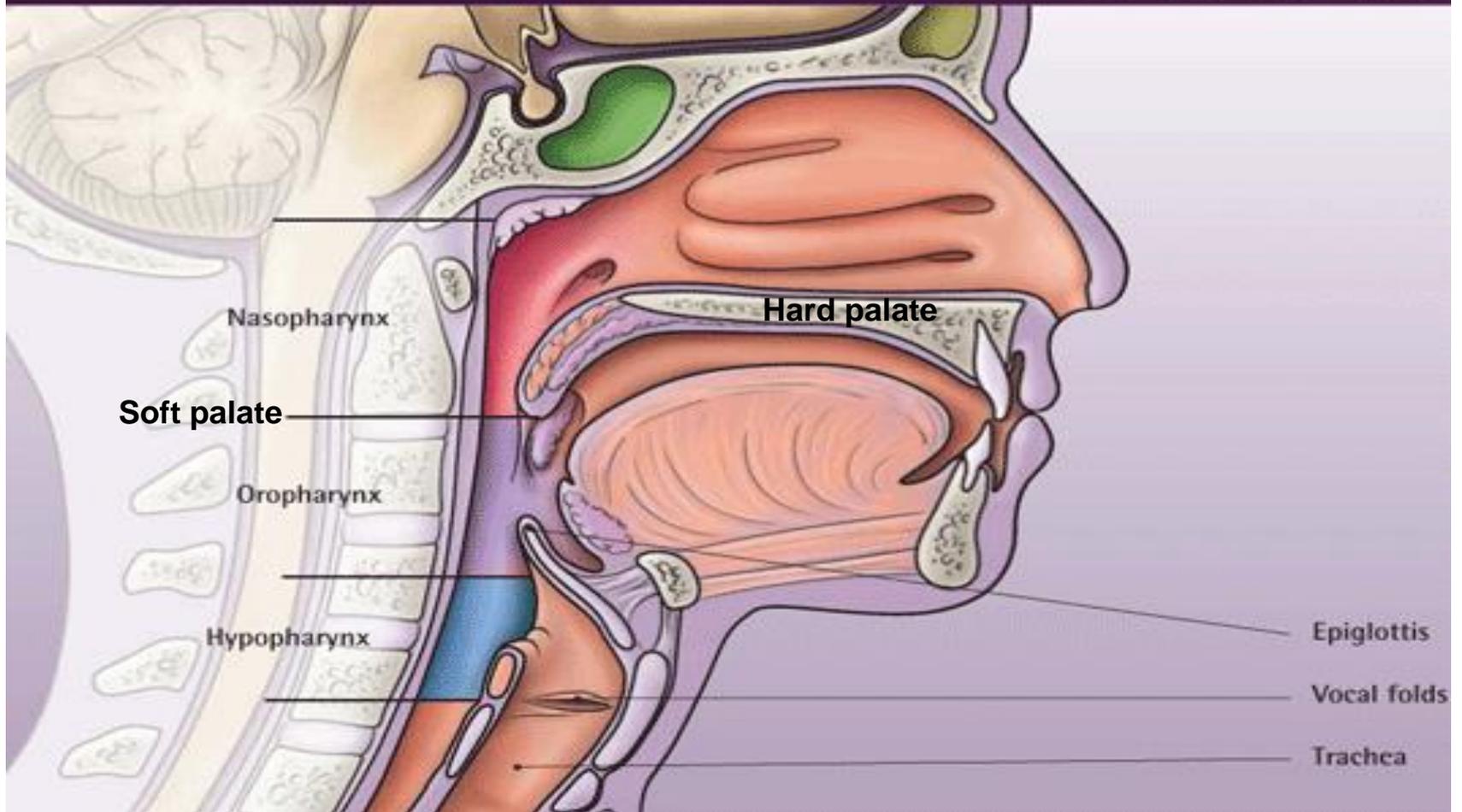


# Pharynx



# 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 5<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup> cranial nerves → swallowing center in medulla oblongata → impulses through the efferent cranial nerves causing:

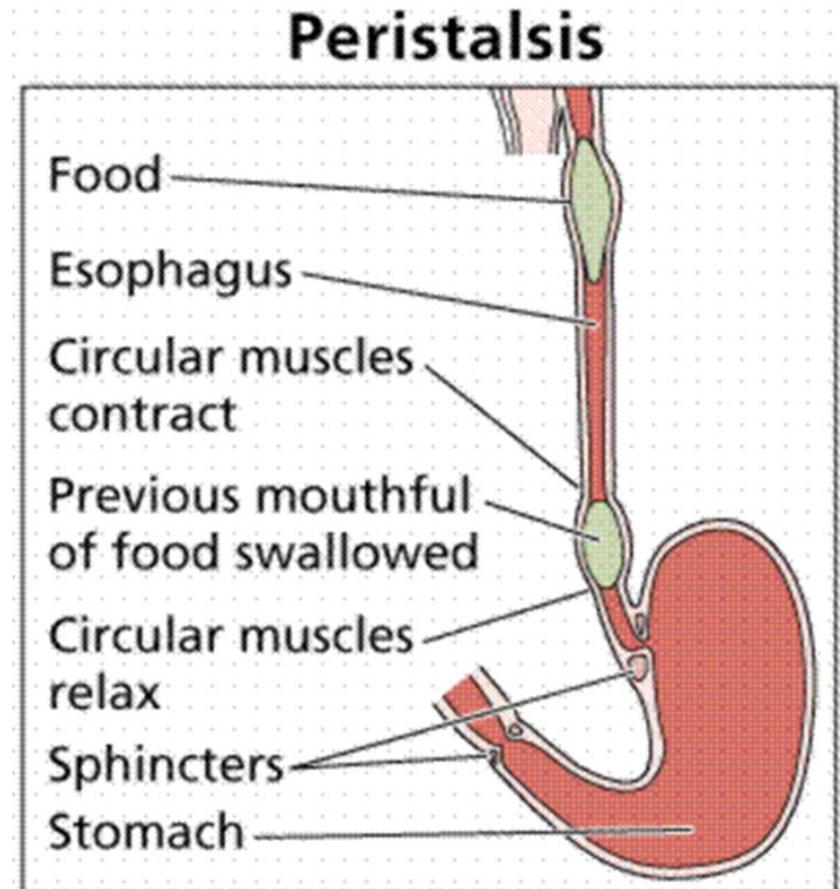
### (a) protective reflexes:

- ✓ 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

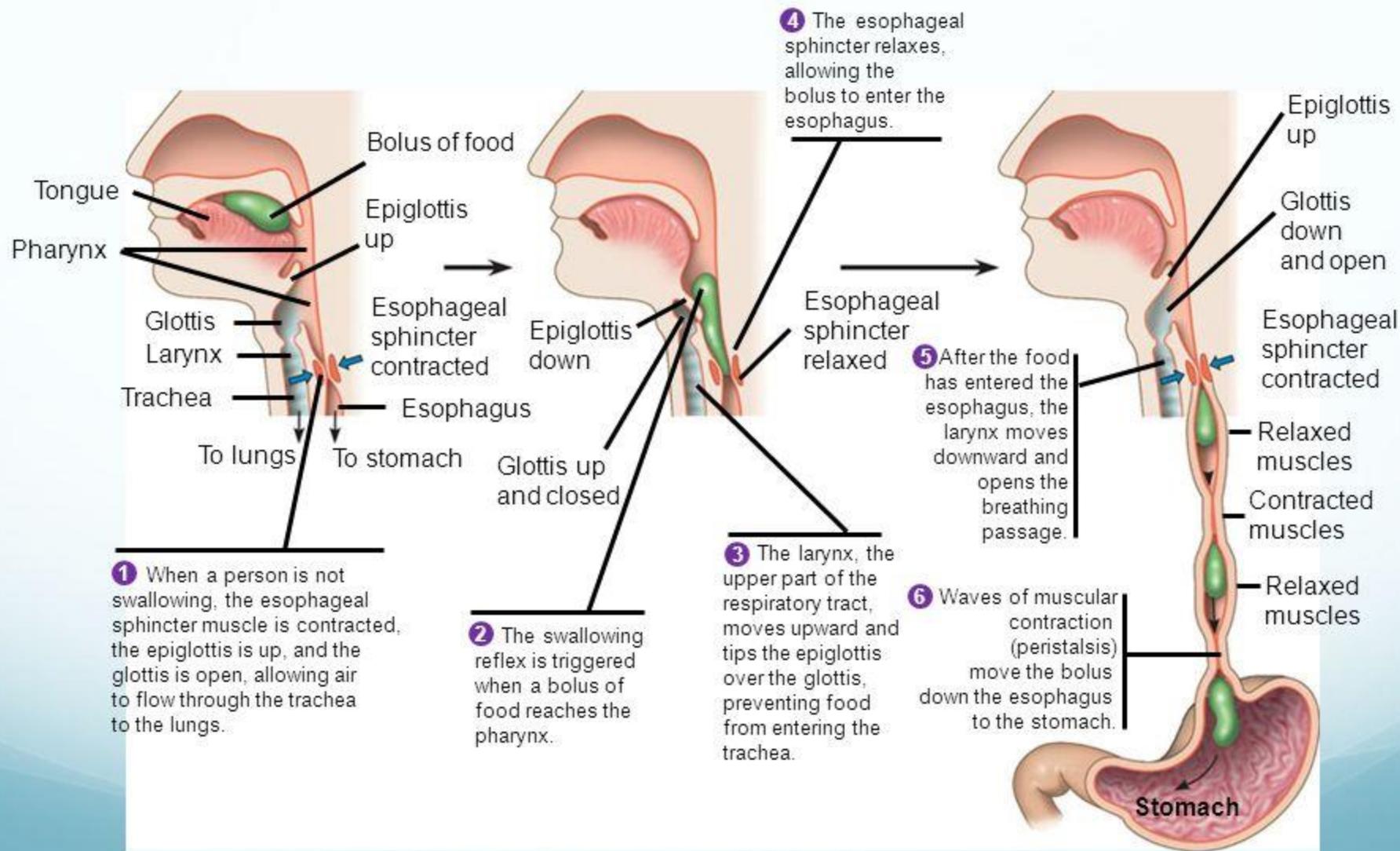
(b) Rapid peristaltic movement + relaxation of the pharyngeoesophageal sphincter → food passes to esophagus

## 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

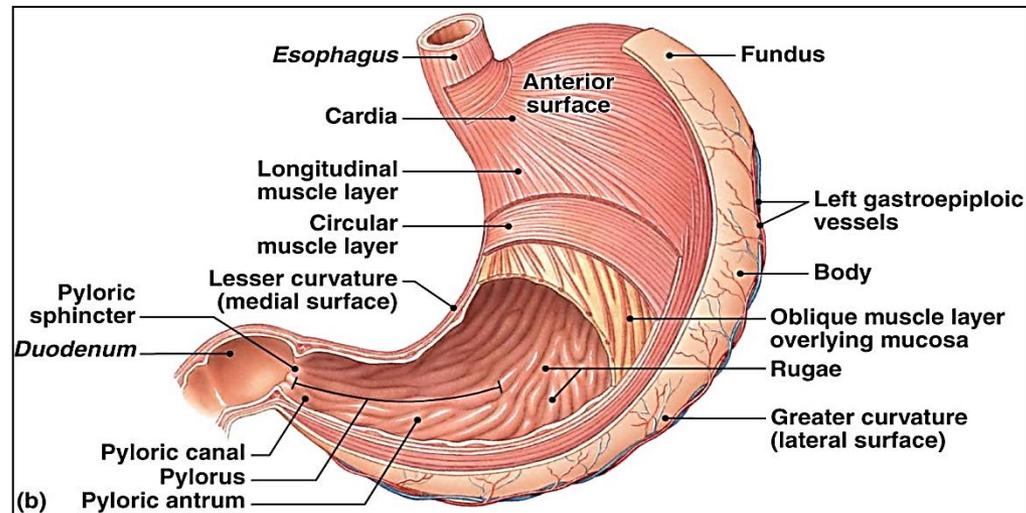
# The Stomach (Simple stomach)

- 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 B<sub>12</sub>).
  - 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  $\text{HCO}_3$

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

**a- Oxyntic (parietal) cells:** secrete  $\text{HCl}$  & 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:  $\text{HCO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{HPO}_4^{--}$ ,  $\text{SO}_4^{--}$ ,  $\text{K}^+$ ,  $\text{H}^+$ ,  $\text{Ca}^{++}$  &  $\text{Mg}^{++}$**
- **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:**

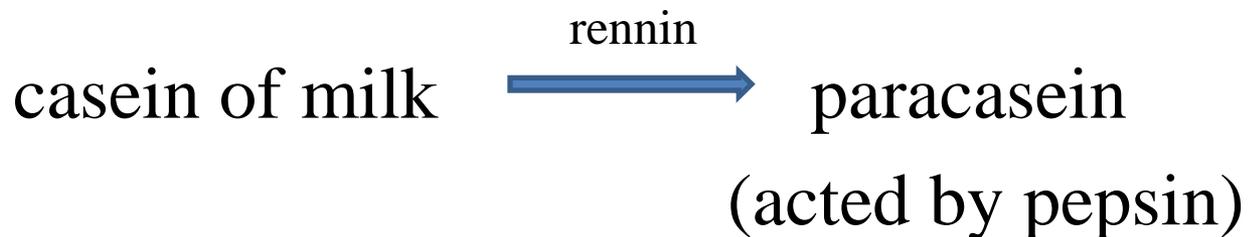
- 1- It provides acidic pH for activation of pepsinogen into pepsin
- 2- It kills most ingested bacteria.
- 3- It stimulates release of CCK& secretin hormones which stimulate bile flow and pancreatic secretion.
- 4- It helps absorption of calcium and iron (by preventing precipitation of  $\text{Ca}^{++}$  salts and converting ferric  $\text{Fe}^{+++}$  to ferrous  $\text{Fe}^{++}$  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 &  $\text{Ca}^{++}$ .
- 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 B<sub>12</sub> → 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.