



# Railway (RRB)

Assistant Loco Pilot (ALP)

Railway Recruitment Board (RRB)

Volume - 3

CBT - I

Science



# Table of Content

S No.	Chapter Title	Page No.
1	Structure of the Human body	1
2	Blood Group and Rh Factor	48
3	Food and Nutrition	52
4	Basics of Everyday Physics	59
5	Basics of Everyday Chemistry	81

# 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**

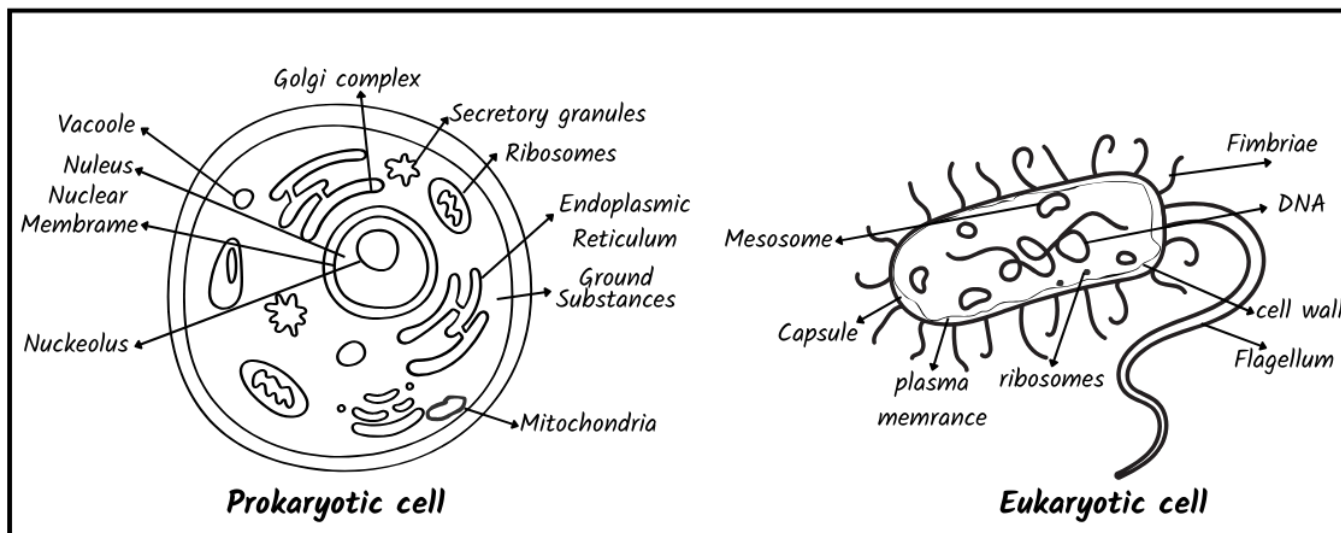
- **Present within a cell & perform certain specific functions to carry out life's processes.**

<b>Plasma / Cell Membrane</b>	<ul style="list-style-type: none"> <li>➤ <b>Outermost covering of the cell</b></li> <li>➤ <b>Separates contents of cell from its external environment.</b></li> <li>➤ <b>A selectively permeable membrane as it allows entry and exit of some materials in and out of the cell.</b></li> </ul>
<b>Cell Wall</b>	<ul style="list-style-type: none"> <li>➤ <b>ONLY in plants</b></li> <li>➤ <b>Outside the plasma membrane.</b></li> <li>➤ <b>Mainly composed of cellulose.</b> <ul style="list-style-type: none"> <li>✓ <b>Cellulose:</b> A complex substance - provides structural strength to plants.</li> </ul> </li> </ul>
<b>Cytoplasm</b>	<ul style="list-style-type: none"> <li>➤ <b>Jelly-like substance present between cell membrane &amp; nucleus.</b></li> <li>➤ <b>Fluid content inside plasma membrane.</b></li> <li>➤ <b>Contains many specialised cell organelles (mitochondria, golgi bodies, ribosomes, etc)</b></li> </ul>
<b>Nucleus</b>	<ul style="list-style-type: none"> <li>➤ <b>Contains chromosomes that contain information for inheritance of features from parents to next generation in form of DNA</b></li> <li>➤ <b>Plays a central role in cellular reproduction.</b></li> <li>➤ <b>Nuclear membrane- a double-layered covering on nucleus.</b> <ul style="list-style-type: none"> <li>✓ <b>Allows transfer of material from inside nucleus to its outside, i.e., to cytoplasm.</b></li> </ul> </li> </ul>
<b>Nucleolus</b>	<ul style="list-style-type: none"> <li>➤ <b>Ribosome synthesis site regulating cellular activity and reproduction.</b></li> </ul>

<b>Gene</b>	➤ <b>Unit of inheritance</b> in living organisms.
<b>Protoplasm</b>	➤ <b>Entire content of a living cell</b> [cytoplasm + nucleus]. ➤ <b>aka living substance of the cell.</b>
<b>Chromosomes</b>	➤ <b>Rod-shaped structures</b> ➤ <b>Visible only when the cell is about to divide.</b> ➤ <b>Contain information for inheritance of features</b> from parents to next generation in the form of DNA (deoxyribo nucleic acid) ➤ <b>Composed of DNA and Protein.</b>
<b>DNA molecules</b>	➤ <b>Contains information necessary for constructing and organising cells.</b> ➤ <b>Functional segments of DNA - genes.</b>
<b>Vacuoles</b>	➤ <b>Empty structure in cytoplasm</b> ➤ <b>Act as storage sacs for solid or liquid contents.</b> ➤ <b>Common in plant cells.</b> ➤ <b>Smaller in animal cells.</b> ➤ <b>Substances stored-</b> amino acids, sugars, various organic acids and some proteins.
<b>Endoplasmic Reticulum</b>	➤ <b>A large network of membrane-bound tubes and sheets.</b> ➤ <b>2 types :</b> <ol style="list-style-type: none"> <li><b>1. Rough endoplasmic reticulum [RER]</b> <ul style="list-style-type: none"> <li>✓ <b>Has ribosomes attached to its surface.</b></li> <li>✓ <b>Ribosomes - sites of protein manufacture.</b></li> </ul> </li> <li><b>2. Smooth endoplasmic reticulum</b> <ul style="list-style-type: none"> <li>✓ <b>Helps in the manufacture of fat molecules, or lipids, important for cell function.</b></li> <li>✓ <b>Some of these proteins and lipids help in building the cell membrane k/a membrane biogenesis.</b></li> </ul> </li> </ol> ➤ <b>Serve as channels for transport of materials</b> between various regions of cytoplasm or between the cytoplasm and the nucleus. ➤ <b>Also functions as a cytoplasmic framework</b> providing a <b>surface for some biochemical activities of cells.</b>
<b>Golgi Apparatus/ Complex</b>	➤ <b>A system of membrane-bound vesicles arranged parallel to each other in stacks called cisterns.</b>

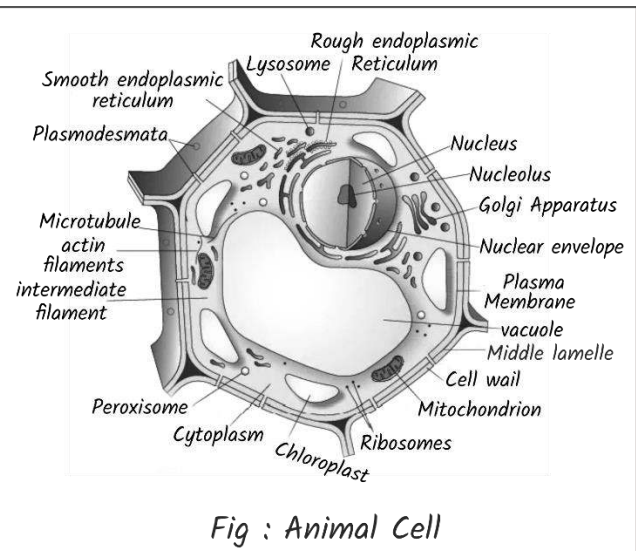
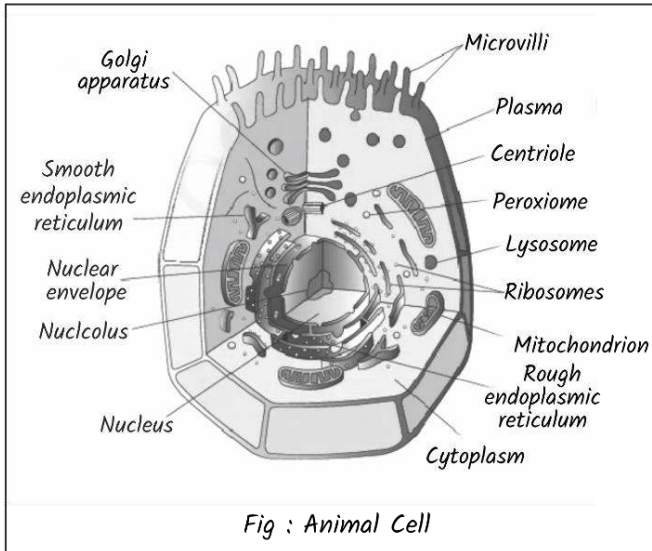
	<ul style="list-style-type: none"> <li>➤ Packages and dispatches material synthesised near ER to various targets inside and outside the cell.</li> <li>➤ Stores, modifies and packages products in vesicles.</li> <li>➤ Involved in the formation of lysosomes. <ul style="list-style-type: none"> <li>✓ Membrane-bound sacs filled with digestive enzymes.</li> <li>✓ Kind of waste disposal system of the cell.</li> <li>✓ Help to keep the cell clean by digesting any foreign material as well as worn-out cell organelles.</li> </ul> </li> </ul>
<b>Mitochondria</b>	<ul style="list-style-type: none"> <li>➤ Aka powerhouse of the cell.</li> <li>➤ Energy required for various chemical activities is released by mitochondria in the form of ATP (Adenosine Triphosphate) molecules.</li> <li>➤ 2 membranes: <ul style="list-style-type: none"> <li>✓ Outer membrane- porous</li> <li>✓ Inner membrane - deeply folded. <ul style="list-style-type: none"> <li>■ Folds create a large surface area for ATP-generating chemical reactions.</li> </ul> </li> </ul> </li> </ul>
<b>ATP</b>	<ul style="list-style-type: none"> <li>➤ aka energy currency of the cell.</li> <li>➤ Body uses energy stored in ATP for making new chemical compounds and for mechanical work.</li> </ul>
<b>Ribosomes</b>	<ul style="list-style-type: none"> <li>➤ Site of protein synthesis.</li> <li>➤ Polyribosomes or Polysomes: Several ribosomes may attach to a single mRNA and form a chain.</li> <li>➤ Prokaryotes- ribosomes are associated with the plasma membrane of the cell.</li> </ul>
<b>Cilia and Flagella</b>	<ul style="list-style-type: none"> <li>➤ Hair-like outgrowths of the cell membrane.</li> <li>➤ Cilia - small structures which work like oars, causing the movement of either the cell or the surrounding fluid.</li> <li>➤ Flagella - comparatively longer and responsible for cell movement.</li> <li>➤ Prokaryotic bacteria have flagella but structurally different from eukaryotic flagella.</li> </ul>
<b>Centrosome and Centrioles</b>	<ul style="list-style-type: none"> <li>➤ Centrosome- an organelle usually containing 2 cylindrical structures called centrioles.</li> <li>➤ Surrounded by amorphous pericentriolar materials.</li> <li>➤ Both the centrioles in a centrosome lie perpendicular to each other</li> </ul>

## Types of Cells



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

## Plant and Animal Cells



**Fig : Animal Cell**

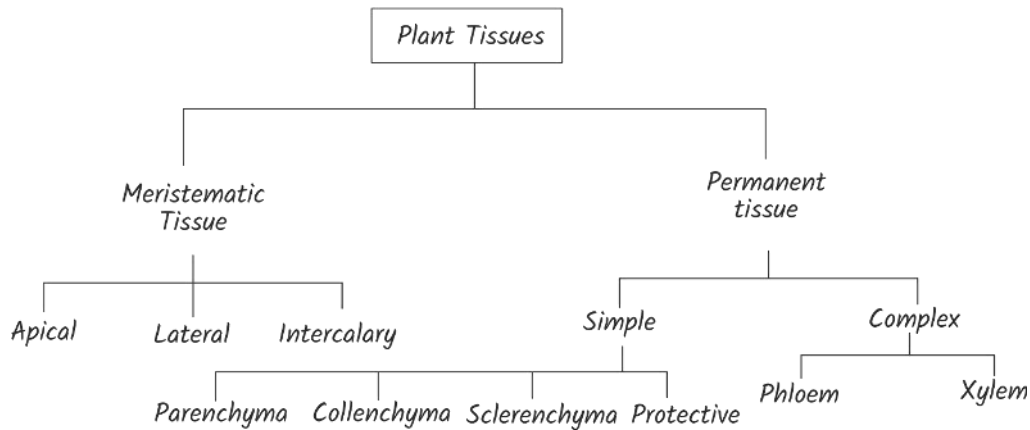
	<b>Animal Cell</b>	<b>Plant Cell</b>
<b>Nucleus</b>	Present	Present
<b>Cilia</b>	Present	Very rare
<b>Shape</b>	Round (irregular shape)	Rectangular (fixed shape)
<b>Chloroplast</b>	NO chloroplasts	Chloroplasts present
<b>Cytoplasm</b>	Present	Present
<b>Endoplasmic Reticulum</b>	Present	Present
<b>Ribosomes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

## Tissues

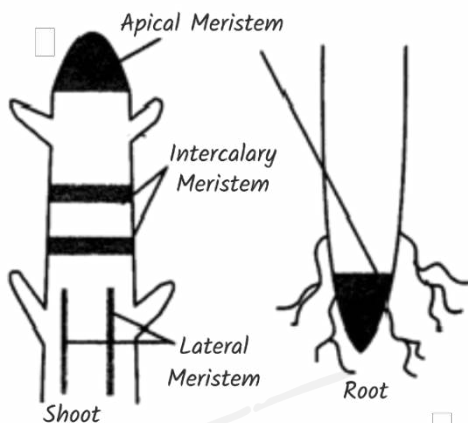
- A group of cells with similar shape and function.
- Group of (cells → Tissues → Organs → Organ systems).
- **Histology:** study of tissues.

## 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.

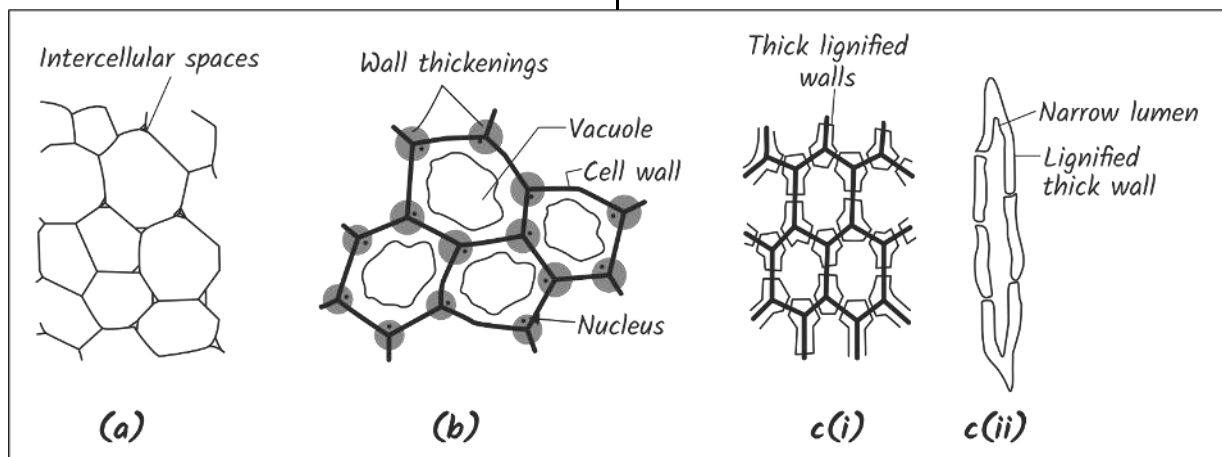
#### B. Permanent Tissues

- Formed when cells from meristematic tissues lose 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 corners.
- 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:**

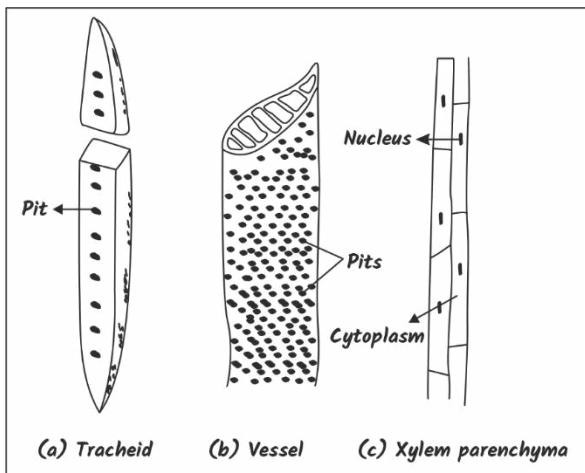
- Consist dead cells with no intercellular spaces.
- Form the outer layer of old tree trunks.
- Cells have a chemical - **suberin** in their walls that makes them impervious to gases and water.
- Protects plants from injuries, germs and water loss.
- **Lightweight** - used for making several products like bottle stoppers and shuttlecock.

**Difference between parenchyma, collenchyma and sclerenchyma**

Features	Parenchyma	Collenchyma	Sclerenchyma
Cell shape	Isodiametric cells which are oval, spherical or polygonal shape.	Circular, oval or polyhedral	Variable in shape Fibres and sclereids
Cell wall	Thin cellulosic cell wall	Uneven thickening on their cell wall	Lignified secondary cell wall present.
Cytoplasm	Abundant	Present	Absent
Nucleus	Present (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 cortex, medullary rays	Dicot stem, petiole and beneath the epidermis Absent in monocot and roots	Dicot hypodermis, bundle sheath, pericycle 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 —**

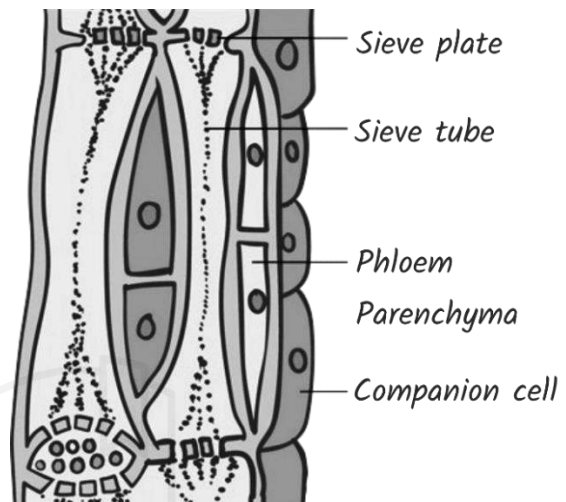
- **Small & thick walled** parenchymatous cells subjected for **storage of starch** (food).

☞ **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**

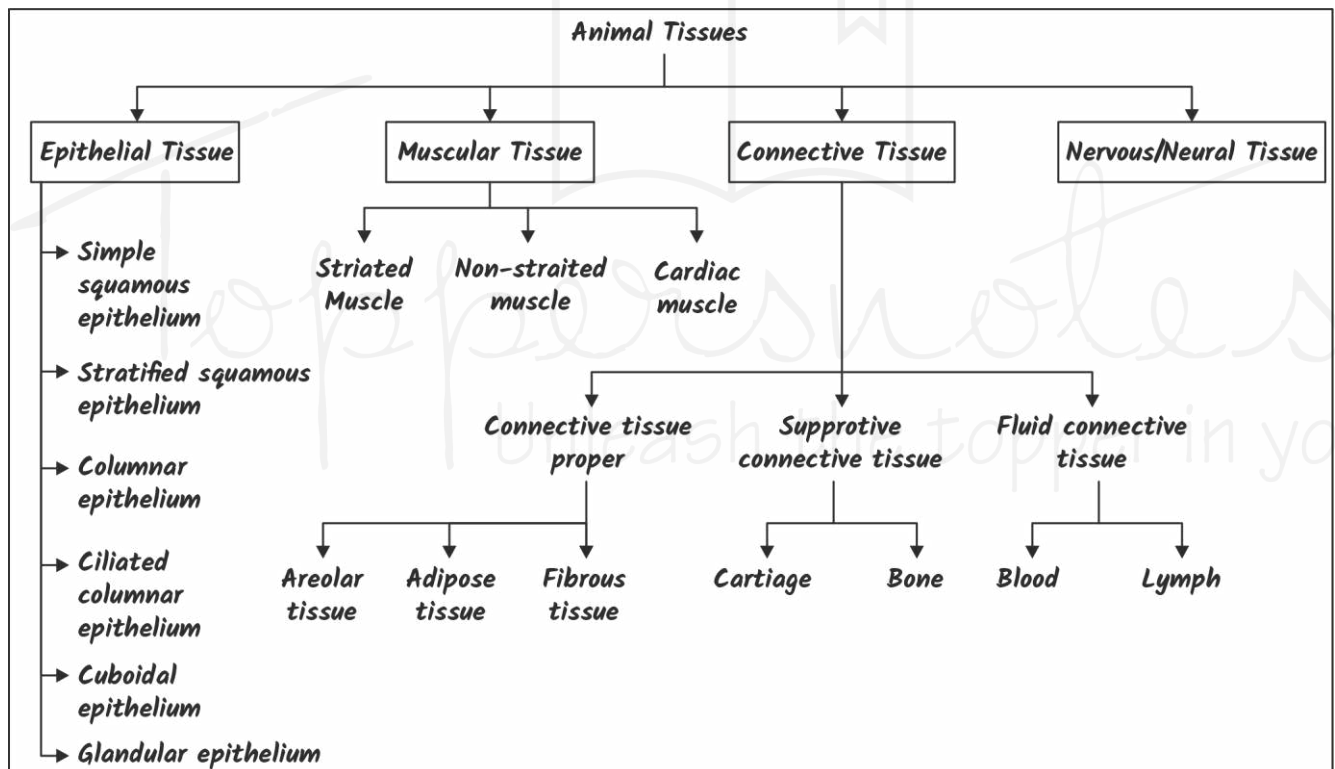
- **Mechanical support to sieve tubes.**

☞ **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	Impermeable	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**

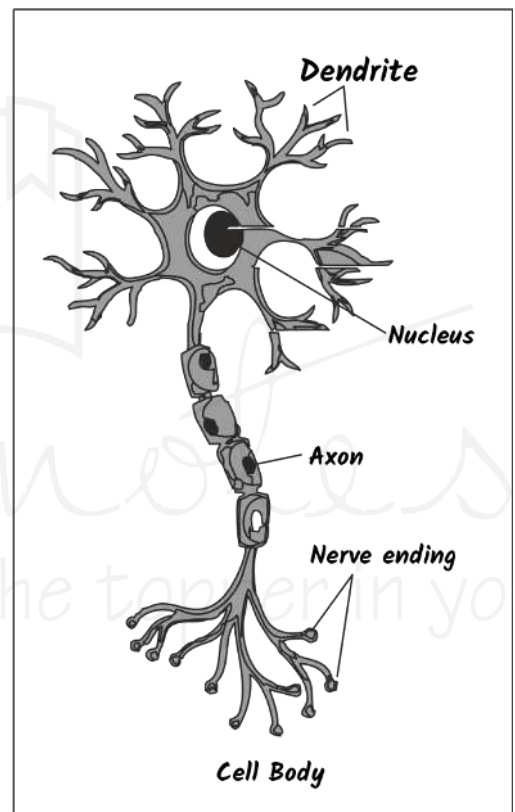
- aka **voluntary muscles** - under the control of one's will.
- **Muscle fibres or cells** are **multinucleated** and **unbranched**.
- **Each fibre** is enclosed by **thin membrane** which is called as **sarcolemma**.
- **Cytoplasm** k/a **sarcoplasm**.
- **Get tired** and need rest.

✓ **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.



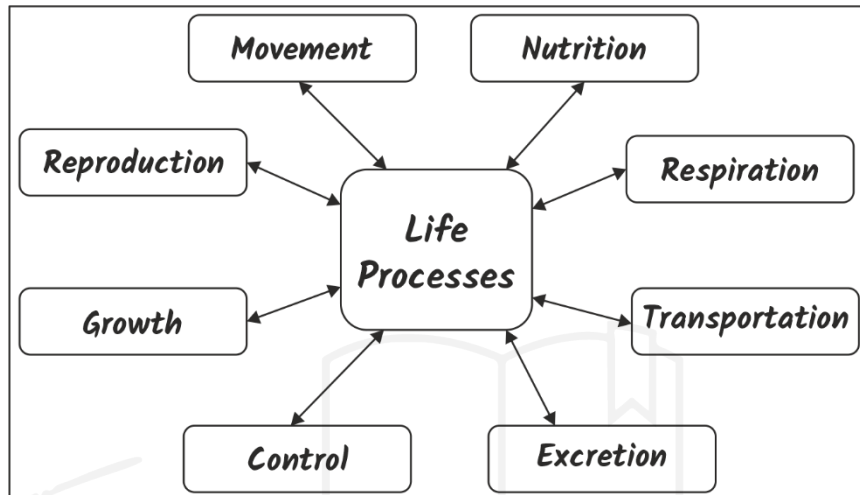
**D. Nervous Tissue**

- **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.

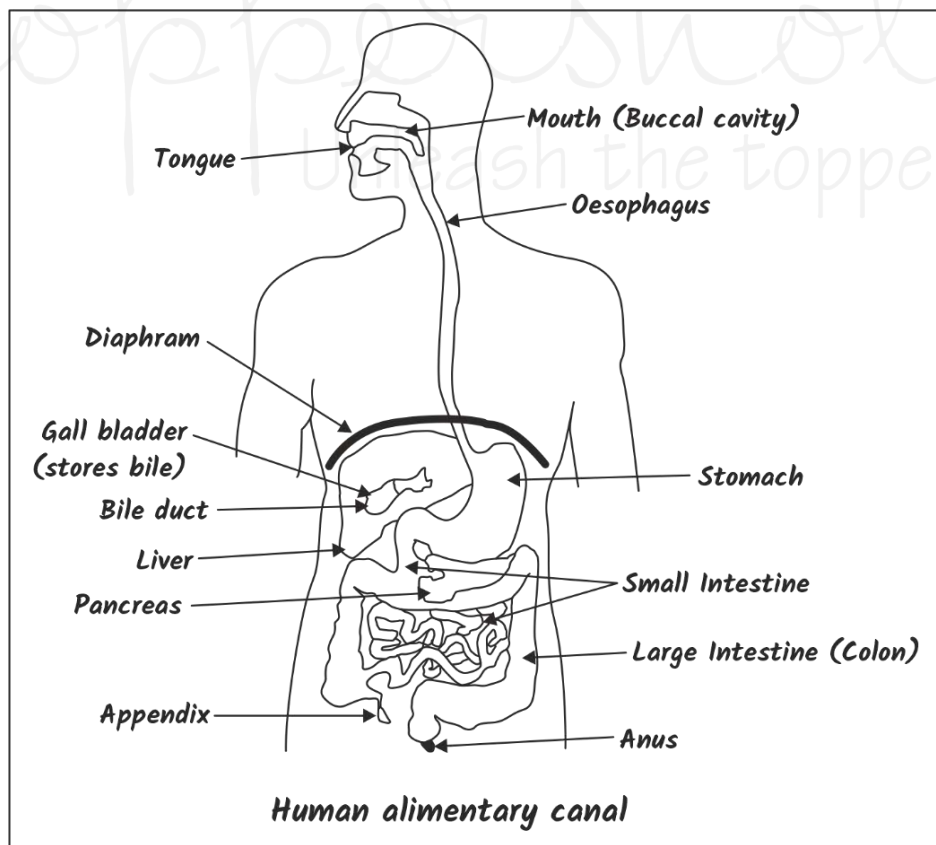
- **Synapse**- Axon of one neuron is very closely placed to the dendrons of another neuron to carry impulses from one to another neuron in the form of electrochemical waves- close proximity k/a synapse.

## 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 Glands ↓	→	Swallowing/pushing down of the food secrete saliva + Mucus Salivary Starch → Maltose Amylase (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.

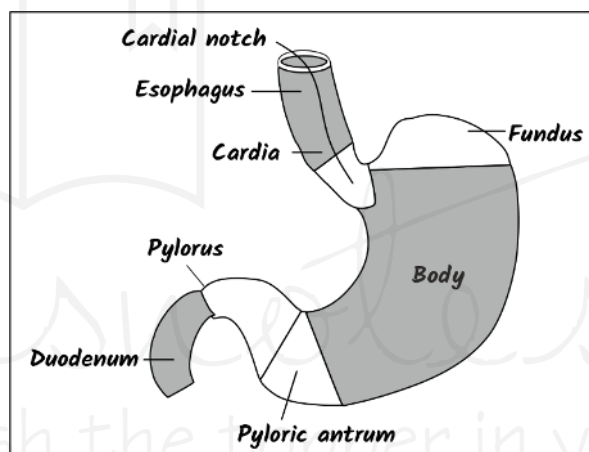
- Process of digestion starts in the mouth itself.

- ✓ Saliva contains an enzyme k/a salivary amylase/ptyalin that converts starch → sugar (sucrose/ maltose).

##### Oesophagus/ Food Pipe:

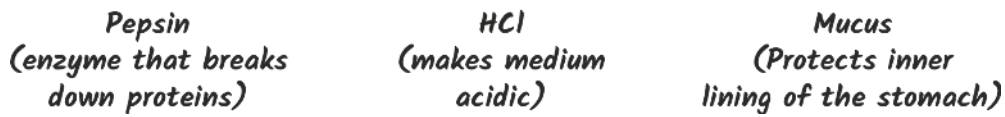
- Slightly digested food in the mouth is swallowed by the tongue.
- Goes down food pipe called oesophagus.
- Food enters the food pipe - walls of food pipe start contraction and expansion movements k/a peristaltic movement.
- Pushes the slightly digested food into the stomach.

##### 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*

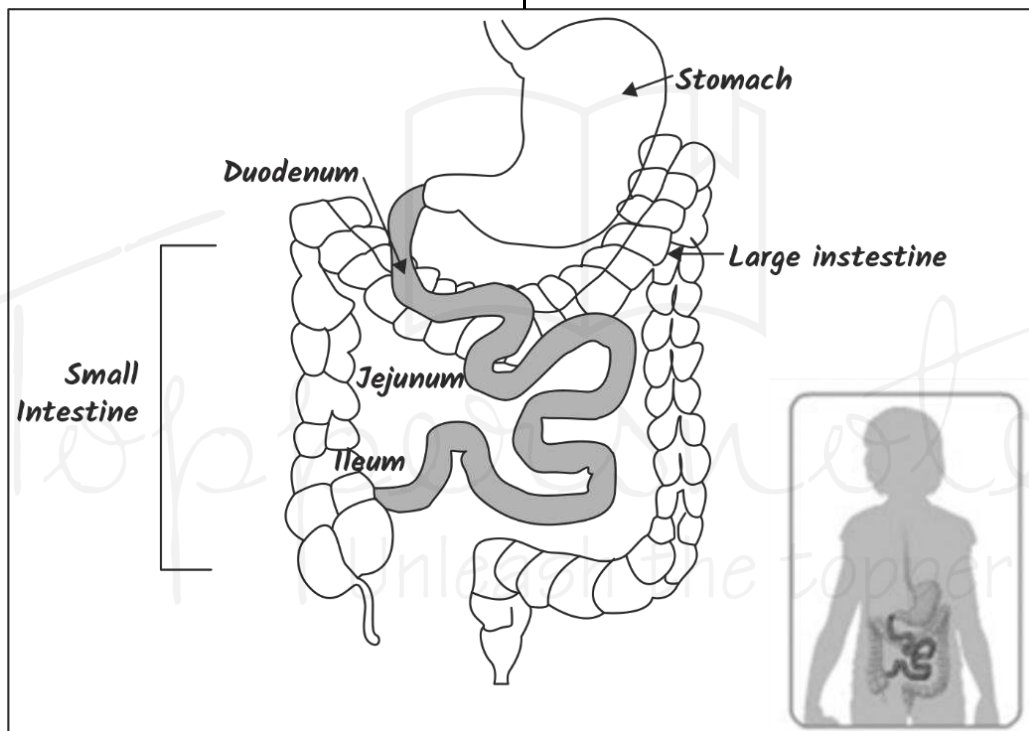


## **Small Intestine**

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.



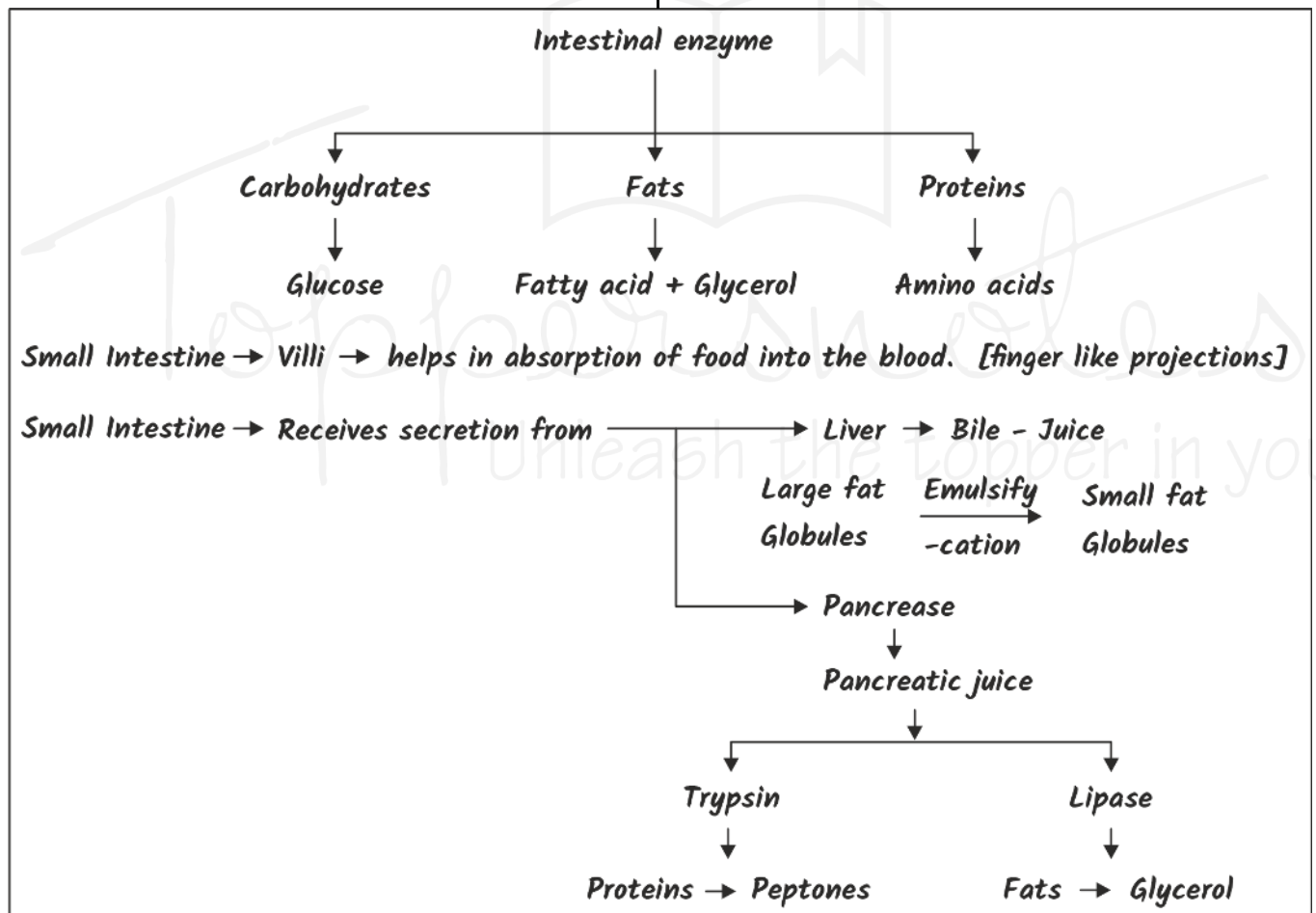
- A highly coiled tube-like structure.
- Longer than large intestine but its lumen is smaller than large intestine.
- 3 parts:
  - ✓ Duodenum
  - ✓ Jejunum
  - ✓ Ileum.
- From stomach, partially digested food enters small intestine.
- Largest part (about 6.5m) of the alimentary canal.
- Very narrow and 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.

- **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 secrete 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.

## 2. Pancreas



## 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 CO<sub>2</sub>.

✓ **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:**

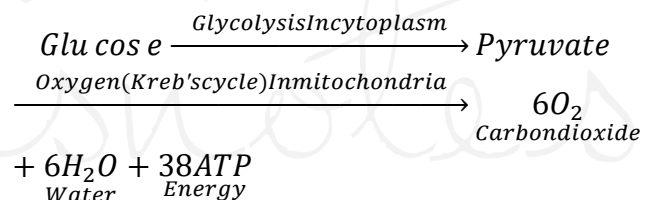
#### **1. Breaking down of glucose into pyruvate:**

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

#### **2. Breaking down of Pyruvic Acid:**

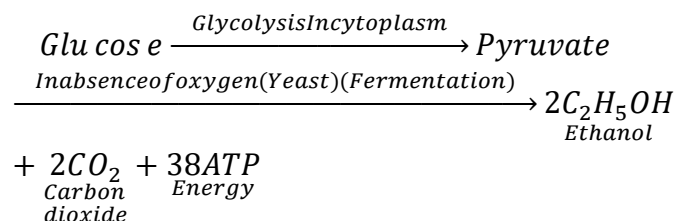
- **In mitochondria**
- **Molecules formed depend on type of respiration:**

##### **1. Aerobic respiration:**



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

##### **2. Anaerobic respiration:**



- **Occurs in the absence of oxygen.**
- **Products:**

✓ **Pyruvic acid → ethyl alcohol or lactic acid.**