Toppersnotes

Unleash the topper in you

SCIENCE & COMPUTER

For All Competitive Exams

SIERRA INNOVATIONS

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1 CHAPTER

Structure of Human Body

Cell

- **Simplest and most basic unit** of life.
- **Discovered:** Robert Hooke (1665)
- All living things made up of cells- **structural, functional, and biological unit of life.**
- Has the **ability to duplicate itself** on its own.
- aka "**building blocks of life.**"

Cell Structure and its components

Cell Organelles

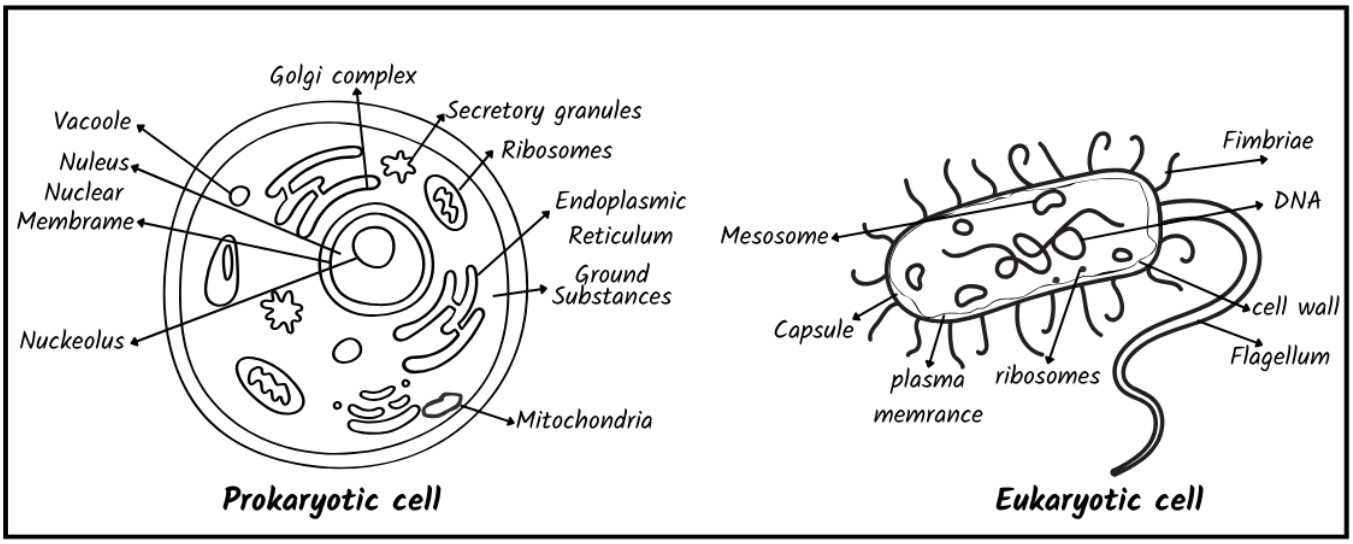
- Present within a cell & **perform certain specific functions to carry out life's processes.**

Plasma / Cell Membrane	➢ **Outermost covering** of the cell ➢ **Separates contents of cell** from its **external environment.** ➢ **A selectively permeable membrane** as it allows entry and exit of some materials in and out of the cell.
Cell Wall	➢ **ONLY** in **plants** ➢ **Outside** the **plasma membrane.** ➢ Mainly **composed of cellulose.** ✓ **Cellulose:** A complex substance - provides structural strength to plants.
Cytoplasm	➢ **Jelly-like substance** present between **cell membrane & nucleus.** ➢ **Fluid content inside plasma membrane.** ➢ **Contains** many specialised **cell organelles** (mitochondria, golgi bodies, ribosomes, etc)
Nucleus	➢ **Contains chromosomes** that contain **information** for **inheritance** of features from parents to next generation in form of DNA ➢ Plays a **central role** in **cellular reproduction.** ➢ **Nuclear membrane**- a **double-layered** covering on nucleus. ✓ **Allows transfer** of **material** from **inside** nucleus **to its outside**, i.e., to cytoplasm.
Nucleolus	➢ **Ribosome synthesis site regulating cellular activity** and **reproduction.**

Gene	➢ **Unit of inheritance** in living organisms.
Protoplasm	➢ **Entire content of a living cell** [cytoplasm + nucleus]. ➢ aka **living substance of the cell.**
Chromosomes	➢ **Rod-shaped structures** ➢ Visible **only when** the **cell is about to divide**. ➢ Contain **information for inheritance of features** from parents to next generation in the form of DNA (deoxyribo nucleic acid) ➢ **Composed** of **DNA** and **Protein**.
DNA molecules	➢ Contains **information necessary for constructing and organising cells**. ➢ Functional segments of DNA - **genes.**
Vacuoles	➢ **Empty structure in cytoplasm** ➢ Act as storage sacs for solid or liquid contents. ➢ **Common in plant cells.** ➢ **Smaller in animal cells**. ➢ **Substances stored-** amino acids, sugars, various organic acids and some proteins.
Endoplasmic Reticulum	➢ A **large network of membrane-bound tubes and sheets**. ➢ **2 types :** 1. **Rough endoplasmic reticulum [RER]** ✓ **Has ribosomes** attached to its surface. ✓ **Ribosomes** - sites of **protein manufacture**. 2. **Smooth endoplasmic reticulum** ✓ Helps in the **manufacture of fat molecules**, or lipids, important for cell function. ✓ Some of these proteins and lipids **help in building the cell membrane k/a membrane biogenesis.** ➢ Serve as **channels for transport of materials** between various regions of cytoplasm or between the cytoplasm and the nucleus. ➢ Also functions as **a cytoplasmic framework** providing a **surface for some biochemical activities of cells.**
Golgi Apparatus/ Complex	➢ A **system of membrane-bound vesicles** arranged **parallel** to each other in **stacks** called **cisterns**.

	➢ **Packages** and **dispatches material synthesised near ER** to **various targets** inside and outside the cell. ➢ **Stores**, **modifies** and **packages products** in vesicles. ➢ Involved in the **formation** of **lysosomes**. ✓ **Membrane-bound sacs** filled with digestive enzymes. ✓ Kind of **waste disposal system** of the cell. ✓ **Help** to **keep** the **cell clean** by **digesting** any **foreign material** as well as **worn-out cell organelles**.
Mitochondria	➢ Aka **powerhouse of the cell.** ➢ **Energy required** for various chemical activities **is released** by mitochondria in the form of **ATP** (Adenosine Triphosphate) molecules. ➢ 2 **membranes:** ✓ **Outer membrane- porous** ✓ **Inner membrane - deeply folded.** ■ **Folds** create a **large surface area** for **ATP-generating chemical reactions**.
ATP	➢ aka **energy currency of the cell.** ➢ **Body uses energy** stored in **ATP** for **making new chemical compounds** and for mechanical work.
Ribosomes	➢ **Site of protein synthesis.** ➢ **Polyribosomes or Polysomes:** Several **ribosomes may attach to a single mRNA and form a chain.** ➢ **Prokaryotes- ribosomes are associated with the plasma membrane of the cell.**
Cilia and Flagella Cilia	➢ **Hair-like outgrowths of the cell membrane.** ➢ **Cilia - small structures which work like oars, causing** the **movement of either the cell or the surrounding fluid.** ➢ **Flagella** - comparatively **longer** and responsible for cell movement. ➢ **Prokaryotic bacteria have flagella but structurally different from eukaryotic flagella.**
Centrosome and Centrioles	➢ Centrosome- **an organelle** usually containing 2 **cylindrical structures called centrioles.** ➢ **Surrounded by amorphous pericentriolar materials**. ➢ **Both** the **centrioles** in a centrosome **lie perpendicular** to each other

Types of Cells



Prokaryotic Cell	Eukaryotic Cell
➢ **Primitive/undeveloped nucleus.**	➢ Has **true or developed nucleus**
➢ **Size** - 0.2 - 2.0 micrometers	➢ **Size**- 10- 100 micrometers.
➢ **Simpler** in **structure**	➢ **More complex**
➢ **Organelles not membrane-bound**	➢ **Organelles membrane bound** & specific in function.
➢ **DNA** arranged in **circular** shape	➢ **DNA linear** in shape
➢ **Cytoplasm present**, but **lacks** in most **cell organelles**.	➢ Consists of **both cytoplasm** and **organelles**
➢ **Cell wall present**. ➢ Made of mucopeptide or peptidoglycan	➢ Usually, **absence of cell** wall here. ➢ Made of cellulose
➢ **Cell division** - binary fission, transduction, conjugation, and transformation	➢ **Cell division** - mitosis
➢ **Mitochondria absent**	➢ Mitochondria **present**.
➢ **Endoplasmic reticulum not present**.	➢ Endoplasmic reticulum **present**.
➢ **Ribosome present**	➢ Ribosome **present**
➢ **Plasmids** commonly **found**. ✓ A **small, circular, double-stranded DNA** molecule **distinct** from a **cell's chromosomal DNA**. ✓ **Naturally exist in bacterial cells.**	➢ **Plasmids** very **rarely found**
➢ **Only asexual reproduction**.	➢ **Both sexual** and **asexual** reproduction.
➢ Have a **single origin** of **replication**	➢ Have **multiple origins** of **replication**
➢ Only 1 **chromosome**.	➢ **Many chromosomes** present
➢ **Eg.** Bacteria and Archaea.	➢ **Eg**. Plant and animal cells.

Plant and Animal Cells

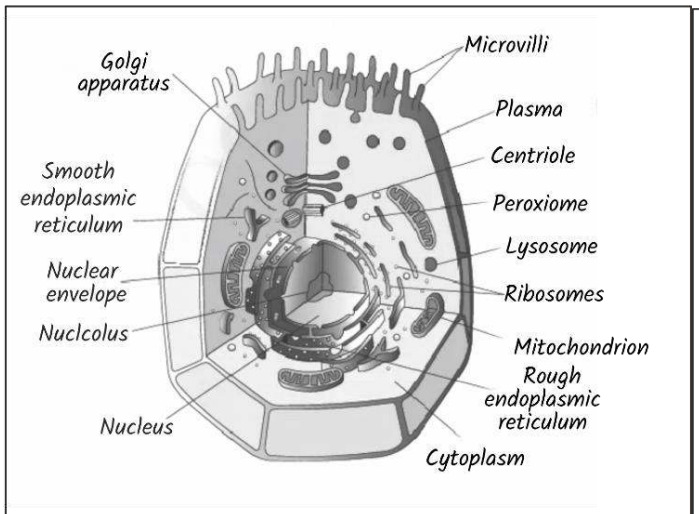


Fig : Animal Cell

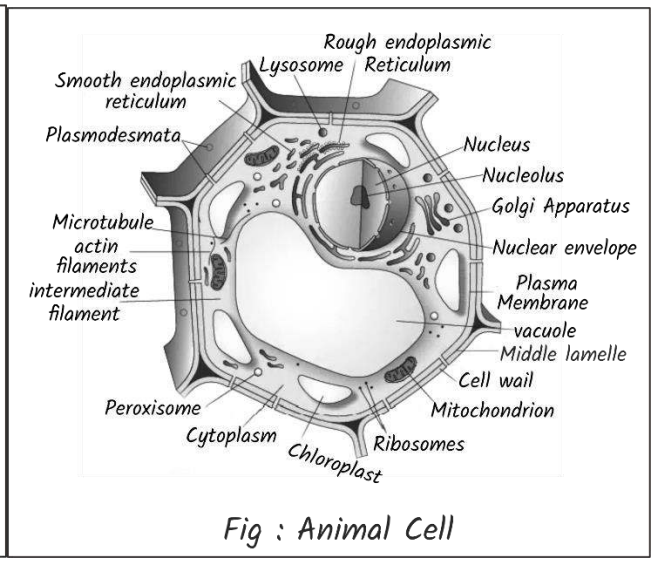


Fig : Animal Cell

Fig : Animal Cell

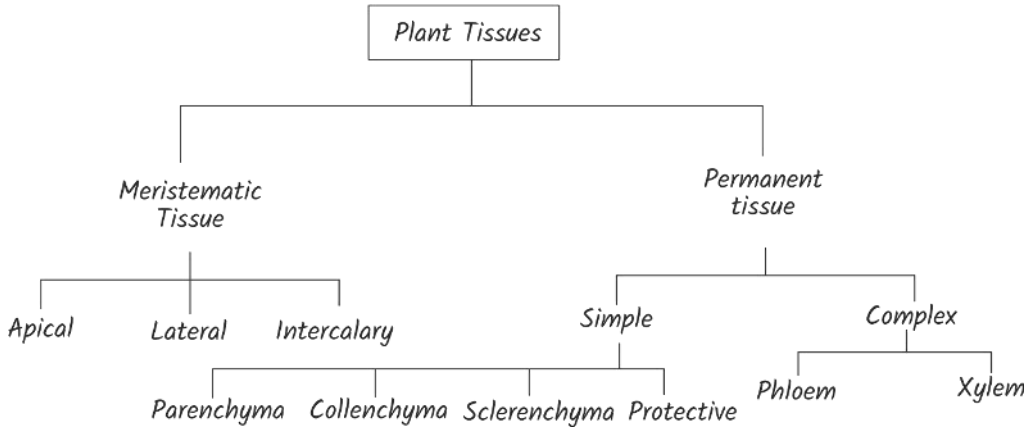
	Animal Cell	**Plant Cell**
Nucleus	Present	Present
Cilia	Present	Very rare
Shape	Round (irregular shape)	Rectangular (fixed shape)
Chloroplast	NO chloroplasts	Chloroplasts present
Cytoplasm	Present	Present
Endoplasmic Reticulum	Present	Present
Ribosomes	Present	Present
Mitochondria	Present	Present
Vacuole	One or more small vacuoles (much smaller than plant cells).	One large central vacuole taking up 90% of cell volume.

Tissues

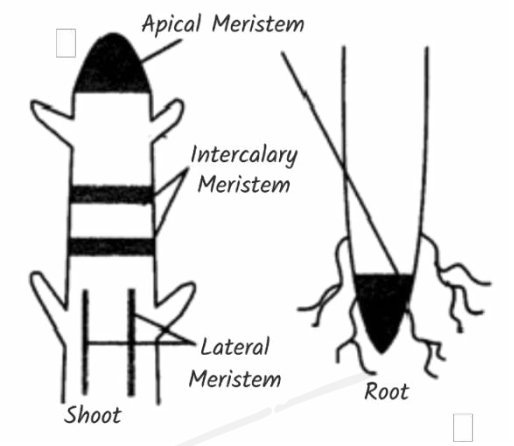
- A **group of cells with similar shape and function**.
- **Group of** (cells →Tissues → Organs → Organ systems).
- **Histology**: study of tissues.

Types of Tissues

1. **Plant Tissues**



On the basis of the dividing capacity, plant tissues are of two types:



A. Meristematic tissues

- Consist of **actively-dividing cells.**
- **3 types:**
  - **a. Apical meristem:**
    - ✓ Present at the **growing tips of stems and roots.**
    - ✓ **Increases** the **length of stems and roots.**
  - **b. Intercalary meristem:**
    - ✓ Present at the **base of leaves or internodes.**
    - ✓ **Longitudinal growth** of plants.
  - **c. Lateral meristem:**
    - ✓ Present on the **lateral sides of the stems and roots.**
    - ✓ **Increases thickness** of stems and roots.

B. Permanent Tissues

- **Formed when cells** from **meristematic** tissues **loose** the **ability** to **divide.**
- 2 **types:**
  - **a. Simple permanent tissue:**
    - ✓ Consist of **only one type of cells.**
    - ✓ **Types:**

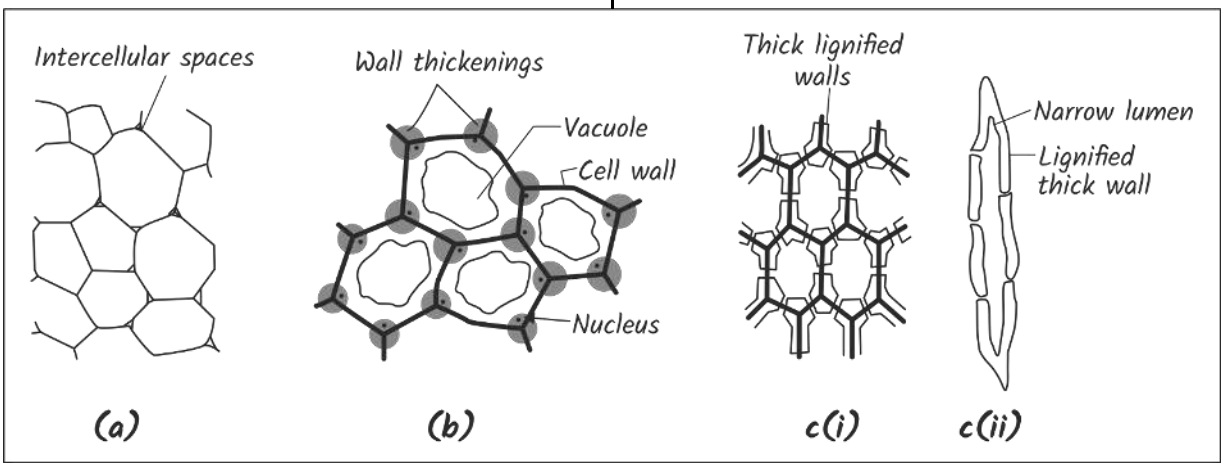


Fig : Various types of simple tissues : (a) Parenchyma (b) Collenchyma (c) Sclerenchyma (i) transverse section (ii) longitudinal section

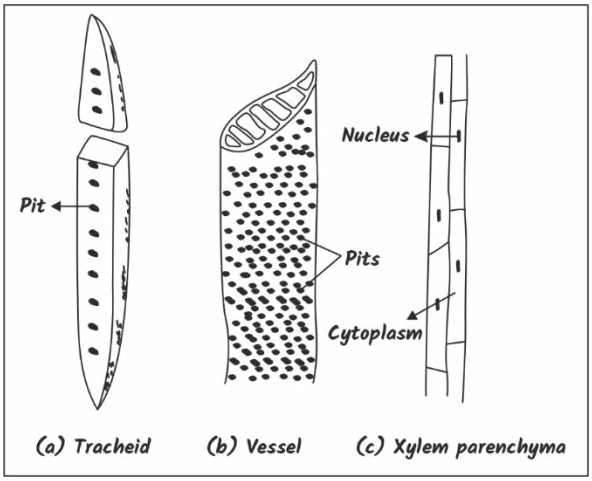
- ✓ **Parenchyma:**
  - **Composed** of **unspecialised living cells** with **relatively thin cell walls**, intercellular space.
  - Present in **soft parts of the plant.**
  - **Main function** - storage.
- ✓ **Collenchyma:**
  - Composed of **living** and **elongated cells** with cell walls **irregularly thickened** at the comers.
  - **No intercellular space**.
  - **Provides mechanical support** and **elasticity** to plant - helps in **bending** of **leaves** and **stems**.
- ✓ **Sclerenchyma:**
  - Composed of long, **narrow**, and **thick-walled cells**.
  - **Made** up of **dead cells**.
  - **No intercellular** spaces.
  - **Present** in **seeds**, **nuts**, the **husk** of a **coconut**, **fibres** of **jute** etc.
- ✓ **Protective tissues:**
  - **Protect the plant body by forming an outer layer.**
  - 2 **types**:
    - ☞ **Epidermis:**
      - **Covers** the **entire** body of **plant**.
      - **Protect plants** from injury, germs and water loss.
      - Cells **form** a **continuous layer without intercellular spaces**.
- ✓ **Cork Simple Tissues:**
  - **Consist dead cells** with **no intercellular spaces**.
  - **Form** the **outer layer** of old tree trunks.
  - **Cells** have a **chemical** - **suberin** in their walls that makes them **impervious to gases and water.**
  - **Protects plants** from injuries, germs and water loss.
  - **Lightweight** - used for making several products like bottle stoppers and shuttlecock.

Difference between parenchyma, collenchyma and sclerenchyma

Features	Parenchyma	Collencyma	Sclerenchyma
Cell shape	Isodiametric cells which are oval, sperical or polygonal shape.	Circular, oval or polyhedral	Variable in shape Fibres and sclereids
Cell wall	Thin cellulosic cell wall	Uneven thickeving on their cell wall	Lighified secondary cell wall present.
Cytoplasm	Abundant	Present	Absent
Nucleus	Prsent (Living tissue)	Present (Living tissue)	Absent (Dead tissue)
Vacuoles	Large vacuole	Vacuolated	Absent
Intercellular spaces	Present	Absent	Absent
Occurrence	Basically packing tissue all soft part of plant-path ocrtex, medullary rays	Dicot stem, petiole and beneath the epidermis Absent in monocot and roots	Dicot hypodermis, bundle sheath, pericyct seed, pulp of fruits.

b. Complex permanent tissue:

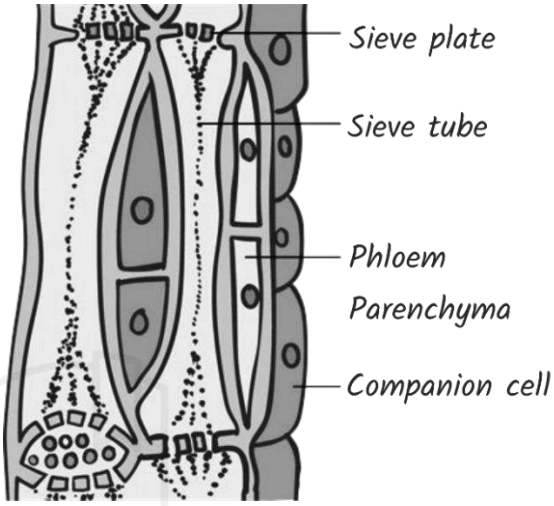
- Made up of **more than one type of cells** (Conducting tissues.)
- **Types:**
  - ✓ **Xylem:**



- **Conducts water** and **minerals** from roots to different parts of plant.
- **4** different types of **cells**:
  - ☞ **Tracheids**
    - **Elongated angular dead cells** mainly involved in **conduction** of **water** and **minerals** in **gymnosperms**.
  - ☞ **Vessels**
    - **Advance element** (generally found in **angiosperms**).
    - **Cylindrical tube like structures** placed one above other end to end to form a continuous channel for efficient conduction of water.
  - ☞ **Xylem parenchyma** –
    - **Small** & **thick walled** parenchymatous cells subjected for **storage of starch** (food).
  - ☞ **Xylem sclerenchyma**
    - **Non-living fibres** with **thick walls** and **narrow cavities** provide mechanical support.

Except xylem parenchyma all other xylem **elements** are **dead**.

- ✓ **Phloem:**



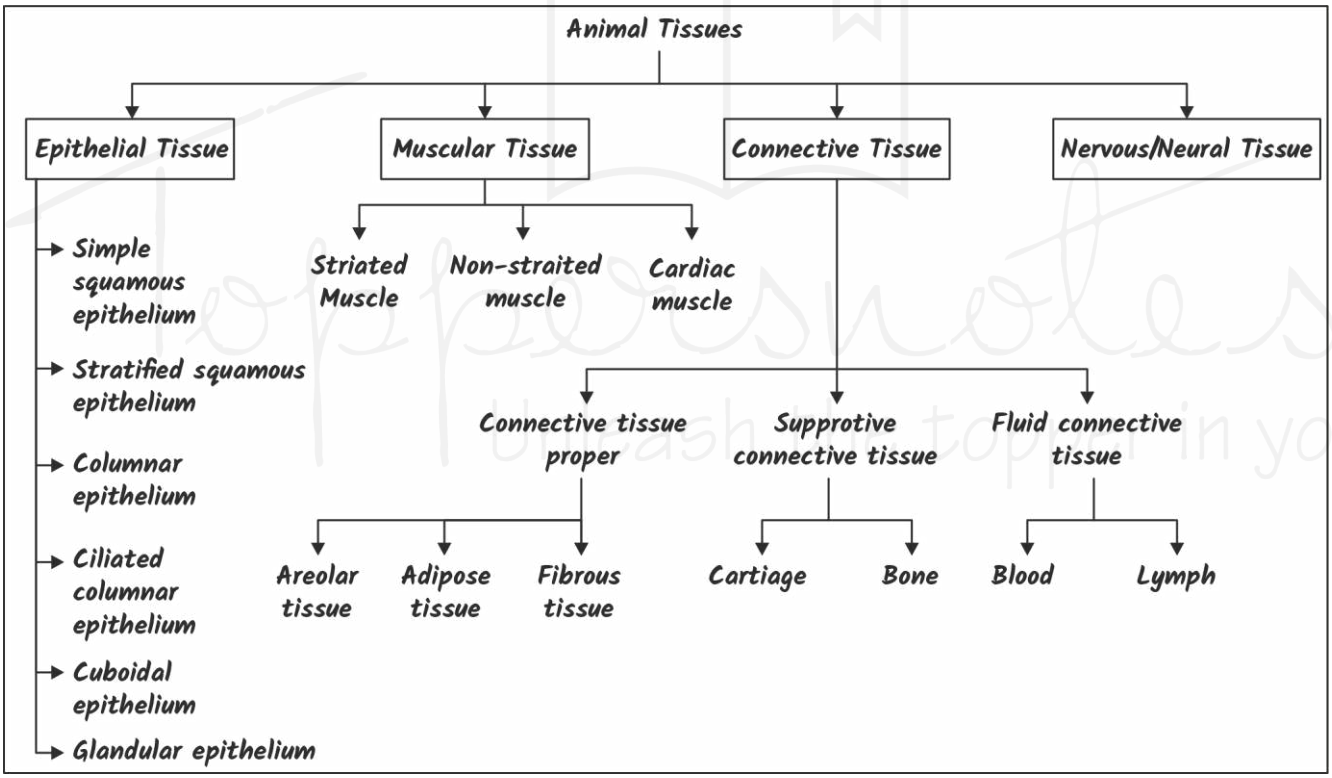
- **Conducts food material** from the leaves to the different parts of the plant.
- **4** types of **cells**
  - ☞ **Sieve tubes:**
    - **Slender tube like structures** made up of elongated, thin walled cells placed end to end.
    - **End walls perforated** by numerous pores, called as **sieve plates**.
  - ☞ **Companion cells**
    - Have **dense cytoplasm** and **prominent nuclei**.
    - **Sieve cells +companion cells = sister cells** (originate from single mother cell).

- ☞ **Phloem fibre**
  - **Mechanical support** to **sieve tubes.**

- ☞ **Phloem parenchyma**
  - **Store food** and help in **radial conduction** of food.

Features	Xylem	Phloem
Cells: Living/ dead	Dead	Living
Cell walls: Thickness	Thick	Thin
Material	Lignin	Cellulose
Permeability	Impermealble	Permeable
Cross walls	None	Sieve Plates
Cytoplasm	None	Yes
Function	Carries water and salts	Carries sugar
Direction of flow	Upwards	Down and up
Special features	Fibres	Companion cells

Animal Tissues



- **4 types:**

  A. Epithelial tissues:

  - ✓ Always **grow on some other types of tissue.**
  - ✓ **Cells** very **close** to each other and **tissue** rests on a **non-cellular basement membrane.**
  - ✓ Consists of **single layer** of **cells.**
  - ✓ **Blood vessels absent** and **non-nervous** in nature.

- ✓ **Covers** all the **organs** and **lines** the **cavities** of hollow organs like **stomach**.
- ✓ **Primarily protective** in function.
- ✓ **Types**:

a. **Squamous epithelium**:
   - aka **pavement epithelium**.
   - **Single layer** of **flat cells**.
   - **Location**: Lining of the mouth, oesophagus, lung, alveoli, etc.

b. **Cuboidal epithelium**:
   - Found in **kidney tubules**, **thyroid vesicles** & in **glands** (salivary glands, sweat glands)
   - **Forms germinal epithelium** of **gonads** (testes & ovaries).
   - Involves **absorption**, **excretion** & **secretion**.
   - Provides **mechanical support**

c. **Columnar epithelium**:
   - Consists of **elongated** or **column-like cells**.
   - **Location**: Inner lining of the intestine and gut.
   - **Function**: secretion and absorption.

d. **Ciliated epithelium** –
   - May be **cubical** or **columnar**.
   - **Cilia present** on its free surface
   - Helps in the **movement of ova** in the **fallopian tube**.

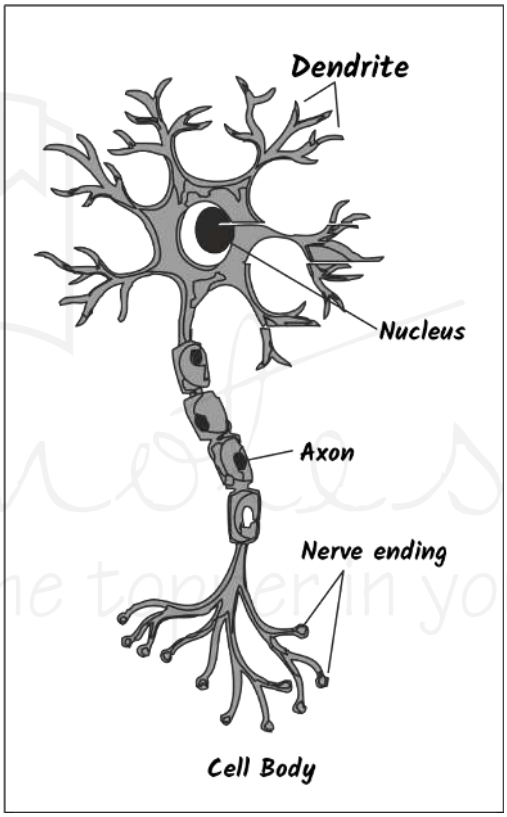
B. **Connective tissues**

- ➢ Cells are **loosely spaced and embedded in an intercellular matrix.**
- ➢ Specialised to **connect various body organs.**
- ➢ **Types**:
  - ✓ **Blood**
    - ■ **Plasma**:
      - ○ **Fluid (liquid) matrix** of blood.
      - ○ A **yellowish liquid** like material.
      - ○ Contains **3 types of blood cells** suspended in it:
    - ■ **RBC** – Red blood cells
    - ■ **WBC** – White blood Cells
    - ■ **Platelets**
  - ✓ **Bones**:
    - ■ **Forms** the **framework** that **supports** the **body**.
    - ■ A **strong** and **nonflexible** tissue.
    - ■ **Cells embedded** in a **hard matrix** composed of calcium and phosphorus compounds.
  - ✓ **Ligaments**:
    - ■ **Connects** 2 **bones**.
    - ■ **Flexible** or **elastic** in nature.
  - ✓ **Tendons**:
    - ■ **Bones connected** to **muscles** by **Tendons**.
    - ■ **Fibrous tissue** with **great strength** but **limited flexibility**.
  - ✓ **Cartilage**:
    - ■ **Widely spaced** cells.
    - ■ **Solid matrix** composed of **proteins** and **sugars**.
    - ■ **Smoothens bone surfaces** at joints
    - ■ **Also** present in the **nose, ear, trachea and larynx.**

- ✓ **Areolar tissue:**
  - *Found in* ***skin*** *and* ***muscles****, around the* ***blood vessels****,* ***nerves****, etc.*
  - ***Fills space inside organs****, supports* ***internal organs*** *and helps in* ***repair*** *of* ***tissues****.*
- ✓ **Adipose tissue:**
  - *Found* ***between*** *the* ***internal organs*** *and* ***below*** *the* ***skin****.*
  - ***Stores fats****.*
  - *Acts as an* ***insulator****.*

C. Muscular Tissue

- ➢ ***Long fibre-like cells*** *called muscle fibres.*
- ➢ *Capable of* ***contraction or relaxation****.*
- ➢ ***Types:***
  - ✓ ***Striated muscles***
    - *aka* ***voluntary muscles*** *- under the control of one's will.*
    - ***Muscle*** *fibres or cells are* ***multinucleated*** *and* ***unbranched****.*
    - ***Each fibre*** *is enclosed by* ***thin membrane*** *which is called as* ***sarcolemma****.*
    - ***Cytoplasm*** *k/a* ***sarcoplasm****.*
    - ***Get tired*** *and need rest.*
  - ✓ ***Cardiac muscles***
    - ***Involuntary*** *muscles.*
    - *Only* ***found*** *in the* ***walls*** *of* ***heart****.*
    - ***Uninucleated*** *and* ***branched****.*
    - *Branches are* ***united by intercalated disc****.*
    - ***Rhythmic contraction*** *and* ***relaxation*** *occurs throughout the life.*
  - ✓ ***Non-striated / Involuntary / smooth muscles.***
    - ***Uninucleated*** *and* ***spindle shaped****.*
    - ***Not enclosed*** *by membrane but many* ***fibres*** *are* ***joined together*** *in* ***bundles****.*
    - ***Found*** *in the* ***walls*** *of* ***stomach****,* ***intestine****,* ***urinary bladder****,* ***bronchi****,* ***iris*** *of eye etc.*
    - ***Eg.*** *Peristaltic movements in alimentary canal are brought about by smooth muscles.*



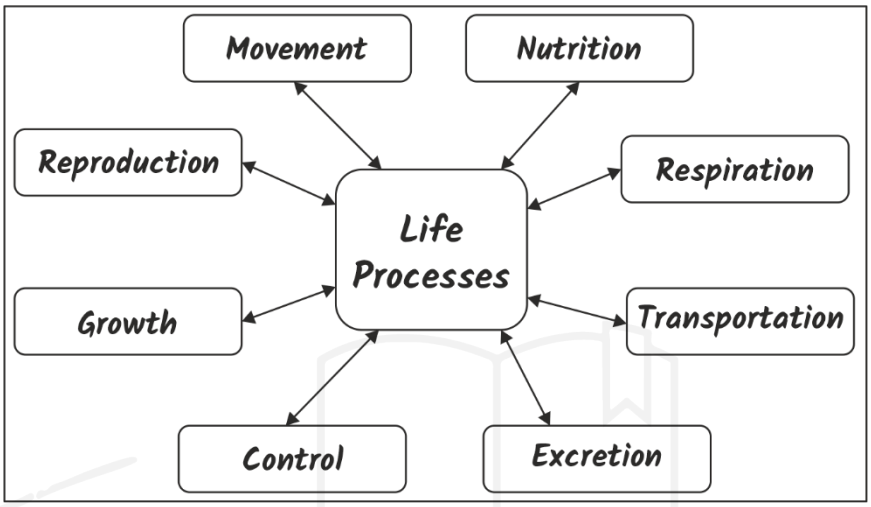
D. Nervous Tissue

- ➢ ***Highly specialized tissue*** *due to which the* ***animals*** *are able to* ***perceive*** *and* ***respond*** *to the* ***stimuli****.*
- ➢ ***Functional unit*** *- nerve cell or neuron.*
- ➢ ***Cell body*** *- cyton - covered by plasma membrane.*

- **Dendron** — Short hair like extensions rising from cyton - further subdivided into dendrites.
- **Axon** — Long, tail like cylindrical process with fine branches at the end - covered by a sheath.

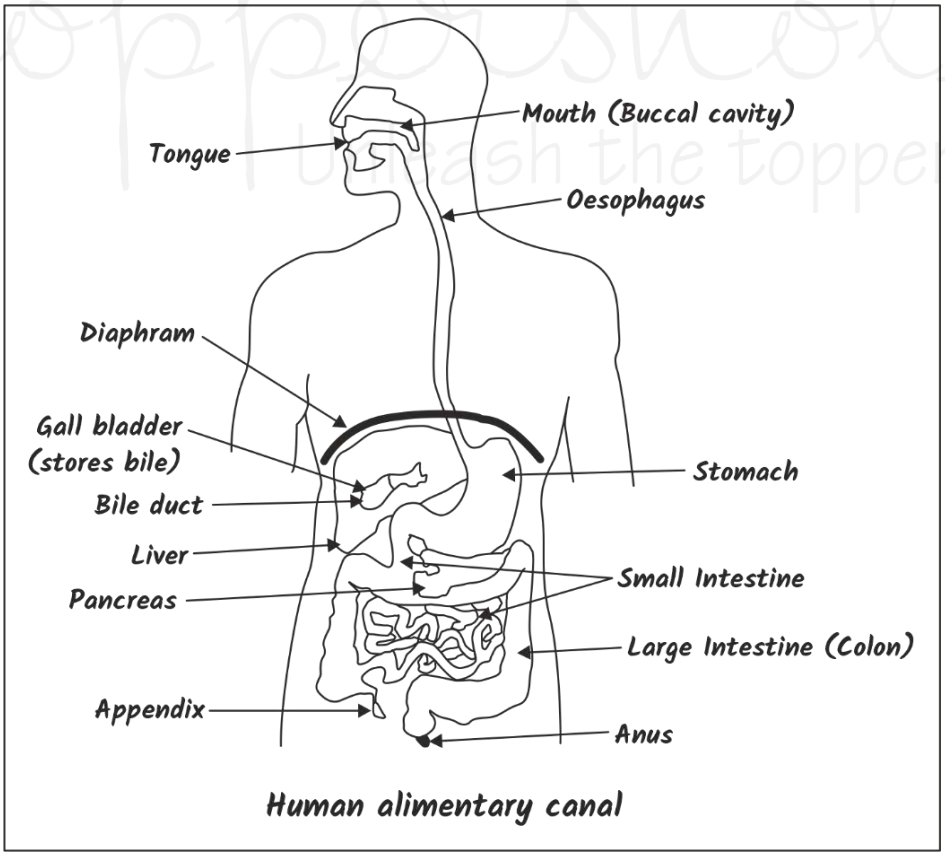
- **Synapse**- Axon of one neuron is very closely placed to the dendrons of another neuron to carry impulses from one to another neuron in the form of electrochemical waves- close proximity k/a synapse.

Life processes



- Process which are **necessary to sustain life on earth.**
- **Eg-** Digestion, Respiration, Circulation etc.

Nutrition in Human Beings / Digestive System



Components:

1. **Alimentary Canal:**
   - Comprises of mouth, oesophagus, stomach, small intestine and large intestine.
2. **Associated Glands:**
   - Salivary gland
   - Gastric Glands
   - Liver
   - Pancreas

1. **Ingestion:**
   - Food is ingested through the mouth.
   - Put into the mouth with the help of hands.
2. **Digestion:**

Mouth or Buccal Cavity:

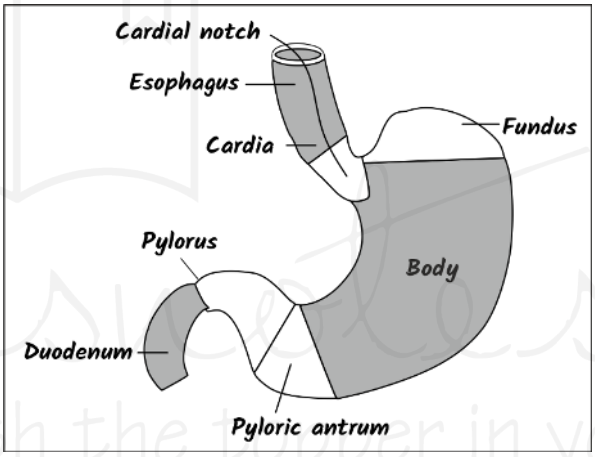
Mouth ↓	→	Intake of whole food
Teeth ↓	→	Chewing/grinding of food
Tongue ↓	→	Rolling of food + Tasting of food +
Salivary Glande ↓	→	Swallowing/pushing down of the food secrete saliva + Mucus Starch $\xrightarrow[\text{Amylase}]{\text{Salivary}}$ Maltose (sugar) [Saliva]

- **Mouth has teeth, tongue** & **salivary glands**.
- **Tongue** - helps in **turning over food** so that **saliva** can be **properly mixed** in it.
- **Teeth** - help in **breaking down food** into smaller particles.
- **Process of digestion** starts in the **mouth** itself.
  - ✓ **Saliva** contains an **enzyme** k/a **salivary amylase/ ptyalin** that converts **starch** → **sugar** (sucrose/ maltose).

Oesophagus/ Food Pipe:

- **Slightly digested food** in the **mouth** is **swallowed** by the **tongue**.
- **Goes down food pipe** called oesophagus.
- **Food enters** the **food pipe** - **walls** of food pipe **start contraction** and **expansion movements** k/a **peristaltic movement**.
- **Pushes** the **slightly digested food** into the **stomach**.

Stomach



- A **J-shaped organ.**
- Highly **muscular walls:**
  - ✓ **Churning the food.**
  - ✓ **Secrete hydrochloric acid** that **kills germs** which may be present in food.
    - **Makes medium** inside stomach **acidic** that **activates enzyme pepsin** - partial digestion of protein.
  - ✓ **Mucus** secreted by walls of the stomach **saves inner lining** of stomach **from** getting damaged from **hydrochloric acid**

Stomach → Gastric glands secrete Gastric Juice

Gastric Juice

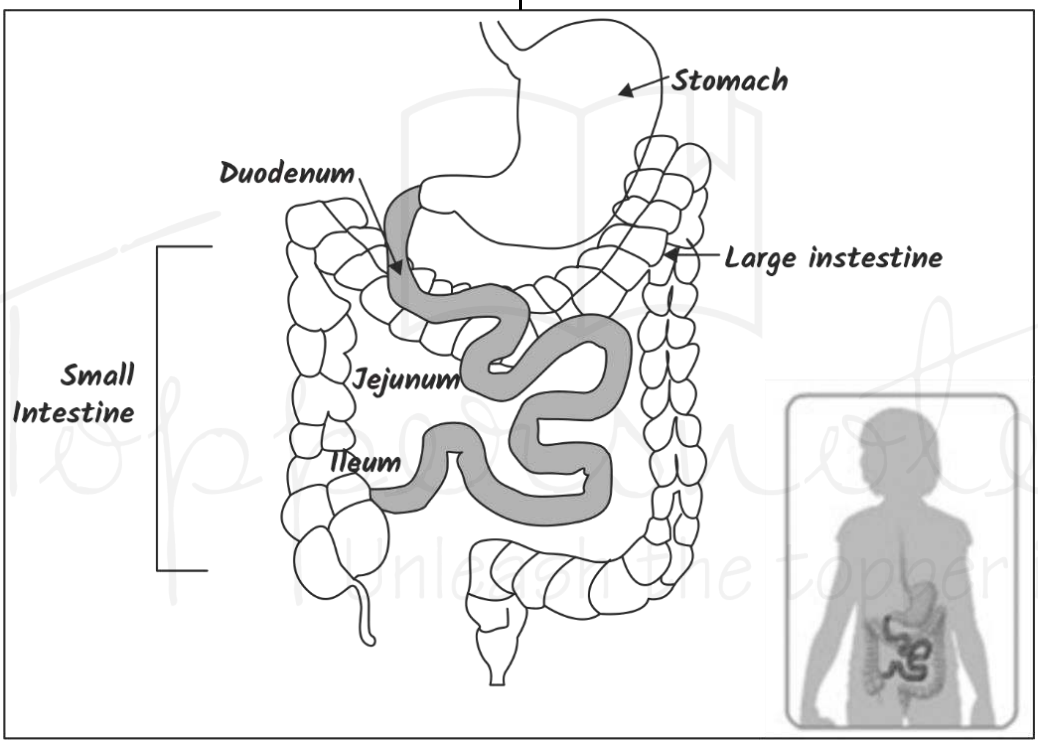
- **Pepsin** (enzyme that breaks down proteins)
- **HCl** (makes medium acidic)
- **Mucus** (Protects inner lining of the stomach)

Small Intestine

The food from the stomach enters the small intestine. This is the longest part of the alimentary canal which is fitted into a compact space because of extensive coiling. The length of the small intestine differs in various animals depending on the food they eat.

Herbivores eating grass need a longer small intestine to allow the cellulose to be digested as it is harder to digest

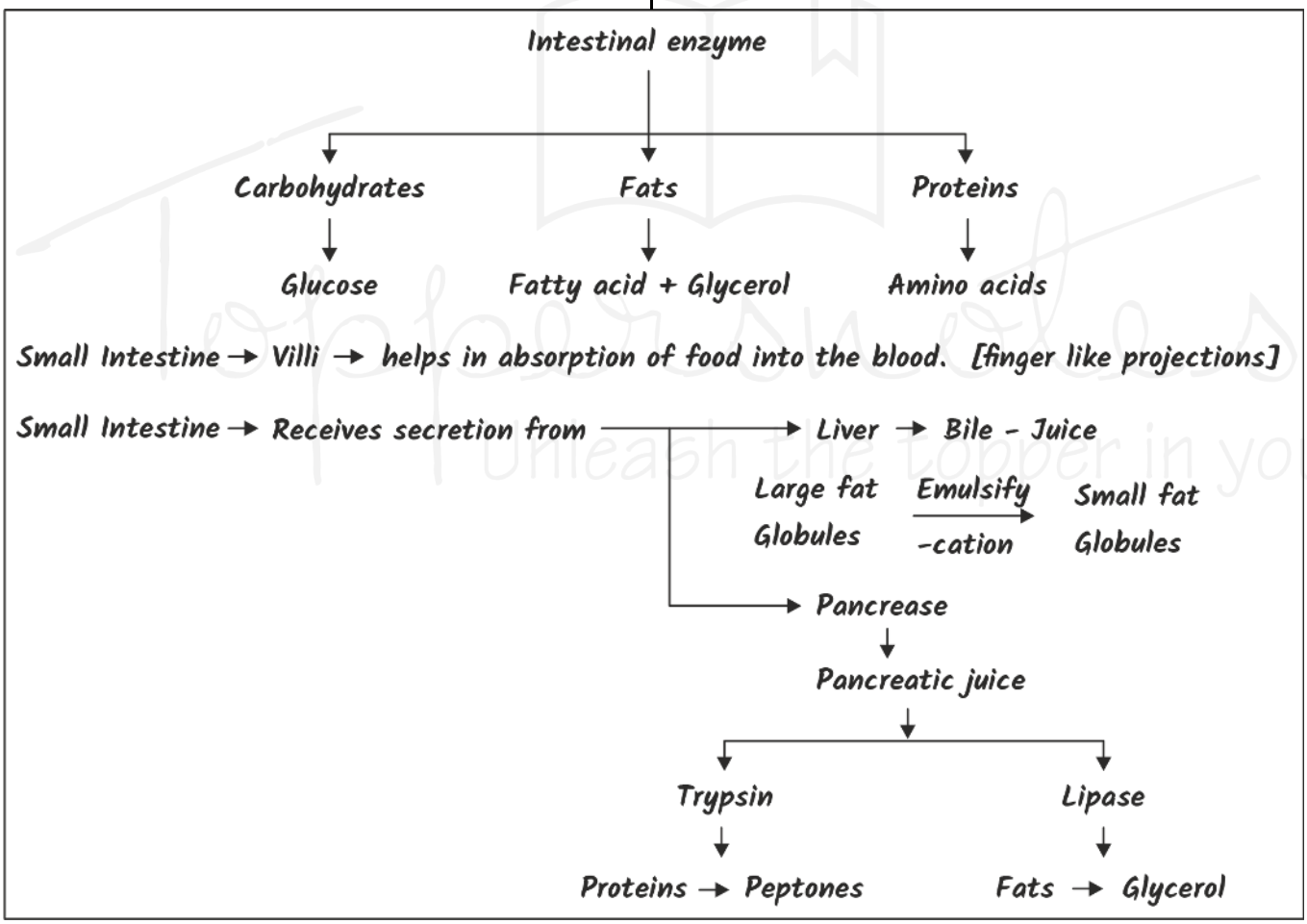
Meat is easier to digest, hence carnivores like tigers have a shorter small intestine.



- A **highly coiled tube-like structure.**
- **Longer than large intestine** but its **lumen** is **smaller** than large intestine.
- **3 parts:**
  - ✓ Duodenum
  - ✓ Jejunum
  - ✓ Ileum.
- **From stomach, partially digested food enters small intestine.**
- **Largest part** (about 6.5m) of the **alimentary canal.**
- Very **narrow** and **arranged** in the **form** of a **coil** .
- **Site of complete digestion** of food (like carbohydrates, proteins and fats)
- Receives **secretion** of **two glands:**

1. **Liver**
   - **Secretes bile** - a **greenish yellow liquid** made in the **liver** and **stored** in gall **bladder**.
   - **Functions** of bile:
     - ✓ **Makes acidic food** from stomach **alkaline - pancreatic enzymes can act**.
     - ✓ **Break fats** present in food **into small globules** making it **easy** for **enzymes** to **act** and **digest** them.

2. **Pancreas**
   - **Secretes pancreatic juice** containing **enzymes** like **pancreatic amylase** for **breaking** down **starch**, **trypsin** for digesting **proteins** and **lipase** for breaking down **emulsified fats**.
   - **Walls** of **small intestine contain glands** which **secretes intestinal juice**. **Enzymes present convert proteins** into **amino acids**, complex **carbohydrates** into **glucose** and **fats** into fatty **acids** and **glycerol**.
   - Convert **large** and **insoluble food molecules** into **small water soluble molecules**.



3. **Absorption:**
   - **Small intestine** - **site** of **absorption** of digested food.
   - **Inner surface** of **small intestine** has numerous finger-like projections k/a **villi**.
   - **Digested food absorbed** through **walls** of **small intestine** goes into our **blood**.

Villi:

- **Finger like structures** in the **inner wall** in **ileum**.
- **Increase surface area** inside ileum - **facilitate optimum absorption**.
- **Reduce lumen** of ileum so that **food can stay** for a **longer duration** in it, for optimum absorption.
- **Digested food** is **absorbed** by villi.

4. Assimilation:

- **Blood carries digested** and **dissolved food** to all **parts** of **body**.
- **Assimilated** as **part of** the **cells and** is **utilised** for obtaining energy, building up new tissues and the repair of old tissues.

5. Egestion:

- **Unabsorbed food** sent into **large intestine** - **reabsorb** water & salts.
- **Rest** is **removed** from the **body via** the **anus**.
- The **exit** of this waste material is **regulated by** the **anal sphincter**.

Large Intestine:

- **Smaller than small intestine.**
- **Undigested food** goes into the **large intestine**.
- **Absorb excess water** and salt.
- **Undigested food** then goes to the **rectum** - **expelled out** through the **anus**.

Respiration

- Involves **2 process:**
  - ✓ **Breathing**: Intake of oxygen and release of CO2.
  - ✓ **Breakdown** of **simple food** in order to release energy **inside** the **cell**.
- An **oxidation reaction** in which **carbohydrate is oxidized to produce energy.**
- **Mitochondria** - **site** of respiration
- **Steps:**

1. Breaking down of glucose into pyruvate:

- In the cytoplasm.
- Glucose (6 carbon molecule) broken down into pyruvic acid (3 carbon molecule).

2. Breaking down of Pyruvic Acid:

- In **mitochondria**
- **Molecules formed** depend on **type** of **respiration:**

1. Aerobic respiration:

$$Glucose \xrightarrow{Glycolysis\,In\,cytoplasm} Pyruvate \xrightarrow{Oxygen(Kreb's\,cycle)\,In\,mitochondria} \underset{Carbon\,dioxide}{6O_2} + \underset{Water}{6H_2O} + \underset{Energy}{38ATP}$$

- Occurs in the **presence of oxygen.**
- **Pyruvic acid** → **carbon dioxide**.
- **Products**: Energy+ water molecule

2. Anaerobic respiration:

$$Glucose \xrightarrow{Glycolysis\,In\,cytoplasm} Pyruvate \xrightarrow{In\,absence\,of\,oxygen(Yeast)(Fermentation)} \underset{Ethanol}{2C_2H_5OH} + \underset{Carbon\,dioxide}{2CO_2} + \underset{Energy}{38ATP}$$

- Occurs in the **absence** of **oxygen**.
- **Products:**
  - ✓ **Pyruvic acid** → ethyl alcohol or lactic acid.

- ✓ **Ethyl alcohol** - yeast or bacteria.
- ✓ **Lactic acid** - microbes / muscle cells.

➢ **Storage of energy** released during respiration:

- ✓ **Energy produced** is **stored** as **ATP molecules** in cells of body.
- ✓ **Energy released** during respiration **used to make ATP** molecules form ADP and inorganic phosphate.

ADP + Phosphate + Energy → ATP
(Low energy) (For respiration) (High energy)

- ✓ So, **energy stored** as **ATP**.
- ✓ When **cell need energy**, **ATP broken down** using water to release energy.

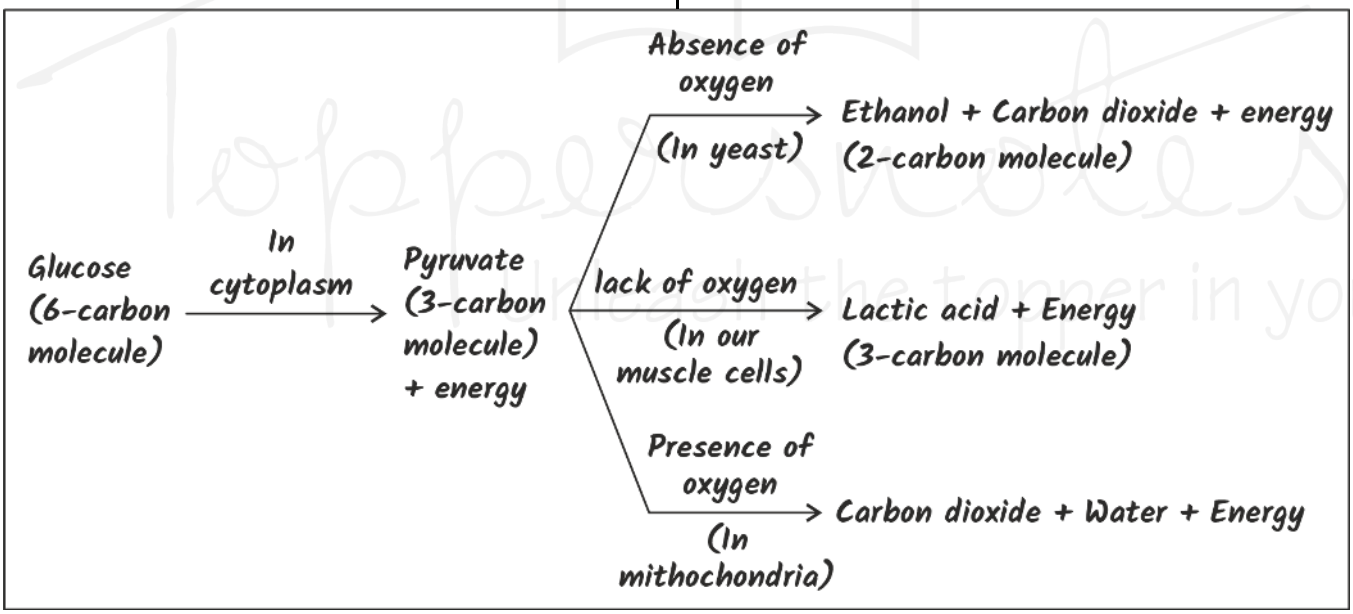
ATP → ADP + Phosphate + Energy
(For use in cells)

- ✓ **ATP - energy currency** of cells.

Breathing and Respiration

Breathing	Respiration
Mechanism by which **organisms obtain oxygen** from air and **release carbon dioxide**.	**Includes breathing** & **oxidation** in cells of organisms to release energy.
A **physical** process.	**Physical** + **biochemical** oxidation of food.
Involves the **lungs** of the organism.	Involves **lungs** and **mitochondria** of cells.

Various pathways of breakdown of glucose



Pain in leg muscles after vigorous activities:

➢ Due to **vigorous exercise**, **demand** for **oxygen** required by muscles increases.

➢ **Lack** of oxygen → **anaerobic** respiration → **lactic acid** → **pain** in the **leg muscles**.

Glucose —Glycolysis (In cytoplasm)→ Pyruvate —In absence of oxygen (Muscle tissue)→ 2 Lactice acid + 2ATP (energy)