



Functions of the Digestive System

- **Ingestion**:- the oral cavity allows food to enter the digestive tract and have mastication (chewing) occurs , and the resulting food bolus is swallowed .
- **Digestion**:
 - **Mechanical digestion** – muscular movement of the digestive tract (mainly in the oral cavity and stomach) physically break down food into smaller particles .
 - **chemical digestion** – hydrolysis reactions aided by enzymes (mainly in the stomach and small intestine) chemically break down food particles into nutrient molecules , small enough to be absorbed.
- **Secretion** – enzymes and digestive fluids secreted by the digestive tract and its accessory organs facilitate chemical digestion .



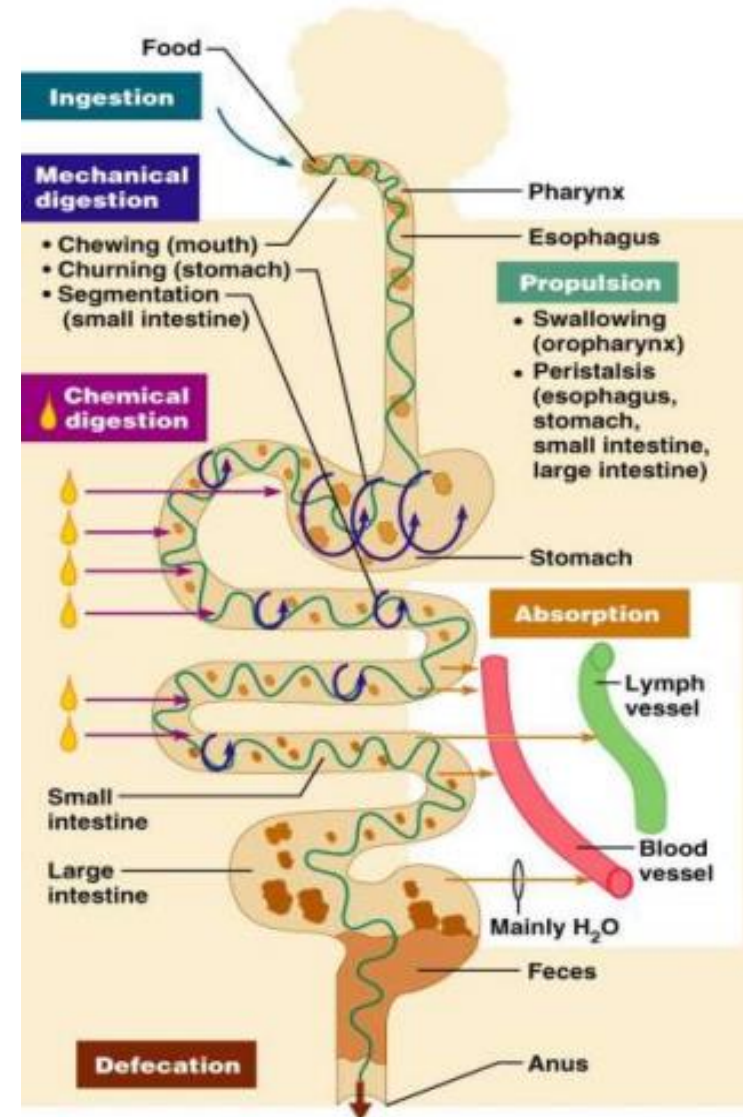
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- **Absorption** – passage of the end – products (nutrients) of chemical digestion from the digestive tract into blood or lymph for distribution to tissue cells .
- **Elimination** – undigested material will be released through the rectum and anus by defecation .





Organization of The Digestive System

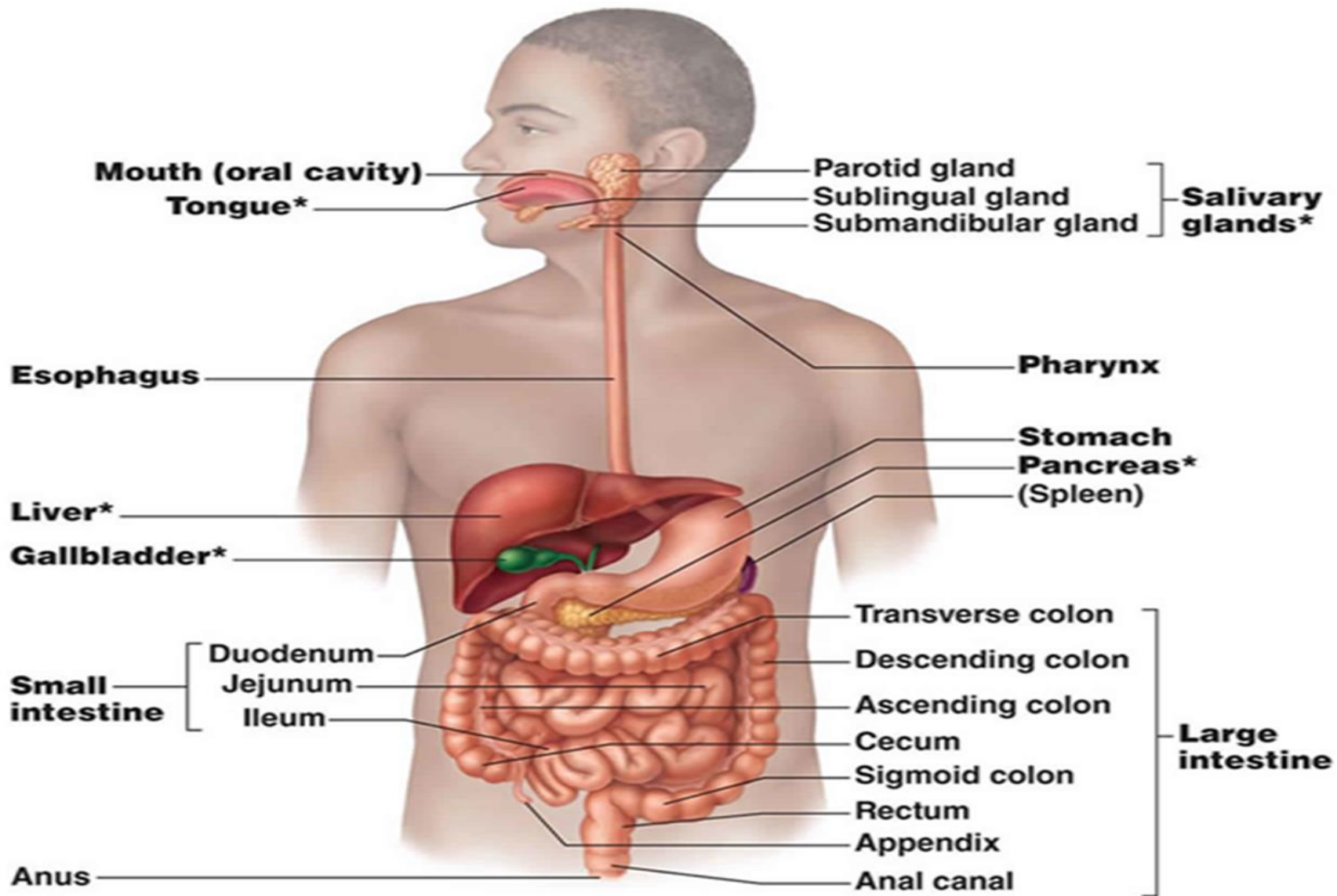
- Organs of the digestive system are divided into 2 main group: the gastrointestinal tract (GI tract) and accessory structures .
- GI tract is a continuous tube extending through the ventral cavity from the mouth to the anus – it consists of the mouth , oral cavity , oropharynx , esophagus , stomach , small intestine , large intestine , rectum , and anus .
- Accessory structures include the teeth, tongue (in oral cavity) , salivary glands , liver , gallbladder , and pancreas .



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Layer of digestive system

- **Submucosa** :-Just beneath the mucosa , Soft connective tissue with blood vessels, nerve endings.
- **Mucosa** :- innermost layer, Moist membrane
 1. Surface epithelium : secretion and absorption, renew every 5-7 days also contain enteroendocrine cells
 2. Small amount of connective tissue (lamina propria): contain blood and lymphatic vessel.
 3. Small smooth muscle layer
- **Muscular** :-is smooth muscle
 1. Inner circular layer
 2. Outer longitudinal layer Between them is myenteric plexus
- **Serosa** :-Outermost layer – visceral peritoneum , Layer of serous fluid-producing cells (mesothelium).



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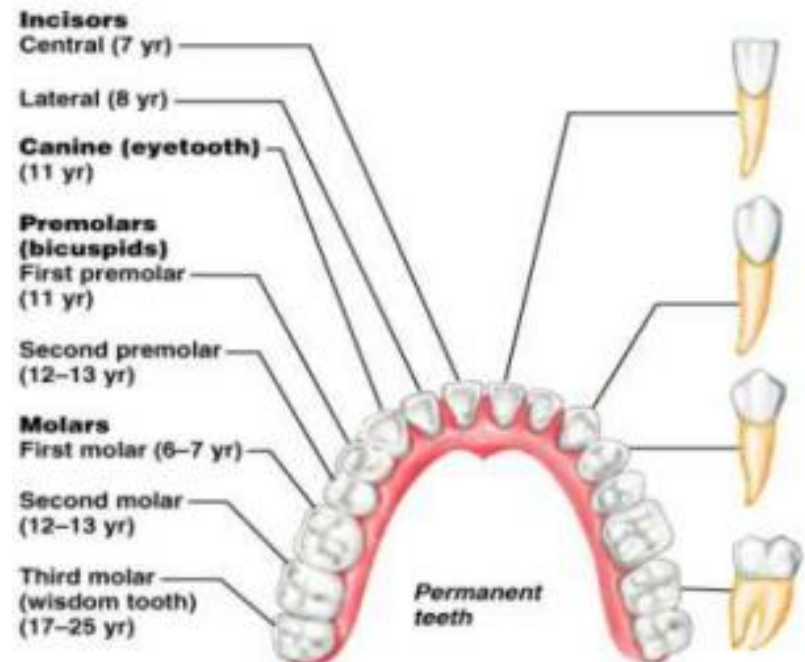
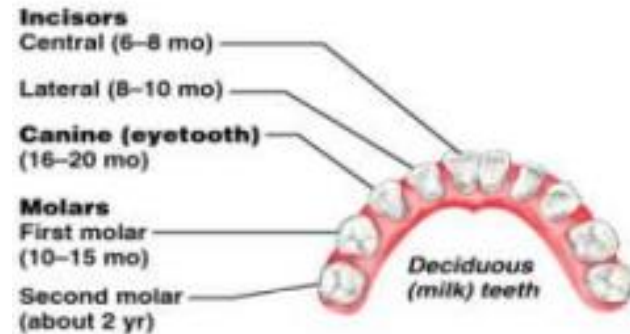
Mouth & Oral Cavity

- Food enters the GI tract by ingestion .
- Food is broken down by mechanical digestion , using mastication .
- One chemical digestive process occur where amylase enzyme in saliva breaks down polysaccharide into disaccharides .
- The tongue , made of skeletal muscle, manipulates the food during mastication . it also contains taste buds to detect taste sensations(intrinsic) .
- Food particles are mixed with saliva during mastication , resulting in a moist lump called bolus for easier passage into or pharynx .



Teeth

- Adapted for mechanical digestion (mastication) in the oral cavity .
- 20 deciduous or primary teeth before the age of 6.
- By age 7, 32 permanent or secondary teeth are developed & are divided into 4 types: incisors (for cutting) , Canines (for tearing) , Premolars (for crushing), and Molars (for grinding). these teeth follow the human dental formula of 2-1-2-3.





Salivary Glands

- 3 pairs of salivary glands called parotid , submandibular , and sublingual gland secrete most of the saliva in the oral cavity , using salivary ducts .
- Saliva helps moisten the food during mastication , dissolve the food in forming the bolus , and help cleanse the teeth.
- Saliva consists of 99.5% water , the remaining 0.5% is dissolved substances including amylase enzyme (for chemically digesting carbohydrate) , bicarbonate ion (HCO_3^- ; maintains pH of saliva at 6.5-7.5) , and many electrolytes.



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Pharynx

- From the mouth, food passes posteriorly into the oropharynx and laryngopharynx, The pharynx is subdivided into the nasopharynx, part of the respiratory passageway; the oropharynx, posterior to the oral cavity; and the laryngopharynx, which is continuous with the esophagus inferiorly.

Esophagus

- The esophagus runs from the pharynx through the diaphragm to the stomach. About 25 cm long, it is essentially a passageway that conducts food (by peristalsis) to the stomach.



Stomach

- A pouch-like organ primarily designed for food storage (for 2-4 hours) , some mechanical and chemical digestion also occur .
- Contains two sphincters at both ends to regulate food movement – cardiac sphincter near the esophagus ,and pyloric sphincter near the small intestine .
- Divided into 4 regions : cardiac stomach (or cardiac), fundic stomach (or funded) , body of stomach , and pyloric stomach (or Pylorus).
- Contain thick folds called rugae at its layer , for providing larger surface area for expansion , secretion , digestion , and some absorption



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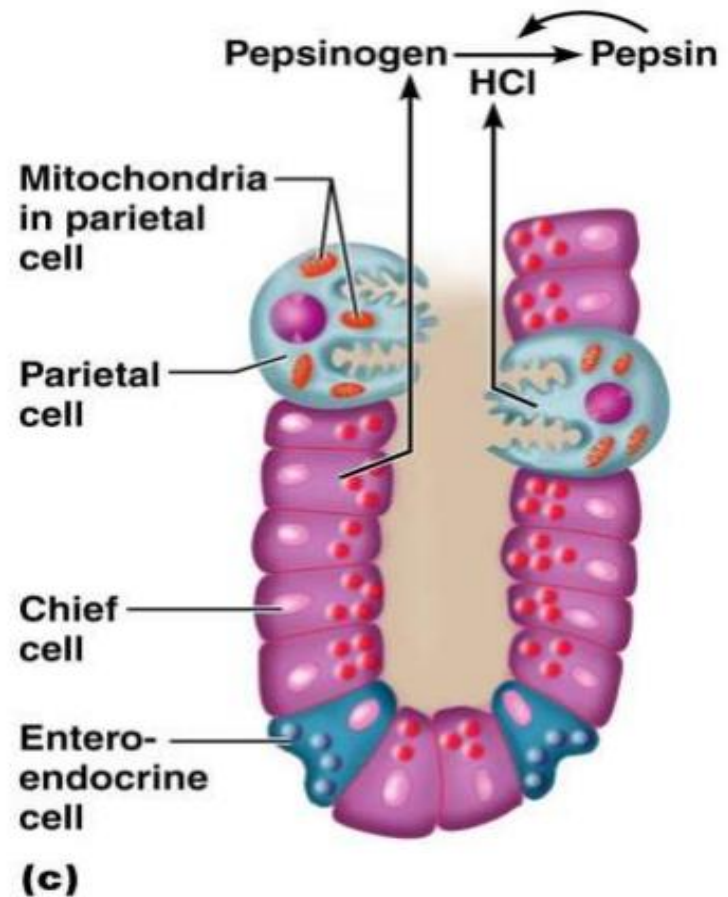
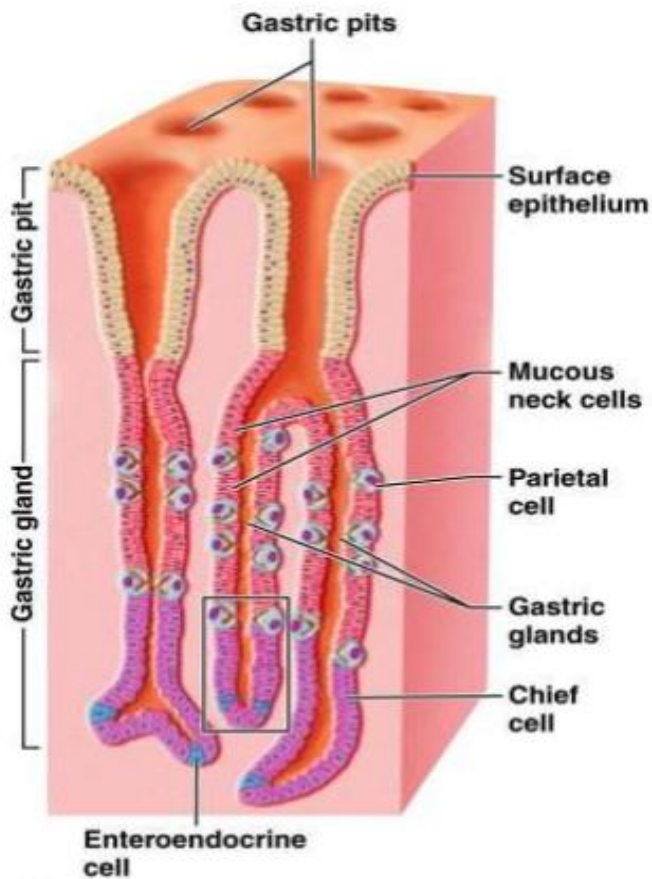
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Gastric Secretory Cells

- **Chief cells:** secrete pepsinogen (an inactive enzyme).
- **Parietal cells:** secrete hydrochloric acid (HCl) and "intrinsic factor" (which helps absorption of vitamin B12 in the intestines).
- **Mucous cells:** secrete mucus and alkaline substances to help neutralize HCl in the gastric juice .
- **G cells:** secrete a hormone called gastrin , which stimulates the parietal cells and overall gastric secretion .

Gastric Cells





Small Intestine

- A long tube, with a small diameter (about 1 inch), extending from pyloric sphincter to the ileocecal valve .
- Divided into Duodenum, Jejunum, and ileum.
- 1. Secretions of small intestine:
 - a. Intestinal glands secrete a watery fluid that lack digestive enzymes but provides a vehicle for moving chyme to villi .Intestinal enzymes include : **maltase** digests maltose into glucose. **sucrose** digests sucrose into glucose and fructose . lactase digests sucrose into glucose and glucose. **peptidases** digest peptides into amino acids . **lipases** digest triglycerides into fatty acids and glycerol . Nucleases digest nucleotides into nitrogenous bases. **Enterokinase** converts trypsinogen into trypsin.



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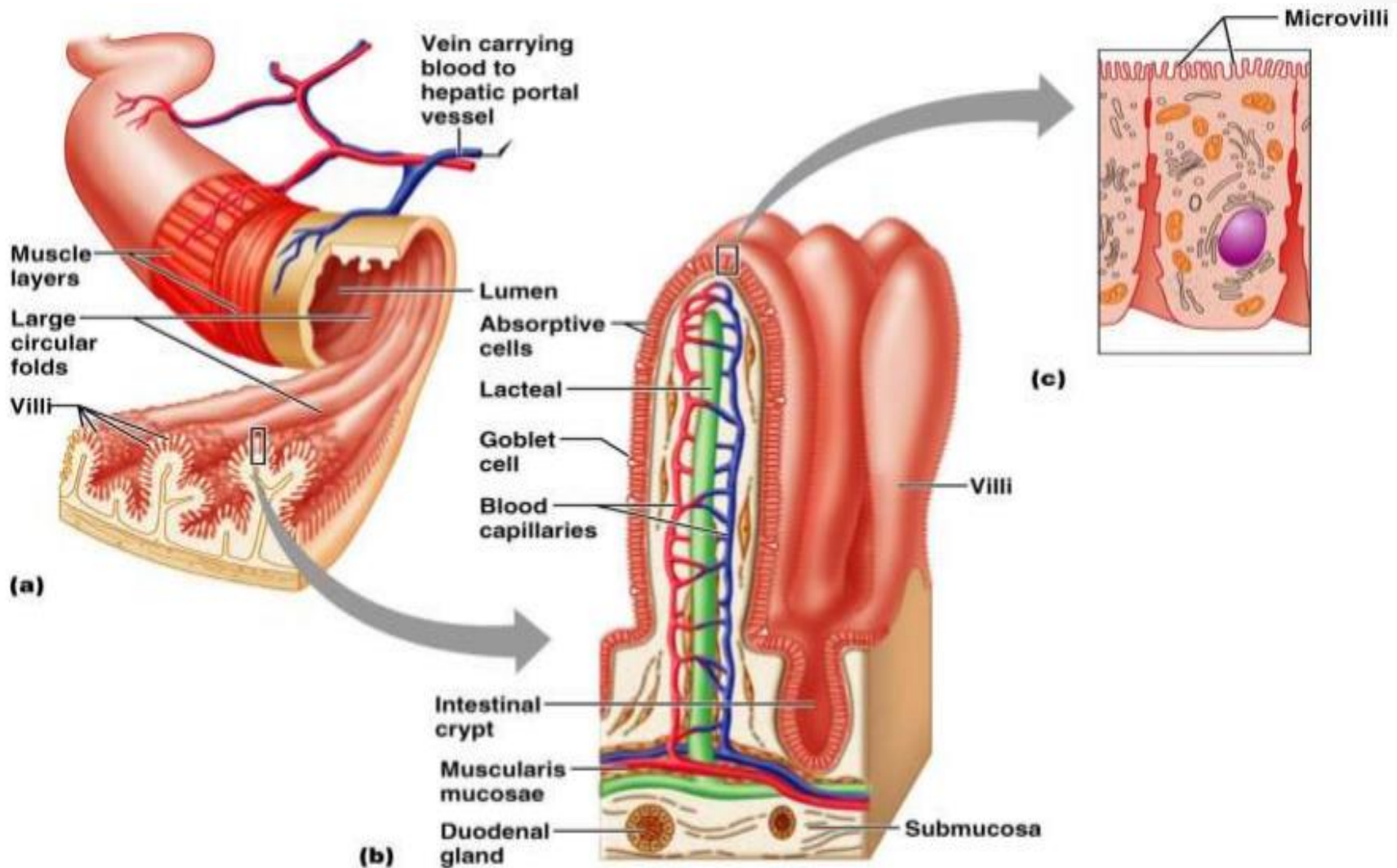
- Digestive enzymes embedded in the surfaces of microvilli split molecules of sugars, proteins and fats .
- Regulation of small intestine secretions: secretion is stimulated by gastric juice , chyme , and reflex stimulated by distension of the small intestinal wall .
- Each villus contains blood capillaries to absorb water , glucose , amino acids , vitamins , minerals , and short-chain fatty acids , and also contains lymphatic capillaries called lacteals to absorb long – chain fatty acids in the forms of micelles .
- Water is absorbed by osmosis , fatty acids are absorbed by diffusion (since they are fat-soluble), and most other nutrients (glucose, amino acids, & minerals) are absorbed by active transport



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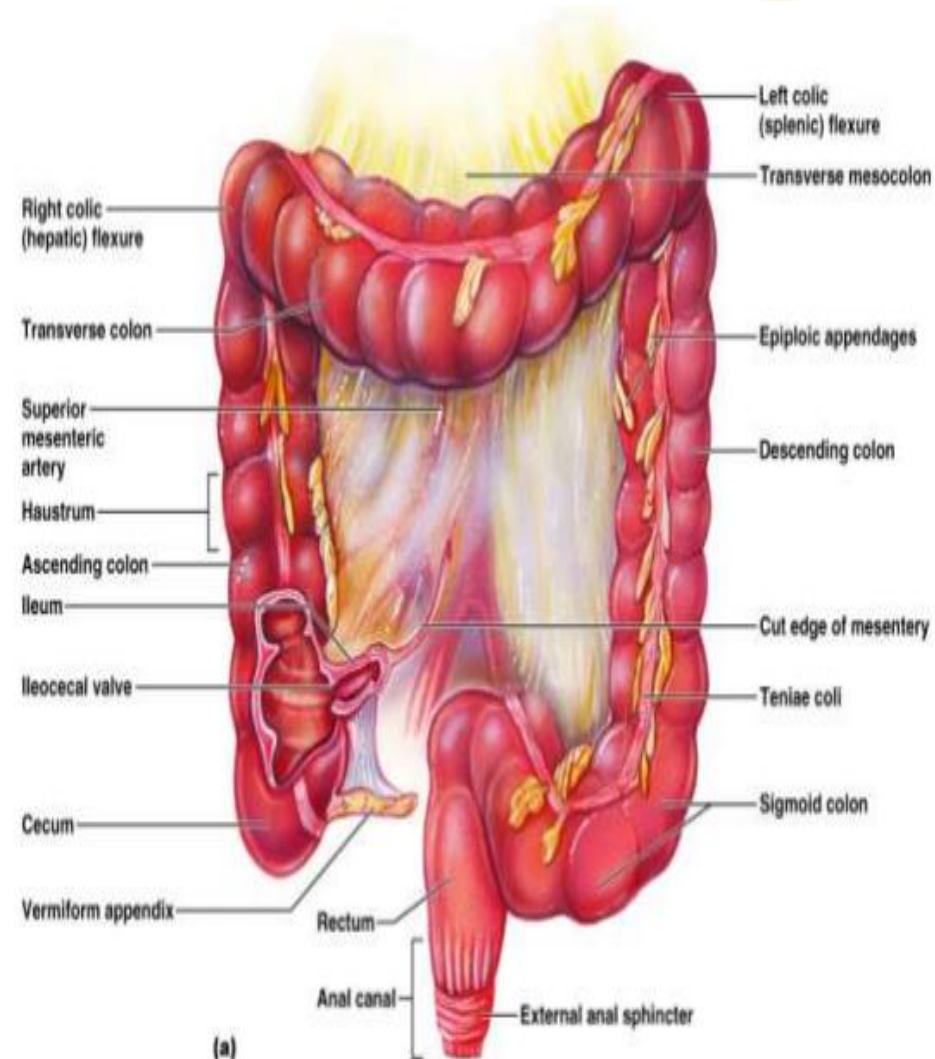
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- Large intestine
- The last segment of the GI tract , with a large diameter (2-3 inches) , extending from the ileocecal valve to the anus .
- Divided into cecum , ascending colon , transverse colon , descending colon , sigmoid colon , rectum , anal canal , and anus.





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- The large intestine has little or no digestive function , although it secretes mucus. Its mucosa has no villa or microvillus , but cotains numerous goblet cells for secreting mucus to aid in the formation of feces and maintain an alkaline condition .
- mechanical stimulation and parasympathetic impulses control the rate of mucus secretion .
- The large intestine only absorbs water, electrolytes and some vitamins .
- Many bacteria inhabit the large intestine , where they break down certain indigestible substances and synthesize certain vitamins .
- feces are formed and stored in the large intestine . Defecation involves a reflex mechanism aided by voluntary contraction of the diaphragm , abdominal muscles ,and the external anal sphincter .



Major Digestive Enzyme

- **Salivary enzyme**: Begins carbohydrates digestion by breaking down starch and glycogen to disaccharides .
- **Gastric enzymes**: Pepsin , from Gastric glands – Begins protein digestion . Lipase, from Gastric glands – Begins fat digestion .
- **Pancreatic enzymes**: Amylase , from pancreas – breaks down starch and glycogen into disaccharides. Lipase, from pancreas – breaks down fats into fatty acids and glycerol .
- **Proteolytic enzymes** : Trypsin, Chymotrypsin, and Carboxypeptidase from pancreas breaks down peptides into amino acids . Nucleases, from pancreas breaks down nucleic acids into nucleotides.



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- **Intestinal Enzymes:** Peptidase, from mucosal cells, breaks down peptides into amino acids. Sucrose, maltase, and lactase , from mucosal cells, breaks down disaccharides into monosaccharide's. Lipase, from mucosal cells, breaks down fats into fatty acid and glycerol. Enterokinase , from mucosal cells, (breaks down) converts trypsinogen into trypsin .