



Digestive System

Anatomy and Physiology of GIT (Part 1)

- ✓ Introduction
- ✓ Parts of Digestive System
- ✓ Anatomical Structure of GIT
- ✓ Major Function of Digestive System
- ✓ Digestive Enzymes

 www.youtube.com/pharmacologyconceptsbyrajeshchoudhary

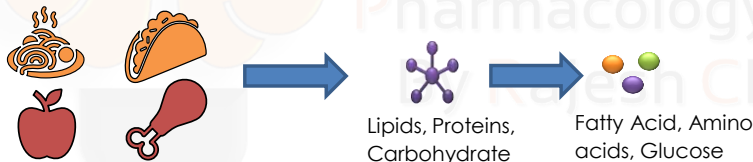
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1

Digestive System

- 💡 **System of Digestion.**
- 💡 The digestive processes gradually break down the foods eaten until they are in a form suitable for absorption.
- 💡 The **gastrointestinal tract (GIT or alimentary canal)** is an organ system within humans and other animals which involve in
 - 💡 Ingestion of food
 - 💡 Digestion of foods
 - 💡 Absorbed nutrients and essential elements for production of energy and
 - 💡 Expels the remaining waste as feces



Digestive System

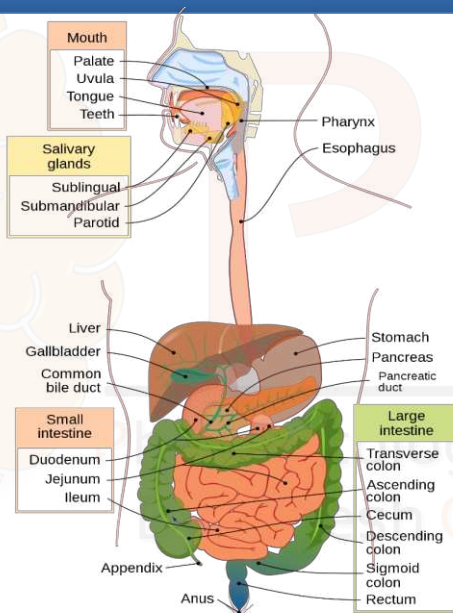
Parts of GIT

A. Alimentary Canal

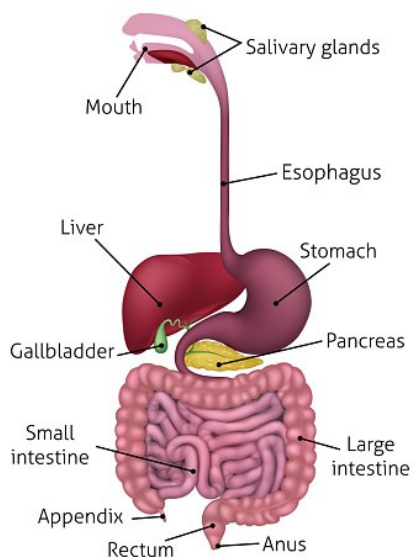
- 👉 Mouth
- 👉 Pharynx
- 👉 Esophagus
- 👉 **Stomach**
- 👉 Small Intestine
- 👉 Large Intestine
- 👉 Rectum

B. Accessory Oegan

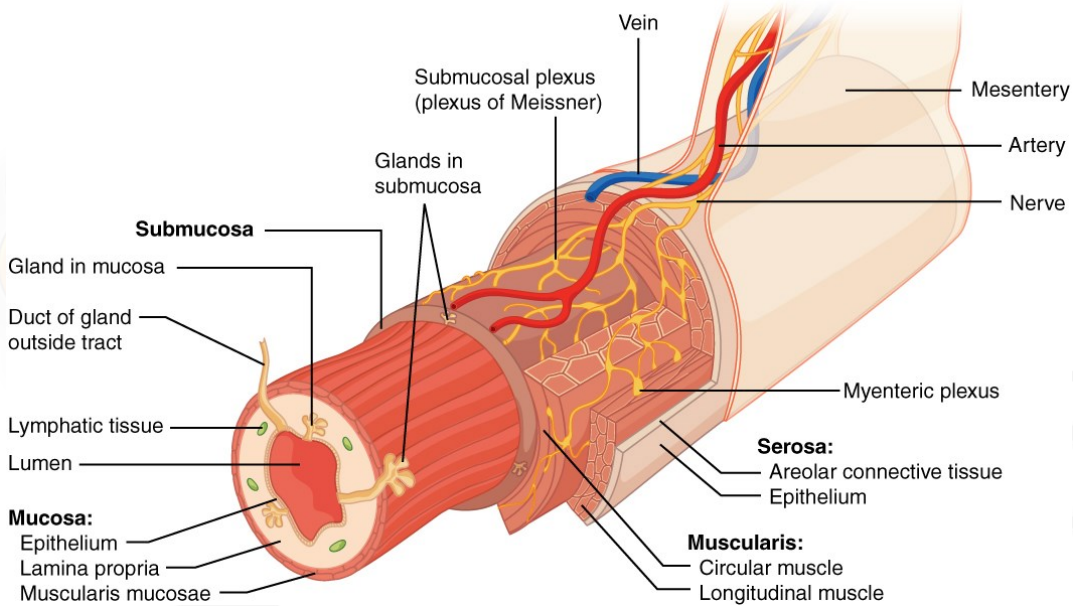
- 👉 **Liver**
- 👉 Gallbladder
- 👉 **Pancreas**
- 👉 **Salivary gland**



Digestive System



Digestive System



Digestive System

Functions of GI tract

- 🔦 **Ingestion:** taking of food into the alimentary tract. i.e. eating & drinking.
- 🔦 **Propulsion:** mixes & moves the contents along the alimentary tract.
- 🔦 **Digestion:** consist of:
 - 🔦 Mechanical breakdown of food e.g. mastication (chewing)
 - 🔦 Chemical digestion of food into small molecules by **enzymes**.
- 🔦 **Absorption:** this is the process by which digested food substances pass through the walls of some organs of the walls of some organs of the alimentary canal into the blood for circulation.
- 🔦 **Elimination:** food substances that have been eaten but cannot be digested & absorbed are excreted from the alimentary canal as faeces by the process of **defaecation**.

Digestive System

Digestive Enzyme

SN	Digestive juices and enzymes	Substance digested	Product formed
1	Saliva Amylase	Starch	Maltose
2	Gastric juice Protease (pepsin) and hydrochloric acid Renin	Proteins Milk protein	Partly digested proteins Casine
3	Pancreatic juice Proteases (trypsin) Lipases Amylase	Proteins Fats emulsified by bile Starch	Peptides and amino acids Fatty acids and glycerol Maltose
4	Intestinal enzymes Peptidases Sucrase Lactase Maltase	Peptides Sucrose (sugar) Lactose (milk sugar) Maltose	Amino acids Glucose and fructose Glucose and galactose Glucose
5	Bile from the liver Bile salts	Fats globules	Fat droplets

Digestive System

Digestive Enzyme

Major Digestive Enzymes			
Enzyme	Produced In	Site of Release	pH Level
Carbohydrate Digestion			
Salivary amylase	Salivary glands	Mouth	Neutral
Pancreatic amylase	Pancreas	Small intestine	Basic
Maltase	Small intestine	Small intestine	Basic
Protein Digestion			
Pepsin	Gastric glands	Stomach	Acidic
Trypsin	Pancreas	Small intestine	Basic
Peptidases	Small intestine	Small intestine	Basic
Nucleic Acid Digestion			
Nuclease	Pancreas	Small intestine	Basic
Nucleosidases	Pancreas	Small intestine	Basic
Fat Digestion			
Lipase	Pancreas	Small intestine	Basic

Digestive System

Physiology of GIT organs (Part 2)



- ✓ Mouth
- ✓ Salivary Glands
- ✓ Teeth

**Human Anatomy and
Physiology**

Digestive System

Mouth

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Digestive System

Mouth

- The mouth is the first portion of the alimentary canal that receives food and produces saliva.
- The mouth or oral cavity is bounded by muscles and bones:
 - Anteriorly**- by lips
 - Posteriorly**-continue with the oropharynx
 - Laterally**-muscles of cheeks
 - Superiorly**-bony hard palate
 - Inferiorly**-muscular tongue & the soft tissues of the floor of the mouth
- The oral cavity is lined throughout with **mucous membrane**, consisting of **stratified squamous epithelium** containing small mucus-secreting glands

Ross & Willison, 12 Ed

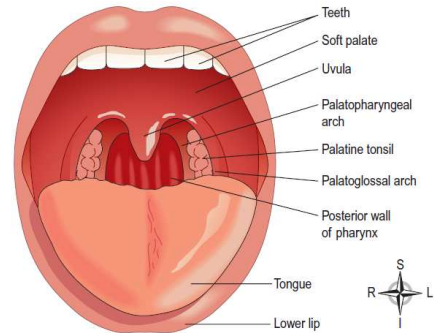


Figure 12.7 Structures seen in the widely open mouth.

Digestive System

Mouth

- The palate forms the roof of the mouth & is divided into the **anterior** hard palate & **posterior** soft palate.
- The **uvula** is a curved fold of muscle covered with mucous membrane, hanging down from the middle.

Tongue

- The **tongue** is a muscular (Voluntary Muscles) organ in the mouth, that manipulates food for **mastication**, and is used in the act of **swallowing**.
- It is of importance in the digestive system and is the primary organ of **taste**. And also involve in **Speech**.

Source: Ross & Willison, 12 Ed

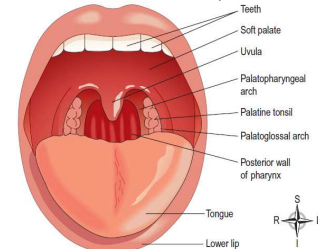
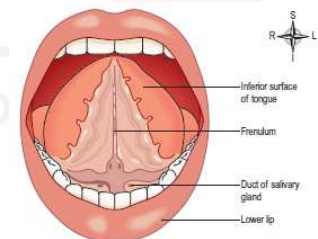


Figure 12.7 Structures seen in the widely open mouth.



Digestive System

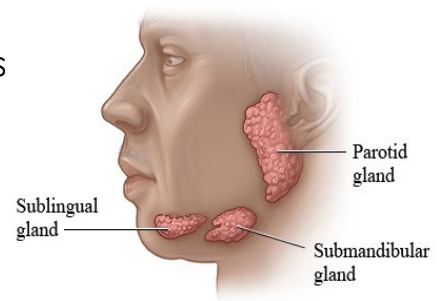
Salivary Glands

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Salivary Glands

- The **salivary glands** are exocrine glands that produce saliva through a system of ducts.
- Humans have 3 paired major salivary glands:
 - Parotid
 - submandibular and
 - Sublingual
- as well hundreds of minor salivary glands.



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A) Parotid glands

- The **largest** of the salivary gland
- The two parotid glands are major salivary glands wrapped around the mandibular ramus in humans.
- They secrete saliva to facilitate mastication and swallowing, and **amylase** to begin the digestion of starches.
- It enters the oral cavity via the parotid duct.

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B) Submandibular glands

- The submandibular glands are a pair of major salivary glands located beneath the lower jaws, superior to the digastric muscles.
- The secretion produced is a mixture of both **serous fluid** and **mucus**, and enters the oral cavity via the **submandibular** duct.

C) Sublingual glands

- The sublingual glands are a pair of major salivary glands located inferior to the tongue, anterior to the submandibular glands.
- Approximately 5% of saliva entering the oral cavity comes from these glands.
- The secretion produced is mainly mucous in nature

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Digestive System

Blood Supply

- External carotid artery

Venous Drainage

- Jugular veins

Composition of Saliva

- About **1.5 litres** of saliva is produced daily & it consists of: Water, Mineral salts, An enzyme (**Amylase**), Mucus, Lysozyme, Immunoglobulins

Function of Saliva

- Oral Hygiene:** It maintain the oral hygiene and reduce the dental caries, gum disease
- Digestion:** Produce amylase enzyme which helps in metabolism of carbohydrate (starch to maltose).
- Lubrication:** moistening food and helping to create a food bolus which easy to pass from mouth to esophagus.

Digestive System

Function of Saliva

- Role in taste:** provide liquid media in which chemicals are carried to taste receptor cells (mostly associated with lingual papillae).
- Maintain the pH**

Digestive System

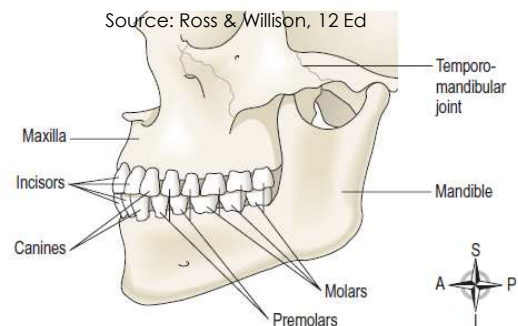
Teeth

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Digestive System

TEETH

- The teeth are embedded in the alveoli or sockets of the alveolar ridges of the mandible and the maxilla
- The **human teeth** function to mechanically break down items of food by cutting and crushing them in preparation for swallowing and digesting
- **Types (Adult have 32 teeth)**
 - incisors (2x4 = 8)
 - canines (1x4 = 4)
 - premolars (2x4 = 8)
 - Molars (3x4 = 12)

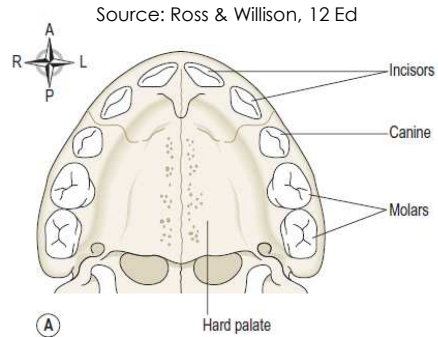


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Digestive System

TEETH

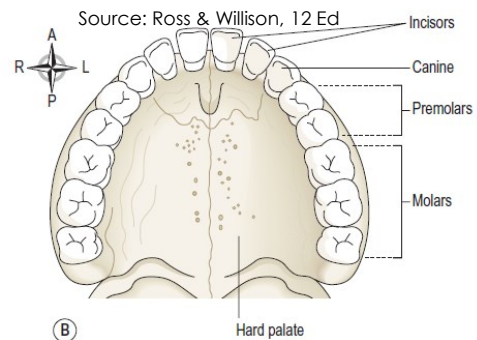
- 🔦 **In babies:** the *temporary* or **deciduous** or *Primary teeth*.
- 🔦 They begin to erupt at about 6 months of age and completed in 24 months
- 🔦 Total 20 teeth (10 set in each jaw)
- 🔦 Dental Formula (ICPM)= 2102
 - 🔦 incisors (2x4 = 8)
 - 🔦 canines (1x4 = 4)
 - 🔦 premolars (0x4 = 0)
 - 🔦 Molars (2x4 = 8)
- 🔦 **two** types of **incisors** – centrals and laterals, **one canine** & **two** types of **molars** – first and second.



Digestive System

TEETH

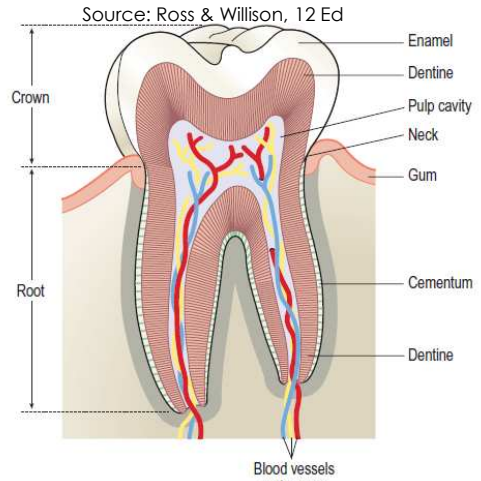
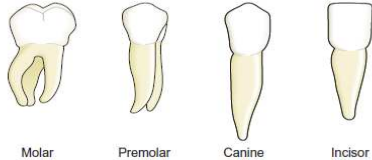
- 🔦 **In Adults:** the **permanent** teeth.
- 🔦 The permanent teeth begin to replace the deciduous teeth in the 6th year of age and this dentition, consisting of 32 teeth, is usually complete by the 21st year
- 🔦 Total 32 teeth (16 set in each jaw)
- 🔦 Dental Formula (ICPM)= 2123
 - 🔦 incisors (2x4 = 8)
 - 🔦 canines (1x4 = 4)
 - 🔦 premolars (2x4 = 8)
 - 🔦 Molars (3x4 = 12)



Digestive System

TEETH

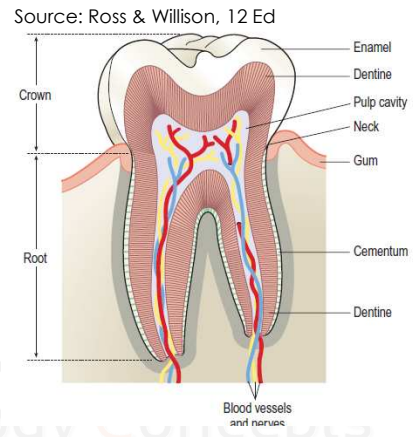
- The permanent teeth are the:
- Two incisor (for cutting)**-central incisor, lateral incisor
- One canine (for tearing)**
- Two premolar (for crushing)**-first premolar, second premolar,
- Three molar (for grinding)**-first molar, second molar, and third molar.



Digestive System

TEETH

- Parts of Teeth:
- A) Enamel**
- Hardest part and most highly mineralized substance of the body.
- 96% of enamel consists of mineral, with water and organic material comprising the rest.
- The normal color of enamel varies from light yellow to grayish white.



Digestive System

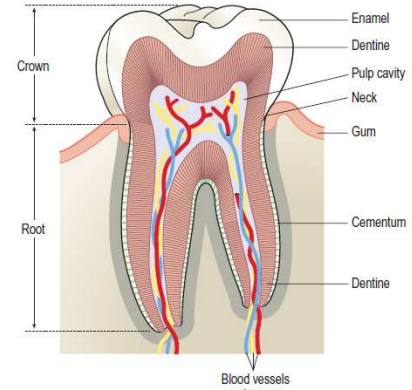
TEETH

Parts of Teeth:

B) Dentin

- The porous, yellow-hued material is made up of 70% inorganic materials, 20% organic materials, and 10% water by weight
- Dentin is a mineralized connective tissue with an organic matrix of collagenous proteins

Source: Ross & Willison, 12 Ed



Digestive System

TEETH

Parts of Teeth:

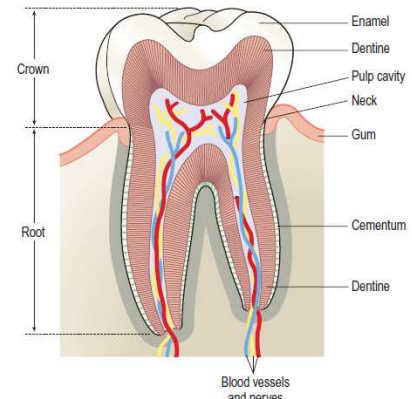
C) Cementum

- Cementum is a specialized bone like substance covering the root of a tooth.
- Its coloration is yellowish and it is softer than dentin and enamel

D) Dental Pulp

- The dental pulp is the central part of the tooth filled with soft connective tissue.
- This tissue contains blood vessels and nerves that enter the tooth from a hole at the apex of the root.

Source: Ross & Willison, 12 Ed



Digestive System

TEETH

Parts of Teeth:

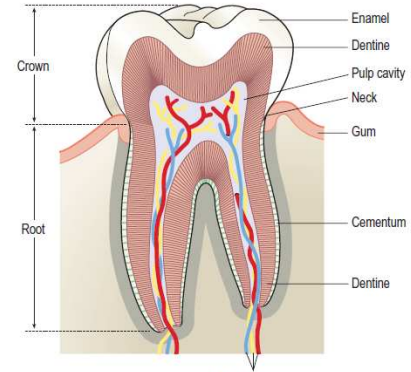
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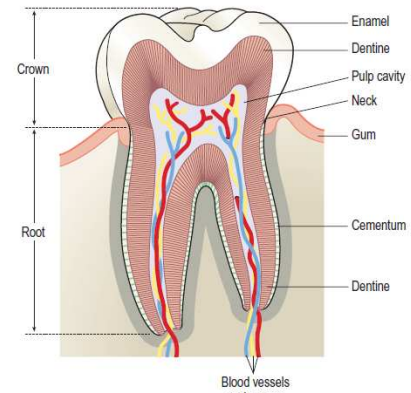
TEETH

- BLOOD SUPPLY:** Maxillary arteries
- VENOUS DRAINAGE:** Internal jugular veins
- NERVE SUPPLY**
 - Maxillary nerves
 - Mandibular nerves

Function of Teeth

- Two incisor -for cutting
- One canine -for tearing
- Two premolar-for crushing
- Three molar-for grinding

Source: Ross & Willison, 12 Ed





Digestive System (Physiology of GIT Organs) (Part 3)

- ✓ Pharynx
- ✓ oesophagus
- ✓ Stomach

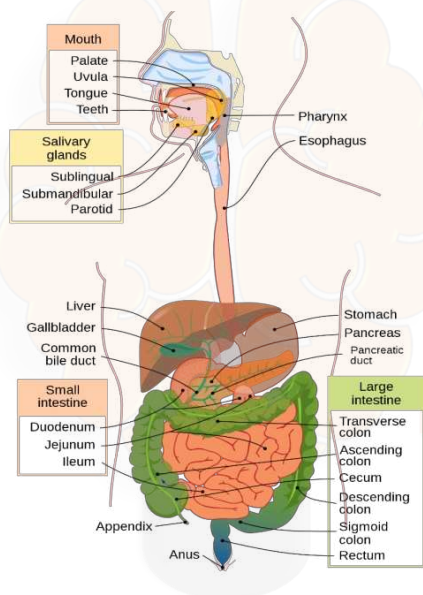
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Digestive System

Pharynx

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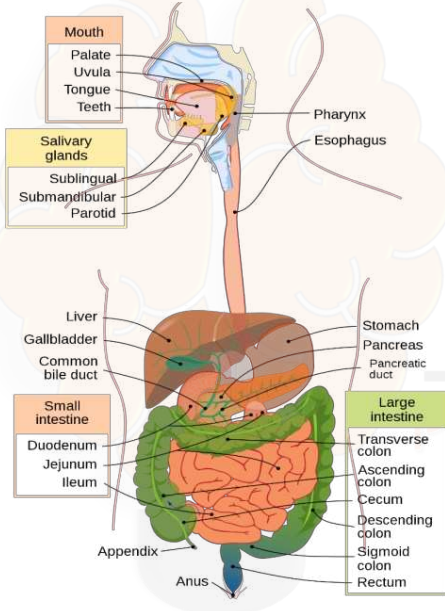
Pharynx

- The pharynx is the part of the throat that is behind the mouth and nasal cavity
- The pharynx is the portion of the digestive tract that receives the food from your mouth and carries to esophagus

Digestive System

Oesophagus

Digestive System



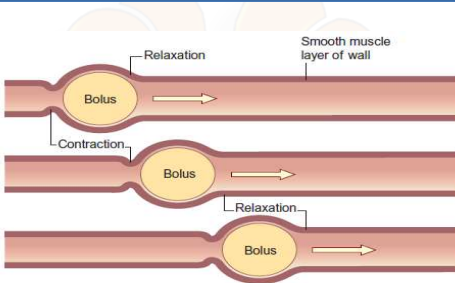
Oesophagus

- Also known as food pipe or gullet,
- The esophagus is a muscular tube connecting the throat (pharynx) with the stomach.
- The esophagus runs behind the windpipe (trachea) and heart, and in front of the spine.

Length :25 cm

Diameter:2 cm

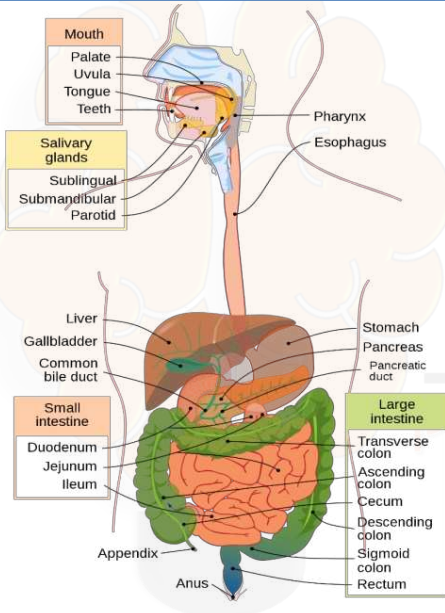
Digestive System



Oesophagus

- Most of the muscle is smooth muscle although striated muscle predominates in its upper third
- It has **two muscular rings or sphincters** in its wall, one at the top and one at the bottom
- A **sphincter** is a circular muscle that normally maintains constriction
- The lower sphincter helps to prevent reflux of acidic stomach content

Digestive System



Oesophagus

FUNCTIONS

- 🔦 **Formation of a bolus**
- 🔦 **Swallowing:** Food is ingested through the mouth and when swallowed passes first into the pharynx and then into the esophagus.
- 🔦 **Reducing gastric reflux:** Constriction of the upper and lower esophageal sphincters help to prevent reflux (backflow) of gastric contents and acid into the esophagus, protecting the esophageal mucosa.

Digestive System

Stomach

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Digestive System

Stomach

- The stomach is a J-shaped dilated portion of the alimentary tract situated in the epigastric, umbilical and left hypochondriac regions of the abdominal cavity
- The stomach receives food from the esophagus. Food storage (2-4 h), mechanical and chemical digestion occurs.
- As food reaches the end of the esophagus, it enters the stomach through a muscular valve called the lower esophageal sphincter.

Source: Ross & Willison, 12 Ed

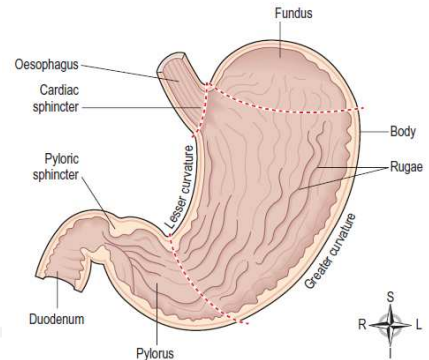


Figure 12.18 Longitudinal section of the stomach.

Digestive System

Stomach

Organs associated with the stomach

- Anteriorly* – left lobe of liver and anterior abdominal wall
- Posteriorly* – abdominal aorta, pancreas, spleen, left kidney and adrenal gland
- Superiorly* – diaphragm, oesophagus and left lobe of liver
- Inferiorly* – transverse colon and small intestine
- To the left* – diaphragm and spleen
- To the right* – liver and duodenum.

Region

- cardiac stomach (or cardiac),
- fundic stomach (or fundus),
- body of stomach
- pyloric stomach (or Pylorus).

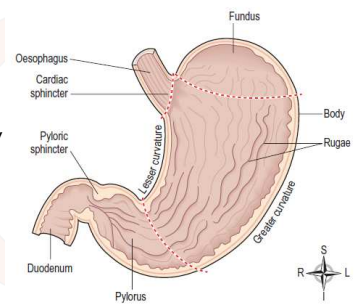


Figure 12.18 Longitudinal section of the stomach.

Digestive System

Stomach

FUNCTION & CONTENTS

🔦 **DIGESTION**

- 🔦 Involved in mechanical digestion
- 🔦 Stomach release pepsin a proteases enzyme (protein digesting enzymes)
- 🔦 Stomach release HCL which kills or inhibits bacteria and provides the acidic pH of 2 for the proteases to work.
- 🔦 Food is mixed by the stomach through muscular contractions of the wall called peristalsis

🔦 **ABSORPTION**

- 🔦 some absorption of certain small molecules and weak acidic drugs, does occur in the stomach through its lining

Digestive System

Stomach

FUNCTION & CONTENTS

🔦 **ABSORPTION**

- 🔦 some absorption of certain small molecules and weak acidic drugs, does occur in the stomach through its lining
- 🔦 Produce intrinsic factor, which helps in Vit B12 absorption

Digestive System

Stomach

FUNCTION & CONTENTS

🔦 GASTRIC JUICE

- 🔦 About 2 litres of gastric juice are secreted daily by specialised secretory glands in the mucosa
- 🔦 Gastric acid, gastric juice or stomach acid, is a digestive fluid formed in the stomach and is composed of hydrochloric acid (HCl), potassium chloride (KCl) and sodium chloride (NaCl).
- 🔦 The acid plays a key role in digestion of proteins, by activating digestive enzymes, and making ingested proteins unravel so that digestive enzymes break down the long chains of amino acids

Digestive System

Stomach

FUNCTION & CONTENTS

🔦 GASTRIC JUICE COMPOSITION

- 🔦 Water
- 🔦 mineral salts
- 🔦 mucus secreted by mucous neck cells in the glands and surface mucous cells on the stomach surface
- 🔦 hydrochloric acid
- 🔦 intrinsic factor
- 🔦 inactive enzyme precursors: pepsinogens secreted by *chief cells* in the glands.

Digestive System

Stomach

GASTRIC JUICE FUNCTIONS

- 💡 **Water** further liquefies the food swallowed.
- 💡 **Hydrochloric acid:**
 - 💡 acidifies the food and stops the action of salivary amylase
 - 💡 kills ingested microbes
 - 💡 provides the acid environment needed for the action of pepsins.
- 💡 **Pepsinogens** are activated to *pepsins* by hydrochloric acid and by pepsins already present in the stomach. Involved in protein digestion. Pepsins have evolved to act most effectively at a very low pH, between 1.5 and 3.5.

Digestive System

Stomach

GASTRIC JUICE FUNCTIONS

- 💡 **Intrinsic factor** (a protein) is necessary for the absorption of vitamin B12 from the ileum. (Deficiency leads to pernicious anemia)
- 💡 **Mucus** prevents mechanical injury to the stomach wall by lubricating the contents. It also prevents chemical injury by acting as a barrier between the stomach wall and the corrosive gastric juice – hydrochloric acid is present in potentially damaging concentrations and pepsins would digest the gastric tissues.

Digestive System

Stomach

GASTRIC SECRETORY CELLS

- 🔦 **Chief cells:** secrete pepsinogen (an inactive enzyme).
- 🔦 **Parietal cells:** secrete hydrochloric acid (HCl) and "intrinsic factor"
- 🔦 **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
- 🔦 **Blood Supply (Artery):** right gastroepiploic artery, left gastroepiploic artery, gastric artery
- 🔦 **Venous Drainage:** gastric Vein
- 🔦 **Nervous Supply:** ANS and ENS

Digestive System

Source: Ross & Willison, 12 Ed

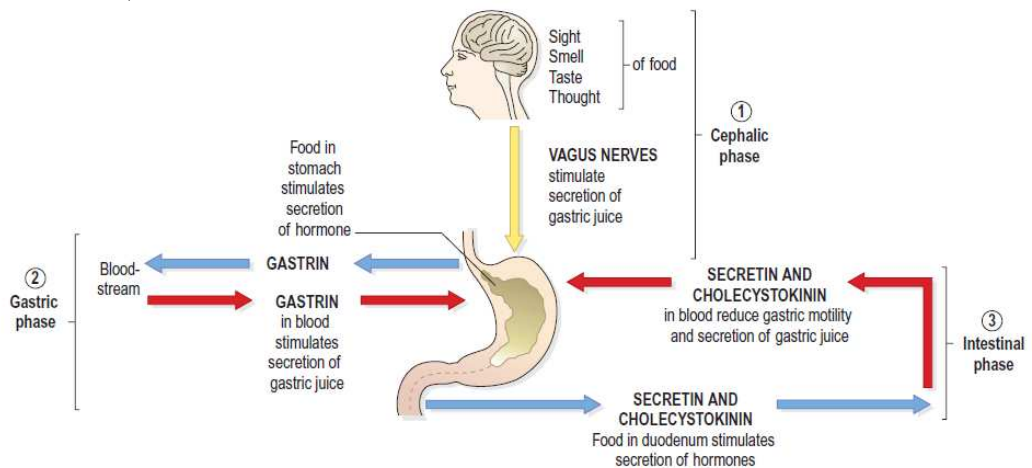


Figure 12.22 The three phases of secretion of gastric juice.



Digestive System (Physiology of GIT Organs) (Part 4)

- ✓Pancreas
- ✓Liver
- ✓Gall Bladder

**Human Anatomy and
Physiology**

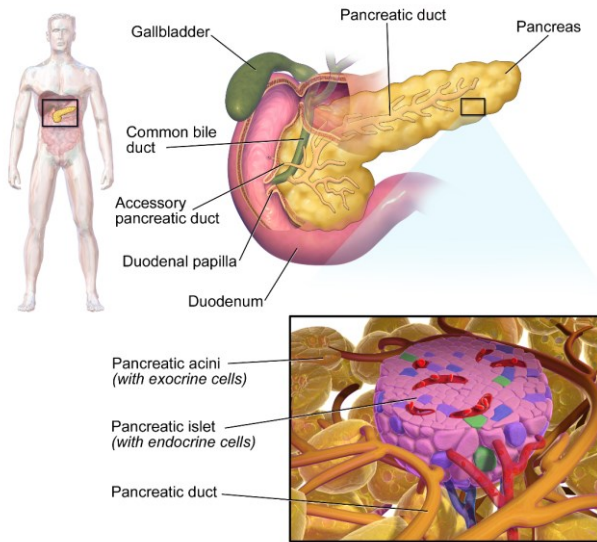
Digestive System



Pancreas

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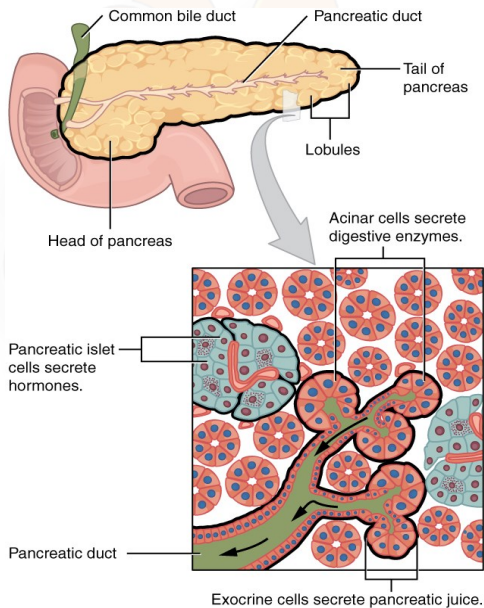
Digestive System



Pancreas

- The pancreas is a **glandular organ** in the digestive system and **endocrine system** of vertebrates.
- It is located in the abdominal cavity behind the stomach, having length about 15 cm.
- It is an endocrine gland producing several important hormones, which circulate in the blood and regulate the metabolic function.

Digestive System



Pancreas

Endocrine Hormone

- **α alpha cells** secrete glucagon (increase glucose in blood)
- **β beta cells** secrete insulin (decrease glucose in blood)
- **δ delta cells** secrete somatostatin (regulates/stops α and β cells)
- **γ (gamma) cells**, secrete pancreatic polypeptide

Digestive System

Pancreas

Pancreatic Juice

- Secreted by exocrine glands and consists of water, salts, **enzymes (amylase, lipase, nuclease)**, and inactive enzyme precursor (trypsinogen, chymotrypsinogen)
- Pancreatic juice is basic (pH 8) due to bicarbonate ions. Acid stomach contents mixed with Pancreatic, bile or intestinal content pH raised between 6 to 8 for optimal activity of pancreatic enzyme, amylase, and lipase

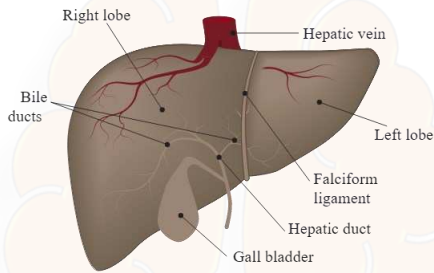
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Digestive System

Liver

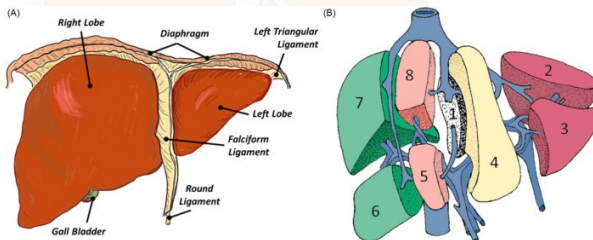
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Digestive System



Liver

- The liver is the largest and heaviest gland in the body, weighing between 1 and 2.3 kg.
- Reddish brown in color
- It is situated in the upper part of the abdominal cavity occupying the greater part of the right hypochondriac region, part of the epigastric region and extending into the left hypochondriac region
- 4 major lob: Right, Left, Caudate, and Quadrate lob



Digestive System

Liver

- **Organs associated with the liver**
- *Superiorly and anteriorly* – diaphragm and anterior abdominal wall
- *Inferiorly* – stomach, bile ducts, duodenum, hepatic flexure of the colon, right kidney and adrenal gland
- *Posteriorly* – oesophagus, inferior vena cava, aorta, gall bladder, vertebral column and diaphragm
- *Laterally* – lower ribs and diaphragm.

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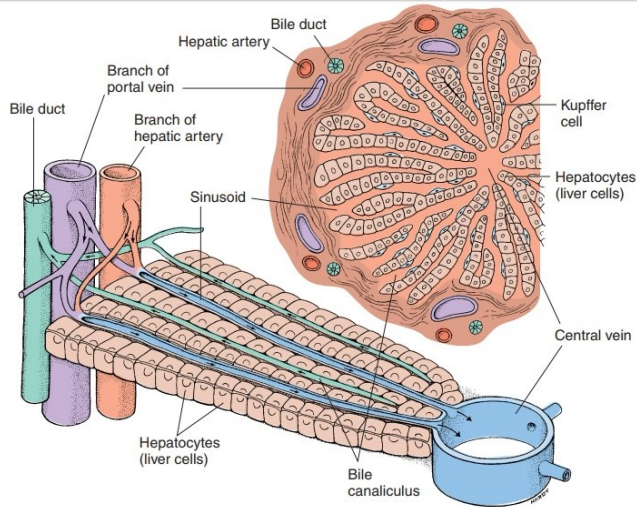


FIGURE Microscopic Structure of the Liver

Digestive System

Liver

Function of the Liver

Metabolism

- 💡 Carbohydrate– Regulate the blood sugar level by glycogenesis, gluconeogenesis, glycogenolysis pathway
- 💡 Fat metabolism- Break down of fat
- 💡 Protein metabolism- Transamination and produce new non-essential amino acid, deamination and produce urea and also cause breakdown of nucleic acid and produce uric acid
- 💡 It may cause the breakdown of insulin and other hormone and bilirubin via glucuronidation, facilitating its excretion into bile

Digestive System

Liver

Function of the Liver

- ✦ **Synthesis of plasma proteins.** These are formed from amino acids and include albumins, globulins and blood clotting factors
- ✦ Breakdown of erythrocytes, and defense against microbes by hepatic macrophages (Kupffer Cells)
- ✦ Detoxification of drug or toxic substance
- ✦ Storage for glycogen, Fat soluble vitamins (Vit A,D,E,K), iron, copper, and water soluble vitamin B12.
- ✦ Heat production
- ✦ Secretion of bile

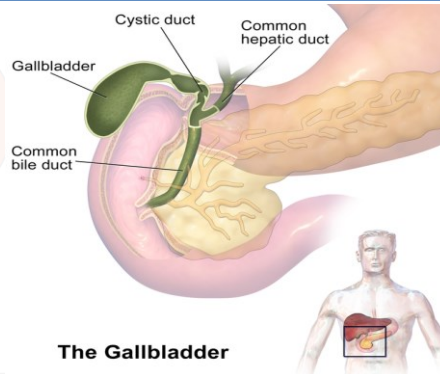
Digestive System

Gall Bladder

Digestive System

Gall Bladder

- The gallbladder is a small hollow organ where bile is stored and concentrated before it is released into the small intestine
- In humans, the pear-shaped gallbladder lies beneath the liver
- The gallbladder has a capacity of about 50 ml
- Bile flows through small vessels into the larger hepatic ducts and ultimately through the cystic duct into the gallbladder, where it is stored



The Gallbladder

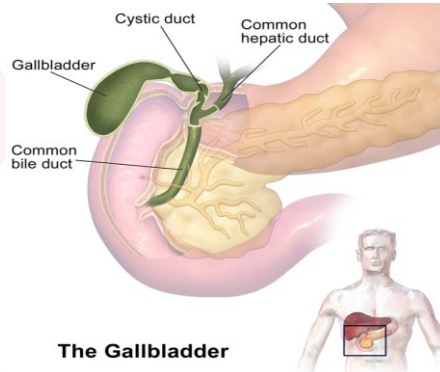
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Digestive System

Gall Bladder

Function of the Gall Bladder

- The main purpose of the gallbladder is to store bile, also called gall, needed for the digestion of fats in food.
- Concentration of the bile by up to 10- or 15-fold, by absorption of water through the walls of the gall bladder
- Release of stored bile.



The Gallbladder

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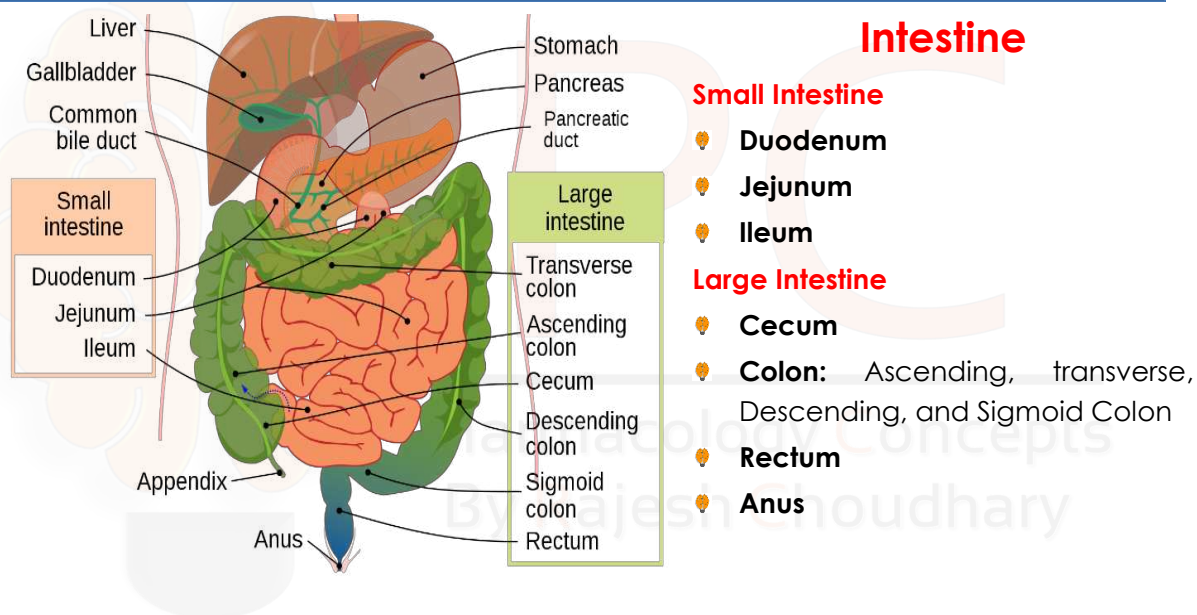


Digestive System (Physiology of GIT Organs) (Part 5)

- ✓ Small Intestines
- ✓ Large Intestine

Human Anatomy and Physiology

Digestive System



Digestive System

Small Intestine

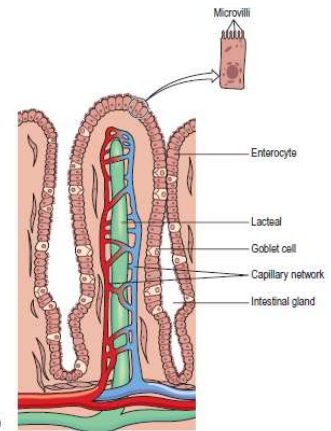
Parts

- 🔦 **Duodenum**- Short structure, C-Shaped, 20-25 cm length
- 🔦 **Jejunum**- 2.5 m long, contains villi
- 🔦 **Ileum**- 3 m long, contains villi for absorption, at end *ileocaecal valve*, which controls the flow of material from the ileum to the *caecum*, the first part of the large intestine, and prevents backflow.

Blood Supply: Superior mesenteric arteries & veins supply the whole part of small intestine.

Intestinal Juice

- 🔦 1.5 L intestinal juice (alkaline) are secreted daily, consist of water, mucus, and mineral salts.



Digestive System

Small Intestine

Function of Small Intestine

- 🔦 onward movement of its contents by peristalsis, which is increased by parasympathetic stimulation
- 🔦 completion of chemical digestion of carbohydrates, protein and fats in the enterocytes of the villi
- 🔦 protection against infection by microbes that have survived the antimicrobial action of the hydrochloric acid in the stomach, by both solitary and aggregated lymph follicles
- 🔦 secretion of the hormones cholecystikinin (CCK) and secretin
- 🔦 absorption of nutrients.
- 🔦 Positively host's immune system by microbial flora

Digestive System

Small Intestine

Chemical Digestion

- 💡 When **acid chyme** passes into the small intestine it is mixed with *pancreatic juice, bile and intestinal juice*, and is in contact with the enterocytes of the villi. The digestion of all nutrients is completed:
 - 💡 carbohydrates are broken down to monosaccharides
 - 💡 proteins are broken down to amino acids
 - 💡 fats are broken down to fatty acids and glycerol.

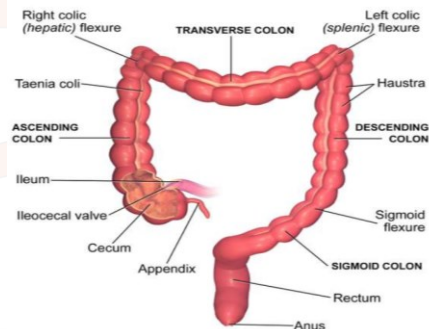
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Digestive System

Large Intestine

Chemical Digestion

- 💡 The large intestine, also known as the **large bowel or colon**, is the last part of the gastrointestinal tract and of the digestive system in vertebrates.
- 💡 Water is absorbed here, and the remaining waste material is stored as feces before being removed by defecation.



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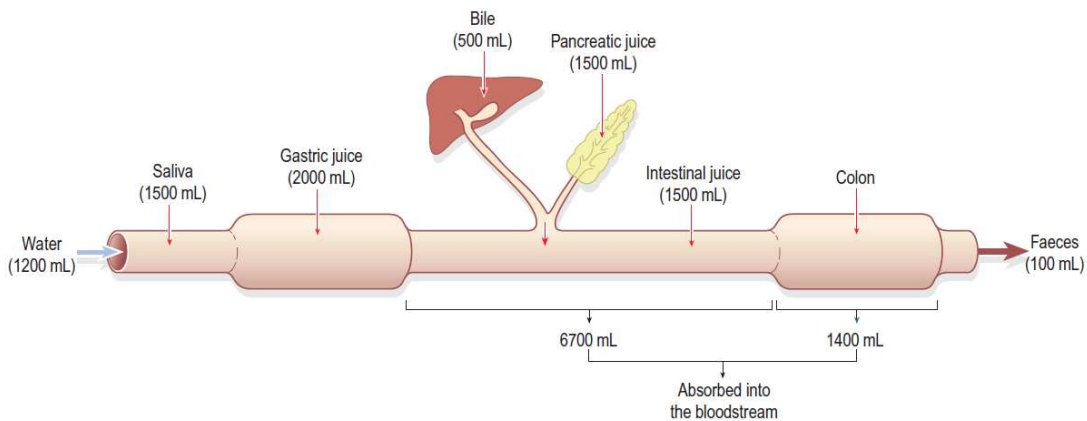
Digestive System

Large Intestine

FUNCTIONS

- The large intestine absorbs water and any remaining absorbable nutrients from the food before sending the indigestible matter to the rectum.
- The colon absorbs vitamins that are created by the colonic bacteria, such as vitamin K.
- Gut flora**
- The large intestine houses over 700 species of bacteria that perform a variety of functions.
- The large intestine absorbs some of the products formed by the bacteria inhabiting this region.
- Undigested polysaccharides (fiber) are metabolized to short-chain fatty acids by bacteria in the large intestine

Digestive System



Digestive System

Table 12.2 Summary showing the sites of digestion and absorption of nutrients

	Mouth	Stomach	Small intestine		Large intestine
			Digestion	Absorption	
Carbohydrate	<i>Salivary amylase</i> : digestible starches to disaccharides	<i>Hydrochloric acid</i> : denatures and stops action of salivary amylase	<i>Pancreatic amylase</i> : digestible starches to disaccharides <i>Sucrase, maltase, lactase</i> (in enterocytes): disaccharides to monosaccharides (mainly glucose)	Into blood capillaries of villi	–
Proteins	–	<i>Hydrochloric acid</i> : pepsinogen to pepsin <i>Pepsin</i> : proteins to polypeptides	<i>Enterokinase</i> (in enterocytes): chymotrypsinogen and trypsinogen (from pancreas) to chymotrypsin and trypsin <i>Chymotrypsin and trypsin</i> : polypeptides to di- and tripeptides <i>Peptidases</i> (in enterocytes): di- and tripeptides to amino acids	Into blood capillaries of villi	–
Fats	–	–	<i>Bile</i> (from liver): bile salts emulsify fats <i>Pancreatic lipase</i> : fats to fatty acids and glycerol <i>Lipases</i> (in enterocytes): fats to fatty acids and glycerol	Into the lacteals of the villi	–
Water	–	Small amount absorbed here	–	Most absorbed here	Remainder absorbed here
Vitamins	–	Intrinsic factor secreted for vitamin B ₁₂ absorption	–	Water-soluble vitamins absorbed into capillaries; fat-soluble ones into lacteals of villi	Bacteria synthesise vitamin K in colon; absorbed here



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