

The Digestive System

Nutrition in humans

- Mouth includes teeth, salivary glands, and tongue. Teeth break down the food. They are of four types – molars (6), premolars (4), canines (2), and incisors (4) in each jaw.
 - Molars and premolars are for chewing and grinding food.
 - Canines are for piercing and tearing food.
 - Incisors are for cutting and biting food.
- In total life span of humans, two sets of teeth grow – milk teeth and permanent teeth.
- Saliva is secreted by salivary glands located under the tongue. It contains a digestive enzyme salivary amylase, which breaks down starch into sugar.
- Tongue helps in chewing and swallowing of food.
- The food from mouth passes down the oesophagus to the stomach, through the movement of walls of oesophagus (peristalsis)
- **Stomach** mixes the food received from oesophagus with digestive juices.
- Inner lining of stomach secretes:
 - Mucus – protects the lining of stomach against the action of the acid.
 - Hydrochloric acid – creates an acidic medium and helps in digestion of proteins.
 - Digestive juices – break down protein into simple substance.
 - Pepsin breaks proteins into polypeptides
 - Rennin changes soluble milk proteins into curd which is insoluble.
- The food from stomach moves into the small intestine.
- **Digestion in small intestine**
 - It is the longest part (about 7.5 m long) of the alimentary canal.
 - It is the site where complete digestion of carbohydrates, proteins, and fats takes place.
 - All the digested food is absorbed by the walls of intestine. This process is known as **absorption**.
 - Inner lining of small intestine has tiny finger-like projections called **villi**.
 - **Villi** increase the surface area for more efficient food absorption.
 - The absorbed food is delivered to each and every cell of the body where they are used to produce complex substances such as proteins, etc. This process is known as **assimilation**.

- It receives intestinal juice from two glands – liver and pancreas that help in further digestion of food.
- **Liver** - It is the largest gland of the body and secretes bile juice. Bile juice is stored in gall bladder and plays an important role in the digestion of fats.
- **Pancreas** - Pancreas contains enzymes that help in complete digestion of all food components.
 - Amylase breaks starch into maltose
 - Lipase breaks complex fats into simple fats.
- The functions of enzymes secreted in small intestine are :
 - Maltase changes maltose to glucose
 - Sucrase changes sucrose to glucose
 - Lactase changes lactose to glucose
 - Peptidase changes polypeptides to amino acids
- **Digestion in large intestine**
 - The digested food from small intestine goes into blood stream and the undigested and unabsorbed material and water enters the large intestine.
 - The function of large intestine is absorption of water and some salts from undigested food.
 - From large intestine, the waste material is stored in rectum in the form of semi-solid faeces.
 - The undigested, stored waste is excreted out from the body as faeces via anus. This process is known as egestion.

Digestive glands

- Three pairs of salivary glands are the parotids, the sub maxillary or sub mandibular, and the sub lingual.
- **Liver** is the largest gland.
- **Cystic duct** (duct of gall bladder) and **hepatic duct** (duct of liver) form a common **bile duct**.
- **Bile duct** and **pancreatic duct** opens together into duodenum as **hepato-pancreatic duct**.
- **Sphincter of Oddi** is located at the surface of duodenum and controls the secretions from liver, pancreas, and gall bladder into the duodenum of small intestine.

- **Crypts of lieberkuhn** are intestinal glands found in epithelial lining of small intestine and colon. These glands secrete maltase, sucrase, etc.
- **Pancreas** act as both exocrine and endocrine gland.
 - i. **Exocrine part** secretes pancreatic juice.
 - ii. **Endocrine part** secretes hormones - insulin and glucagon.
- Glands present in the mucosa of stomach are called gastric glands. Gastric glands have three major types of cells.
 - Mucus cells – Secrete mucus
 - Peptic or chief cells – Secrete pepsinogen
 - Parietal or oxyntic cells – Secrete HCl

Digestion of food

- **Digestion of carbohydrate**
- It takes place in **mouth** and in the **small intestine** region of alimentary canal.

In mouth:

- Carbohydrate digestion stops in stomach and is then resumed in small intestine. Mainly, protein digestion takes place in stomach.

In small intestine:

- **Pancreatic juice** contains pancreatic amylase.
- **Intestinal juice** contains enzymes such as maltase, lactase, sucrase, etc., which convert complex sugars into simple sugars.

- **Digestion of protein**
- It begins in **stomach** and gets completed in **small intestine**.
- Enzymes involved are called **proteases**.
- **In stomach:**
- **Gastric juice** contains **HCl, pepsinogen, and rennin**.
- **HCl** creates acidic medium that activates pepsinogen into pepsin.

Proteins + pepsin----- Proteoses + peptones

- **Rennin** plays a role in coagulation of milk.
- **In small intestine:**
- **Pancreatic juice** contains inactive enzymes such as **trypsinogen, chymotrypsinogen, and carboxypeptidases**.
- **Enterokinase** secreted by **intestinal mucosa** activates trypsinogen into trypsin.
- **Intestinal juice** contains dipeptidases, which digest dipeptides into amino acids.
- **Digestion of fat**
- It takes place in **small intestine**.
- **Bile juice** is secreted by **liver** and is stored in **gall bladder**.
- **Bile juice** contains bile salt that helps in breakdown of fat into smaller globules. It is known as **emulsification of fat**.

Absorption of digested products:

- The absorption of food materials is carried out by passive (e.g. chloride ions), active (e.g. amino acids, glucose), or facilitated diffusion (e.g.

fructose).

- Digested food is absorbed mainly through intestinal walls.
- The inner lining of small intestine has **villi**. **Villi** contain lymph vessels called lacteal to absorb the products of fat digestion.
- **Large intestine** absorbs water and minerals from undigested food.
- **Rectum** stores the undigested matter before they are excreted out from body via **anus**.
- **Test for carbohydrates**
 - Carbohydrates are mainly present in the form of starch and sugars.
 - Starch can be tested using iodine solution.
 - Appearance of blue-black colour on adding iodine indicates the presence of starch.
 - Glucose can be tested by Benedict's test
 - Appearance of brick-red precipitate confirms the presence of glucose.
- **Test for proteins**
 - Proteins can be tested using copper sulphate and caustic soda.
 - Appearance of violet colour on adding above two mentioned chemicals indicates the presence of proteins.
 - The above test is known as Biuret test.
- **Test for fats**
 - Fats can be tested by crushing a food item on a piece of paper.
 - Appearance of oily patch indicates the presence of fats.