

DIGESTIVE SYSTEM

Major functions of digestive system

- *Ingestion*- Process by which food enters our body through the oral cavity.
- *Secretion*- Release of enzymes, acids, water, buffers and salts in the digestive tract which aids indigestion and absorption.
- *Mechanical processing* - Physical breakdown of food to make the food easy to pass through the digestive tract.
- *Digestion*- Chemical breakdown of food into smaller pieces which is easier for absorption.
- *Absorption*- The process by which the end products of digestion are taken up from the gastrointestinal tract (GI) into the blood or lymph for use by the body.
- *Defecation*- Elimination of waste products or indigestible substances from the body.

Structure of the GI tract

Has four layers

1. *Mucosa*

- Innermost layer
- Consist of an epithelium
- Secretes mucus and enzymes and absorbs nutrients

2. *Submucosa*

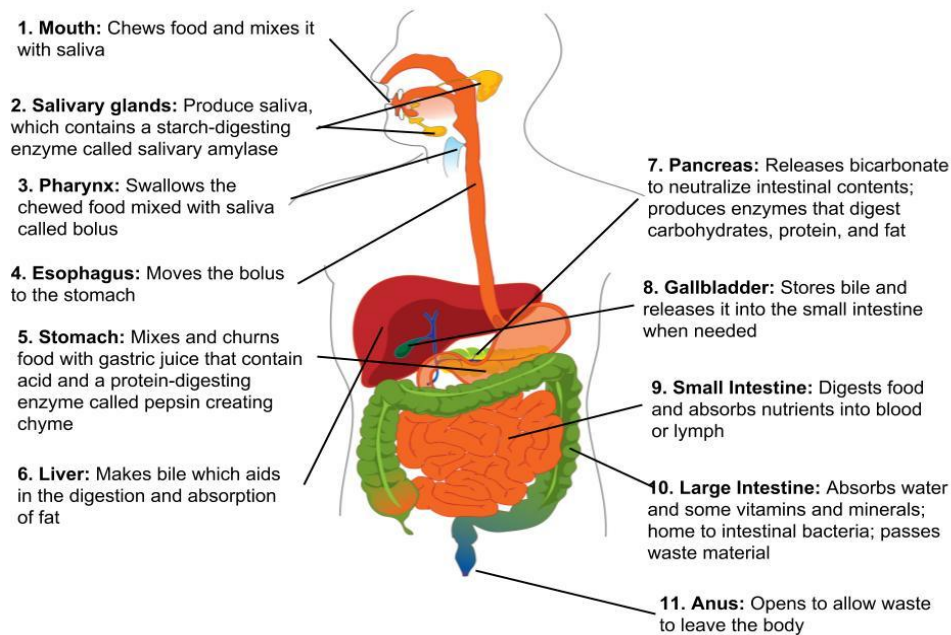
- Irregular connective tissue
- Mainly has the nerves, blood vessels and the lymphatics

3. *Muscularis External*

- Has smooth muscle cells.
- The inner circular layer is essential for formation of valves.
- The outer longitudinal layer is essential for moving materials along the digestive tract.

4. *Serosa*

- Outermost protective layer
- Helps to reduce the friction with other organs



Key and accessory organs

Food does not directly pass through the accessory organs but they in aid in digestion by releasing secretions in the GI tract. Eg, Liver, Gall bladder, pancreas, salivary glands

1. *Oral cavity or buccal cavity*

- Ingestion takes place
- Food gets mixed with saliva secreted from the salivary glands
- Mechanical digestion takes place through teeth, tongue and palatal surfaces
- Chemical digestion of carbohydrate by salivary amylase present in saliva starts
- Chemical digestion of lipid by lingual lipase present in saliva starts

2. *Pharynx and oesophagus*

- The oropharynx and the laryngopharynx are passages for food and respiratory gases
- Epiglottis is a flaplike structure which prevents the food from entering larynx during swallowing.
- Oesophagus is a long muscular tube connecting pharynx to the stomach which moves food from pharynx to stomach through peristalsis.

3. *Stomach*

- Rugae: Folds allowing expansion.

- Three muscle layers: Longitudinal, circular, oblique – enhance mixing.
- Gastric pits: Contain cells for secretion.

Secretions & Functions

- HCl: Acidic pH (1.5–3.5), kills bacteria, activates pepsinogen → pepsin.
- Pepsinogen: Inactive enzyme → digests proteins.
- Mucus: Protects stomach lining from acid.
- Intrinsic factor: Required for vitamin B12 absorption.
- Highly acidic environment to enable enzyme activity and protein denaturation.
- Stomach mainly has two types of cells:

Parietal cells= Secrete intrinsic factor required for vitamin B12 absorption in small intestine

Secrete HCL

Chief cells=secrete pepsinogen – becomes pepsin when activated by HCl, digests protein.

If the enzyme has an 'ogen' at the end like trypsinogen it is inactive, or if it has a 'pro' at the start like proelastase it is inactive.

4. Pancreas

- Both endocrine and exocrine gland
- Endocrine- Secrete insulin and glucagon hormone
- Exocrine- Secrete pancreatic juices into duodenum which consists of

Amylase- digestion of carbohydrates

Lipase - digestion of fat

Trypsinogen (trypsin) - digestion of protein

Bicarbonate ions – neutralise acidic chyme from the stomach

- Pancreatic juices have a bicarbonate that neutralise the stomach acid before it enters the small intestine which protects the lining of the small intestine.

5. Liver

- Produce up to 1L of bile everyday which emulsifies fats
- Removes toxins from the body such as alcohol, medications, ammonia (converted to urea for excretion in urine)
- The liver processes nutrients absorbed from the digestive system:
 - Carbohydrates → stored as glycogen
 - Lipids (fats) → converted to energy or stored
 - Proteins → amino acids processed, ammonia removed
- Stores nutrients such as vitamin A, D, E, K, B12, iron, copper
- synthesis and release of the plasma proteins, including albumin, transport proteins, clotting proteins and complement proteins.

6. Gall Bladder

- Store and concentrate the bile secreted from the liver
- Contains 40-70 ml of bile when full

7. Small intestine

- Has three parts:
 - Duodenum - The entrance to the small intestine
 - Jejunum - The middle part of the small intestine where most of the chemical digestion and nutrient absorption takes place
 - Ileum - Meets the large intestine at the ileocecal valve.
- Has circular folds, villi and microvilli which increase the surface area for absorption
- Majority of nutrient absorption takes place in small intestine
- Absorption occurs by simple diffusion, facilitated diffusion, osmosis and active transport

8. Large intestine

- Absorbs water and electrolytes (calcium and sodium)
- Produces and absorbs vitamins
- Forms and propels faeces toward the rectum for defecation.
- No enzymes are secreted in large intestine
- Faecal continence is maintained by two sphincters
 - External anal sphincter is skeletal muscle that can be consciously controlled
 - Internal anal sphincter is smooth muscle cannot be consciously controlled

Location and enzyme	Substrate digested	Product formed
Saliva . Salivary amylase	polysaccharides	trisaccharides
Tongue . Lingual lipase	triglycerides	fatty acids and monoglycerides
Stomach . protease	Proteins	polypeptides
Pancreas - proteases - pancreatic lipase - pancreatic amylase	Polypeptides, triglycerides, trisaccharides	Peptides, fatty acids and monoglycerides, disaccharides
Small intestine - peptidases - sucrase - lactase - maltase	peptides sucrose (disaccharide) lactose (disaccharide) maltose (disaccharide)	amino acids glucose and fructose glucose and galactose two glucose

Liver . Bile	Fat globules	Fat droplets
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- Carbohydrate- component molecule is **monosaccharides**
- Protein- component molecule is **amino acid**
- Lipids- component molecule is **fatty acids**
- Digestive enzymes are secreted by salivary glands, tongue, stomach, pancreas, small intestine
- Digestive enzymes act in mouth, stomach and small intestine