JSR IAS ACADEMY

GENERAL SCIENCE

BIOLOGY

Physiology

Human Digestive System

- **Cells** are the basic fundamental units of an organism.
- Our **nervous system** directs our arms and legs to work.
- Simultaneously, **respiratory, digestive and circulatory systems** work to provide energy to the muscles.

Organ Systems	Organs	Functions
Integumentary system	Skin and skin glands	Protection, Excretion, etc.
Skeletal system	Skull, Vertebral column, Sternum, Girdles and Limbs	Give support, shape and form to the body.
Muscular system	Muscle fibres	Contraction and relaxation resulting movement.
Nervous system	Brain, spinal cord and nerves.	Conduction of nerve impulse.
Circulatory system	Heart, blood and blood vessels	Transportation of respiratory gases, nutritive substances and waste products.
Respiratory system	Respiratory tract and Lungs	Breathing
Digestive system	Digestive tract and digestive glands	Digestion, Absorption, Egestion
Excretory system	Kidneys, ureters, urinary bladder and urethra.	Elimination of nitrogenous waste products.
Reproductive system	Testes and ovary	Gamete formation and development of secondary sexual characters.
Sensory system	Eyes, nose, ears, tongue and skin	Sight, smell, hearing, taste and touch.
Endocrine system	Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, Pineal body, Thymus, Reproductive glands, etc.	Co-ordinates the functions of all organ systems.

Human Digestive System

The five stages of nutrition process include

1. ingestion,
2. digestion,
3. absorption,
4. assimilation and
5. egestion.

Parts of the body concerned with the digestion of food form the **digestive system.**

The digestive system

consists of two sets of organs. They are as follows:

1.Alimentary canal (digestive tract/gastrointestinal tract):

It is a passage starting from the mouth and ending with the anus.

2.Digestive glands:

- the salivary glands,
- gastric glands,
- pancreas,
- liver and
- intestinal glands.

Structure of the Alimentary

Alimentary canal consists of **mouth, buccal cavity, pharynx, oesophagus, stomach, small intestine (consisting of duodenum, jejunum and ileum), large intestine (consisting of caecum, colon and rectum) and anus.**

Mouth:

- The mouth leads into the buccal cavity.
- The jaws bear teeth.

Teeth:

- In human beings **two sets of teeth (Diphyodont**) are developed in their life time.
- The first appearing set of **20 teeth called temporary or milk teeth** are replaced by the **second set of thirty two permanent teeth**, sixteen in each jaw.
- Each tooth has a root fitted in the gum **(Theocodont).**

Permanent teeth are of **four types**

1. incisors,
2. canines,
3. premolars and
4. molars.

Types of teeth	Number of teeth	Functions
Incisors	8	Cutting and biting
Canines	4	Tearing and piercing
Premolars	8	Crushing and grinding
Molars	12	Crushing, grinding and mastication

The types of teeth are denoted as incisors (i), canine (c), premolars (pm) and molars (m). The dental formula is presented as:

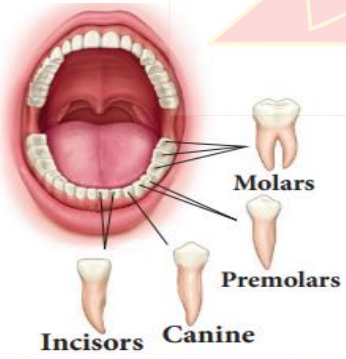


Figure 20.2 Different kinds of teeth

For **Milk teeth** in each half of upper and lower jaw:

$$\frac{2,1,2}{2,1,2} = 10 \text{ x2= } 20$$

For **Permanent teeth** in each half of upper and lower jaw:

$$\frac{2,1,2,3}{2,1,2,3} = 16\text{x2= } 32$$

Salivary glands:

Three pairs of salivary glands are present in the mouth cavity.

a. Parotid glands

are the largest salivary glands, which lie in the cheeks in front of the ears (in Greek Par - near ; otid - ear).

b. Sublingual glands

are the smallest glands and lie beneath the tongue.

c. Submaxillary or Submandibular glands

lie at the angles of the lower jaw.

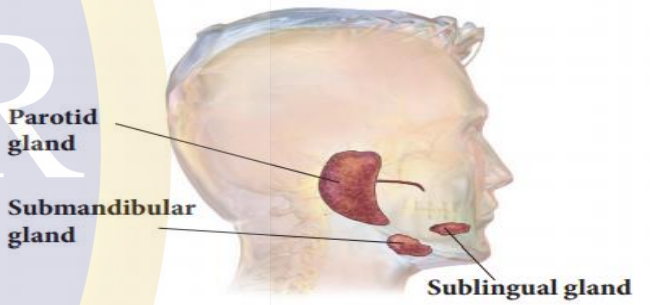


Figure 20.3 Salivary glands

- The salivary glands secrete a viscous fluid called **saliva,** approximately **1.5 liters per day.**
- It digests starch by the action of the enzyme **ptyalin (amylase)** in the saliva which **converts starch (polysaccharide) into maltose (disaccharide).**
- Saliva also contain an **antibacterial enzyme called lysozyme.**

Tongue:

- The tongue **is a muscular, sensory organ** which **helps in mixing the food with the saliva.**
- **The taste buds** on the tongue help to recognize the taste of food.
- **The masticated food** in the buccal cavity becomes a bolus which is rolled by the tongue and passed through pharynx into the oesophagus by swallowing.
- **During swallowing**, the epiglottis (a muscular flap-like structure at the tip of the glottis, beginning of trachea) closes and prevents the food from entering into trachea (wind pipe).

Pharynx:

- The pharynx is a membrane lined cavity behind the nose and mouth,
- connecting them to the oesophagus.
- It serves as a pathway for the movement of food from mouth to oesophagus.

Oesophagus:

Oesophagus or the food pipe is a muscular-membranous canal about **22 cm in length.**

Stomach:

- The stomach is a **wide J-shaped muscular organ** located between oesophagus and the small intestine.
- The gastric juice is **colourless, highly acidic, containing mucus, hydrochloric acid and enzymes rennin (in infants) and pepsin.**
- **Hydrochloric acid kills the bacteria** swallowed along with food and makes the medium acidic while the mucus protects the wall of the stomach.
- The action of the gastric juice and churning of food in the stomach convert the bolus into a semidigested food called **chyme.**

Rennin: Causes curdling of milk protein caesin and increases digestion of proteins.

Renin: Converts angiotensinogen to angiotensin and regulate the absorption of water and Na^+ from glomerular filtrate.

Small intestine:

The small intestine is the **longest part of the alimentary canal**, which is a long coiled tube measuring about **5 – 7 m.**

It **comprises three parts**- duodenum, jejunum and ileum.

a. Duodenum

is **C-shaped** and receives the bile duct (from liver) and pancreatic duct (from pancreas).

b. Jejunum

- is the middle part of the small intestine.
- It is a **short region** of the small intestine.
- intestinal juice which **contains the enzymes like sucrase, maltase, lactase and lipase.**

c. Ileum

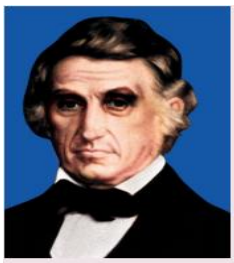
- Ileum is the **longest part of the small intestine.**
- It **contains minute finger** like projections called **villi** (one millimeter in length) where absorption of food takes place.
- They **are approximately 4 million in number.**

The small intestine **serves both for digestion and absorption.**

- It receives the bile from liver and the pancreatic juice from pancreas in the duodenum.
- The intestinal glands secrete the intestinal juices.

Table 20.3 Chart showing the Digestive Enzymes

Digestive glands	Enzymes	Substrate (nutrient)	Products of digestion
Salivary glands	Ptyalin (Salivary amylase)	Starch	Maltose
Gastric glands	Pepsin	Proteins	Peptones
	Rennin (in infants)	Milk protein or caseinogen	Curdles milk to produce casein protein
Pancreas	Pancreatic amylase	Starch	Maltose
	Trypsin	Proteins and peptones	Peptides and amino acids
	Chymotrypsin	Protein	Proteoses, Peptones, Polypeptide, tri and dipepetides
	Pancreatic lipase	Emulsified fats	Fatty acids and Glycerol
Intestinal glands	Maltase	Maltose	Glucose and Glucose
	Lactase	Lactose	Glucose and Galactose
	Sucrase	Sucrose	Glucose and Fructose
	Lipase	Fats	Fatty acids and Glycerol



William Beaumont (1785-1853)

William Beaumont was a surgeon who was known as the 'Father of Gastric Physiology'. Based on his observations he concluded that the stomach's strong hydrochloric acid played a key role in digestion.

Liver:

- It is the **largest digestive gland of the body which is reddish brown in colour.**
- It is divided into two main lobes, right and left lobes.
- **The right lobe is larger** than the left lobe.
- On the under surface of the liver, **gall bladder is present.**
- **The liver cells secrete bile** which is temporarily stored in the gall bladder.
- Bile is released into small intestine when food enters in it.
  1. It has bile salts **(sodium glycolate and sodium tauraglycolate)**
  2. bile pigments **(bilirubin and biliviridin).**

Bile salts help in the digestion of fats by bringing about their **emulsification** (conversion of large fat droplets into small ones).

Functions of Liver

- Controls blood sugar and amino acid levels
- Synthesizes foetal red blood cells.
- Produces **fibrinogen and prothrombin**, used for clotting of blood.
- Destroys red blood cells.
- Stores iron, copper, vitamins A and D.
- Produces **heparin** (an anticoagulant).
- Detoxifies substances including drugs and alcohol.

Pancreas:

- It is a lobed, **leaf shaped gland** situated between the stomach and duodenum.
- pancreatic juice which **contains three enzymes- lipase, trypsin and amylase** which acts on fats, proteins and starch respectively.

The intestinal glands

secrete intestinal juice called **succus entericus**

Absorption of food:

Absorption is the **process by which nutrients obtained after digestion are absorbed by villi** and circulated throughout the body by blood and lymph

Assimilation of food:

- Assimilation means the incorporation of the absorbed food materials into the tissue cells
- The final products (fatty acids and glycerol) are again converted into fats and **excess fats are stored in adipose tissue.**
- The excess sugars are converted into a complex polysaccharide, glycogen in the liver.

The small intestine is about 5 m long and is the longest part of the digestive system. The large intestine is a thicker tube, but is about 1.5 m long.

Large intestine:

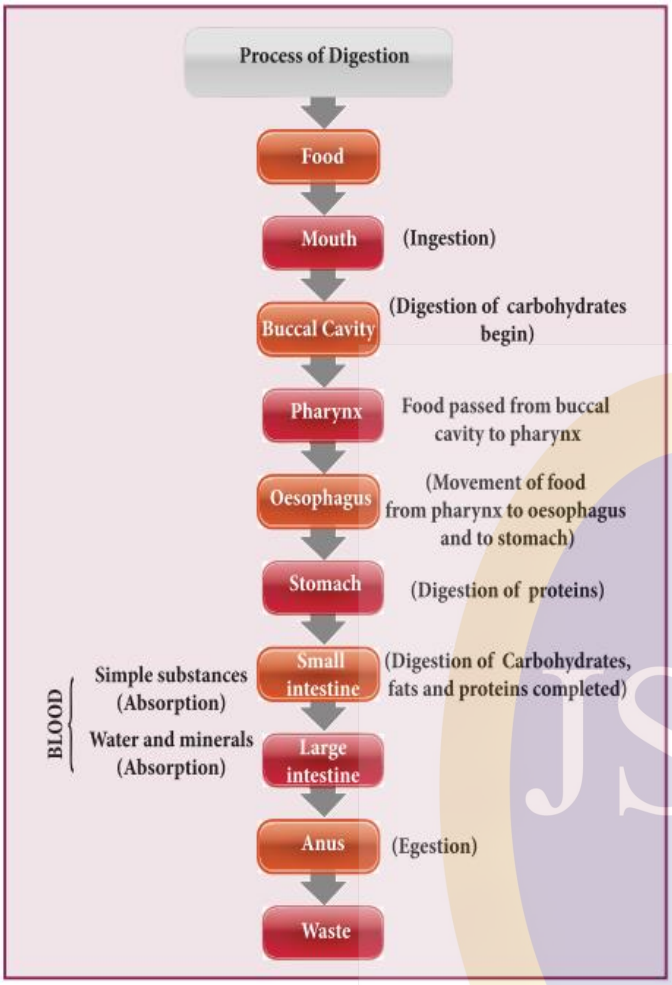
- The unabsorbed and undigested food is passed into the large intestine.
- It **extends from the ileum to the anus.**
- It is about **1.5 meters in length**.
- It has **three parts- caecum, colon and rectum.**

The caecum

- situated at the junction of the small and large intestine.
- From its blind end a finger – like structure called vermiform appendix arises.
- It is a **vestigeal (functionless)** organ in human beings.

The colon

- The rectum is the **last part which opens into the anus.**
- This is known as **egestion or defaecation.**


Process of Digestion
Food
Mouth
(Ingestion)
Buccal Cavity
(Digestion of carbohydrates begin)
Pharynx
Food passed from buccal cavity to pharynx
Oesophagus
(Movement of food from pharynx to oesophagus and to stomach)
Stomach
(Digestion of proteins)
Small intestine
(Digestion of Carbohydrates, fats and proteins completed)
BLOOD
Simple substances (Absorption)
Water and minerals (Absorption)
Large intestine
Anus
(Egestion)
Waste