Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Empowered Autonomous)

Department of Zoology

INDEX

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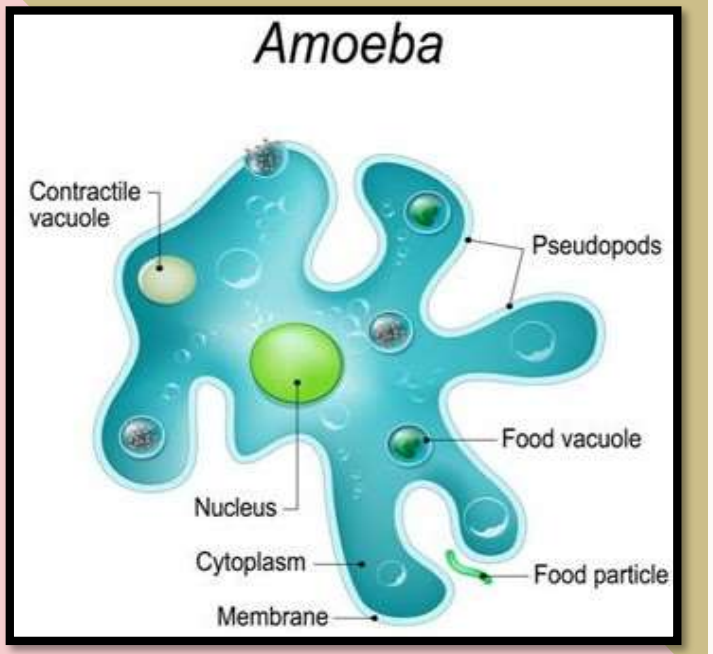
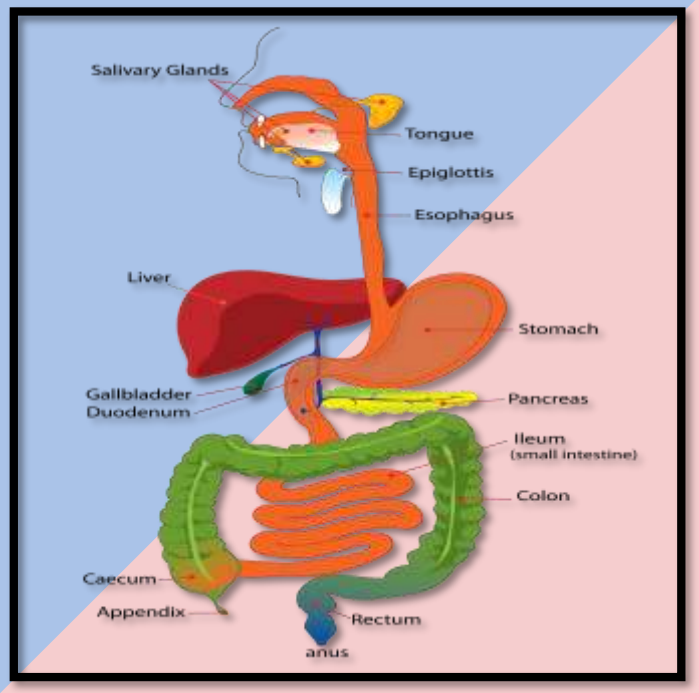
B.Sc. II

Presentation on topic: Digestion

SUB-TOPICS

- Introduction
- Brief account of digestive system
- Histology of G.I. tract
- Digestive glands
  - Salivary glands
  - Liver
  - Pancreas





INTRODUCTION

Digestion is the process of enzymatic conversion of complex form of food into simple, diffusible form for absorption and assimilation. Digestion is classified into two main types:

1. Intracellular digestion:

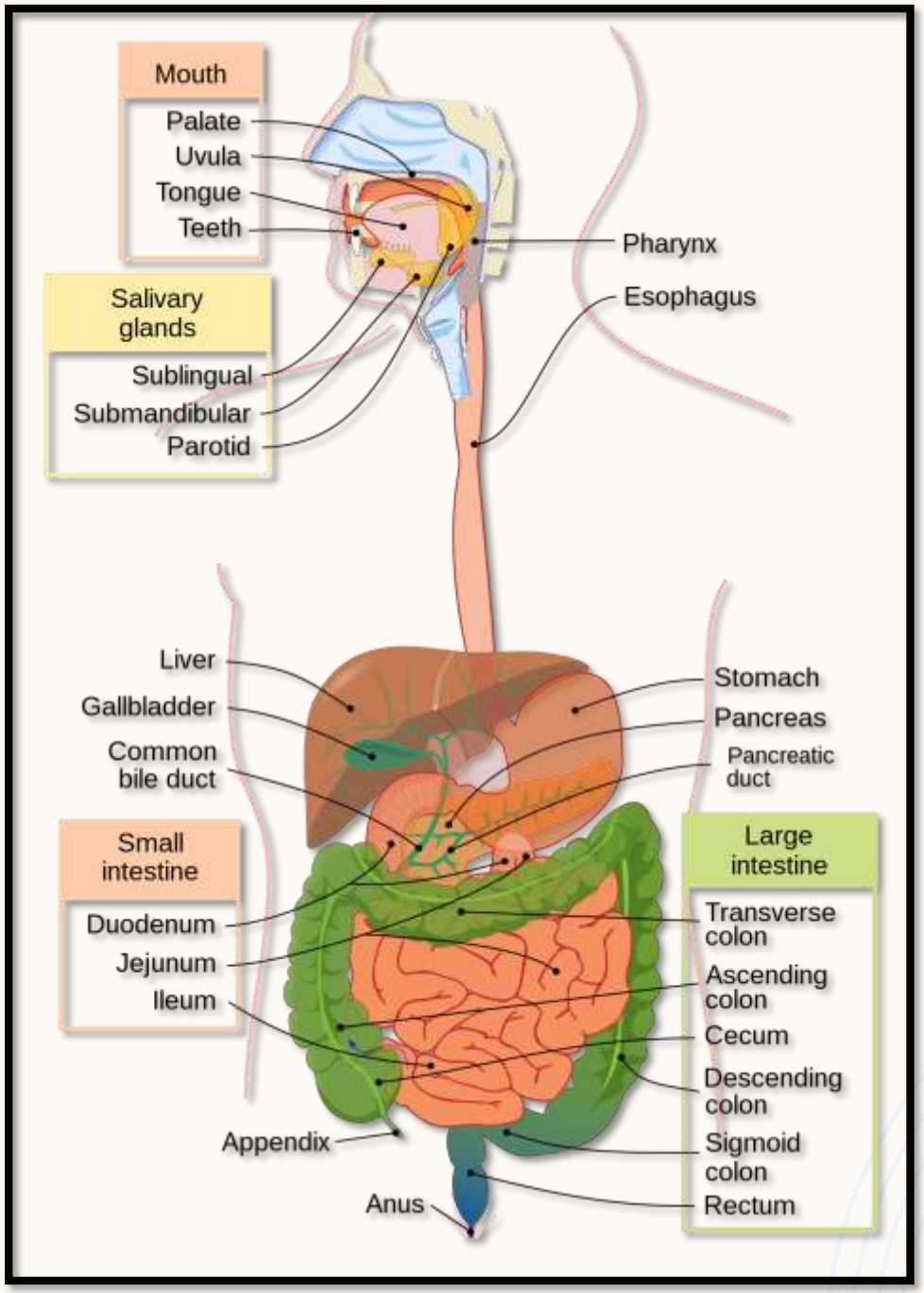
This digestive process is observed in primitive heterotrophs. In protozoa like amoeba, porifers, coelenterates, certain parasitic helminths digestion of food material occurs within the cells.

2. Extracellular digestion:

In this, digestion of food material takes place in the lumen of digestive tract outside the cells. E.g. digestion in mammals.

❖ HUMAN DIGESTIVE SYSTEM

- The **digestive system** is a complex physiological system in the human body responsible for the ingestion, breakdown, absorption, and assimilation of nutrients from ingested food.
- The ultimate goal of the digestive system is to provide the body with the nutrients and energy necessary for its proper functioning and growth.



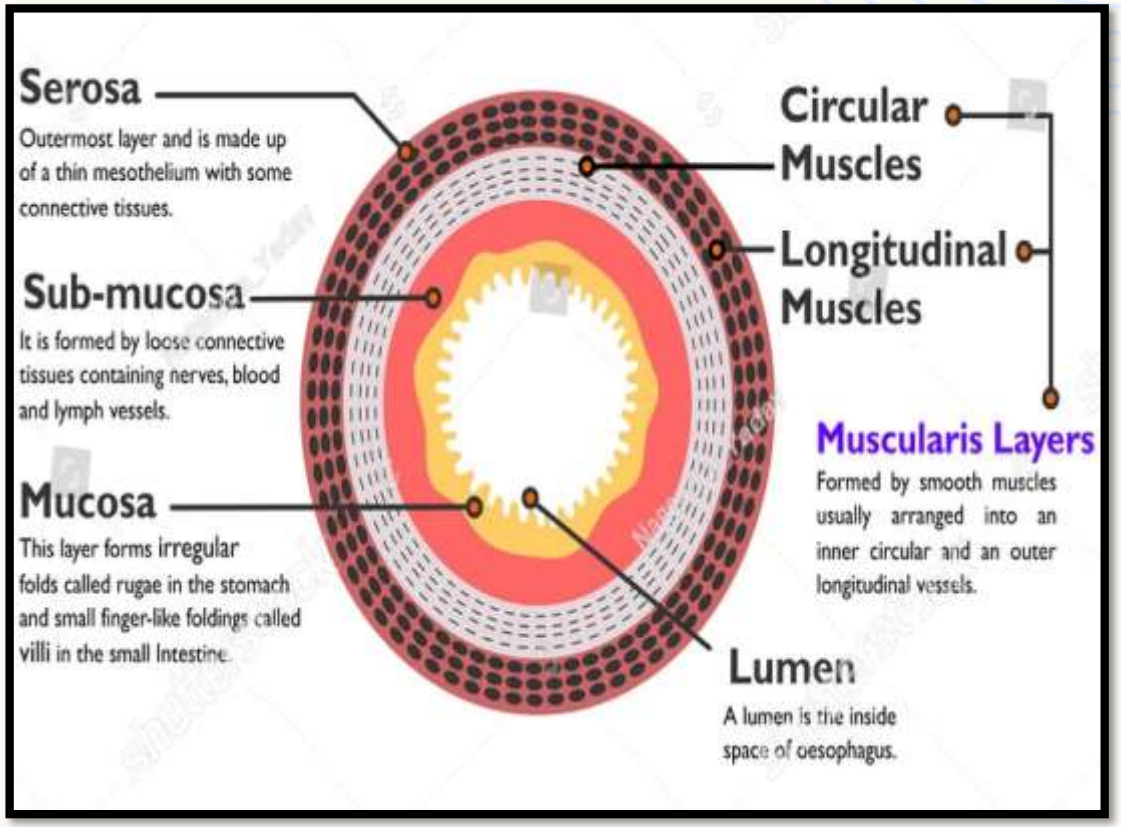
HUMAN DIGESTIVE SYSTEM CONSISTS OF: SEVERAL COMPONENTS :

1. Mouth: Begins mechanical and chemical digestion with chewing and saliva production.
2. Esophagus: Transports food from the mouth to the stomach through muscular contractions (peristalsis).
3. Stomach: Acidic environment helps break down food; digestive enzymes and stomach muscles aid in further breakdown.
4. Small Intestine: Major site of digestion and nutrient absorption. Consists of the duodenum, jejunum, and ileum.
5. Liver: Produces bile, which emulsifies fats, and performs various metabolic functions.
6. Gallbladder: Stores and releases bile into the small intestine to aid in fat digestion.
7. Pancreas: Produces digestive enzymes and releases them into the small intestine; also regulates blood sugar.
8. Large Intestine (Colon): Absorbs water and electrolytes, forms feces, and houses gut bacteria that aid in digestion. It consists of caecum, colon and rectum.
9. Rectum: Stores feces before elimination.

HISTOLOGY OF ALIMENTARY CANAL

The Alimentary canal is lined by four basic layers from inside to outside, namely **mucosa, submucosa, muscularis and serosa.**

- Serosa: It is the outermost layer made up of squamous epithelium called mesothelium
- and connective tissue.
- Muscularis: It is the muscular layer and consists of outer longitudinal muscles, middle
- circular muscles and inner oblique muscles.
- Sub-mucosa: It contains blood vessels, lymph vessels, connective tissues and nerves.
- Duodenal sub-mucosa shows presence of gland.
- Mucosa: It is the innermost layer throughout the length of the alimentary canal it shows the presence of goblet cells that secrete mucus. Mucosa in the stomach projects into irregular folds called rugae. The mucosa of the small intestine forms finger-like projections called villi.



DIGESTIVE GLANDS

Salivary glands

1.Parotid Glands:

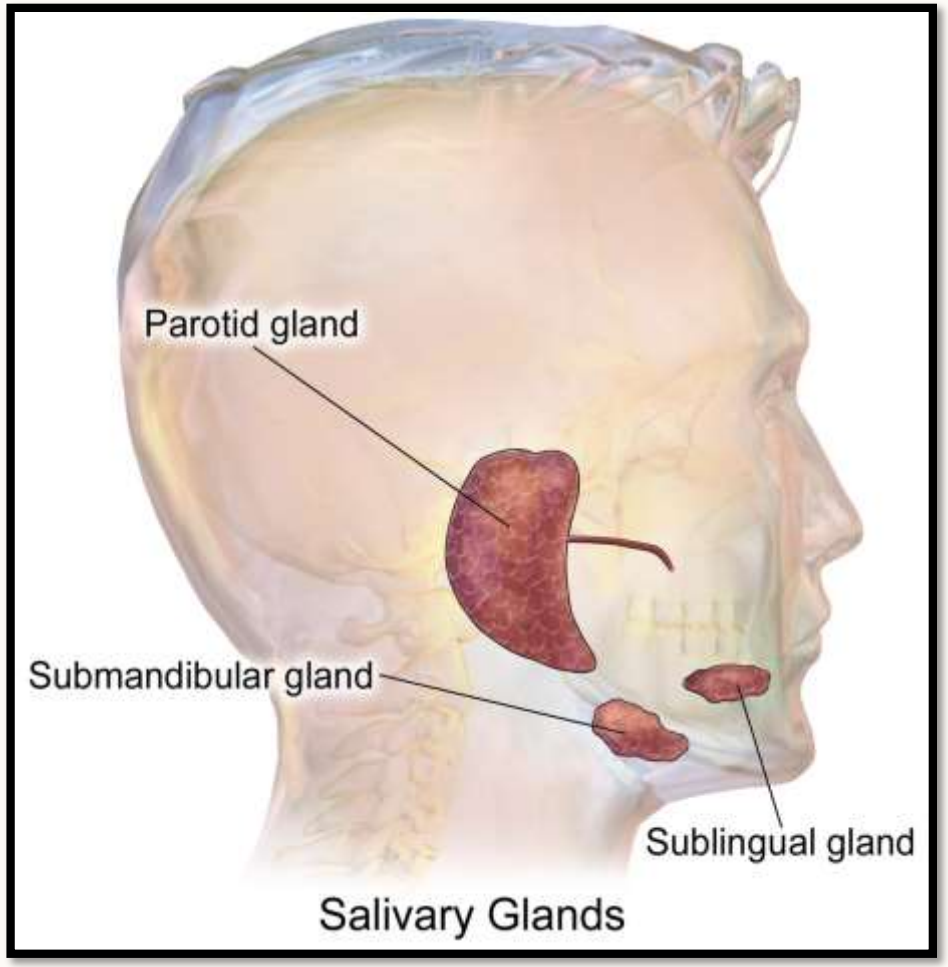
1. **Location:** Near the ears, on the sides of the face.
2. **Secretion:** Produces a watery saliva rich in enzymes, especially amylase for carbohydrate digestion.

2.Submandibular Glands:

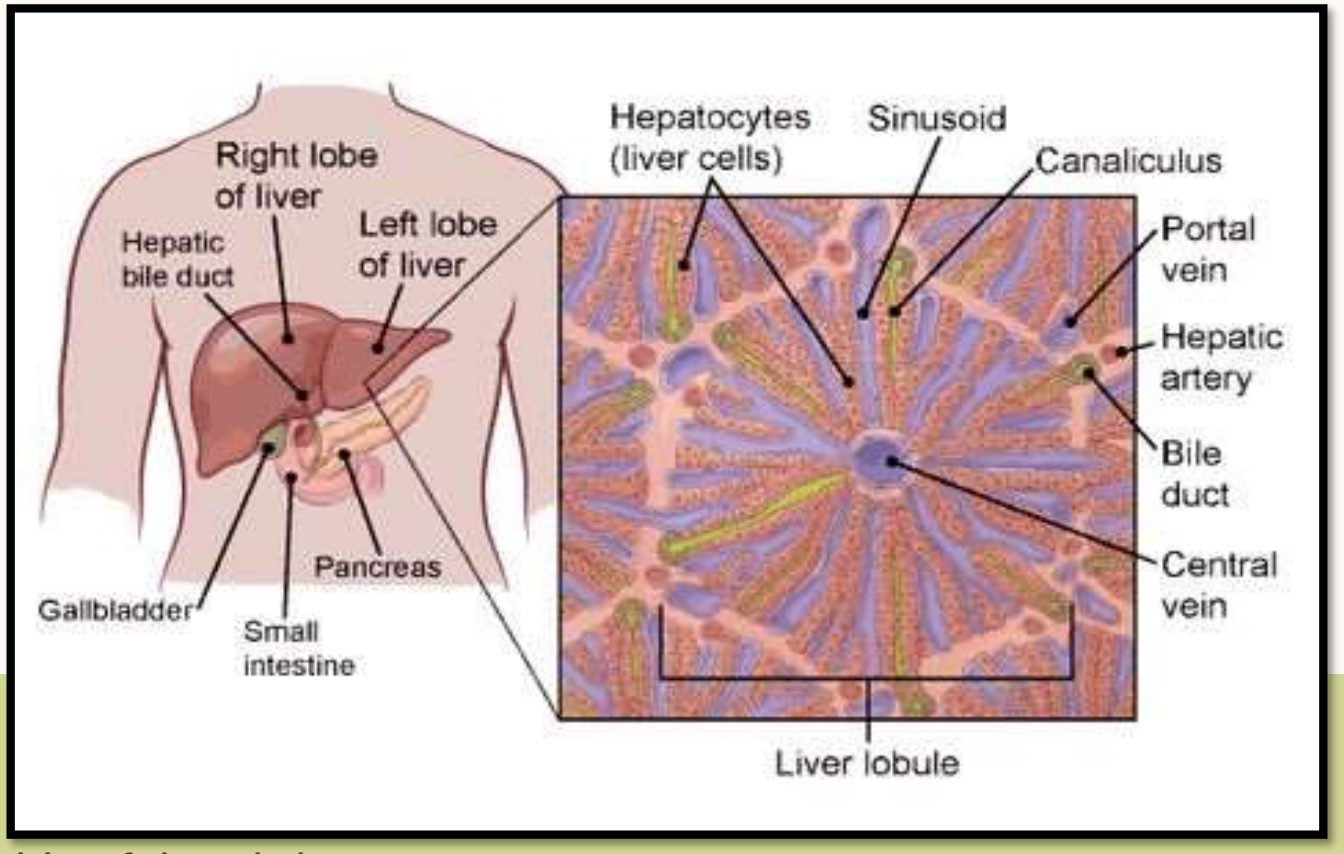
1. **Location:** Below the jaw, on both sides of the mouth.
2. **Secretion:** Produces a mixed saliva with enzymes for carbohydrate digestion and mucin for lubrication.

3.Sublingual Glands:

1. **Location:** Beneath the tongue.
2. **Secretion:** Produces a thick mucous saliva that aids in lubrication and contains some enzymes.

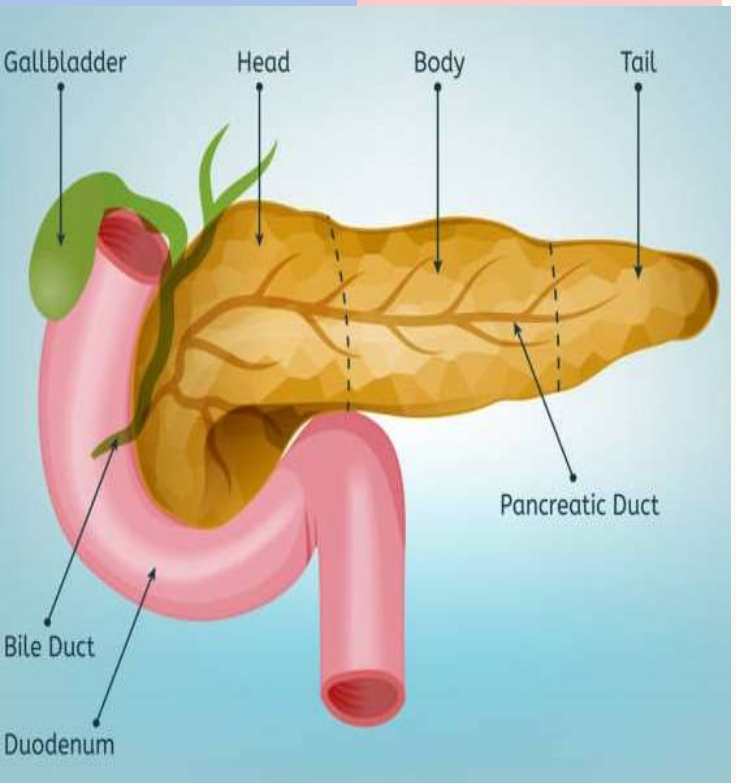


LIVER



- **Location:** Upper right side of the abdomen.
- **Size:** About the size of a football. Largest gland in our body.
- **Appearance:** Dark reddish-brown.
- **Functions:**
  - Produces bile for fat digestion.
  - Metabolizes nutrients (carbs, fats, proteins).
  - Detoxifies harmful substances.
  - Stores glycogen, vitamins, and minerals.
  - Synthesizes proteins for blood clotting and maintaining blood volume.

PANCREAS



- Location: Positioned behind the stomach, extending horizontally across the upper abdomen.
- Discovery: Herophilus first described the pancreas around 300 BCE.
- **Functions:**
- Enzyme Production (Exocrine Function): Secretes digestive enzymes (lipase, protease, and amylase) into the small intestine, aiding in the breakdown of fats, proteins, and carbohydrates.
- Insulin and Glucagon Production (Endocrine Function): Regulates blood sugar levels. Insulin facilitates the uptake of glucose by cells, lowering blood sugar, while glucagon stimulates the release of glucose, raising blood sugar.
- Appearance: Elongated and flattened organ with three main parts:
- Head: Nestled in the curve of the duodenum (the first part of the small intestine).
- Body: Extends across the abdomen.
- Tail: Reaches toward the spleen on the left side.

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CELL CYCLE AND CELL DIVISION

B.Sc. I

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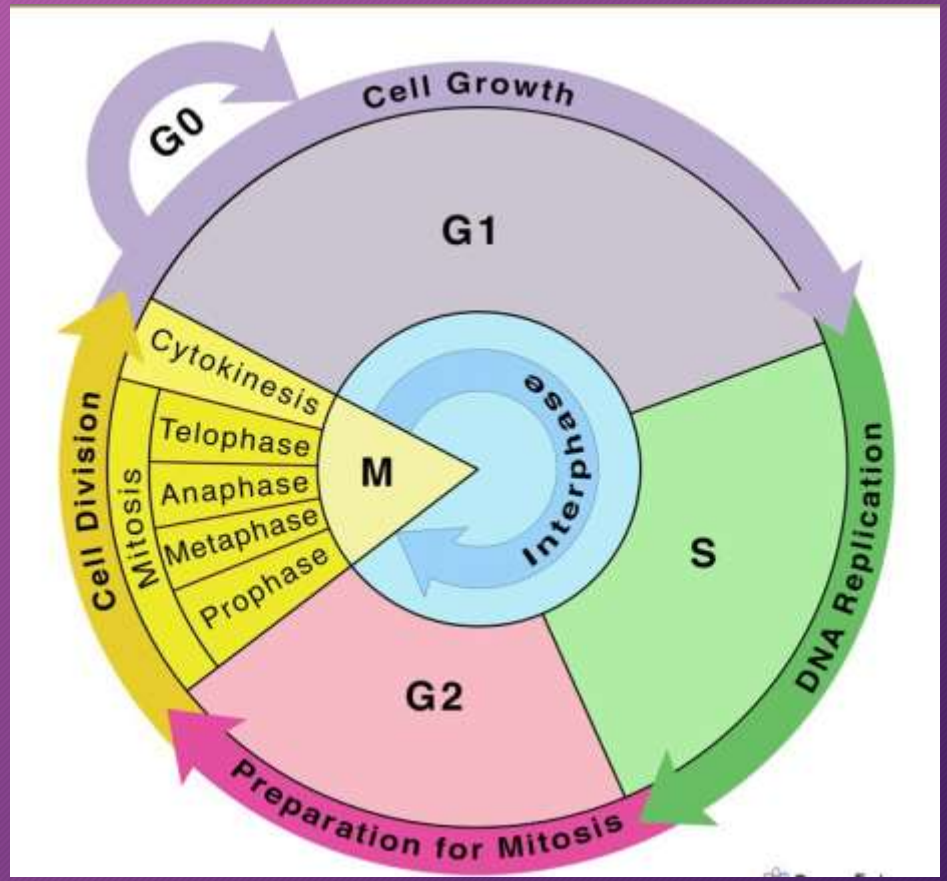
Cell Cycle Definition:

The cell cycle is a fundamental and highly regulated process in biology that describes the sequence of events that a eukaryotic cell undergoes from its formation to cell division.

Significance of the Cell Cycle:

- Growth and Development:
- Tissue Repair
- Genetic Continuity
- Prevention of abnormalities



Phases of cell cycle:

The cell cycle is a complex process that consists of several distinct phases, each with specific events and regulatory checkpoints. The cell cycle is traditionally divided into two main phases:

Interphase and Mitotic (M) Phase.

- Interphase is the longest phase of the cell cycle and is further divided into three subphases: G1 (Gap 1), S (Synthesis), and G2 (Gap 2). During interphase, the cell prepares for cell division, replicates its DNA, and carries out various metabolic processes.
- a. G1 Phase (Gap 1):During this phase, the cell grows in size, synthesizes proteins, and carries out normal metabolic activities.
- b. S Phase (Synthesis):In the S phase, DNA replication occurs, leading to the synthesis of an identical copy of the cell's genetic material.
- c. G2 Phase (Gap 2):G2 follows the S phase and is a period of further growth and preparation for cell division. During this phase, the cell continues to synthesize proteins, including those required for mitosis.

Mitotic (M) Phase:

The Mitotic phase is the stage where the cell physically divides into two a cells. It includes several distinct stages:

a. Prophase:

During prophase, chromatin (the loose, thread-like form of DNA) condenses into visible chromosomes.

b. Metaphase:

In metaphase, chromosomes align at the cell's equatorial plane, known as the metaphase plate.

c. Anaphase:

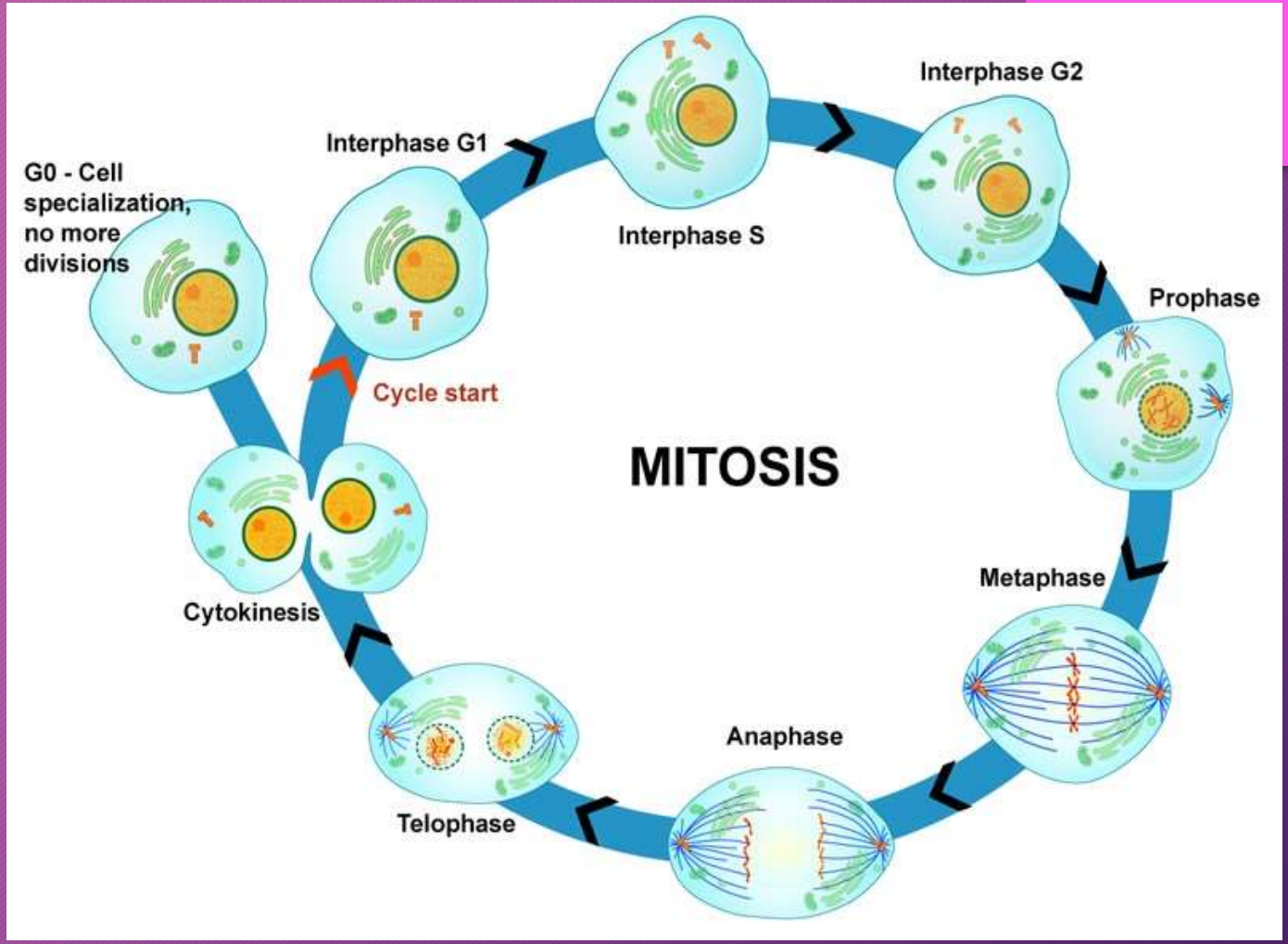
The centromere splits, and each chromatid is pulled to opposite poles of the cell.

d. Telophase:

In telophase, the separated chromatids reach the cell’s poles and decondense back into chromatin.

e. Cytokinesis:

It involves the division of the cytoplasm and organelles between the two daughter cells.



Meiosis

Meiosis is a specialized form of cell division that occurs in sexually reproducing organisms, resulting in the formation of haploid gametes (sperm and egg cells in animals) or spores (in plants and some fungi).

Meiosis consists of two sequential divisions, known as Meiosis I and Meiosis II.

Meiosis I

Prophase I: initiates meiosis with chromosome condensation, synapsis of homologous chromosomes, and crossing over. The nuclear envelope breaks down, enabling spindle formation.

Metaphase I:

In Metaphase I, tetrads align at the cell's equatorial plane.

Anaphase I:

Anaphase I is characterized by the separation of homologous chromosomes.

Telophase I and Cytokinesis:

In Telophase I, the separated chromosomes arrive at the poles, and the nuclear envelope may reform. Cytokinesis occurs, dividing the cell into two daughter cells.

Meiosis II

Meiosis II is similar to a mitotic division but occurs in haploid cells resulting from Meiosis I. It consists of the following stages:

Prophase II:

marks the start of the second meiotic division, involving chromosome condensation and spindle formation in haploid cells.

Metaphase II:

Chromosomes align at the cell's equatorial plane in Metaphase II.

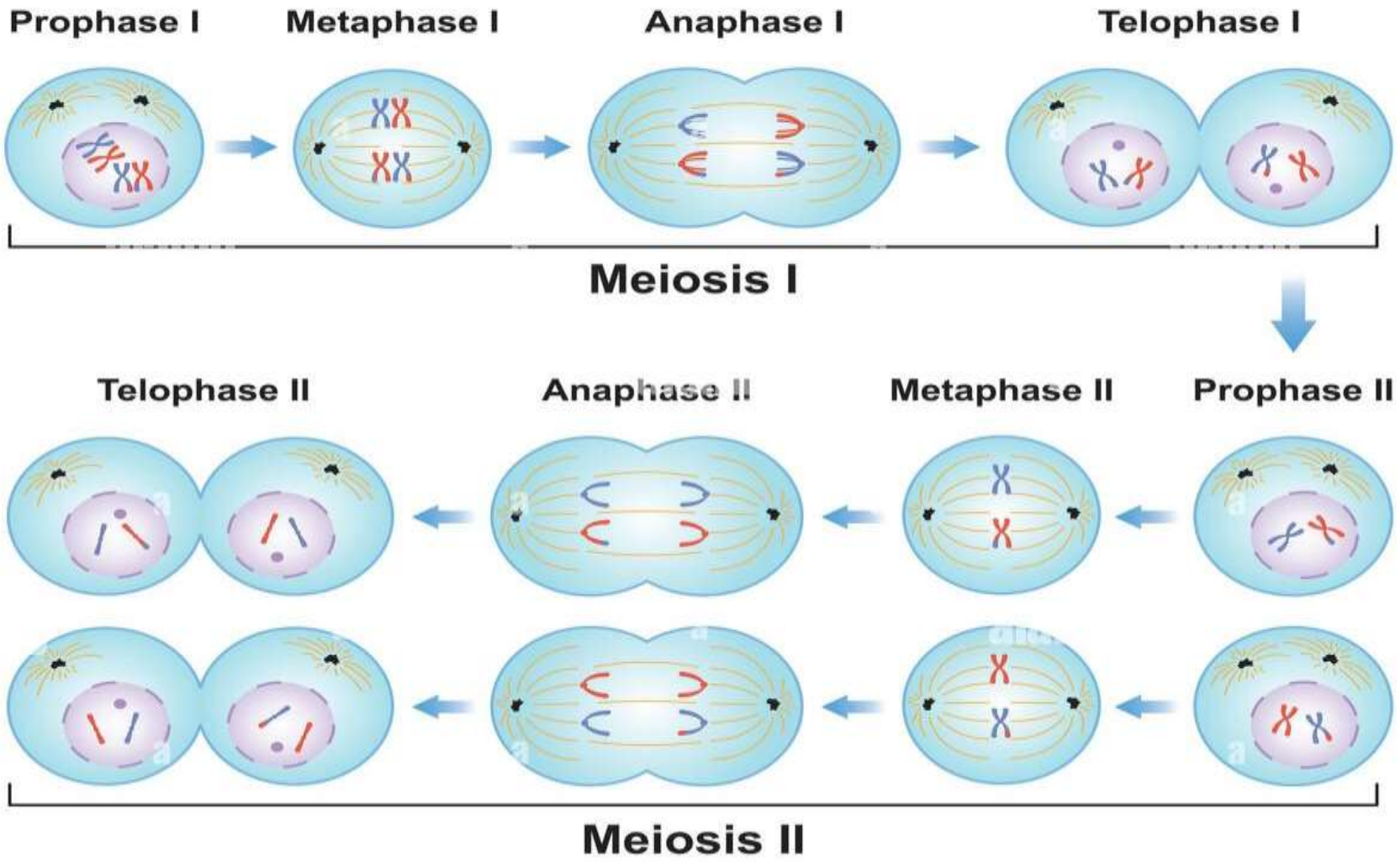
Anaphase II:

Sister chromatids are separated as spindle fibers pull them to opposite poles of the cell.

Telophase II and Cytokinesis:

In Telophase II, the chromatids arrive at the poles and decondense.
A nuclear envelope forms around each set of chromatids, resulting in four haploid daughter cells.
Cytokinesis occurs, dividing these cells into four unique haploid gametes or spores.

Meiosis Phases



SIGNIFICANCE:

1.Mitosis:

1. Generates identical somatic (body) cells.
2. Essential for growth, tissue repair, and asexual reproduction.
3. Maintains genetic stability by passing on genetic information without significant variation.

2.Meiosis:

1. Produces gametes (sperm and egg cells) with half the chromosome number.
2. Introduces genetic diversity through crossing over and independent assortment.
3. Crucial for sexual reproduction, genetic variation, and evolution.

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DNA FINGERPRINTING

B.Sc. III

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INTRODUCTION TO DNA FINGERPRINTING

- DNA fingerprinting is a laboratory technique used to determine the probable identity of a person based on the nucleotide sequences of certain regions of human DNA that are unique to individuals. DNA fingerprinting is also called DNA typing or DNA profile.

- DNA (deoxyribonucleic acid) represents the blueprint of the human genetic makeup.The human genome is made up of 3 billion nucleotides, which are 99.9% identical from one person to the next. The 0.1% variation, therefore, can be used to distinguish one individual from another.

- In forensics laboratories, DNA can be analyzed from a variety of human samples including blood, semen, saliva, urine, hair, buccal (cheek cells), other tissues, or bones. DNA can be extracted from these samples and analyzed in a lab and results from these studies are compared to the DNA analyzed from known samples.

-**Geneticist “Alec J. Jeffreys**” from the University of Leicester in Great Britain first discovered that there are certain patterns of genetic material that are unique to almost every individual. He called these patterns “Repetitive DNA Sequences” or "Minisatellites.“

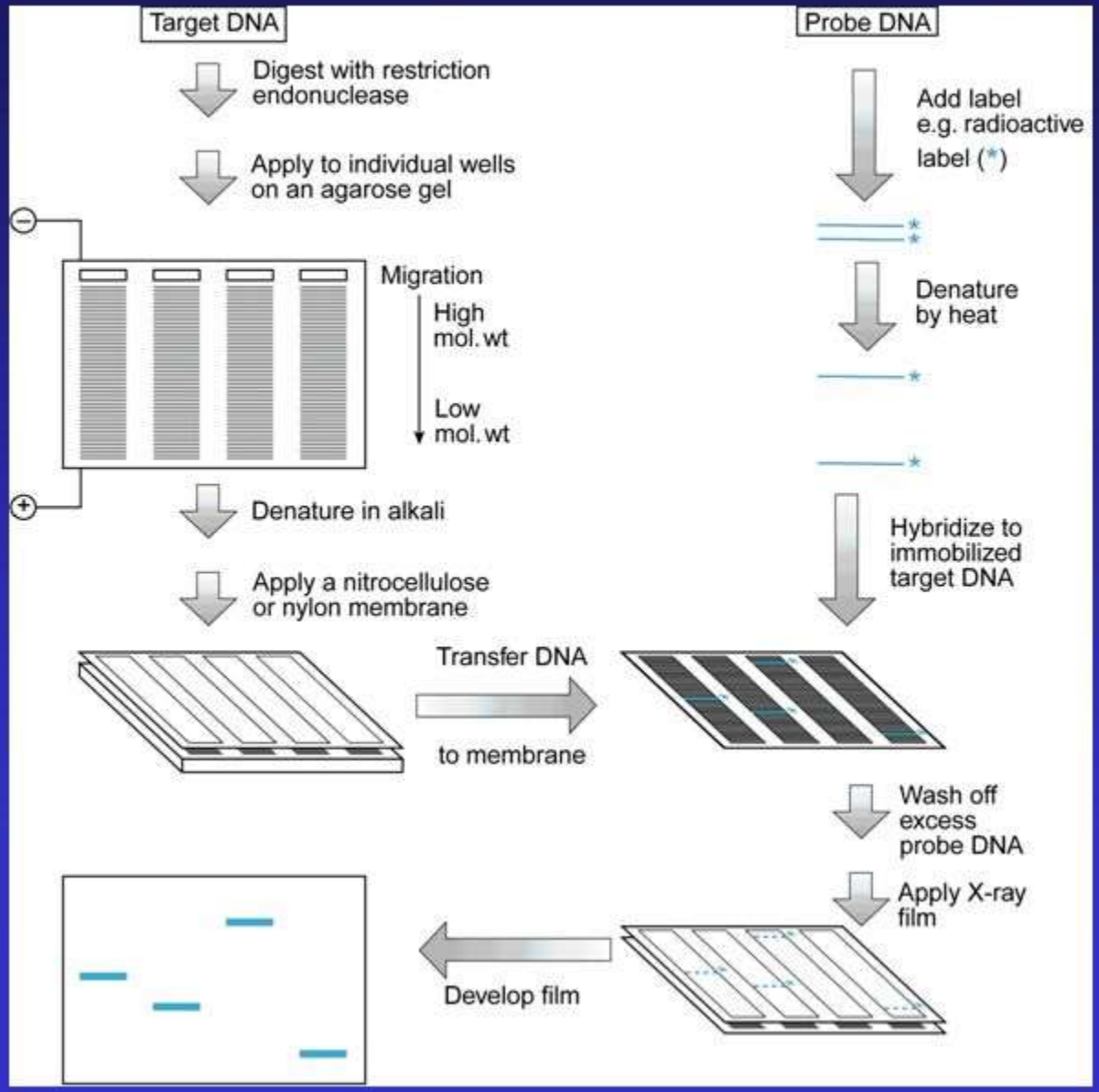
PRINCIPLE

-DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called as repetitive DNA, because in these sequences a small stretch of DNA is repeated many times. These repetitive DNA (Satellite DNA) are non-coding sequences and do not code for any proteins. They show high degree of polymorphism and forms the basis of DNA fingerprinting.

Six steps of DNA fingerprinting

- Extracting the DNA from cells
- Cutting up the DNA using an enzyme
- Separating the DNA fragments on a gel
- Transferring the DNA onto paper
- Adding the radioactive probe
- Setting up the X-ray film

Procedures of DNA Fingerprinting



DNA fingerprinting procedure

- The original DNA fingerprinting procedure uses VNTR (Variable Number of Tandem Repeats), VNTR belongs to a class of satellite DNA referred to as mini-satellite. The pattern, length and number of these repeats are unique for each individual.

- DNA samples from the crime scene and the suspects DNA can be collected and, it can be subjected to DNA digestion using the desired restriction endonucleases that act as molecular scissors by cutting specific recognition sequences.

- The restricted DNA fragments are then exposed to gel electrophoresis. Gel electrophoresis separates the DNA fragments depending on the size. The DNA fragments are poured in the well of Agarose gel. The gel is connected to positive and negative electrodes. Gel electrophoresis works on the fact that the unlike charges attract each other and smaller fragments move faster than the larger fragments.

- Once the gel electrophoresis is performed, the DNA fragments are transferred (blotted) from the gel onto a nitrocellulose or nylon membrane. A radioactive labelled DNA probe is added to the membrane. It will bind (hybridize) to the matching DNA sequences on the membrane.

- finally autoradiography or Imaging is performed where the membrane is exposed to X-rays or a specialized camera is used to visualize and record the bound DNA fragments.

SOME OF THE KEY APPLICATIONS OF DNA FINGERPRINTING INCLUDE:

- Forensic Identification: DNA fingerprinting is widely used in forensic science to identify individuals based on biological samples found at crime scenes.

- Paternity Testing: By comparing the DNA profiles of a child, mother, and alleged father, paternity can be confirmed or refuted.

- Missing Persons and Unidentified Bodies: DNA profiling assists in identifying missing persons and unidentified bodies by comparing DNA samples from the individuals in question with samples from their relatives or from a database of known individuals.

- Medical Diagnosis and Research: DNA fingerprinting can be used for medical purposes, such as identifying genetic disorders and predicting susceptibility to certain diseases.

- Disaster Victim Identification: In cases of mass disasters, DNA fingerprinting assists in the identification of victims by comparing their DNA profiles with samples obtained from relatives, facilitating the process of returning remains to families.

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Practical based on Animal Diversity

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Obelia

Classification:

Kingdom- Animalia
Sub-Kingdom-Eumetazoa
Phylum- Cnidaria.
Class- Hydrozoa.

Common Name- Sea fur. Obelia is a typical example of a marine, colonial ...

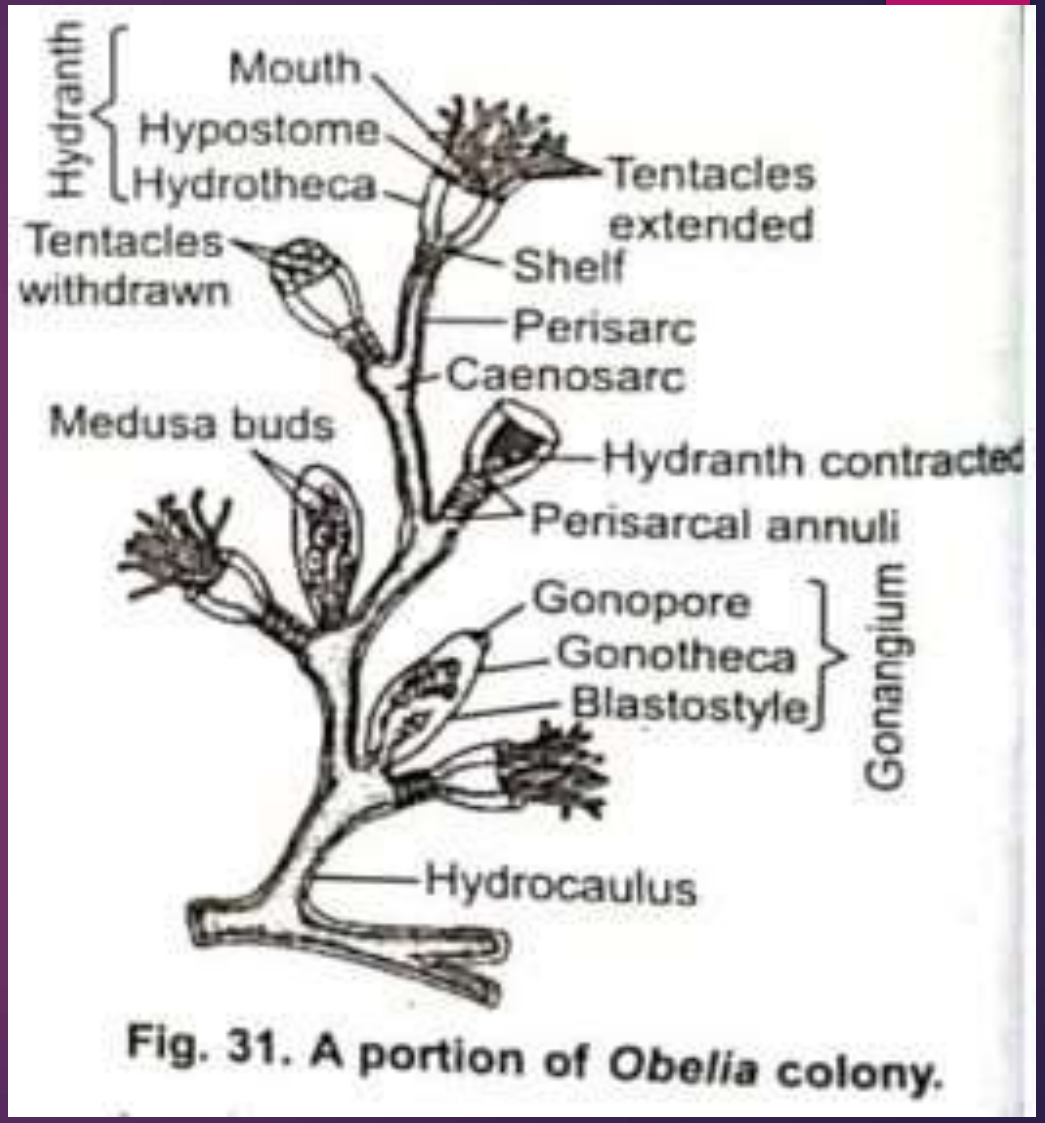


Fig. 31. A portion of *Obelia* colony.

Characters:

1. Obelia is a colonial, marine, sedentary coelenterate, attached to seaweeds, shell and rocks.
2. The colony of Obelia is made up of the branches and zooids.
3. The colony is trimorphic having three types of zooid. Polyp, blastostyle and medusa.
4. Polyp has a cylindrical body attached to the axis of the hydrocaulus. It is covered by cup shaped hydrotheca.
5. The hypostome is covered by number of tentacles provided with nematocysts. Polyp is nutritive zooid.

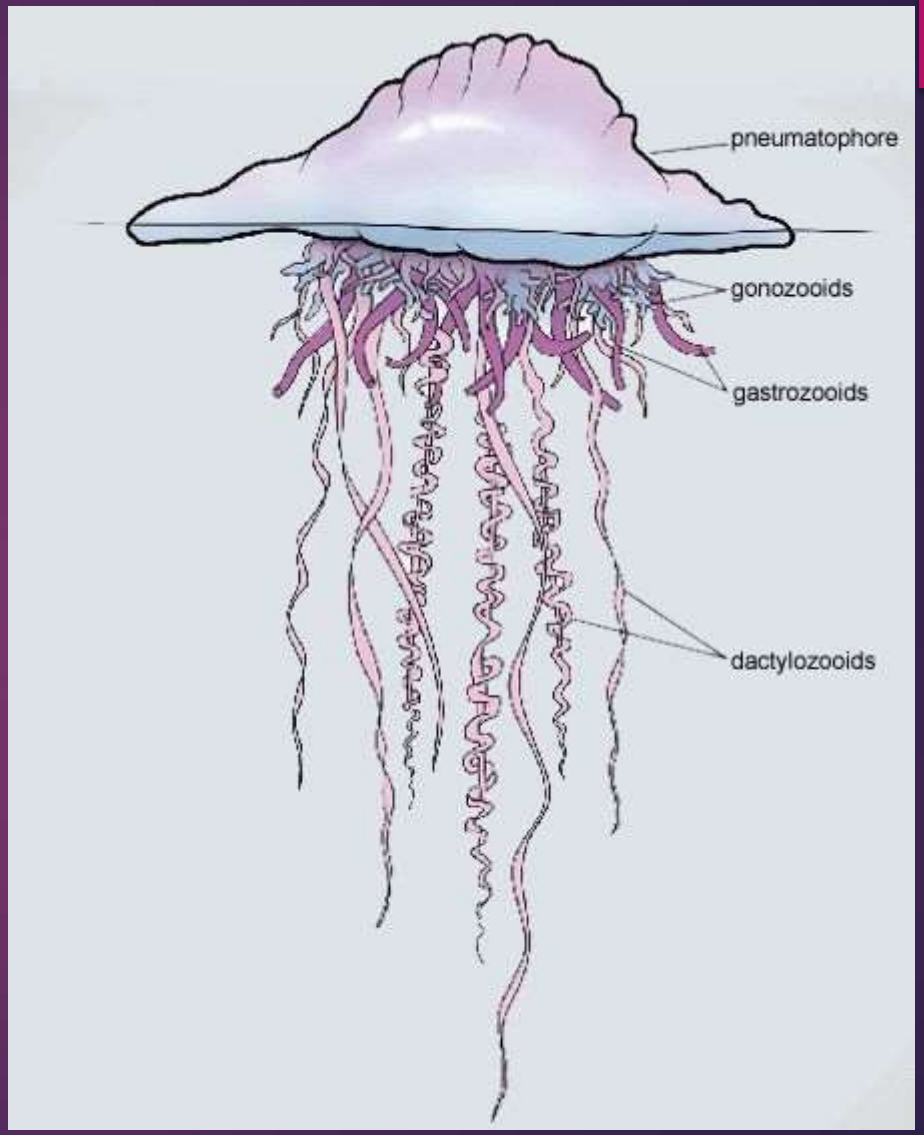
6. Blastostyle is a reproductive zooid covered by a covering called as gonotheca. It gives rise to buds which develop into medusae.
7. Medusa is bell shaped and free living.
8. Life history of obelia exhibits alternation of generation.
9. A medusa produces gametes (male & females), which are shed into the water; upon fertilization, the structure develops into a swimming larva, which later on settles and develops in a polyp. Polyps produce medusa asexually by budding.

Physalia

Classification:

Kingdom- Animalia
Subkingdom. Eumetazoa
Phylum- Cnidaria
Class- Hydrozoa

Common name: Portuguese man O' war.



Characters:

1. Physalia, also called “Portugese Man of War”.
2. It is a marine, colonial, swimming or floating pelagic animal. Distributed in tropical and subtropical seas.
3. This warm ocean creature deceives with its beautiful colours, but in fact it’s very dangerous.
4. Physalia has contractile tentacles that can reach 10-20 m in length when extended.
5. Colony has a large pneumatophore or float which is brightly coloured or blue or purple.

6. The float is bladder like and the upper surface of float is produced into a crest or sail.

7. A gas gland present inside the float secretes a gas of composition similar to that of air. This helps the animal in floating over the surface of water.

8. Beneath the float three main types of zooids hang down (i) Gastrozooids – Nutritive zooids having a mouth but tentacles are absent. (ii) Dactylozooids – this help to capture the prey for food. They have numerous nematocyst- bearing tentacles.

(iii) Gonozooids – Reproductive zooids bearing clusters of male and female medusa.

9. Tentacles are large and bear stinging batteries or nematocysts to kill fishes.

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Practical based on Animal Diversity

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HIRUDINARIA

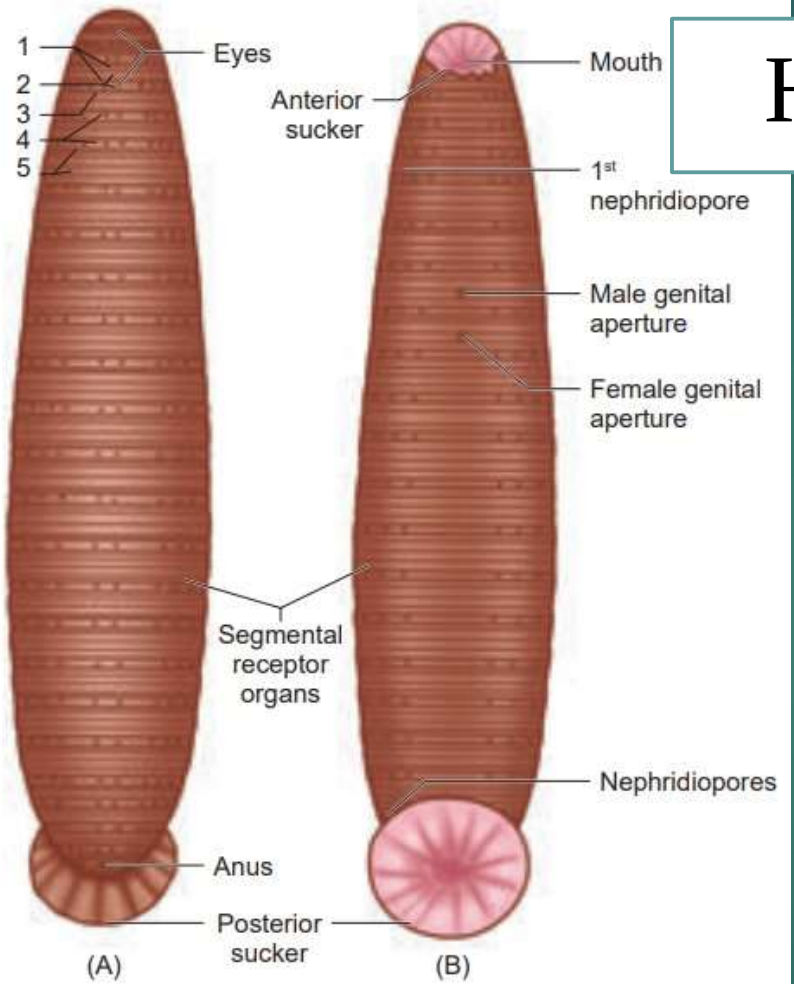


Figure 13.1 External morphology of Leech

A. Dorsal View B. Ventral view

CLASSIFICATION:

kingdom: Animalia

Phylum: Annelida

Class: Hirudinea

Genus: Hirudinaria

GENERAL CHARACTERS:

1. *Leeches have a soft, elongated, dorsoventrally flattened body that measures approximately 30-35 cm in length.*

2. *Mostly freshwater but some are found in marine or terrestrial environments. Generally ectoparasitic. It is sanguivorous (blood-sucking) in habit.*

3. *Their body is divided metamerically into **33 segments** or somites. Each segment is further divided into annuli or rings.*

4. *The dorsal five segments have 5 pairs of **eyes**.*

5. *They also have well-developed posterior and anterior suckers.*

6. *The posterior sucker is circular and serves as an organ of adhesion and locomotion.*

7. *The anterior sucker is ventral and oval in shape. It forms a triradiate mouth by the fusion of prostomium and a few anterior segments.*

8. *Nephridia are 17 pairs and are segmentally arranged from the 6th to 22nd segment.*

9. *The alimentary canal is a straight tube placed on the 25th segment.*

10. *Leeches are hermaphrodites.*

11. *The male organs include testis sacs, vas efferens, vas deferens, epididymis, ejaculatory ducts and genital atrium. The female organs include the ovaries, oviducts and vagina.*

12. *Sexual reproduction is common.*

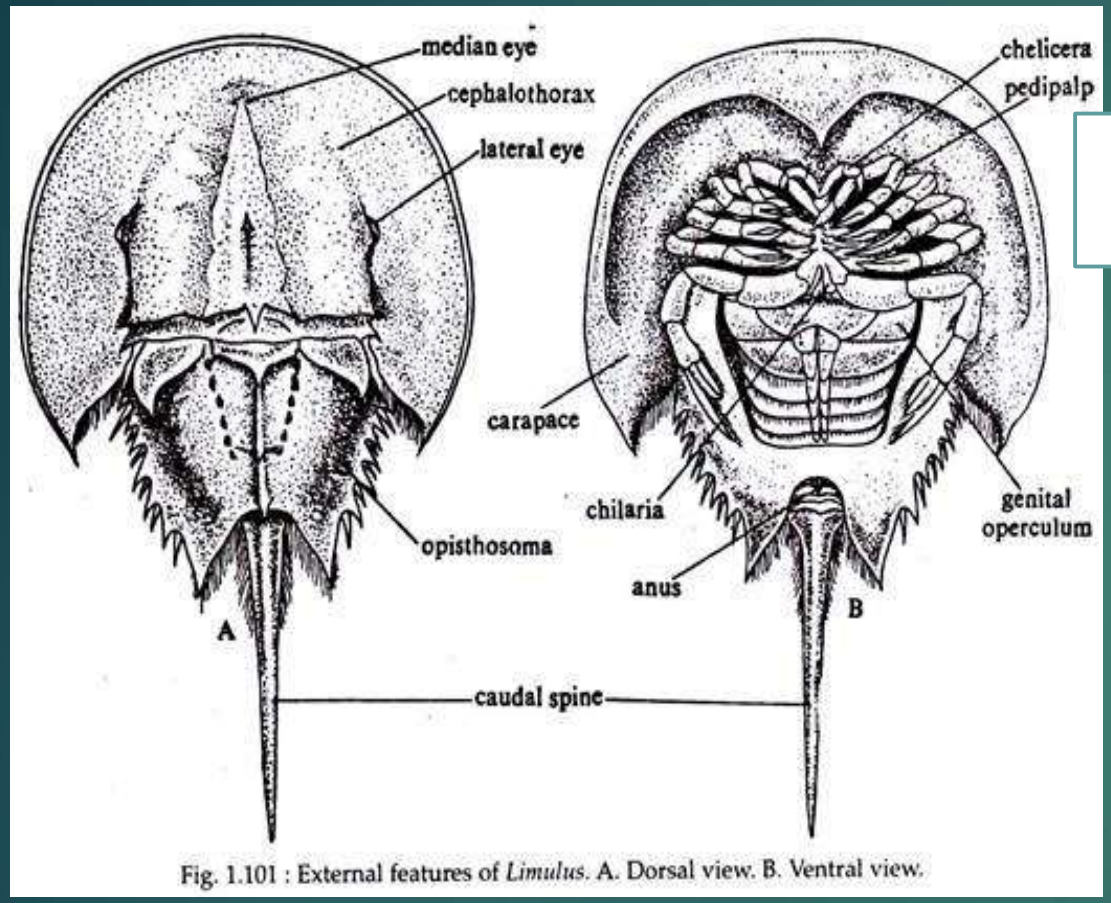


Fig. 1.101 : External features of *Limulus*. A. Dorsal view. B. Ventral view.

LIMULUS

CLASSIFICATION:

Kingdom: Animalia

Phylum: Arthropoda

Class: Arachnida

Genus: Limulus

GENERAL CHARACTERS:

1. *It is commonly known as king-crab or horseshoe crab, it is a living fossil.*
2. *It is a marine arthropod found burrowing in sand.*
3. *The body is differentiated into anterior prosoma (cephalothorax) and posterioropisthosoma.*
4. *Body regions are the cephalothorax, abdomen, and a long spike-like telson or tail.*
5. *Prosoma is broad, convex above, and concave below.*
6. *It bears a pair of median eyes a pair of lateral eyes and three longitudinal ridges above.*

7. Prosomatic appendages are six pairs of appendages in which first pair is of chelate chelicerae, four pairs of chelate legs and the last one of non chelate legs.

8. The opisthosoma is divided into mesosoma, metasoma and telson.

9. Mesosoma is hexagonal and contains six pairs of immovable spines.

10. First pair of mesosomatic appendage is united to form a genital operculum, whereas the remaining five pairs bear book-gills or book-lungs for respiration.

11. Excretion through coxal glands.

PERIPLANATA

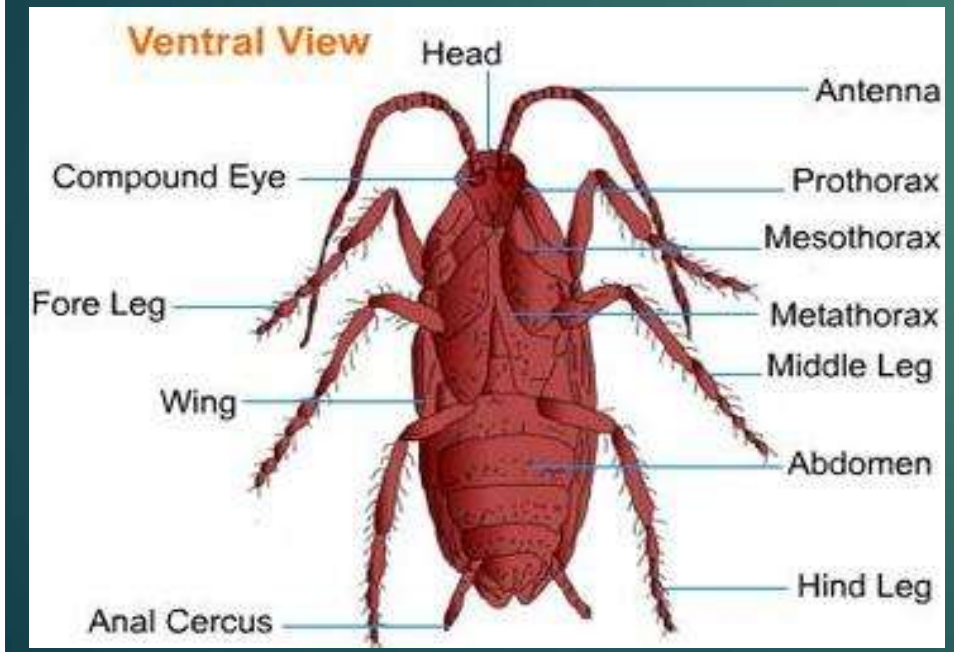
CLASSIFICATION:

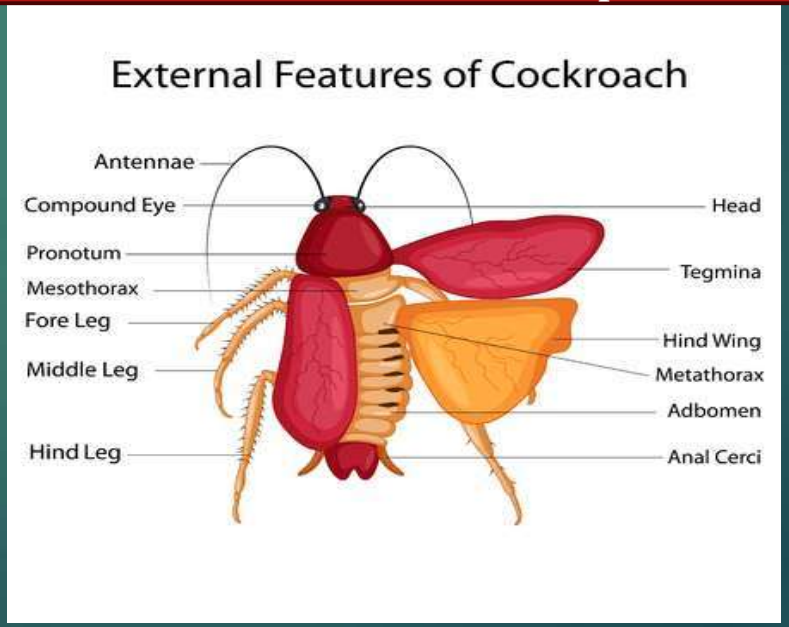
Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Genus: Periplanata





GENERAL CHARACTERS:

1. *Cockroaches are world-wide in distribution and found in such places where darkness, warmth, dampness and plenty of organic debris is available. They are nocturnal and omnivorous, Cursorial – fast runner.*
2. *Head is narrow, elongated, bilaterally symmetrical and flattened.*
3. *The body of cockroach is divisible into three distinct regions they are head, thorax and abdomen.*
4. *Exoskeleton is hard, brown in colour and made up of chitin.*
5. *The hardened plates of exoskeleton are called the sclerites.*

6. Cockroach is dioecious animal with separate male and female sexes.

7. The male species are longer in length, while the females are slightly smaller than the males.

8. Head is triangular having great mobility due to flexible neck.

9. A pair of compound eyes is present on the head. Head also bears antennae with monitor the surrounding environment.

10.The head bears mouth parts such as labrum, pair of mandibles, a pair of maxillae and a labium.

11. Each segment of the thorax has a pair of walking legs.

12. Cockroaches comprises of 2 pairs of wings , forewings of cockroaches are mesothoracic and are known as tegmina or elytra. The cover the hind wings and have a protective function. Hind wings are used for flying.

13. Abdomen is made up of 10 segments. The 7^{th} , 8^{th} , 9^{th} sterna forms a genital pouch in females. In males the genital pouch is present in the hind end of abdomen.

14.The male cockroach has a thread like anal styles, which are missing in female cockroaches.

15. *Reproduction is sexual.*

16. *Digestive system is complete.*

17. *Excretion in cockroaches is carried out through Malpighian tubules, fat body cells, uricose glands, and the cuticle in cockroaches.*

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