phanerogams
- 2) Non-Flowering Plants OR Cryptogams

**Flowering Plants:**

Flowering plants are those plants which contain seed. These are known as Phanerogams. They are further subdivided into:

- i) Gymnosperms
- ii) Angiosperms

**Gymnosperms:**

Gymnosperms are those flowering plants which contain naked and unprotected seeds.

Examples: Pine, Fir, Cedar, Spruce and Cypress etc.

**Angiosperms:**

Angiosperms are those flowering plants whose seeds are protected by a fruit or seed pod.

Examples: Grass, Crops, Vegetables, Fruits and weeds.

**Non-Flowering Plants:**

Non-Flowering plants are also known as cryptogams. These are the plants which do not have seed or in other words they are seedless. Following are the main characteristics of these plants:

- They reproduce by spores
- They have long life
- They have no long fibres
- They cannot grow to greater size
- They generally have simple structure, except ferns.

Examples: Mosses, Ferns, Algae.

**Flower & Its Parts:**

The flower is the reproductive part of the plant. It is mainly concerned with formation of seeds. It is regarded as the modified shoot for the purpose of reproduction.

**Parts Of Flower:**

A typical flower consists of a short axis known as the thalamus, on which floral leaves are inserted in four distinct whorls, which are as under:

- i) Calyx
- ii) Corolla
- iii) Androecium
- iv) Gynaecium

**Calyx:**

Calyx is the outermost whorl of floral leaves called sepals. The sepals can be defined as the green and leaf like structures which are mainly concerned with the protective function.

**Corolla:**

Corolla is the second whorl of floral leaves called petals. The petals are beautifully coloured which are responsible for the attraction to the insects towards them.

**Androecium:**

The third whorl of the leaves consists of stamens. It is considered as the male part of the flower.

**Gynaecium:**



Gynaecium is the inner most whorl of the floral leaves called carpels. It is considered as the female part of the flower.

**Parts Of Plants:**

- i) Ginger: Modified Stem (rhizome) and it is also a root.
  
- ii) Cinnamon: Bark of stem
- iii) Radish: Root
- iv) Potato: Stem (tuber)
- v) Peanut: Seed
- vi) Saffron: Stigma/flower
- vii) Almond: Fruit
- viii) Chillies: Fruit
- ix) Spinach: Leaves
- x) Tomato: Fruit
- xi) Turnip: Root
- xii) Carrot: Root
- xiii) Cucumber: Fruit

**Photosynthesis:**

**Definition:**

Photosynthesis is a process in which plants manufacture their food (simple carbohydrates) in the presence of chlorophyll and sunlight by the combination of carbon dioxide and water.

**Raw Material For Photosynthesis:**

- i) Carbon dioxide: Taken from air
- ii) Water: Absorbed by roots from soil
- iii) Sunlight: From Sun
- iv) Chlorophyll: green pigment present in leaves

**By-Products Of Photosynthesis:**

- i) Carbohydrates (simple sugar): used by plants as a food material and excess of it is converted into starch
- ii) Oxygen: Released into air

**Importance Of Photosynthesis:**

- i) Major process of food production in plants
- ii) Utilization of CO<sub>2</sub> of the atmosphere and liberation of oxygen
- iii) Important in reducing CO<sub>2</sub> of the atmosphere which is dangerous for the human beings as well as animal health.

**Pollination:**

**Definition:**

Pollination is the phenomenon of transfer of pollen from male reproductive organ (anther) to female reproductive organ (stigma) in flowering plants through biological or physical agency.

**Types Of pollination:**

There are two types of Pollination

**i) Self-Pollination:**

In this type of pollination pollens are transferred to the stigma in the same flower. Some plants are by

nature self-pollinated as wheat and grasses.

**ii) Cross Pollination:**

In this type the pollen grains are transferred from the anther of one flower to the stigma of another flower. The cross pollination is considered and advantageous to the plant as the seeds produced by cross-pollination are usually greater in number and the plant germinated from them are superior in vigour, height and weight.

**Vehicles For Pollination:**

Vehicles for pollination are animals, water, wind and insects. Therefore cross pollination may be:

- a) Entomophily-by insects
- b) Anemophily-by wind
- c) Hydrophily-by water
- d) Zoophily-by animals

**Importance Of Pollination:**

- Vital process for reproduction in plants
- Reproduction is carried out by reproductory organs of plants due to pollination
- It is the process by which seeds are produced.

**Fertilization:**

The fusion of male and female gametes is called fertilization.

**Types Of Fertilization:**

Following are the major types of fertilization:

- i) External Fertilization
- ii) Internal Fertilization
- iii) Self-Fertilization
- iv) Cross-Fertilization

**External Fertilization:**

- This type of fertilization is generally observed in simple aquatic animals.
- In such animals both ova and sperms are released into the water where fertilization occurs.
- In terms of evolution external fertilization is of primitive type and is not better biologically as compared to internal fertilization.

**Internal Fertilization:**

- In the internal fertilization the females keep ova inside their bodies and males deposit sperms within the tube of reproductive tracts of females.
- For all land animals internal fertilization is almost must because sperms are quickly killed by dehydration.
- In terms of evolution internal fertilization is highly evolved and much better biologically as compared to external fertilization.

**Self-Fertilization:**

- Self-fertilization occurs within the same animal.
- It is that fertilization in which sperms are used by the ovaries of same animal e.g. Tapeworm

**Cross-fertilization:**

• Cross-fertilization is the process in which sperms of one animal are transferred into the body of another animal e.g. Earthworm.

**Animals:**

**Types Of Animals:**

**i) Invertebrates:** Animals having no backbone or vertebral column.

**ii) Vertebrates:** Animals with backbone or vertebral column.

**Classification Of Invertebrates:**

**The invertebrates are classified into following categories:**

- i) Phylum Protozoa
- ii) Phylum Porifera
- iii) Phylum Coelentrata
- iv) Phylum Platyhelminthes
- v) Phylum Nematode
- vi) Phylum Annelida
- vii) Phylum Mollusca
- viii) Phylum Arthropoda
- ix) Phylum Echinodermata

**Following are the most common examples of invertebrate animals with their relative phyla:**

- Euglena: Phylum Protozoa
- Paramecium: Phylum Protozoa
- Amoeba: Phylum Protozoa
- Sponges: Phylum Porifera
- Hydra: Phylum Coelentrata
- Jelly fish: Phylum Coelentrata
- Tapeworm: Phylum Platyhelminthes
- Ascaris: Phylum Nematode
- Hookworm: Phylum Nematode
- Filaria: Phylum Nematode
- Snails: Phylum Mollusca
- Squids: Phylum Mollusca
- Cockroach: Phylum Arthropoda
- Honey bee: Phylum Arthropoda
- Mosquito: Phylum Arthropoda
- Butter fly: Phylum Arthropoda

**Classification Of Vertebrates:**

**Vertebrates have been divided into following five major classes:**

- i) Fishes
- ii) Amphibians
- iii) Reptilian
- iv) Birds
- v) Mammals

**Some Animals & Their Location:**

- i) Blue whale: Found in all oceans

- ii) Panda: China
- iii) Dolphin: In seas
- iv) Porpoises:
- v) Kangaroo: Australia
- vi) Snow Leopard: Central Asia
- vii) Yak: Central Asia
- viii) Llama: South America
- ix) Ibex: Wild mountain goat
- x) Cobra: South Asia
- xi) Alligator: N.America
- xii) Tortoise: Water
- xiii) Rattle Snake: America
- xiv) Lizards:
- xv) Crocodiles:
- xvi) Ostrich: Deserts Of Africa
- xvii) Penguin: Antarctic Region
- xviii) Kiwi: New Zealand
- xix) Rhea: South America
- xx) Emu: Australia
- xxi) Shark: Found in all oceans
- xxii) Trout: Fresh water fish
- xxiii) Cod:

#### **Scavenger:**

Scavengers are the animals that 'Clean up' after the other animals by consuming their leavings and sometimes prey on sick or dying animals or consume dead bodies. Scavengers are also called detritus feeders. Vultures, coyotes, jackals, hyenas and wild dogs are scavengers which eat the left over prey or dead bodies of hunted animals.

#### **Ecosystem:**

##### **Definition:**

A natural of habitat or system where living organisms and physical components of their environment interact with one another and exchange materials so as to achieve a functional stability is called an ecosystem.

##### **Characteristics Of Ecosystem:**

- An ecosystem is a basic unit of ecology of living organisms.
- An ecosystem may be natural like a pond, lake, stream, river, ocean or a forest.
- It may also be artificial like an Aquarian, an artificial pond or an agricultural field.
- A pond is an excellent example of a small ecosystem to demonstrate interrelationship between abiotic and biotic component of the ecosystem.

##### **Components Of Ecosystem:**

i) Abiotic Components Of Ecosystem.

Following are the abiotic components of ecosystem.

- a. Light
- b. Temperature

- c. Water
- d. Atmosphere and wind
- e. Fire
- f. Soil
- g. Topography
- h. Gravity
- i. Inorganic nutrients
- ii) Biotic Factors.

**Following are the biotic components of ecosystem.**

- a. Producers: Green Plants
- b. Consumers: Animals and Man
- c. Decomposers and reducers: Bacteria, fungi

**Types Of Ecosystem:**

There are two main types of ecosystem:

- i) Terrestrial Ecosystem: it includes Forest and Desert Ecosystem
- ii) Aquatic Ecosystem: it includes small pool, a pond, stream, river, lake and an oceanic ecosystem

**Heredity:**

**Terminology Of Genetics:**

**Gene:**

The basic unit of hereditary material which is responsible for development of a trait.

**Alleles:**

Alternatives forms of genes are called alleles, e.g. tall versus dwarf.

**Dominant:**

The dominant alleles are those traits which show complete expression even in heterozygous state.

Dominant alleles dominate the recessive alleles in heterozygous state.

**Recessive:**

Recessive alleles or traits are those which fail to express themselves in heterozygous state. For example r and y are recessive alleles for wrinkle and green seeds.

**Homozygous:**

Homozygous is a condition in which an individual possess similar alleles for a particular trait. For example TT for tallness and tt for dwarfness.

**Heterozygous:**

Heterozygous is a condition in which an individual possess dissimilar alleles for a particular trait. For example Tt for tallness.

**Genotype:**

Genetic make of an organism is called genotype.

**Phenotype:**

External appearance or expression of genotype is called phenotype. For example, roundness, wrinkleness of seeds and tall or dwarf plants represent different phenotype.

**Gene:**

**Definition:**

The fundamental unit of heredity, formed as a sequence of bases in DNA.

**Characteristics Of Genes:**

- Each gene has a definite position at the chromosome and may occur as alleles.
- The name gene was introduced by Johannsen in 1909 and the structure of DNA was elaborated by Watson and Crick in 1953.
- Genes determine all the structural and functional characters of an individual, like eye colour, skin colour, height, weight, blood group, hair, intelligence, temperament and all others.
- The characters from one generation to other are taken by genes.
- They sometimes change through the process of mutation. This gives variety in characters.
- The accurate structure of the proteins and enzymes in the body is determined by genes.

### **Chromosomes:**

A chromosome is a rod-like portion of the chromatin of a cell nucleus, performing an important part in meiotic cell division, and in the transmission of heredity characteristics. Normally they are constant in number for any species; there are 22 pairs of chromosomes and two sex chromosomes in the human.

**Types Of Chromosomes:** in higher animals and plants, there are two fundamental types of chromosomes, which are classified on the basis of sex determination these are:

- i) Autosomes
- ii) Sex Chromosomes:

### **Autosomes:**

These are paired somatic chromosomes that play no part in sex determination of organisms. These chromosomes are similar in males and females.\

### **Sex Chromosomes:**

The chromosomes that determine sex in organisms are called sex chromosomes. There are two types of sex chromosomes.

- a) X- chromosome
- b) Y- Chromosome

### **Genetic Engineering:**

The deliberate modification of the characteristics of an organism by manipulating its genetic material.  
OR

Scientific alteration of the structure of genetic material in a living organism. It involves the production and use of recombinant DNA and has been employed to create bacteria that synthesize insulin and other human proteins.

### **Significance Of Genetic Engineering:**

- i) To Cure the genetic disorders

Heredity diseases can possibly be treated by this technique by transplanting normal genes in the place of abnormal or diseased genes.

- ii) To Prepare Better Crops

Crops with desired characteristics could possibly be produced by introducing desired genes.

- iii) To Get Better Breeds Of Animals

Like plants better breeds of animals can also be produced by the introduction of recombinant DNA.

- iv) Interferon

Interferons are effectively used in the treatment of Hepatitis of A & B.

- v) Insulin

Human insulin is being produced by genetic engineering to treat diabetes

- vi) Vaccines

Genetic engineering has also helped in the production of vaccines which are used for controlling and treating viral diseases.

**Biotechnology:**

The exploitation of biological processes for industrial and other purposes, esp. the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc.

OR

Biotechnology is the use of living organisms (especially microorganisms) in industrial, agricultural, medical and other technological applications.

**Importance Of Biotechnology:**

- i) To increase production
- ii) To introduce improved quality of seeds and plants
- iii) To introduce plants resistant to disease and insect pests
- iv) To introduce varieties suited to particular climates and soils.
- v) To introduce varieties resistant to lodging
- vi) To improve nutritional value of crops
- vii) To save rare varieties of plants by rapid clonal propagation for breeders to use in future.

**Teeth:**

The humans have two sets of teeth one replaced by the second. The primary set or milk or deciduous teeth are 20 in number while there are 32 permanent teeth in adults.

1. In children there are 20 deciduous or milk teeth. These are

Incisor: 2 pair  $\times 2 = 8$

Canine: 1 pair  $\times 2 = 4$

Premolars: 2 pair  $\times 2 = 8$

2. In adults there are 32 permanent teeth. In each jaw on each side there are:

Incisors: 2 pair  $\times 2 = 8$

Canines: 1 pair  $\times 2 = 4$

Premolars: 2 pair  $\times 2 = 8$

Molars: 3 pair  $\times 2 = 12$

**Incisors:**

The central front teeth are called incisors. There are four in upper jaw and four in lower jaw.

Canines:

The pointed, dark colored teeth on either side of the incisors are canines. 2 in upper jaw and 2 in lower jaw.

Premolars:

These are bi-cusped teeth after the canines. There are 8 premolars. 4 in the upper jaw and 4 in the lower.

**Molars:**

There are 12 molars, 6 in the upper jaw and 6 in the lower jaw.

**Structure Of Teeth:**

Each tooth consists of a crown which is the visible part and the root, which anchors it in sockets in the jaw. A tooth consists mainly of dentine. The crown is coated with even harder enamel, while the root is covered with cementum to help anchor it in the jaw. Inside each tooth, there is a cavity full of pulp, carrying nerves and the tooth's blood and eats through the dentine to the pulp when the decay reaches the pulp, pain and inflammation follows and tooth may die.

A nerve, an artery, a vein and lymph duct enters the pulp cavity through the root canal. The nerves give sensation of hot and cold.

### **Antibody:**

Antibody is a protein produced by white blood cells that help to destroy bacteria. Antibodies react with the antigens and inactivate or destroy them. A large number of antibodies are produced in blood which are targeted against various types of antigens. Antigens are foreign molecules, cells, bacteria, viruses or fungi which enter the body usually a disease causing microorganisms. Antibodies are the integral part of the defence mechanism of human body. They are also involved in immunity against disease.

### **Hemophilia:**

- It is a disease in which the person has prolonged blood clotting time resulting in excessive bleeding from injury.
- It is due to the deficiency of vitamin K.
- It is a semilethal disease controlled by recessive gene.
- It is less common in women than in men.

### **Important Facts About Human Physiology:**

The largest gland of the body: Liver

The largest organ of the body: Skin

The longest bone of the body: Femur

The total number of bones in the body: 206

The hardest bone of the body: Tooth

The smallest bone of the body: Stapes

Total number of muscles in the body: 600

The filter of the body: Kidney

The pump of the Body: Heart

Total number of bones in vertebral column: 33

The normal body temperature: 98.4 F (37 C)

The normal respiratory rate of the Body: 16-18 per min

The total volume of blood in body: 4-5 litres

Total number of bones in face: 14

Vascular connection between foetus and uterus: Placenta

### **Brain:**

Human brain is contained in skull. It has three major parts.

- i) The Cerebrum or bigger brain
- ii) The Cerebellum or Smaller brain
- iii) Medulla Oblongata or hind brain

The cerebrum constitutes the major volume of brain. It consists of two large masses of nervous material known as cerebral hemispheres. Human consciousness, thought, emotions, sight, will, hearing, sensation of pain, memory and speech are centered in the cerebrum. Some parts of it also control motor nerves, operating the arms and legs.



The cerebellum or the smaller brain is related with the coordination of action of nerves and muscles. In this way movements of body are managed. Medulla or hind brain contains the centres for reflex actions in addition to automatic movements such as breathing and walking.

**Reflex Action:**

- Reflex actions are the responses to environmental changes both internal and external and are immediate or automatic and are without intervention of will.
- These reflexes may be simple or conditioned e.g. watering of mouth on seeing or smelling of food.
- Simple reflexes are inborn, inherited or unlearned responses to stimuli.
- The structural and functional basis of simple reflex is called reflex arc.
- Impulses are carried from receptors to sensory neurons to CNS from where they are passed on via motor neurons to the effectors for necessary response.

**Thermoplastics:**

Substances (esp. synthetic resins) that become plastic on heating and harden on cooling and are able to repeat these processes

OR

A type of plastic that can be softened by heat, hardened by cooling, and then softened by heat over and over again.

Properties of Thermoplastics:

Thermoplastics have wide ranging properties.

- They can be very much like rubber, or as strong as aluminium.
- are light in weight,
- Can withstand temperature extremes of up to 600 F, while others retain their properties at -100 F.

Some

- Thermoplastic materials have no known solvents at room temperature.
- Most thermoplastic materials are excellent insulators, both electrical and thermal.
- Are recyclable materials that are used frequently today to create objects such as foam cups, polyethylene squeeze bottles, acrylic lenses and safety helmets.
- In general the combination of light weight, high strength, and low processing costs make thermoplastics well suited to many applications.

**Uses:**

- They are useful for a variety of applications, including consumer goods, machine parts, medical equipment and packaging and storage materials.

**Examples:**

- PVC/Vinyl
- Polystyrene
- Polyethylene
- Cellulose Acetate
- PTFE/Teflon
- Nylon/Polyamide
- Polyester

**Synthetic Polymers:**

Polymers are composed of very large molecules (macromolecules) formed by linking together many smaller, more simple units called monomers. There can be as few as five or as many as several thousand monomers units in a polymer. There are a large number of synthetic polymers prepared and in use. Some of these are polyamides( nylon), polyethylene, propylene, polyvinylchloride, synthetic rubber, cellulose acetate, cellulose nitrate and silicones.

### **Blood:**

Blood is vital connective tissue (fluid) consisting of fluid portion i.e. plasma, in which are suspended the formed elements i.e. RBCs, WBCs, and the platelets, along with other particles.

Blood is opaque, alkaline and appears scarlet red when taken from arteries and purplish from veins. The difference in colour is due to its oxygen content.

### **Composition Of Blood:**

The human blood is composed of:

#### 1) Formed Elements

Formed elements of blood are:

- RBCs
- WBCs
- Platelets

#### 2) Plasma;

The fluid portion of blood is known as the plasma. It is composed of:

- Water: 91 to 92%
- Solids: 8 to 9%

**The solids are again classified as inorganic and organic:**

#### **Inorganic solids include:**

- Sodium
- Magnesium
- Iron
- Potassium
- Phosphorous
- Copper

#### **While organic substances are:**

##### i) Proteins:

- Serum Albumin
- Serum Globulin
- Prothrombin
- Fibrinogen

##### ii) Non-Protein Nitrogenous Substances:

e.g. urea, uric acid, xanthine, creatinine, NH<sub>3</sub> and amino acids etc.

##### iii) Fats:

Like: Natural fats, phospholipids, cholesterol etc.

##### iv) Carbohydrates

Like: Glucose

v) Other Substances:

These include internal secretions, antibodies, enzymes i.e. amylase, protease and lipase etc.

Functions Of Blood:

- To transport oxygen and nutrients from the lungs and intestines respectively to all cells in your body.
- To fight pathogens and kill bacteria and other microbes.
- To keep our core body temperature stable.
- To help heal and clot wounds.

### **Excretory System:**

The excretory system is a system that removes excess, unnecessary or dangerous materials from an organism, so as to help maintain homeostasis within the organism and prevent damage to the body Excretory Organs

1) Accessory Excretory Organs:

- i) Lungs: They remove or excrete CO<sub>2</sub> as a waste product from the body.
- ii) Skin: Skin functions in excretion by sweating out waste products from the sweat glands
- iii) Liver: The liver excretes cholesterol, steroid hormones, certain vitamins and drugs through the bile and also urea, ammonia, amino acids etc.

2) Main Excretory Organ

- i) Kidneys: Excretes waste products in the form of urine

### **Structure & Working Of Kidney:**

#### **External Structure:**

- i) Renal Artery: The renal artery enters the kidney and brings oxygenated blood carrying toxic nitrogenous wastes into the kidneys.
- ii) Renal Vein: The renal vein drains away deoxygenated blood which is free of toxic substances
- iii) Ureter: The ureter, a tube, runs from each kidney downwards into the lower part of the abdomen connecting each kidney to the urinary bladder. Its function is to transport the urine from the kidneys to the urinary bladder.
- iv) Urinary Bladder: This is a large muscular storage sac that collects urine from both the kidneys through the ureters.
- v) Urethra: This is a short muscular tube that carries urine at intervals from the urinary bladder to the outside.

Internal Structure

- i) Renal Cortex: This is the outer pale red colored layer.
- ii) Renal Medulla: This forms the inner dark red zone
- iii) Renal Pelvis: This is a large funnel-shaped region behind the renal medulla.
- iv) Nephrons: These are structural and functional microscopic filtering units of the kidney. There are more than 1,250,000 nephrons in each kidney.

Microscopic Structure of a Nephron

- i) Malpighian Corpuscle: This consists of two parts:
  - a) Bowman's Capsule: This is a cup - shaped structure which is double walled in the hollow of which is a network of capillaries called the glomerulus
  - b) Glomerulus: This is a knotted mass of blood capillaries formed by the afferent arteriole (incoming) and the efferent arteriole (outgoing).
- ii) Renal Tubule: This further consists of

- a) Proximal Convolved Tubule: This is the region behind the Bowman's capsule and consists of a coiled tube that descends to form the Henle's loop.
- b) Henle's loop: This is continuous with the proximal convoluted tubule and is U-shaped having a narrow descending limb and a thick ascending limb
- c) Distal Convolved Tubule: This is another coiled and twisted tubule that continues from the ascending limb of loop of Henle found in the renal cortex.
- iii) Collecting Tubule: The distal convoluted tubule continues to form the collecting tubule.
- iv) Collecting Ducts: Several collecting tubules fuse to form large collecting ducts which pass downwards from the cortex to the medulla region.

### **Working Of The Kidney:**

- The nephron is the kidney's functional unit.
- In its first section renal corpuscles filtration occurs.
- As fluid, small molecules and blood are filtered from glomerulus capillaries.
- The filtered material called filtrate is captured in Bowman's capsules.
- Filtrate then enters the proximal convoluted tubule.
- Reabsorption of important molecules and ions from the filtrate into the blood occurs here.
- These include glucose, amino acids, vitamins, water, sodium, potassium, chloride and bicarbonates.
- Filtrate then enters into Loop of Henle which consists of descending limb and ascending limb.
- In descending limb only water is reabsorbed and in ascending limb only salt is reabsorbed.
- In distal convoluted tubule secretion occurs. Ammonia, hydrogen ions, uric acid are secreted from blood vessels into the distal tubule.
- As result concentrated fluid called urine is produced which enters into collecting.

### **Composition Of Urine:**

The urine is composed of following substances:

- i) Water: 95%
- ii) Dissolved Substances: 5%
  - a. Urea: 2%
  - b. Uric Acid and other ammonium compound: 1%
  - c. Organic and inorganic salts: 2%
- iii) Inorganic constituents
- iv) Nitrogenous Constituents
- v) Other Constituents.

### **Functions Of Kidney:**

#### **1) Excretory:**

- Excrete waste products especially nitrogenous substances
- Eliminates drugs and toxic substances

#### **2) Synthetic**

- Synthesis ammonia and Hippuric acid

#### **3) Endocrine**

- Secretes Renin

#### **4) Regulatory**

- Maintains
- pH balance

- Sodium ion, potassium ion and electrolyte balance
- Osmotic pressure in blood
- Water balance, extra fluid volume
- Blood pressure

### **Endocrine System:**

#### **Definition:**

The endocrine system is a control system of the body, which controls various functions of the human body through secretions known as hormones, secreted by the endocrine glands.

#### **Endocrine Glands:**

Endocrine glands are secretory tissues (glands) which secrete hormones directly into the blood stream. They are also called ductless glands. The study of endocrine glands is called endocrinology.

#### **Important Endocrine Glands & Their Functions (secretions)**

Following are the important endocrine glands of the human body.

- i) Pituitary Gland
- ii) Hypothalamus
- iii) Thymus
- iv) Pineal
- v) Thyroid
- vi) Parathyroid
- vii) Adrenal
- viii) Pancreas
- ix) Testes
- x) Ovaries

#### **Pituitary Gland:**

The pituitary gland is a small bean-shaped reddish gray organ, located near the hypothalamus (forebrain). It produces at least nine hormones which perform following functions:

#### **Functions:**

- Responsible for normal skeletal growth, milk secretion in mammary glands.
- Controls normal functioning of thyroid and adrenal glands
- Stimulates the formation of the graffian follicles in the female ovary and development of spermatozoa in male.
- Stimulate the contraction of the uterine muscles during the final stage of pregnancy
- Control the amount of urine secreted by the kidney.

#### **Hypothalamus**

The hypothalamus is located immediately below the thalamus at the centre of the brain, and controls many automatic functions of the body.

#### **Function:**

The general functions of the hypothalamus are of extreme importance for the body, such as:

- Pituitary gland regulation
- Blood pressure regulation
- Hunger and salt cravings
- Feeding reflexes
- Thirst

- Body temperature regulation

### **Thymus:**

The thymus gland, which is shaped like a pyramid, is a specialized organ of the human immune system. It is also one of the important glands in the human body. It is a pinkish gray colored organ that is situated in the upper thoracic region, under the sternum or the breast bone.

### **Function:**

The thymus gland is very active, when the individual is a child. It plays a crucial role in developing and improving a child's immunity system. The main function of the thymus gland is to produce and process lymphocytes or T cells.

### **Pineal Gland:**

The pineal gland is a pine cone shaped gland of the endocrine system. A structure of the diencephalon of the brain, the pineal gland produces several important hormones including melatonin.

### **Function:**

The pineal gland is involved in several functions of the body including:

- Secretion of the Hormone Melatonin
- Regulation of Endocrine Functions
- Conversion of Nervous System Signals to Endocrine Signals
- Causes Feeling of Sleepiness
- Influences Sexual Development

### **Thyroid Gland:**

The thyroid gland is paired organ located in upper region of the neck in front of windpipe. It produces the hormone thyroxin (T4), Triiodothyronine (T3) and calcitonin.

### **Functions:**

- Plays an important role in regulating the body's metabolism
- The T4 and T3 hormones stimulate every tissue in the body to produce proteins and increase the amount of oxygen used by cells.
- The calcitonin hormone works together with the parathyroid hormone to regulate calcium levels in the body.

### **Parathyroid Gland:**

The parathyroid glands are embedded in the thyroid gland.

### **Functions:**

- Controls the concentration of calcium (Ca ion) and phosphorus (phosphate) in the blood.
- Stimulates the absorption of calcium and magnesium from the gut.
- Increases tubular reabsorption of calcium, magnesium and hydrogen ions.

### **Pancreas:**

The pancreas is located deep in the abdomen, sandwiched between the stomach and the spine. It produces two important hormones which are insulin and glucagon.

### **Functions:**

- Insulin and glucagon are especially important for the maintenance of blood sugar, as insulin lowers the blood sugar and glucagon increases the blood sugar according to the body's needs.

### **Adrenal Gland:**

The adrenal gland curve over the top of each kidney in abdomen. The important hormones secreted by adrenal gland are adrenaline, Aldosterone hormone, and cortisol.

**Function:**

- Adrenal glands are responsible for secreting hormones essential for carrying out some important metabolic processes. Besides, they also help the body in dealing with physical and mental stress.

**Ovaries:**

It is not only a reproductive organ which produces gametes but also make many steroidal hormones. The important ovary hormone is estrogen.

**Function:**

- Ovary hormones are responsible for female characteristics e.g. sound, body, bones, hair etc.

**Testes:**

It is not only a reproductive organ in males but also performs endocrine functions. Important hormone of testes is androgens.

**Function:**

Testes hormones are responsible for the development of male characteristics in male e.g. sound, bones, hairy body etc.

Some Important Hormone Of Endocrine Glands.

- i) Insulin: By Pancreas
- ii) Thyroxin: By Thyroid Gland
- iii) Adrenalin: By Adrenal Gland
- iv) Oestrogen: Ovaries
- v) Testosterone: Testes
- vi) Cortisol: Adrenal Gland
- vii) Melatonin: Pineal Gland
- viii) Glucagon: Pancreas
- ix) Aldosterone: Adrenal Gland
- x) Renin: Adrenal Gland

**Exocrine Glands:**

Exocrine glands are the glands which do not pour their secretions directly into blood (like endocrine glands) but into a duct. These are the glands with ducts and the effect of their secretions is not generalized on all tissues of the body but specialized.

**Example:**

- i) Salivary Glands
- ii) Exocrine Pancreas
- iii) Lacrimal Gland
- iv) Bile Producing Cells of Liver
- v) Secretory Cells of Stomach and Intestine

**Exocrine Pancreas:**

Pancreas secret pancreatic juice which contains a large number of digestive enzymes. Pancreatic juice goes to the intestine through a pancreatic duct and performs the function of digestion inside the intestine.

**Mammary Glands:**

Mammary glands are also exocrine glands which secret milk or colostrum. Milk is collected by a series of

ducts and secreted outside the body.

**Salivary Glands:**

Salivary glands are present inside the jaw. These secrete saliva which comes to the mouth (oral cavity) through salivary duct. Saliva is responsible for lubrication of food and early digestion of starch.

**Lacrimal Gland:**

Lacrimal is the gland which is present in the eye. Its secretion is the lachrymal secretion in the form of tears. Lachrymal secretion washes the eye and the lysozyme enzyme present in this secretion kills bacteria to protect the eye.

**Bile Producing Cells Of Liver:**

The liver produces bile then it is stored in the gall bladder until needed to digest fatty foods.

**Secretory Cells Of Stomach And Intestine:**

Secretory cells of the stomach secrete gastric juice which is poured into the stomach. Gastric juice contains enzymes like pepsin which digest proteins. Similarly, secretory cells of the intestine secrete intestinal juice which contains many digestive enzymes.

**Exocrine Glands And Their Secretions:**

- i) Lachrymal Gland: Tears
- ii) Sweat Gland: Sweat
- iii) Salivary Gland: Saliva
- iv) Mammary Glands: Milk
- v) Liver: Bile
- vi) Sebaceous Gland: Sebum

**ii) Hormones:**

Hormones are the chemical substances secreted by the endocrine glands. They carry electro-chemical messages to different parts of the body. Hormones are circulated in the body through blood. The function of the endocrine system depends upon these hormones. These hormones work in a similar way as the nervous system works in the body. Insulin, glucagon, thyroxine and testosterone are a few kinds of hormones. Hormones play an important role in a living organism. A small amount of hormones in the blood produces specific effects in the body. Several dozen hormones travel through the blood stream and influence different kinds of target cells, modifying their activity in a variety of ways.

iv) Antibody:

- Antibody is a protein produced by white blood cells that help to destroy bacteria.
- Antibodies react with the antigens and inactivate or destroy them.
- A large number of antibodies are produced in blood which are targeted against various types of antigens.
- Antigens are foreign molecules, cells, bacteria, viruses or fungi which enter the body usually as disease-causing microorganisms.
- Antibodies are the integral part of the defence mechanism of the human body.
- They are also involved in immunity against disease.



**vi) Haemophilia:**

- It is a disease in which the person has prolonged blood clotting time resulting in excessive bleeding from injury.
- It is due to the deficiency of vitamin K.
- It is a semi lethal disease controlled by recessive gene.
- It is less common in women than in men.