HUMAN PHYSIOLOGY 1

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Class I B.Sc

Unit 1

Cell and Tissue

- Structure and functions of Tissues

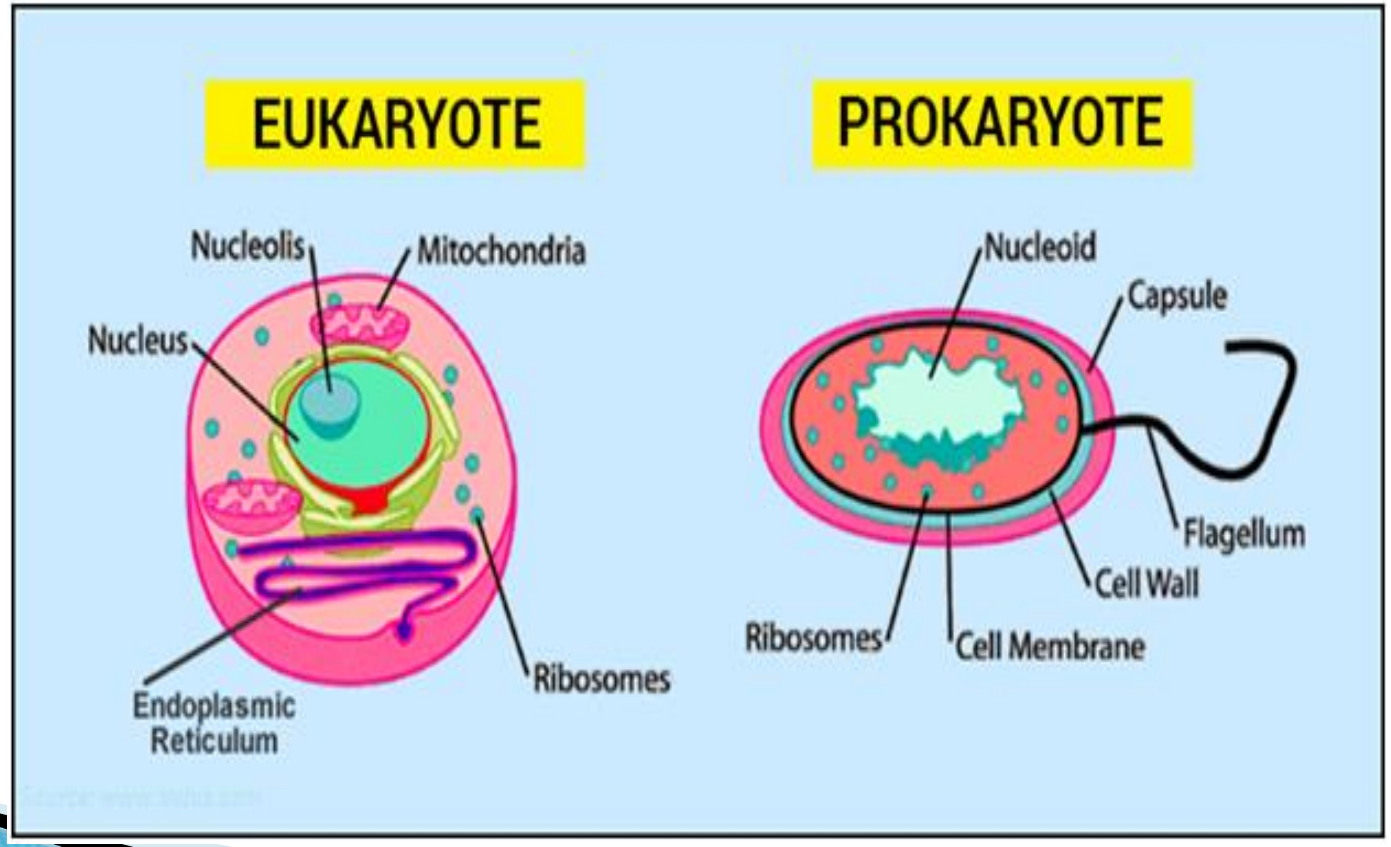
CELL

CELL

- The cell is the basic functional and structural unit of life.
- All the living organisms are composed of cells.
- All cells are formed by the division of the already existing cells which in terms of biology means reproduction.
- All the activities of the cell depend mainly on the activities of the sub cellular structure that lies within the cell.

The cells can be divided into two types

- Eukaryotic
- Prokaryotic



Eukaryotic cells

- Eukaryotic cells are cells that contain a nucleus and organelles, and are enclosed by a plasma membrane.
- Organisms that have eukaryotic cells include protozoa, fungi, plants and animals.
- These organisms are grouped into the biological domain Eukaryota.

Prokaryotic cells

- Prokaryotic cells are cells that do not have a true nucleus or membrane- bound organelles.
- Organisms with the domains Bacteria and Archaea have prokaryotic cells, while other forms of life are eukaryotic.

Cell Wall

- The plant cells have a definite cell wall, which the animal cell has no cell wall.
- The plant cells have a fixed shape because of a cell wall.
- It is sufficiently strong, thick and rigid.

Plasma Membrane

- This membrane control the flow of molecules to and fro the cell.
- This membrane is responsible for the communication of a cell with the outside world.

Endoplasmic Reticulum

- It is a fine reticulum or network in the plasma of the cell.
- Endoplasmic surface is with ribosome's and it termed as Rough Endoplasmic reticulum(RER).ER that is without ribosome's such ES known as Smooth ER (SER)

Functions

- The RER synthesizes serum proteins
- The SER synthesizes lipids
- The ER detoxifies the impure food and drugs that we eat

Golgi Apparatus

- The Golgi apparatus serves to package the material for export to the other parts of the cell and prepare for secretions.

Lysosomes

- They are formed from the leftovers of the vesicles budded of the Golgi apparatus.
- They are involved in intracellular digestion and are the scavengers of the cell.

Cytoplasmic Vacuoles

- These are the voids in the cytoplasm which store small molecules such as water, ions, sucrose and amino acids.

Ribosome

- Ribosomes are small, but complex structures, roughly 20 to 30 nm in diameter

Mitochondria

- These are called as the powerhouse of the cell", that contain their own DNA.

Plastids

- Plastids are the self- replicating Cytoplasmic organelles of plant and algal cells.

Nucleus

- Nucleus is the core of the cell
- It is a part of the cell that contain DNA and RNA and is responsible growth and reproduction.
- It is a large organelle that controls all activities of the cell.

Centrioles

- These are the two small cylindrical cell organelles that are found near nucleus.

Celia And Flagella

- Celia and flagella are projection from the cell.
- They are made up of microtubules, like the centrioles.
- They are motile and designed either to move the cell itself or to move substances over or around the cell.

TISSUES

INTRODUCTION

- Cells are the body's smallest functional units they are grouped together to form **tissues**, each of which has specialized functions,e g.blood , muscle

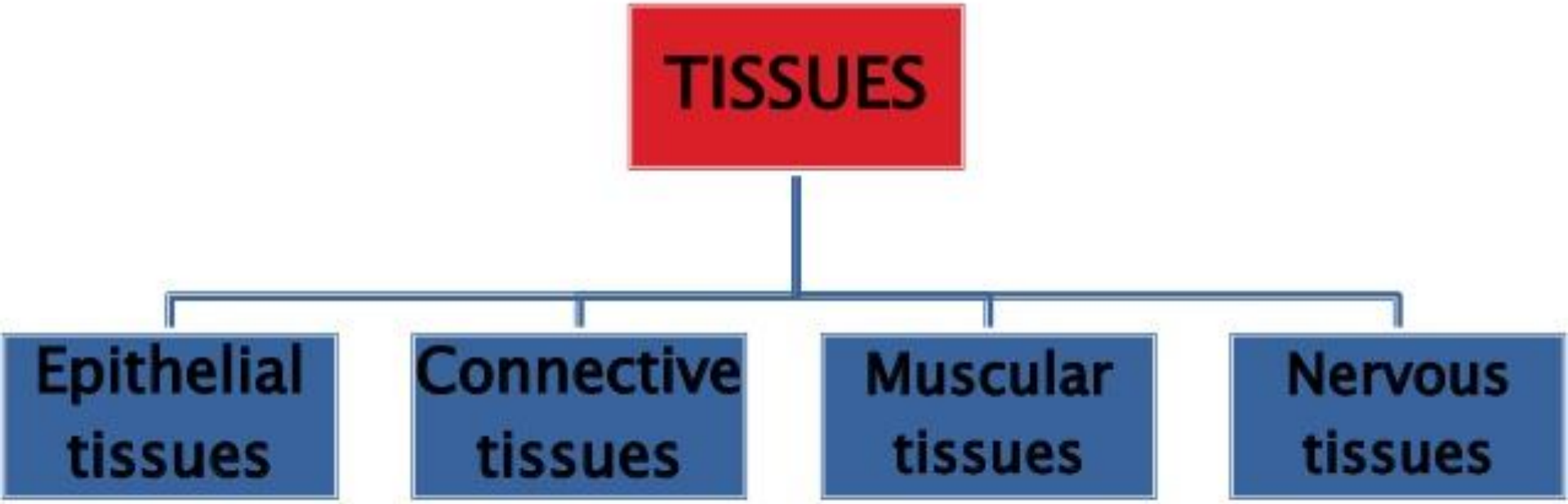
- Study of tissues is called **histology**.

- Tissues are grouped together to form **organs** e.g heart,stomach ,brain.
- Organs are grouped together to form **system**,each of which performs a particular functions.eg digestive system

TISSUES

- **DEFINITION:**
- Tissue is a collection of cells which have similar structure and perform relatively common functions.

TYPES OF TISSUES

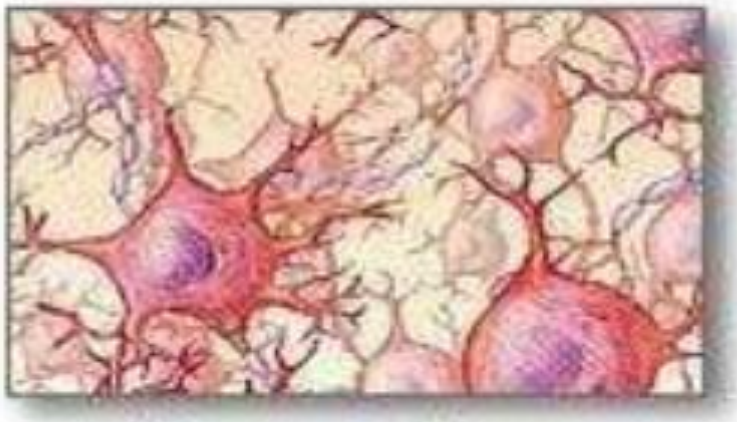


Four types of tissue

Connective tissue

Epithelial tissue

Muscle tissue



Nervous tissue

EPITHELIAL TISSUES

CHARACTERISTICS

- Cells are closely packed without any intercellular spaces
- Lie on basement membrane

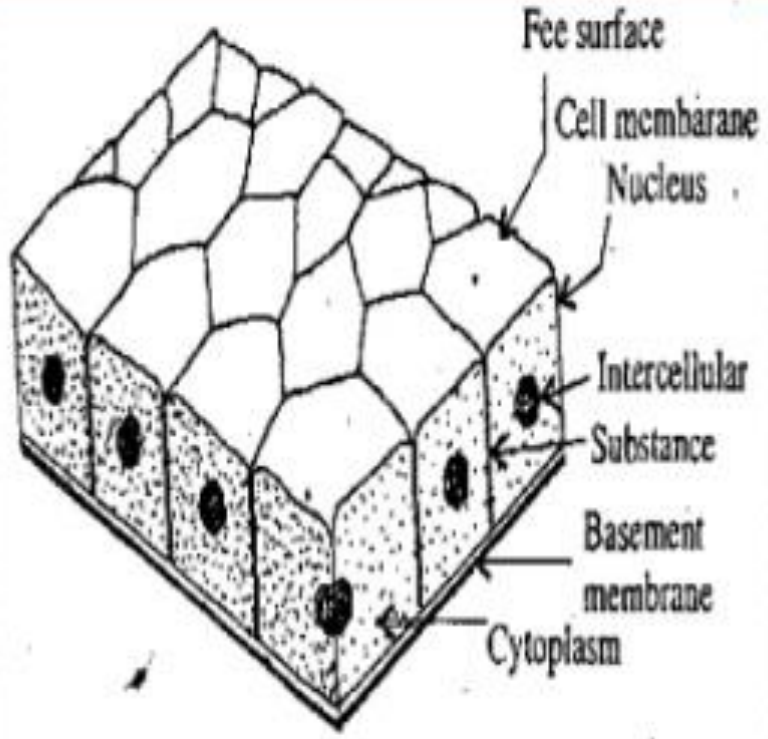


Fig. 10.1 General Structure of Epithelia

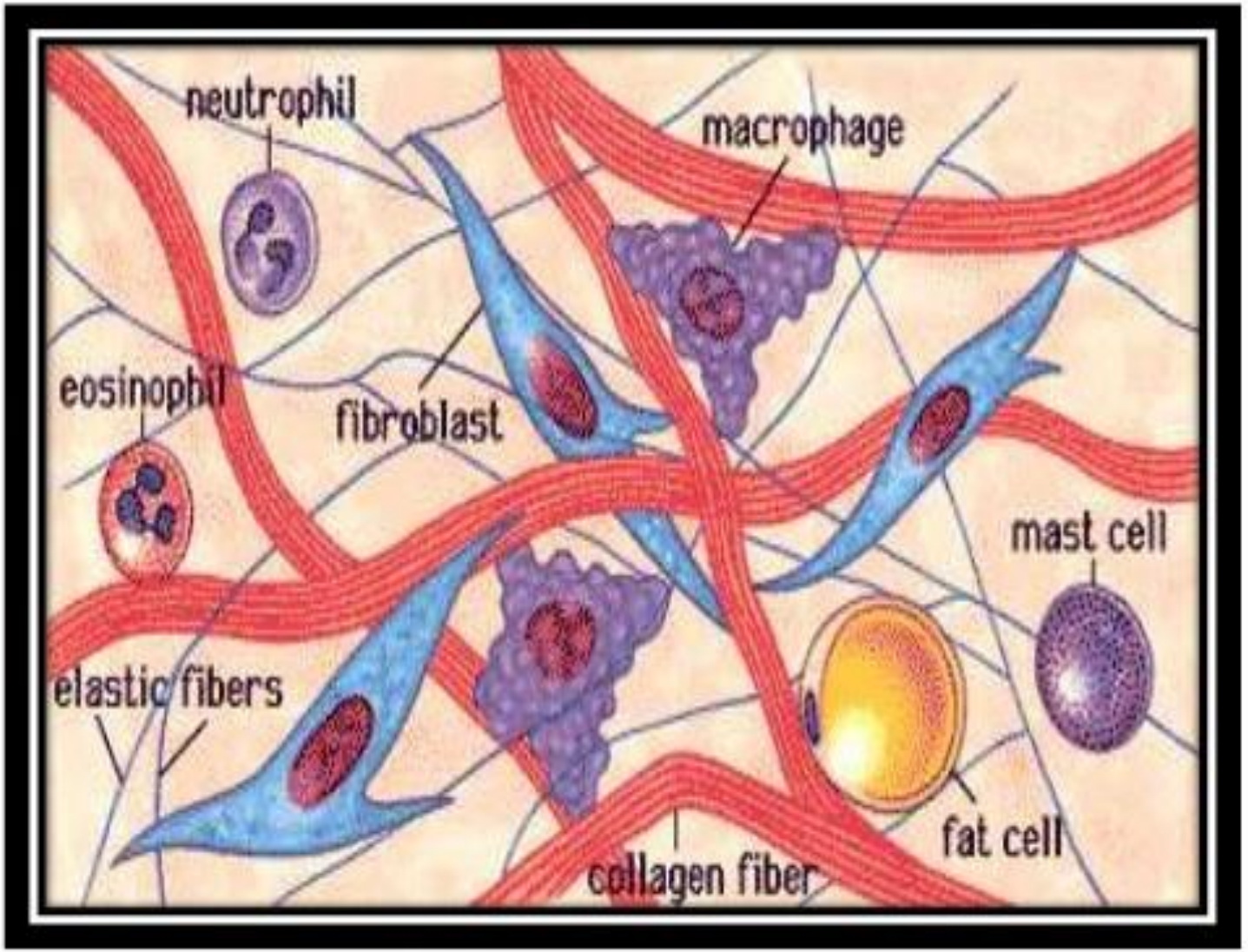
LOCATION

- Found covering the body and lining cavities and tubes. Outer and inner linning of most of the body organs such as gastrointestinal tract(GIT), urinary tract , blood vessels, heart chambers uterus.
- Found on the entire exposed surface of the body such as skin.
- Also found in glands

- It is highly cellular, with little or no extracellular material present between cells
- Adjoining cells form a specialized intercellular connection between their cell membrane called as cell junction
- The basal lamina, a mixture of glycoproteins and collagen, provides an attachment site for the epithelium, separating it from underlying connective tissue

CONNECTIVE TISSUES

- It is most abundant tissue in the body
- Connective tissues cells are more widely separated from each other than in epithelial tissues and intercellular substance (matrix) is present in larger amount
- Made up of cells like **fibroblast, fat cells, macrophages,leukocytes and mast cells.**


neutrophil
macrophage
eosinophil
fibroblast
mast cell
elastic fibers
fat cell
collagen fiber

FUNCTIONS OF CONNECTIVE TISSUES

- Provide support
- Transport materials from one part of the body to another
- Store energy.
- Protection
- Insulation

Areolar Tissue

- It is a loose tissue beneath the scalp
- They are made up of elastin and collagen fibres provides support

Adipose Tissue

- It is very prominent in obese person
- It prevents heat loss by forming a heat – insulating layer beneath the skin

White Fibrous Tissue

- Tissue is made up of fibres that have great tensile strength
- The many bones of the skull are made immovable by this tissue

Tendon

- It join muscles to bone
- It is made of collagen fibres

Ligament

- Ligament join the bones at joints
- They made up of elastin fibres

Cartilage

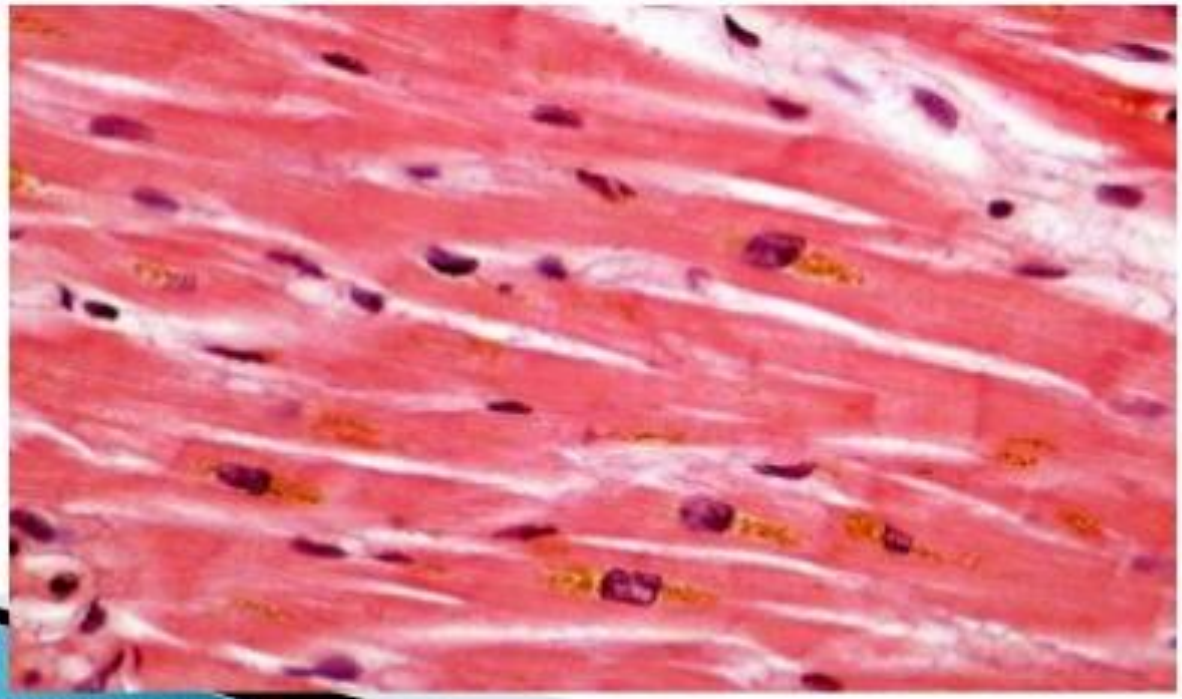
- It is a flexible semi – rigid structures
- It connect ribs to the sternum and between invertebral discs

Bone

- Bones have cavity called marrow cavity
- They are red and yellow marrows
- Red marrows form erythrocytes and leucocytes
- Red marrows are found in ribs, vertebrae, skull bones and end of the long bones
- Yellow marrow is composed of fatty tissue
- It stores fat and produce blood corpuscles only in emergency situations

MUSCULAR TISSUES

- It is made up of muscle cells(muscle fibers) which unite to form muscle.
- It contracts and relaxes rhythmically.



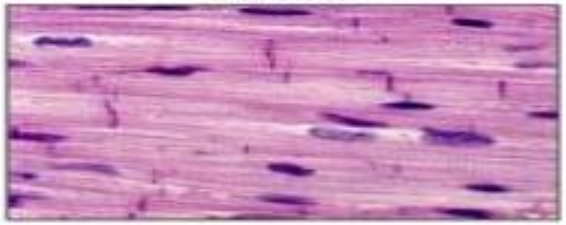
- Muscle is very specialized tissue that has both the ability to contract and to conduct electrical impulses
- Muscle contractile proteins are actin and myosin
- Muscles are classified both functionally and structurally
- Functionally – voluntary or involuntary
- Structurally – straited or smooth

TYPES OF MUSCULAR TISSUES

Smooth Muscle Tissue

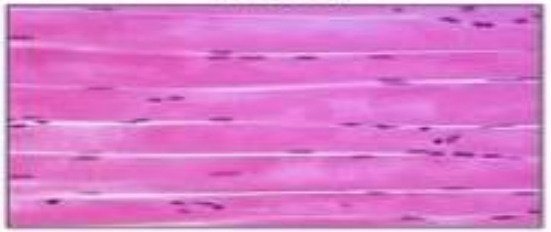
Involuntary Control

Cardiac Muscle Tissue



Involuntary Control

Skeletal Muscle Tissue



Voluntary Control

Cardiac Muscle

- It is a straited involuntary muscle
- The muscle proteins of cardiac muscle are identical to those of skeletal muscle
- They are actin, tropomyosin and troponin

Skeletal Muscle

- It is a straited voluntary muscle
- Skeletal muscles attached to the bones
- One can contract them on desire and are thus termed us voluntary muscle

Smooth Muscle

- It is a smooth involuntary muscle
- Smooth muscle is known for its property of plasticity
- The urinary bladder is a typical example
- Smooth muscle is not under voluntary control and is divided into type's- single unit or multi unit

Nervous Tissue

- Nervous tissue comprises of two types of cells
- Nerve cells or neurons and glial cells
- Neurons have long process and transmit nerve impulses
- The glial cells have short processes and protect neurons

- The remaining processes are small and radiate like branches of a tree and are called dendrites or Dendron’s.

Functions of Tissue

- Epithelial tissue creates protective boundaries
- Connective tissue underlies and supports other tissue types
- Muscle tissue contracts to initiate movement in the body
- Nervous tissue transmits and integrates information through the central and peripheral nervous system

DIGESTIVE SYSTEM

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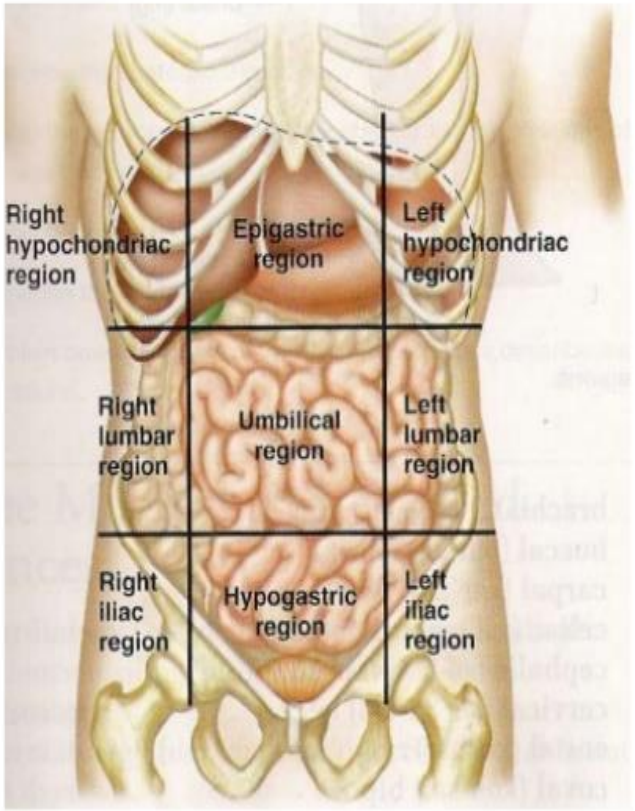
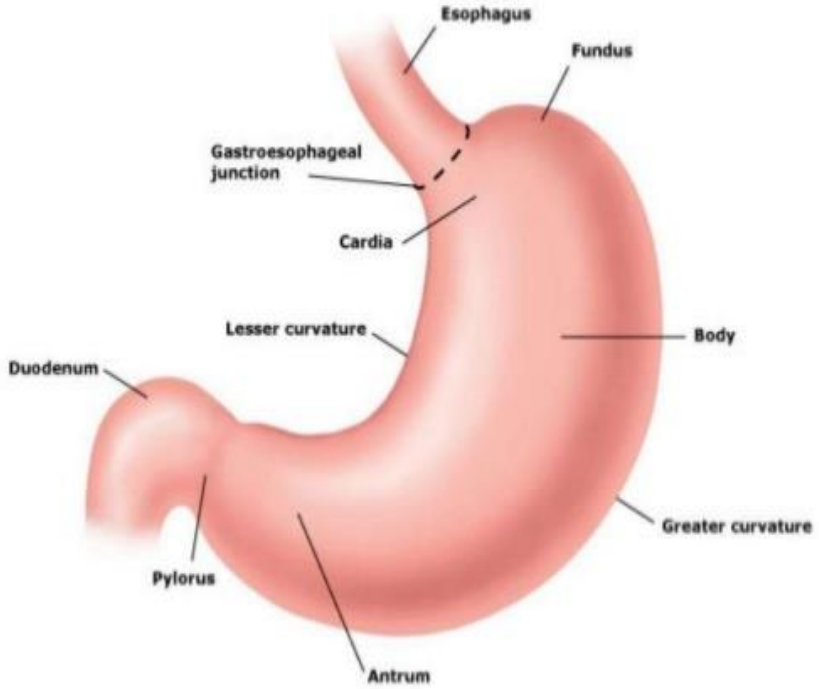
Unit – 2
Digestive System

- Functions of the stomach
- Saliva and bile
- Movements of the alimentary canel
- Digestion of food

- The stomach is the widest part of the alimentary canal
- It is a muscular sac situated immediately below the diaphragm towards the left side
- It acts as a reservoir of a large amount of food
- The walls of the stomach are composed of smooth muscle
- The inner most lining is made up of mucosa and is thrown into numerous longitudinal folds, called rugae
- The upper part of the stomach is known as fundus and the expanded middle portion is known as the body

- The lower constricted portion is known as the pylorus with a sphincter called the pyloric sphincter, which regulates the passage of food from the stomach to the duodenum
- The mucous membrane of the stomach is densely packed with simple tubular glands which remain arranged like parallel tubes


Right hypochondriac region
Epigastric region
Left hypochondriac region
Right lumbar region
Umbilical region
Left lumbar region
Right iliac region
Hypogastric region
Left iliac region


Esophagus
Fundus
Gastroesophageal junction
Cardia
Lesser curvature
Body
Duodenum
Greater curvature
Pylorus
Antrum

- These glands secrete gastric juice
- These glands are made up of different types of cells
- They are, 1. mucous cells, which secrete mucin

  2. Peptic cells which secrete pepsin and other digestive enzymes of the stomach

  3. parietal cells which secrete hydrochloric acid

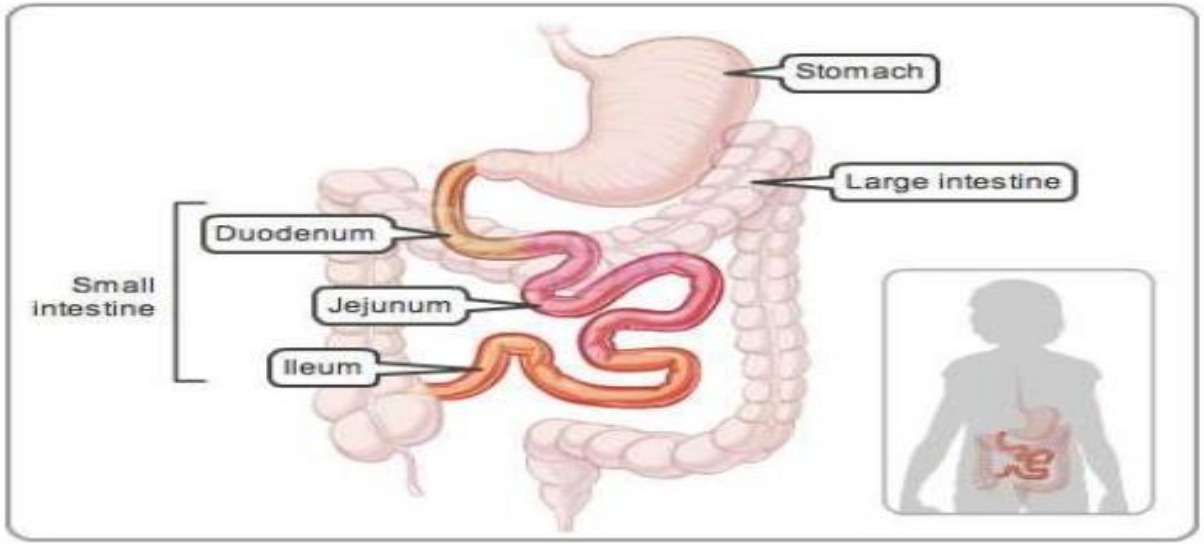
FUNCTIONS OF THE STOMACH

1. Storage of food
2. Mixing the bolus with gastric juice and convert it to chyme
3. Digestive function by the gastric juice
4. Hcl in gastric juice destroys bacteria entering through food
5. Acts in hemopoietin function
6. Many substances like toxins, alkaloids and metals are excreted

SMALL INTESTINE

- The small intestine extends from the stomach to the large intestine
- It is longer than the large intestine but smaller in diameter
- It also contains four layers, outer serosa, sub mucosa, thin muscular layer and inner mucous membrane
- The mucous membrane of the small intestine is thrown into numerous finger like processes called villi projecting into the intestinal cavity
- This increases the surface area for absorption

- It is externally lined with columnar epithelium
- In the centre of the villus is a lymphatic vessel called the lacteal
- Each villus is supplied with a small artery and vein



- The small intestine is divided into 3 regions called duodenum, jejunum and ileum
- In man its length about 21 feet
- The first 10” are called the duodenum, encircles the head of the pancreas
- In to the duodenum opens the bile and the pancreatic ducts
- The rest of the small intestine is divided into an upper portion called jejunum, and a lower somewhat narrower portion called the ileum
- But there is no clear demarcation

- The small intestine from the duodenum onwards is attached to the posterior abdominal wall by a shaped membrane called the mysentry which carries the blood vessels and nerves to the intestinal wall
- The intestinal mucosa contains the intestinal glands called Crypts of Lieberkuhn which is found in the base of the villi
- They secrete the intestinal juice or the succus entericus

FUNCTIONS OF SMALL INTESTINES

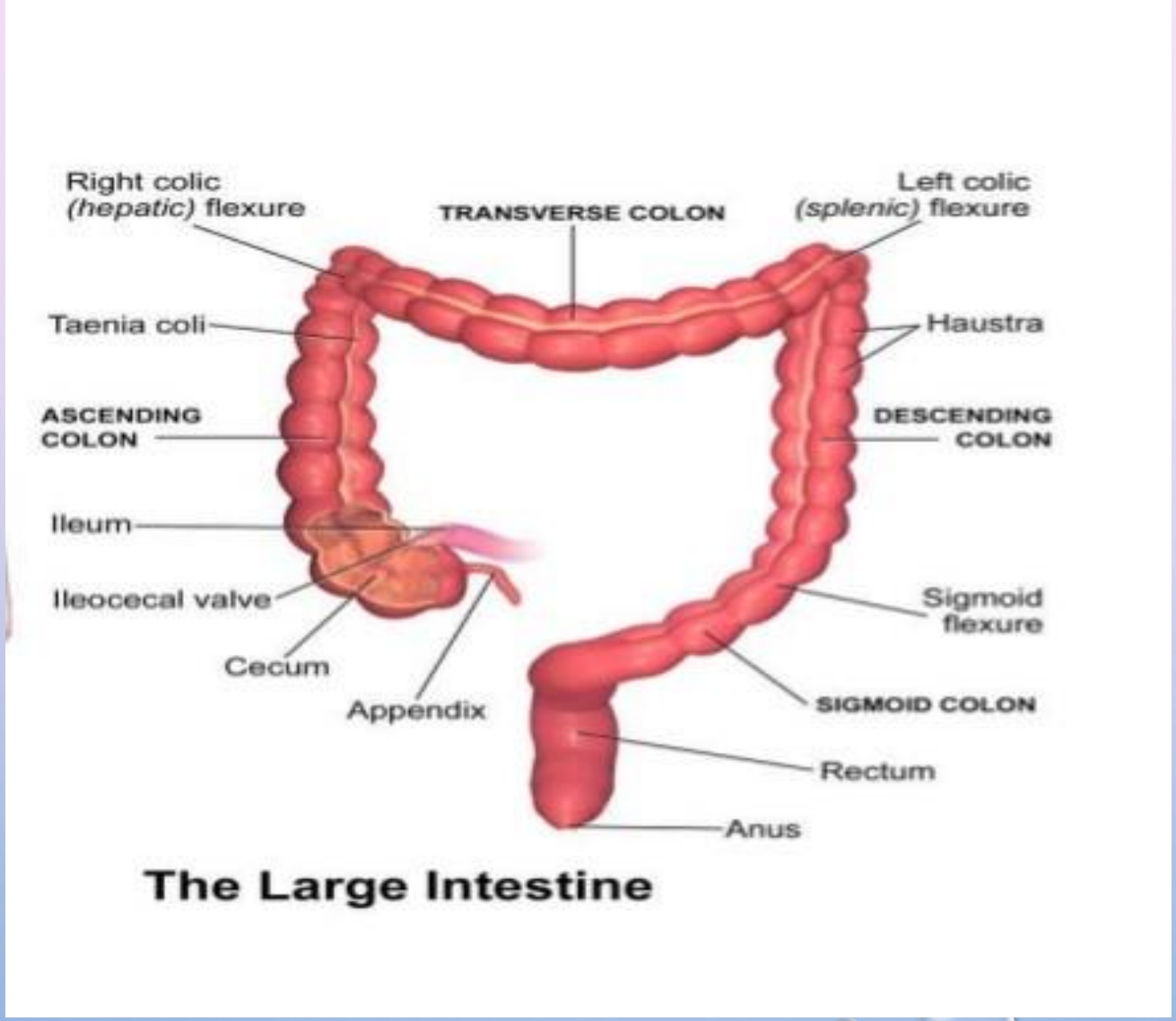
1. **Mechanical function** – mixing of chyme with digestive juice
2. **Secretory function –** secreates many hormones which regulates the activities of small intestine
3. Completion of digestion
4. It has haemopoietic action
5. Villi and microvilli increases the absorptive function of intestine

LARGE INTESTINE

- The large intestine extends from ileum to anus and it is divided into the Caecum, Colon and Rectum
- The caecum is a blind sac seen just below the opening of the ileum into the large intestine
- To the caecum is connected a finger like process the vermiform appendix
- The colon is divided into 3 parts

1. The ascending colon
2. The transverse colon and
3. The descending colon

- The ascending colon is the part extending from the caecum to the lowest surface of the liver and then lies horizontal to the abdominal cavity to form the transverse colon and then bends down below the stomach on the left side and opens into the rectum
- The rectum is about 5” long and extends till the anus which is guarded by an anal sphincter

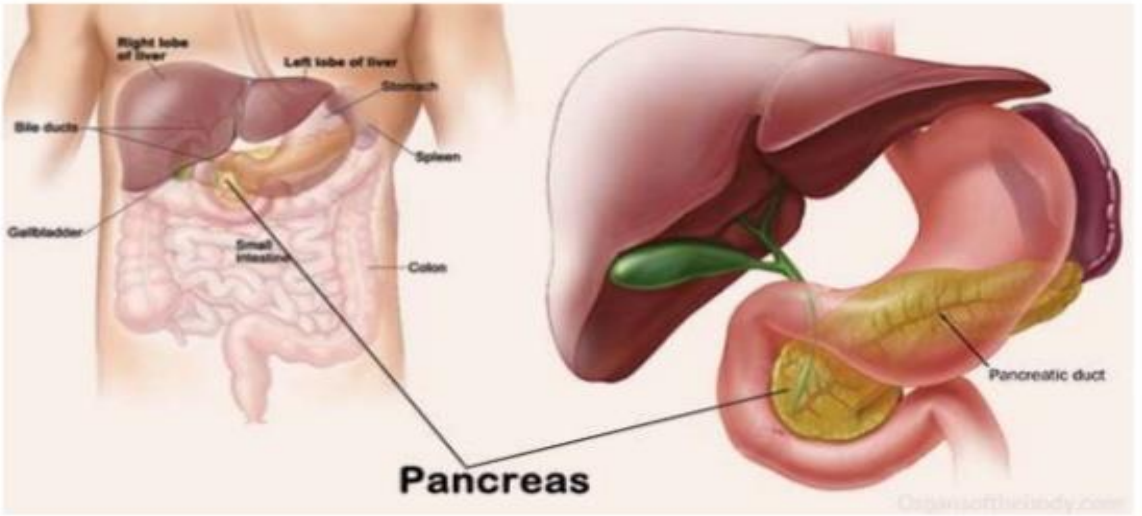

Right colic
(hepatic) flexure
TRANSVERSE COLON
Left colic
(splenic) flexure
Taenia coli
Haustra
ASCENDING
COLON
DESCENDING
COLON
Ileum
Ileocecal valve
Sigmoid
flexure
Cecum
Appendix
SIGMOID COLON
Rectum
Anus
The Large Intestine

FUNCTIONS OF LARGE INTESTINE

1. Neutralisation of acid
2. Secretes mucin and inorganic substances like chlorides and bicarbonates
3. Synthesise B12, folic acid and vitamin K
4. Helps in absorption of Nutrients

PANCREAS

- Pancreas is an elongated fish shaped gland situated behind the stomach with the head and neck in the ‘ C’ shaped curve of the duodenum
- It functions both as an exocrine and endocrine gland
- Exocrine gland will have a duct to carry the secretion
- Endocrine glands are ductless
- Pancreas contains a group of cells called Islets of Langerhans
- They are divided into α and β cells
- α secrete glucagon and β secrete insulin

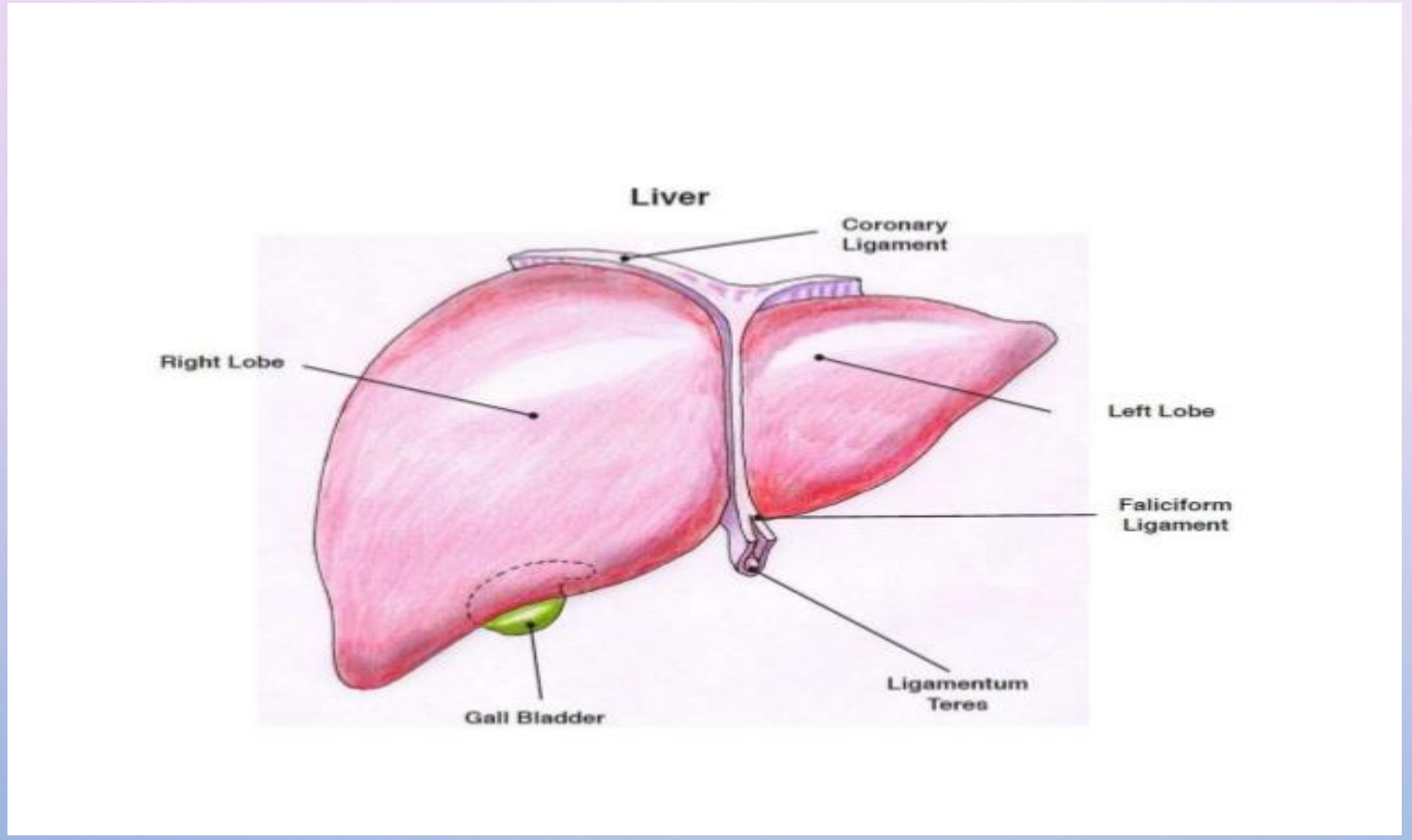

Right lobe of liver
Left lobe of liver
Stomach
Bile ducts
Spleen
Gallbladder
Small intestine
Colon
Pancreatic duct
Pancreas

FUNCTIONS OF PANCREAS

- Pancreas secrete a digestive juice called pancreatic juice
- The volume is around 1200 – 2500 ml/24 hrs with an alkaline pH 8 – 8.4
- It is composed of H2O – 97 – 98 % and solids 1 – 3 %
- The enzymes are trypsinogen, amylo peptitase, chymo trypsinogen, carboxyl peptidase, amylase, maltase pancreatic lipase and nucleases
- It also contains small amounts of albumin, globulin and nucleoproteins

- Trypsinogen and chymotrypsinogen are converted to trypsin and chymotrypsin which act on peptones to convert it into peptides
- Pancreatic lipase acts on fat in the presence of bile
- It hydrolyses triglycerides to free fatty acids and glycerols
- Pancreatic amylase acts on all forms of starch and dextrins converting into maltose
- The nucleases act on DNA & RNA

LIVER


Liver
Coronary Ligament
Right Lobe
Left Lobe
Faliciform Ligament
Ligamentum Teres
Gall Bladder

- Liver is the largest gland in body located under the diaphragm and occupies the right side of abdomen near stomach
- The liver is divided into a large right lobe and a smaller left lobe
- The right lobe is again sub divided into the right lobe proper, the quadrate lobe and the cardate lobe

- The liver cells are arranged in the form of plates
- Liver has phagocytic cells called the Kupffer cells which kill foreign particles
- Blood is brought to the liver by the hepatic artery and the portal vein which is finally breaks into capillaries in lobules and finally forms the hepatic vein
- The biliary capilries are located within the liver cells

- These ducts then unite to form the hepatic duct
- The hepatic duct is joined by cystic duct from the gall bladder and continues as the common bile duct which opens into duodenum where it is also jointed by pancreatic duct
- The gall bladder is pear shaped sac, under right lobe of liver with a capacity of 30 – 50 ml
- It acts as a reservoir for the storage of bile which is continuously formed by liver
- After a meal especially of fat, gall bladder contracts and discharges bile into duodenum

- Gall bladder concentrates the bile by the absorption of H2O
- It reduces alkalinity of bile
- Cholesterol is excreted through bile

FUNCTIONS OF THE LIVER

1) **Metabolic function –** it controls metabolism of CHO, fats and proteins

a) **CHO Metabolism –** liver helps in the conversion of glucose into glycogen and also breakdown of glycogen into glucose and thus maintains the blood glucose level in the body

b) **Protein Metabolism –** liver helps in the deamination and transamination of amino acids

c) **Fats –** fats are also metabolised and converted into other types of material in the liver

2.) Liver helps in the formation of bile

3.) It helps in destruction of RBC and transforming Hb into bilirubin and biliverdin

4.) Liver helps in storage of glycogen mainly and also stores protein, vitamin A, D,B12, folic acid and Iron etc..,

5.) Liver synthesizes plasma proteins, albumin , fibrinogen, prothrombin, etc.,

6.) Heparin which is an anti – coagulant is synthesized in the liver

7.) The reticulo endothelial cells in the liver helps phagocytosis and antibody information

8.) Liver inactivates certain drugs, helps in the de- toxication of some substances which are otherwise harmful to the body

SALIVA AND BILE

- The human saliva contains 99.27% water.
- Rest of the saliva contains 0.2% inorganic (salts) like nacl, kcl, carbonates, phosphates, etc.
- It also contains some protein material like albumin, globulin etc.
- The enzyme present in saliva is ptyalin or salivary amylase.
- Other inorganic constituents are urea, mucin, maltase, etc.
- The saliva is slightly acid in reaction.
- The average adult secretes 1200-1500 c.c Of saliva in 24 hrs.

FUNCTIONS OF SALIVA

1. It moistens the food and so facilitates mastication and swallowing by coating it with mucin and lubricating it and renders the food slippery and easy to swallow. This action helps in speech also.
2. The constant flow of saliva exerts a cleaning effect. The mouth and teeth are rinsed and kept free from foreign particles, food particles etc. In this way, saliva inhibits the growth of bacteria.
3. Saliva keeps the mouth moist even between the meals. It's absence may stimulate thirst.

4. Saliva is essential for appreciation of taste.

5. All solid substances are dissolved in saliva in order to stimulate taste buds.

6. Saliva excretes many organic and inorganic substances.

7. The important function of saliva is digestion.

- The enzyme ptyalin acts upon boiled starch and glycogen and converts it through the stages of soluble starch – erythrodextrin – achrodextrin – dextrin – maltose.
- Salivary amylase or ptyalin is most active at a ph of 6.
- Ptyalin has no action on cellulose and so the starch must be cooked for the ptyalin to act.

- Salivary secretion occurs through reflexes.
- The salivary response evoked by the introduction of food material in the mouth is called as unconditioned or inborn reflex.
- The secretion following the smell, sight and thought of food is called as conditioned reflex or acquired reflex.

COMPOSITION OF BILE

- Liver secretes bile, a greenish or golden yellow fluid slightly alkaline, viscous with a bitter taste.
- It is continuously secreted. About 500-1000ml. Of bile is secreted per 24 hours.
- The chief constituents are bile salts, bile pigments, cholesterol, lecithin, bile acids and inorganic salts like Na, K, ca, mg, HCO_3 chloride etc.

FUNCTIONS OF BILE

- Bile is essential for life.
- Although, it does not contain any enzyme, yet it acts as a very important digestive juice.
- It's importance is so much that life cannot be maintained without it.
- Lack of bile leads to death. Bile is essential for the complete digestion of fats and to some extent of protein and carbohydrate.
- The action is due to the presence of bile salts which act in the following ways.

i. **Absorption:** bile helps in the absorption of fats iron, ca, vitamin A, D, E and K.

ii. **Excretion:** heavy metals, toxins, bacteria, cholesterol, bile pigments etc are excreted through bile.

iii. **Laxative action:** bile salts stimulate peristalsis.

iv. **Cholagogue action**: bile acts as its own stimulant. Bile salts are the strongest cholagogues. They are absorbed from intestine, carried to the liver, where it stimulates further bile secretion. The taurocholate is stronger in this respect than the glycocholate. Bile helps to maintain a suitable ph of the duodenal contents and thus helps the action of all the enzymes. Bile is an important source of alkali for neutralizing the HCL entering the intestine from stomach.

v. Mucin of bile acts as a buffer and a lubricant.

MOVEMENTS OF THE ALIMENTARY CANEL
MOVEMENTS OF PHARYNX AND OESOPHAGUS

- Deglutition it is otherwise known as swallowing.
- It is the transport of a bolus liquid or solid from the mouth to the stomach by the movement of the tongue, cheeks and lips.
- The food is pushed into the pharynx and oesophagus in 3 stages.

- The first stage or oral phase is voluntary and the bolus of food is carried into the pharynx.
- In the second phase known as pharyngeal phase, food passes through the pharynx by the contraction of muscles of pharynx.
- In the third stage or oesophageal phase, the food is carried through the oesophagus and at this time the larynx will be closed.

- But, if by any chance food enters the larynx, it excites the coughing reflex.
- Liquids and soft foods pass through the oesophagus very fast. But solid foods require more time (4 – 8 sec.).
- Oesphagus is a narrow muscular tube about 10” in length and connects the pharynx with the stomach. It’s wall is provided with circular and longitudinal muscles.
- By the peristaltic movement of these muscles, the food is pushed down.

MOVEMENTS OF THE STOMACH
GASTRIC TONE

- This is the relation between the length of the muscle fibre and the tension, which maintains good gastric tone this is needed for proper digestive movements.
- Hunger contractions are peristaltic waves seen when the stomach is empty.
- This stimulates the nerves and induces hunger.
- Digestive peristalsis replaces hunger contractions which cease when food enter the stomach.

- Digestive peristalsis moves gastric contents forward and backward.
- Peristalsis moves it forward and closed pyloric sphincter moves it backward.
- This helps to mix the food thoroughly with the gastric juice.
- When the food has reached a suitable consistency, it is pushed into the duodenum through the pylorus by a strong descending peristalsis.
- It also shows a slow pendular movement.

MOVEMENTS OF SMALL INTESTINE

The small intestine shows 3 types of movements. They are:

1. Pendular movement

- This is a swaying movement up and down the small intestine.
- They are simple constructions of the intestinal wall and results in the to and fro movements of intestinal contents and helps to mix intestinal contents thoroughly with intestinal juice.

2. Segmenting movements

- It is also known as rhythmic segmentation movement of the intestine.
- It helps to break up the food into smaller parts and mix thoroughly and contents are made to come in contact with the absorptive surfaces.
- Thus food is systematically divided into small segments and pushed forward

3. Peristaltic movements

- It is defined as a wave of contraction followed by a wave of relaxation by means of which the food is pushed from one point to the other.
- Mechanical, chemical and electrical stimuli can induce peristalsis.
- Peristalsis is always towards the anal region, but in certain abnormal cases, reverse of this happens. It is called anti-peristalsis.
- Strong stimuli such as irritant may induce strong peristalsis which sweeps over the entire length of the small intestine without interruption. This is called peristaltic rush.
- Peristaltic waves are seen in oesophagus, stomach, small intestine, large intestine, rectum and anus.

MOVEMENT OF THE VILLI

- The villi exhibit two types of movements.
- They are the side to side swaying movement and the pumping movement (elongation and contraction).
- These movements are due to the contraction of the smooth muscle fibres inserted in the villi.
- The hormone villikinin increases the villi movements.

MOVEMENTS OF LARGE INTESTINE

- The large intestine also shows large circular constructions similar to segmentation movements.
- Peristalsis and anti-peristalsis are also exhibited by the colon.
- Mass peristalsis – are strong peristaltic waves which start at the upper end of the ascending colon and move swiftly over the colon and empty the colon of its contents into the rectum.

- Mass peristalsis after meals is mainly caused by the duodenocolic reflex and to a less extent by the gastrocolic reflex.
- Gastrocolic reflex is an important reflex involved in intestinal activity.
- When food materials like hot drinks reach the stomach a reflex activity is initiated by which, there is a tendency to evacuate the colon.

DIGESTION OF FOOD

In the mouth, food is masticated by the movement of the lower jaw, lips and cheeks. The teeth cut and tear the food. The whole mass thus becomes thoroughly mixed with saliva.

- After mastication it is carried to the stomach.
- In stomach gastric secretion takes place in 3 phases.
- The 1st phase is the psychic or cephalic. Here, gastric secretion starts even before any food has entered the stomach. Gastric secretion occurs from the sight, smell or the taste of food. Here the secretion is by a conditioned reflex which is not inborn.
- The 2nd phase is the gastric phase and during this phase gastric juice is secreted

- After food has entered the stomach.
- It continues for a much longer period. In this phase, secretion is mainly due to the action of local hormone, called gastrin.
- This hormone stimulates the gastric cells to secrete the digestive juice.
- In the 3rd phase the gastric juice continues to be secreted after the partially digested food materials have reached intestine.
- The products of protein digestion continue to exert a stimulatory effect upon the gastric juice.