The Digestive System

Prepares food for use by all body cells.

Digestion

- The chemical breakdown of complex biological molecules into their component parts.
  - Lipids to fatty acids
  - Proteins to individual amino acids
  - Carbohydrates into simple sugars

Function

- Produces various chemicals to break down the food.
- Filters out harmful substances.
- Gets rid of solid wastes.

Digestion

- Mechanical
  - Changes the physical form of food
    - Chew
    - Tear
    - Grind
    - Mash
    - Mix

Digestion

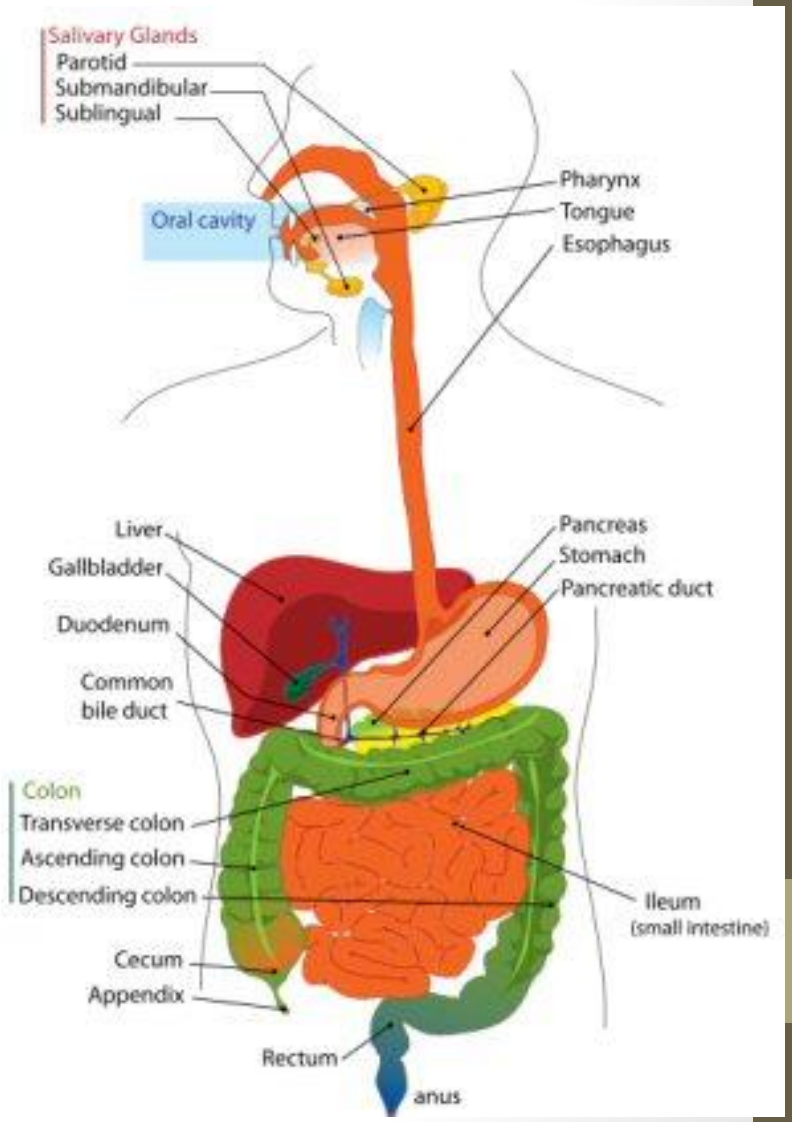
- Chemical
  - Changes the chemical composition of food with the aid of digestive enzymes
    - Carbohydrate
    - Protein
    - Lipid
  - Digestive enzymes are special proteins that help break up large molecules of food into very tiny molecules that can be absorbed and used by the cells in the form of nutrition.

Phases of Digestion

- Ingestion
- Movement
- Digestion
- Absorption
- Further digestion

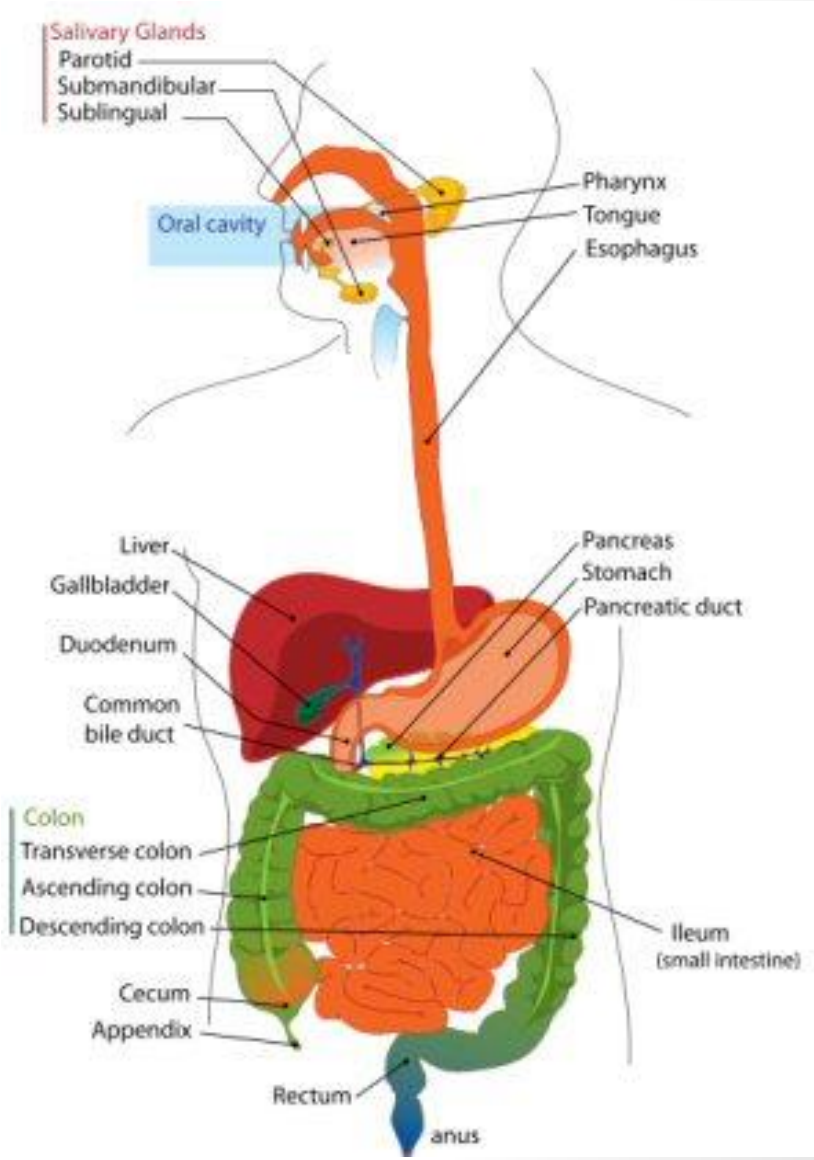
The Digestive Tract

- A long muscular tube with many sections and areas.
- Begins with the mouth and ends with the anus.



The Digestive Tract

- Parts of the Digestive Tract
  - Mouth
  - Pharynx
  - Esophagus
  - Stomach
  - Small Intestine
  - Large Intestine



Accessory Parts

- Organs that are not in the digestive tract but helps in the digestion
  - Teeth
  - Tongue
  - Salivary glands
  - Liver
  - Gall bladder
  - Pancreas

Mouth

- Functions:
  - Food enters in the mouth or oral cavity
  - Tasting
  - Mechanical breakdown of food
  - Secretion of salivary glands (salivary amylase)

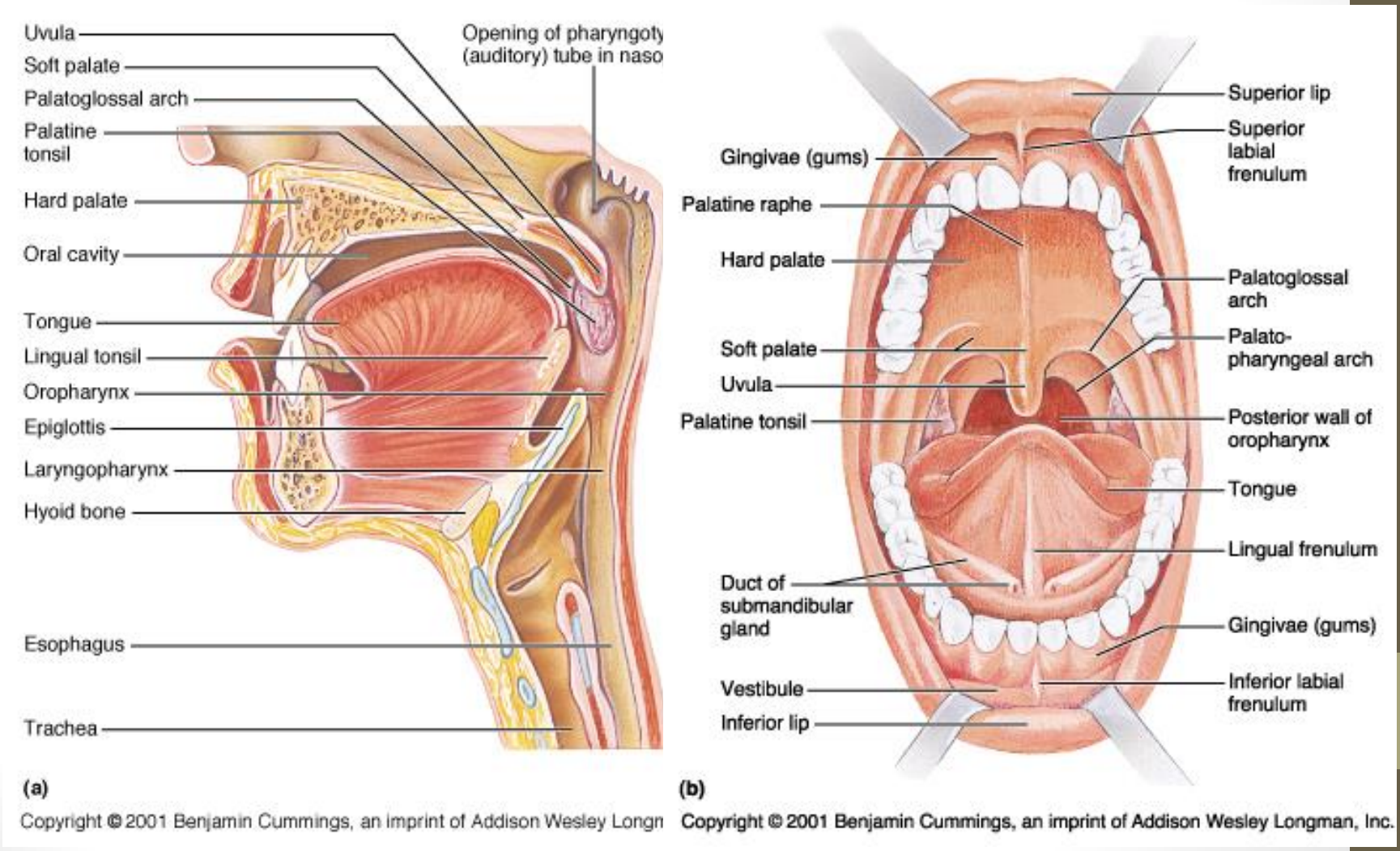
Mouth

- Structures in the mouth that aids digestion:
  - Teeth – cut, tear, crush and grind food.
  - Salivary glands – produce and secrete saliva into the oral cavity.
    - *Parotid (beneath the cheeks)*
    - *Submaxillary (below the jaw bone)*
    - *Sublingual (below the tongue)*
      - saliva moistens the food and contains enzymes (**ptyalin** or **salivary amylase**) that begins digestion of starch into smaller polysaccharides.

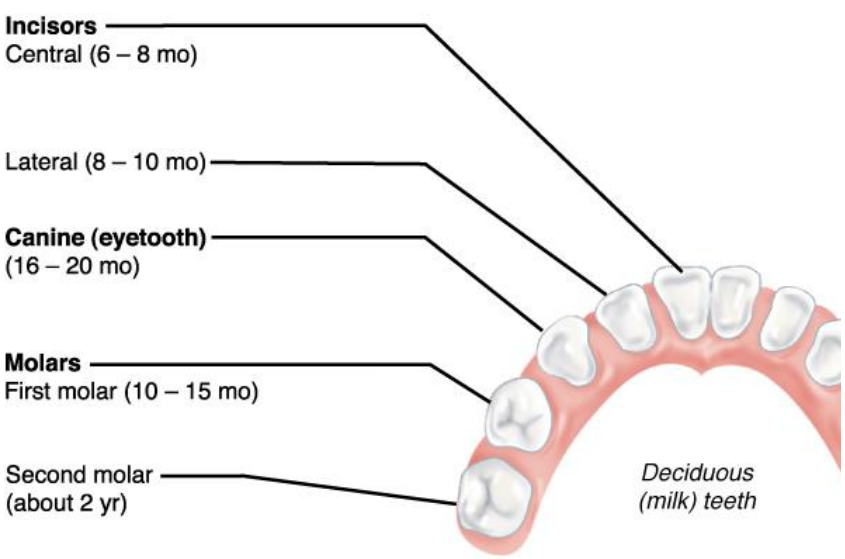
Mouth

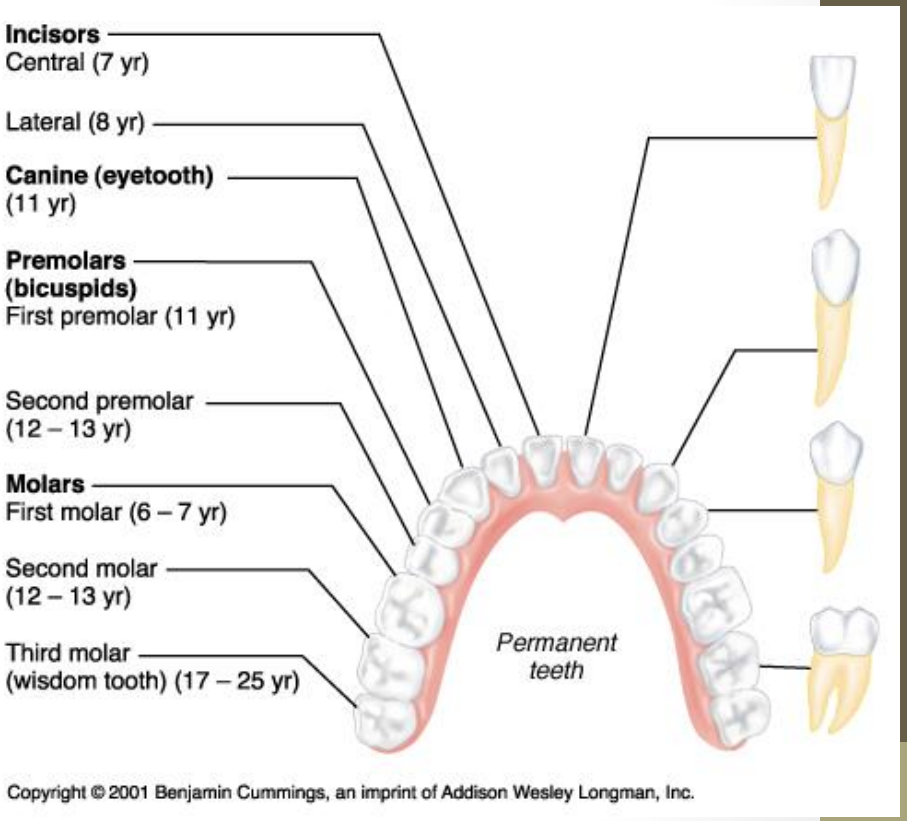
- Tongue
  - **Mixes and rolls food into tiny mashed up bits (Bolus)**
  - Pushes the bolus toward the pharynx and into the esophagus when swallowing.

Anatomy of the Mouth and Throat



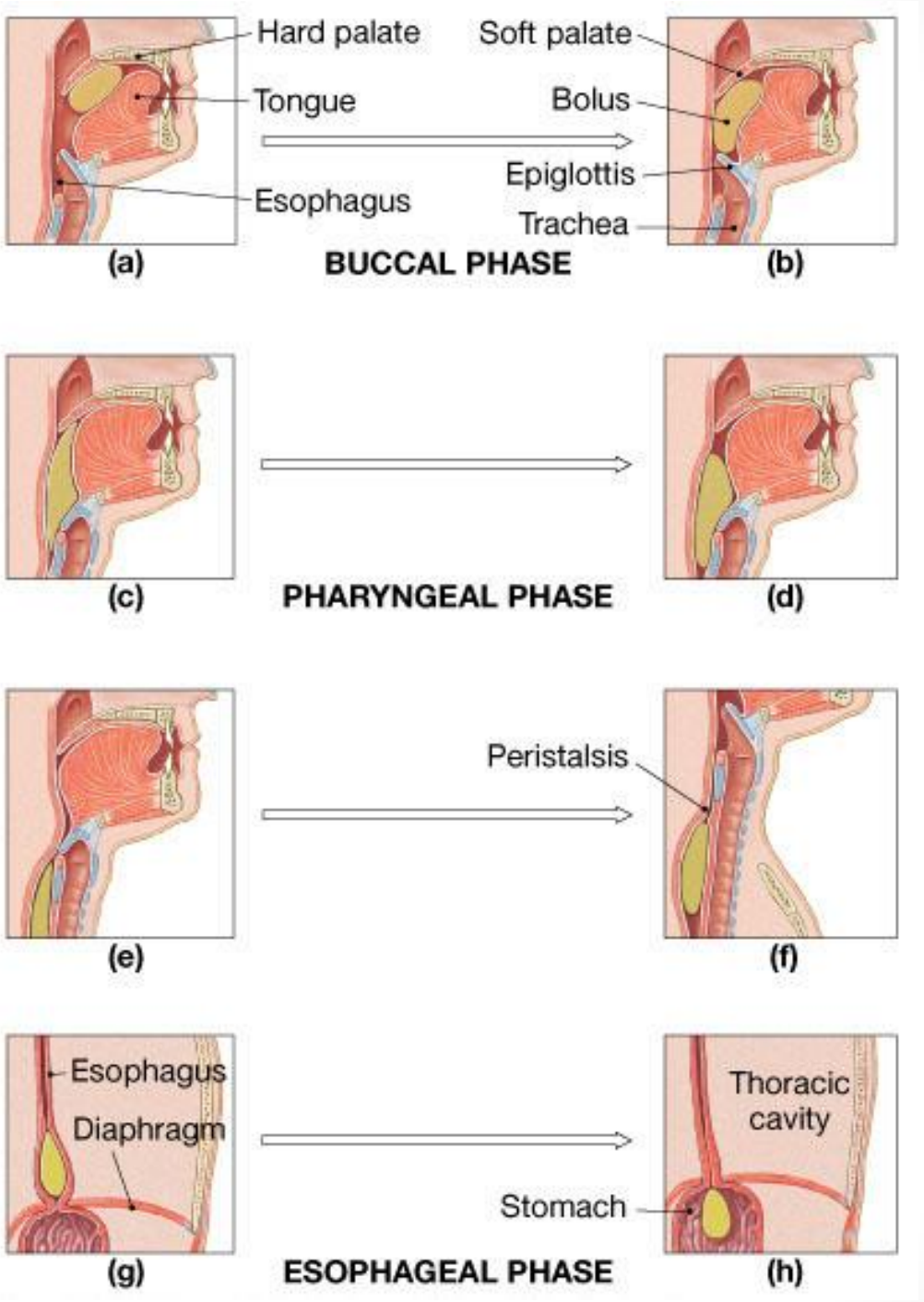
Human Deciduous and Permanent Teeth





Mechanism of Swallowing

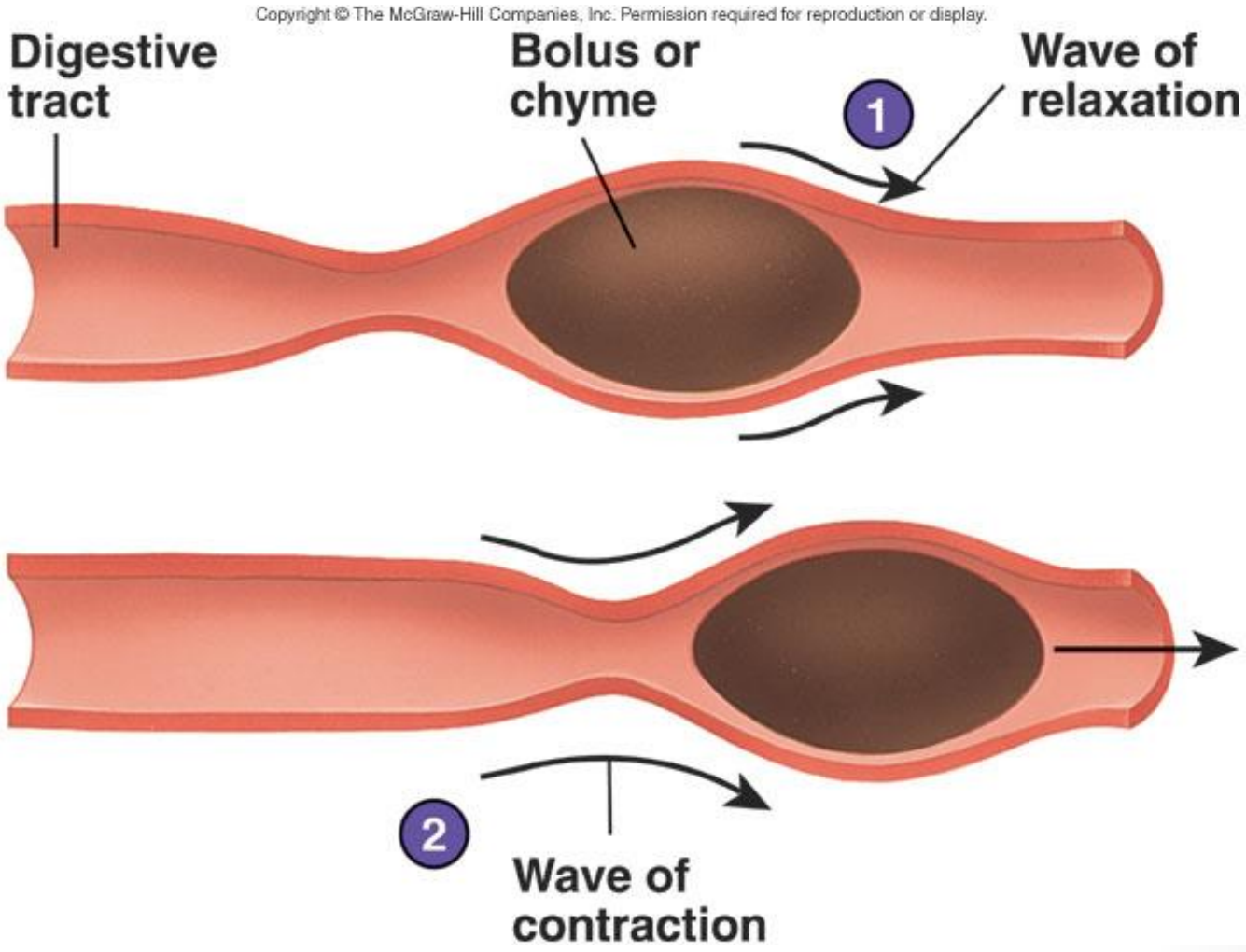
- Swallowing is a coordinated activity of the tongue, soft palate, pharynx and esophagus.
- Phases
  - Food is pushed into the **pharynx** by the tongue. (voluntary)
  - Tongue blocks the mouth
  - Soft palate closes off the nose
  - Larynx (Adam's Apple) rises so the **Epiglottis** (a flap of tissue) can close the opening of the trachea.


Hard palate
Tongue
Esophagus
Soft palate
Bolus
Epiglottis
Trachea
(a)
BUCCAL PHASE
(b)
(c)
PHARYNGEAL PHASE
(d)
Peristalsis
(e)
(f)
Esophagus
Diaphragm
Thoracic cavity
Stomach
(g)
ESOPHAGEAL PHASE
(h)

Esophagus

- A straight muscular tube that is about 10 inches (25 cm) long which connects the mouth with the stomach
- Food takes about 4 to 8 seconds as it passes through to the stomach.
- Its walls contain smooth muscles that contracts in wavy motion (**Peristalsis**).
- **Peristalsis propels food and liquid slowly down the esophagus into the stomach**.
- Cardiac Sphincter (ring-like valve) relaxes to allow food into the stomach.

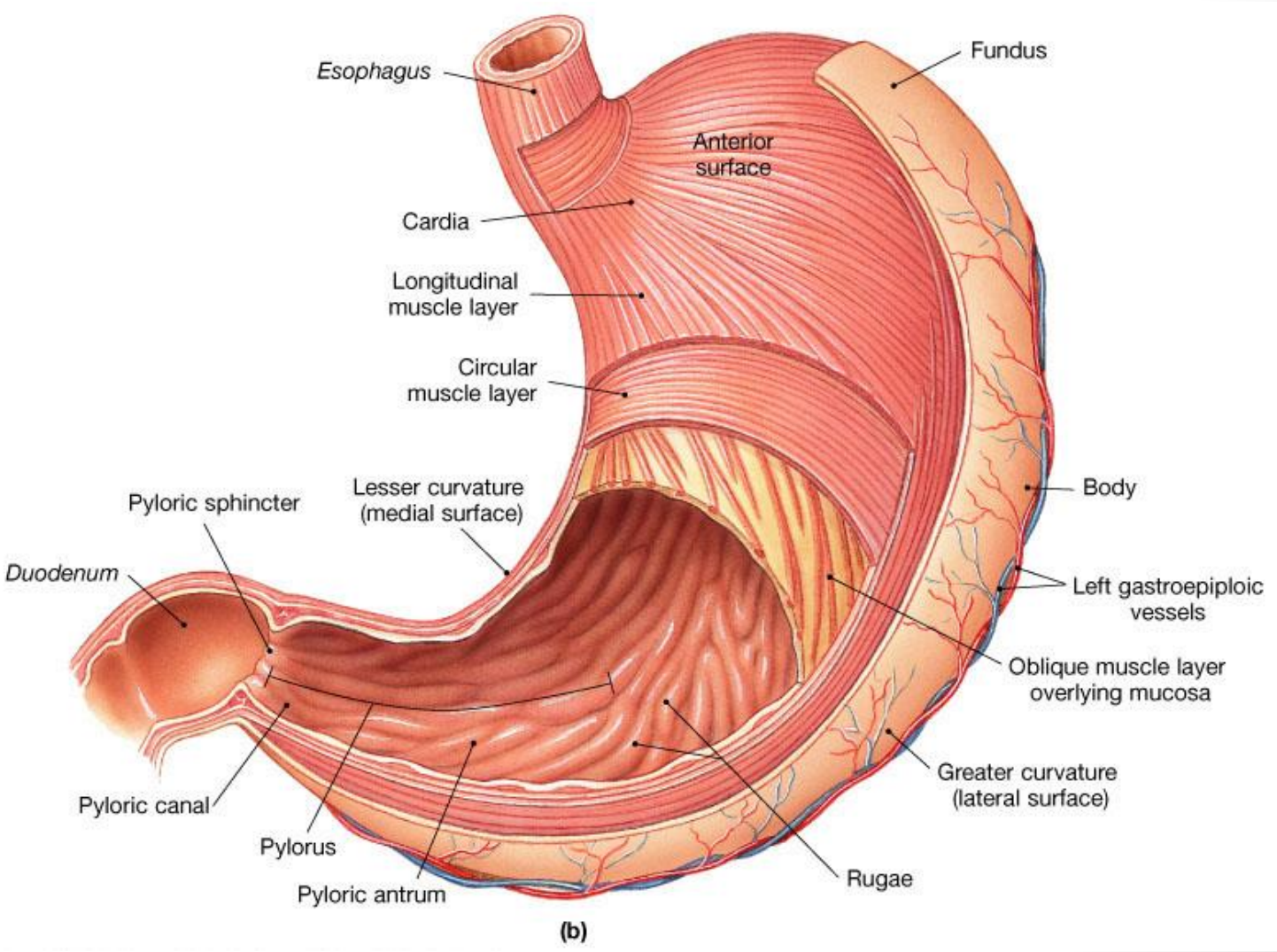
Peristalsis



Stomach

- J-shaped muscular sac
- Has inner folds (**rugae**) that increases the surface area of the stomach.
- Churns and grinds together the bolus into smaller pieces.
- Food is mixed with gastric juices (hydrochloric acid and enzymes) secreted by the stomach walls.
- HCL helps break down food and kills bacteria that came along with the food.

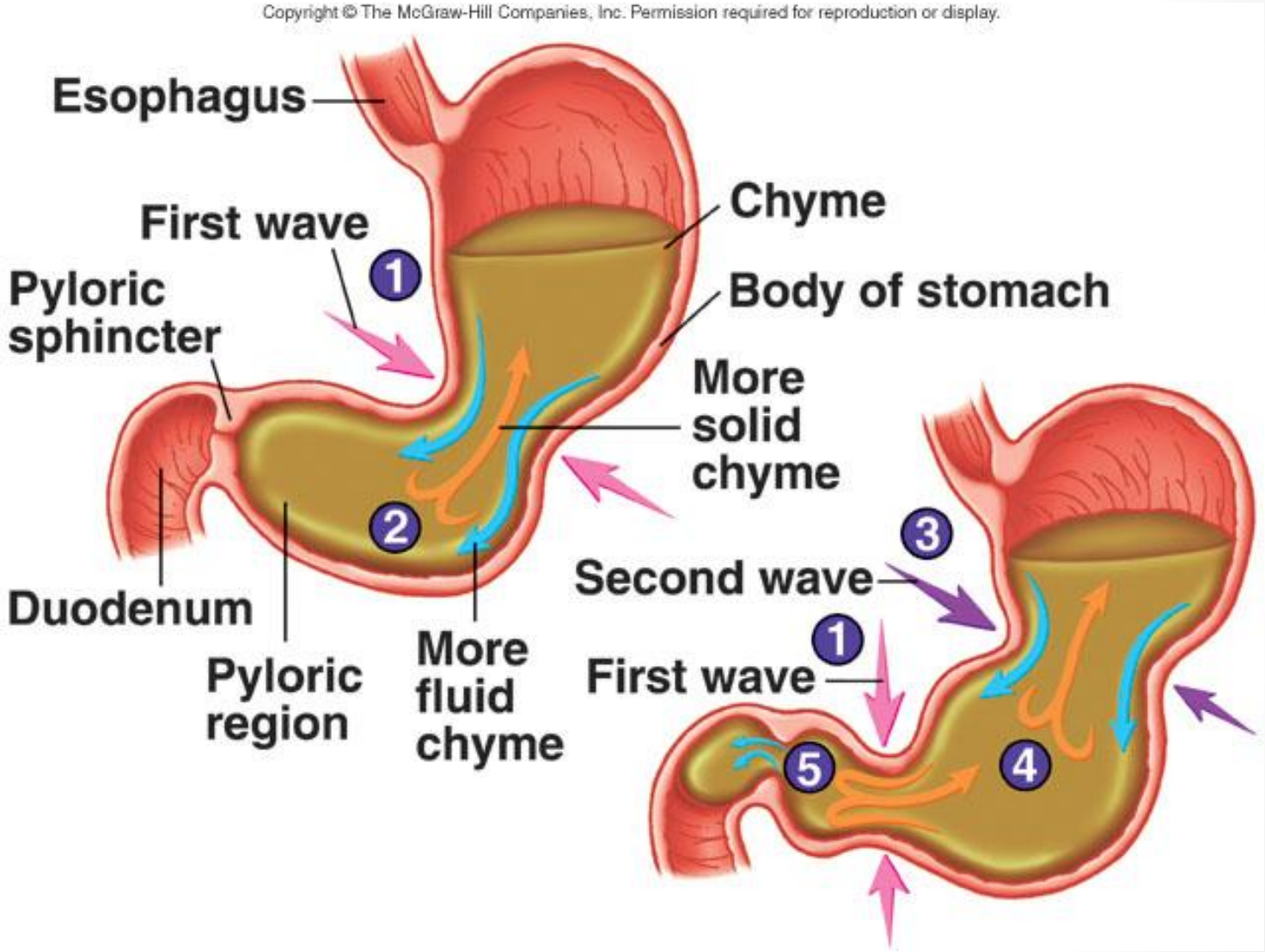
Stomach


Esophagus
Fundus
Anterior surface
Cardia
Longitudinal muscle layer
Circular muscle layer
Lesser curvature (medial surface)
Pyloric sphincter
Body
Duodenum
Left gastroepiploic vessels
Oblique muscle layer overlying mucosa
Greater curvature (lateral surface)
Pyloric canal
Pylorus
Pyloric antrum
Rugae
(b)

Stomach

- **Pepsin** – major enzyme; converts proteins into peptides in the presence of HCL.
- **Mucus** – lubricates food and protects the gastric lining from strong digestive juices.
- **Converts the bolus into a liquid (chyme)** after 4 hrs of mechanical and chemical digestion
- Chyme passes through the **pyloric sphincter** into the small intestine.

Movements in Stomach

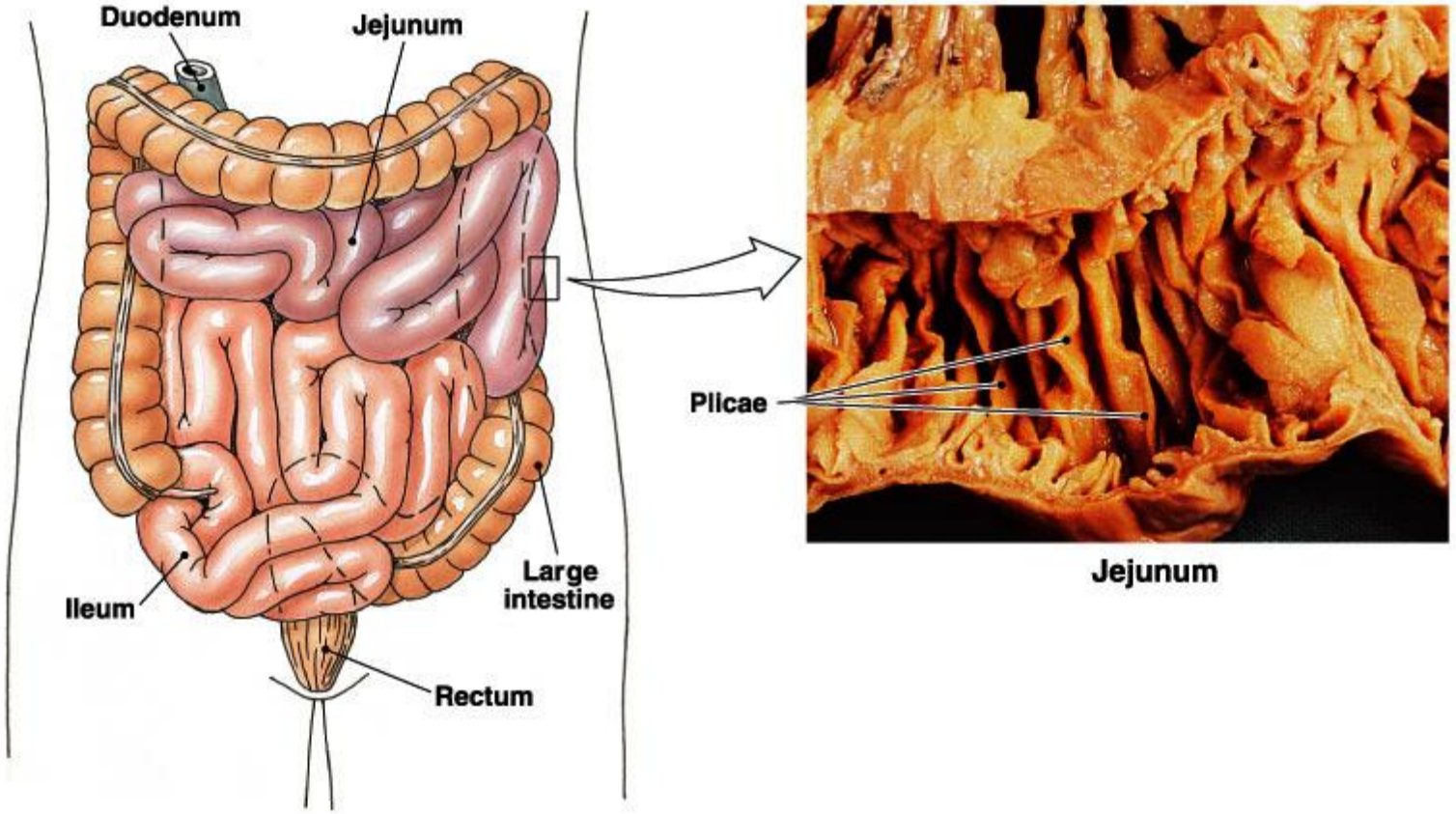


Small Intestine

- Long (20 ft), coiled tube beneath the stomach.
- Has three parts:
  - Duodenum – upper part; about 10 in; connected to the stomach where the digestive juices from the pancreas and the liver combine with chyme making it thin and watery.
  - Jejunum – about 8 ft
  - Ileum – about 12 ft

Small Intestine

- Site of greatest amount of digestion and absorption



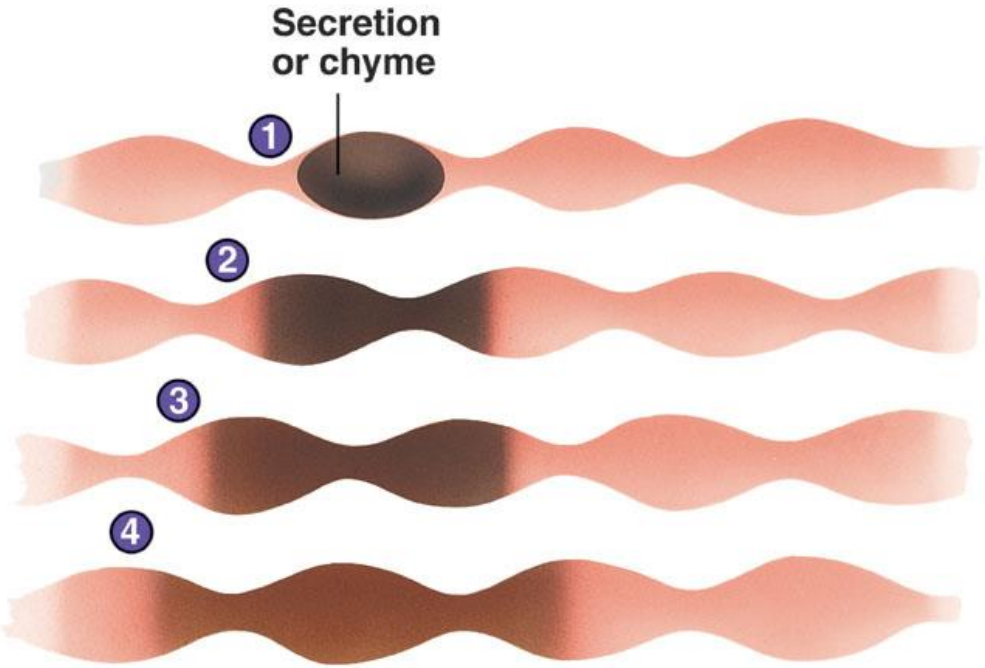
Small Intestine

- Takes about 4 – 8 hrs to complete its journey.
- Mucosa (inner wall) – secretes several enzymes that acts on the food.
- Where the pancreatic enzymes are emptied into.
- **Digested nutrients are absorbed through intestinal walls.**
- Absorbed materials cross the mucosa into the blood then other parts of the body for storage or further chemical change.

Small Intestine

- Has folded inner walls covered with fingerlike projections (**villi**; sing. – villus)
- Each villus has tinier projections called **microvilli** that absorbs digested food.
- Villi and microvilli increases the surface area of the small intestine for greater absorption.
- Peristalsis moves the undigested food to the large intestine.

Movement in small intestine:

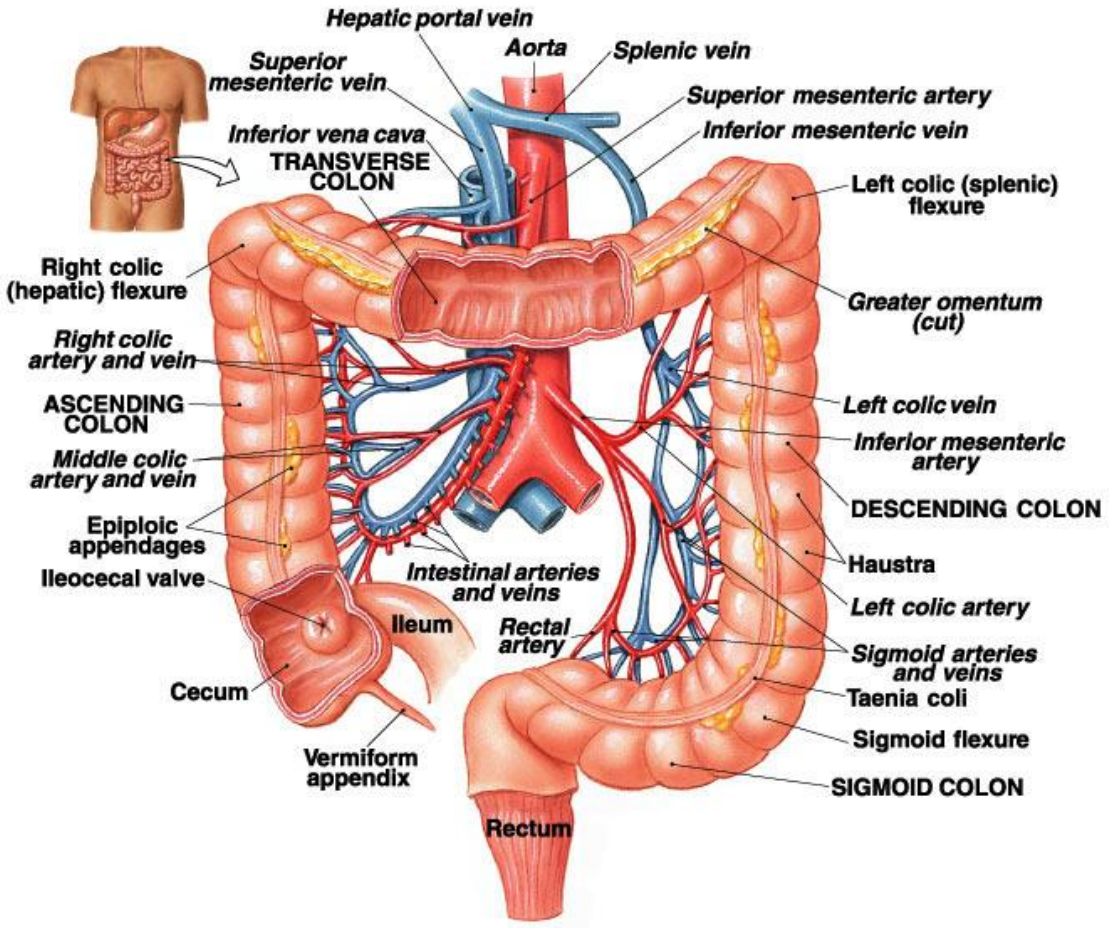


- Mixing: Segmental contraction that occurs in small intestine
- Secretion: Lubricate, liquefy, digest
- Digestion: Mechanical and chemical
- Absorption: Movement from tract into circulation or lymph
- Elimination: Waste products removed from body

Large Intestine

- a.k.a. Colon
- larger diameter, but shorter (5 ft)
- Water is absorbed from the undigested food making the waste harder until it becomes solid.
- Waste stays for 10 – 12 hours.

Large Intestine



Large Intestine

- Waste is pushed into the expanded portion (rectum) of the large intestine.
- Solid waste stays in the rectum until it is excreted through the anus as feces.
- Appendix hangs on the right side of the large intestine.

Accessory Organs

- Produce or store enzymes that helps in digestion.
- Liver
  - Largest gland of the body
  - Stores vitamins A,D,E,K
  - Stores sugar and glycogen
  - Produces **bile** (watery, greenish substance)
  - Secretes bile to the gall bladder via the hepatic duct and cystic duct.

Accessory Organs

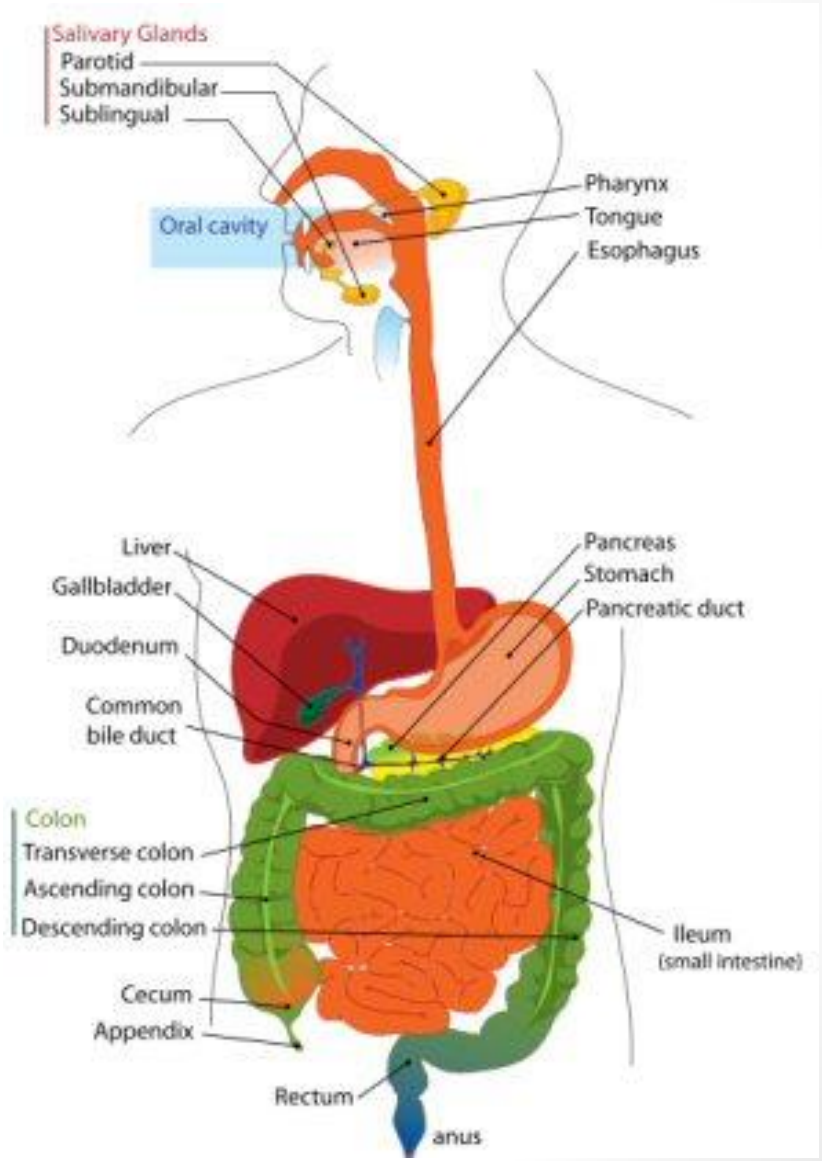
- Gall bladder
  - Stores bile in between meals
  - Secretes bile to the duodenum through the bile duct during mealtime.
    - Bile contains bile salts, pigments, cholesterol and phospholipids.
    - Bile is an emulsifier NOT an enzyme.
    - Emulsifier – dissolves fat into the watery contents of the intestine.

Accessory Organs

- Pancreas
  - Produces a juice that contains enzymes (**amylase and insulin**) to break down carbohydrates, fats and protein.
  - Secretes the juice into the duodenum through the pancreatic duct.

Path of Digestion

- Mouth
- Pharynx
- Esophagus
- Stomach
- Small Intestine
- Large Intestine
- Anus



The Excretory System

Gets rid of wastes and other substances that the body doesn't need.

Two Types of Wastes

- Solid Waste – from the Digestive System in the form of feces.
- Metabolic Wastes – produced by chemical reactions like respiration, hydrolysis, synthesis and neutralization.
  - Water
  - Carbon Dioxide
  - Salts
  - Urea

Removal of Wastes

- Egestion
  - removal of digestive waste.
- Excretion
  - removal of metabolic waste.

Organs of Excretion

- Skin
  - Allows water, salt and urea to diffuse from the blood (capillaries) into the sweat glands.
  - Releases sweat from the sweat glands through the sweat ducts out to the skin pores.

Organs of Excretion

- Lungs
  - Excretes the waste product of respiration during exhalation.
  - Carbon Dioxide and Water Vapor.

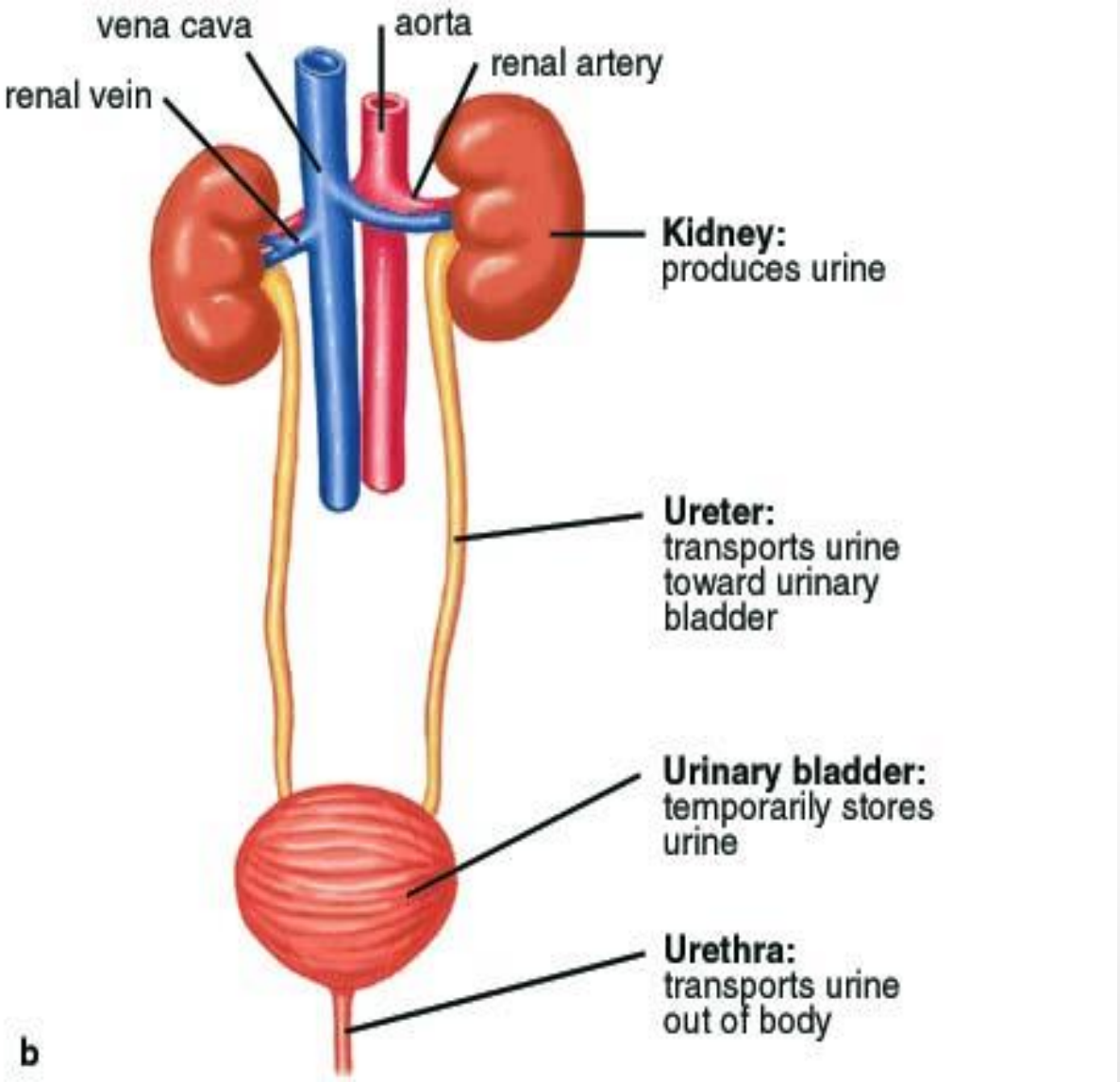
Organs of Excretion

- Liver
  - Part of the digestive, circulatory and excretory systems.
  - Removes excess amino acids from the body.
  - Breaks down the amino acids through **deamination** to form the urea which is excreted in the urine.

Organs of Excretion

- Kidneys
  - Major excretory organs of the body which removes most of the body wastes.
  - Purify blood by filtering out water, salts, digested food particles and urea in the form of urine.
  - Urine passes out through the urinary tract.

Urinary System



Excretion of Urine

- Kidney
- Ureter – a tube that transports urine to the urinary bladder.
- Urinary Bladder – a sac of tissue that has the ability to expand as it fills with urine.
- Urethra – a tube at the bottom of the bladder where urine passes out of the body.