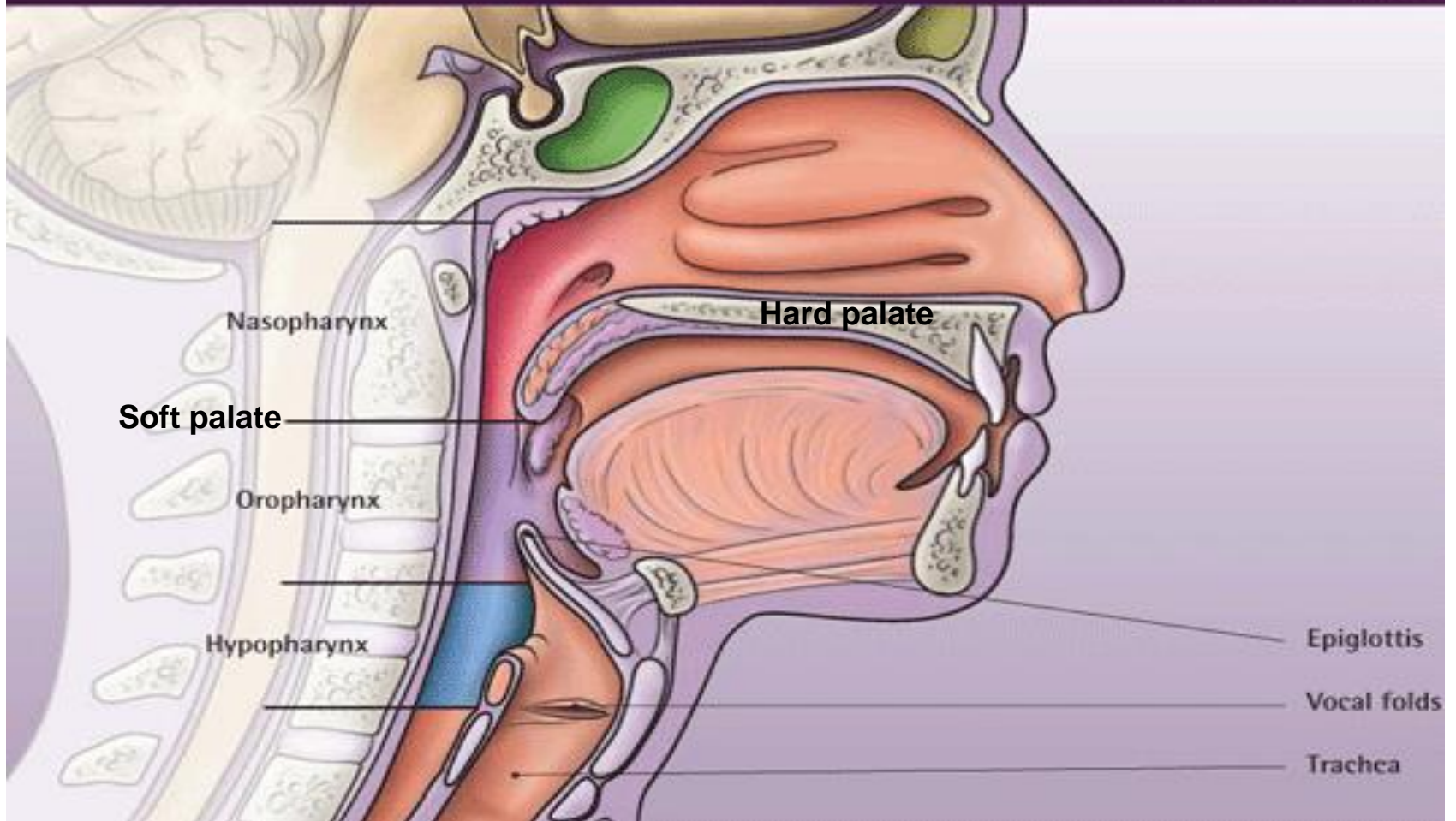


Pharynx



Swallowing (Deglutition)

- Passage of food from the mouth (through pharynx & esophagus) to the stomach

- **Phases:**

- 1) Buccal phase:**

- Voluntary
- Food passes from mouth to pharynx
- After mastication & bolus formation → voluntary elevation of the tongue against the hard palate → backward pushing of bolus to pharynx

2) Pharyngeal phase:

- Involuntary (autonomic)
- Bolus → stimulates pharyngeal receptors → afferent impulses through 5th, 9th, 10th cranial nerves → swallowing center in medulla oblongata → impulses through the efferent cranial nerves causing:

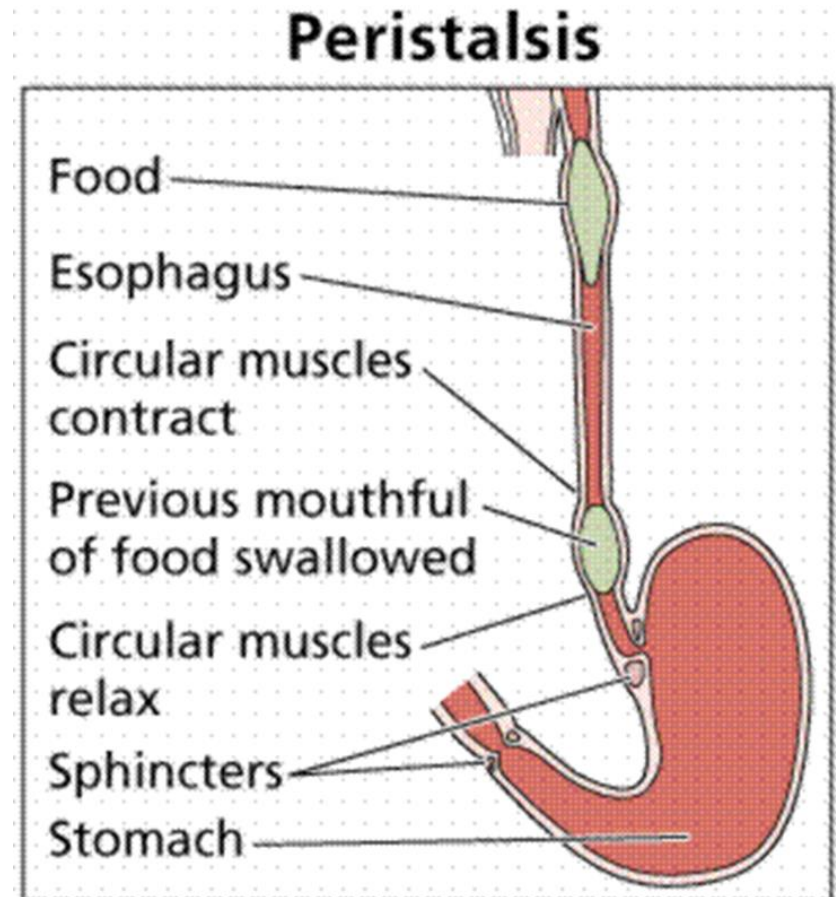
(a) protective reflexes:

- ✓ Inhibits respiratory center to stop breathing (temporal apnea)
- ✓ Elevation of soft palate to prevent entering of food to nasal cavity
- ✓ Contraction of mylohyoid muscle → press tongue against hard palate → closing the oral opening of pharynx to prevent return of food to mouth
- ✓ Elevation of larynx to be closed by epiglottis preventing food entrance to trachea.
- ✓ Contraction of muscles of the vocal cords to close the glottis

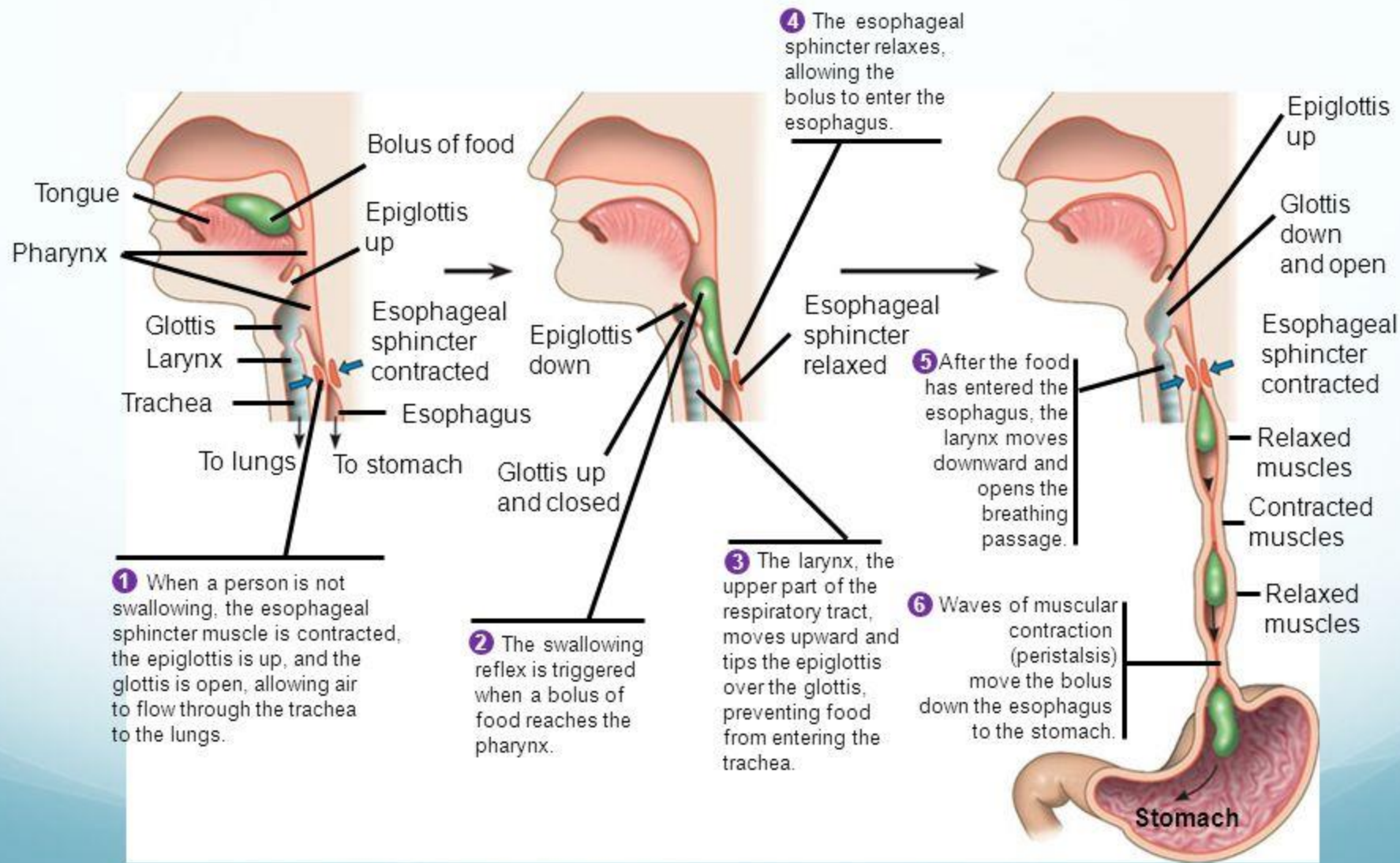
(b) Rapid peristaltic movement + relaxation of the pharyngeoesophageal sphincter → food passes to esophagus

2) Esophageal phase:

- Involuntary
- Peristaltic movement occurs in the esophageal wall from the upper to the lower esophageal sphincters to propel the bolus to stomach
- Types of peristaltic movements of the esophagus : primary & secondary.



From mouth to stomach: the swallowing reflex and esophageal peristalsis



The esophageal sphincters

- They are circular smooth muscles:
- a) **Upper esophageal sphincter:**
 - Between pharynx & esophagus.
 - Usually closed to prevent entrance of air into the stomach during breathing
 - Relaxes during swallowing till the bolus enters the esophagus then contract again.
- a) **Lower esophageal sphincter:**
 - Between esophagus & stomach
 - Usually closed to prevent reflux of stomach content into esophagus
 - Relaxes during swallowing for propulsion of food to stomach

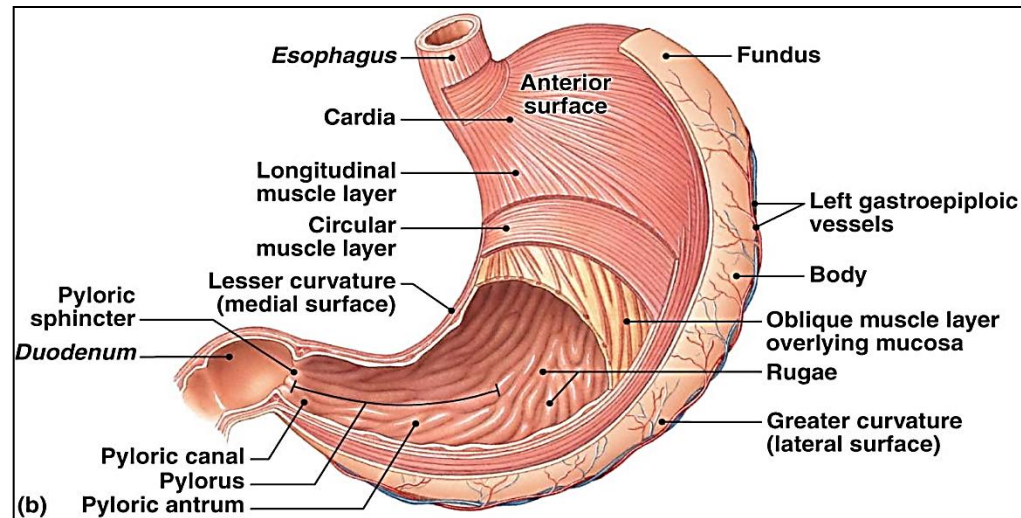
The Stomach (Simple stomach)

- According to its mechanical function, it consists of 3 zones:

1) **Fundus:** responsible for reception & storage of food

2) **Body:** responsible for mixing of food with gastric juice

3) **Antrum (pylorus):** consists of pyloric canal & pyloric sphincter. It is responsible for pumping food to duodenum.



The gastric Juice

The gastric mucosa

- It contains simple tubular glands which open at the mucosal surface.
- **The glands of gastric mucosa grouped in 3 types:**
 - 1- Oxyntic (parietal) cells:** secrete HCl and intrinsic factor (essential for absorption of vitamin B₁₂).
 - 2- Peptic (chief) cells:** secrete enzymes mainly pepsinogens (proteolytic enzymes).
 - 3- Mucous cells:** secrete mucus.
 - 4- G cells:** secrete gastrin hormone

The origin of gastric juice

- The gastric mucosa is divided into:

I- Non glandular zone: covered by stratified squamous epithelium

II- Glandular zone: contains 3 regions

1) **Cardiac glands area** { insoluble mucus
basal alkaline fluid contains HCO_3

2) **Oxyntic glands area** consists of:

a- Oxyntic (parietal) cells: secrete HCl & intrinsic factor

b- Peptic (chief) cells: secrete pepsinogens, gelatinase, gastric lipase & rennin.

c- Mucus neck cell: secrete soluble mucus.

3) **Pyloric glands area:** secrete soluble mucus & some pepsinogen.

It also contains G cells: secrete gastrin hormone

Composition of gastric juice

□ During the inter-digestive period:

-When no food is in the stomach

- The gastric glands not secrete

- The surface epithelial cells produce:

a) **Insoluble mucus:** all over the gastric mucosa

b) **Basal alkaline fluid:** (rich in sodium, chloride, bicarbonate & potassium with very low conc. of hydrogen)

Composition of gastric juice

□ During the digestive (Postprandial) period :

- Presence of food.
- There is large volume of gastric juice composed of
 - a) **Water (97- 99%)**
 - b) **Organic substances: enzymes, mucus, intrinsic**
 - c) **Inorganic part: HCO_3^- , Cl^- , HPO_4^{--} , SO_4^{--} , K^+ , H^+ , Ca^{++} & Mg^{++}**
- **pH of gastric juice 1.5 - 2**

Functions of gastric juice:

1) Soluble mucus:

- From mucus neck cell of the oxyntic glands area
- After vagal stimulation
- To lubricate the food.

2) Hydrochloric acid (HCl):

- From oxyntic or parietal cells
- Stimulated by Ach, gastrin & histamine

- **Functions of Hcl:**

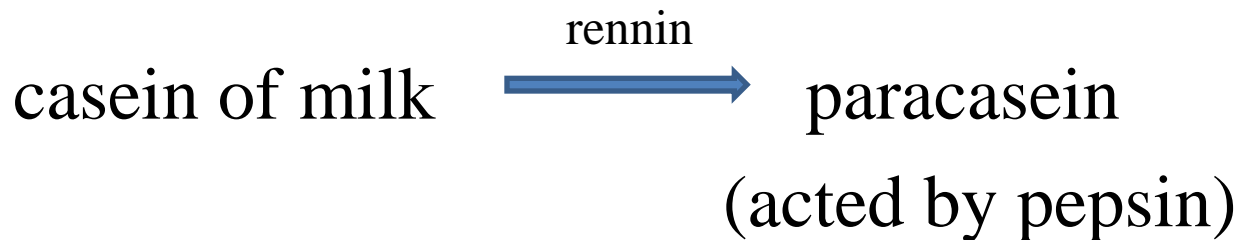
- 1- It provides acidic pH for activation of pepsinogen into pepsin
- 2- It kills most ingested bacteria.
- 3- It stimulates release of CCK& secretin hormones which stimulate bile flow and pancreatic secretion.
- 4- It helps absorption of calcium and iron (by preventing precipitation of Ca^{++} salts and converting ferric Fe^{+++} to ferrous Fe^{++} ions).
- 5- In adults it causes milk curdling with pepsin to prevent rapid passage to duodenum & keeping it in stomach for digestion.
- 6- It regulates gastric emptying (entry of acid chyme in duodenum delays gastric emptying through enterogastric reflex)

3) Pepsinogen:

- Secreted from peptic or chief cells.
- It is the inactive form of pepsin.
- It is activated by HCl in gastric lumen then by pepsin itself (+ve feedback mechanism)
- It is a proteolytic enzyme that starts protein digestion.
protein → peptides (endopeptidase)
- The optimal pH for pepsin action is 5.3 in neonates' animals and 1-2 in adults.

4) Rennin (chymosin or Rennet)

- Secreted from abomasal mucosa of the preruminants animals & absent in stomach of adults.
- Secreted as prorennin (inactive)
- It is activated by HCL & Ca^{++} .
- Optimal pH for its activity is (3.5-6.5)
- It causes curdling (coagulation) of milk in infants as it prevents rapid passage of milk from stomach.



5) Gastric intrinsic factor:

- A protein secreted from parietal or chief cells, mucus cells & duodenum (according to the species)
- It units with vit B₁₂ → complex that is absorbed in ileum.

6) Gastric lipase:

- It has little importance in lipid digestion in adults due to highly acidic pH.
- It is active in neonate due to suitable pH

7) Gelatinase enzyme:

- It liquefies gelatin.