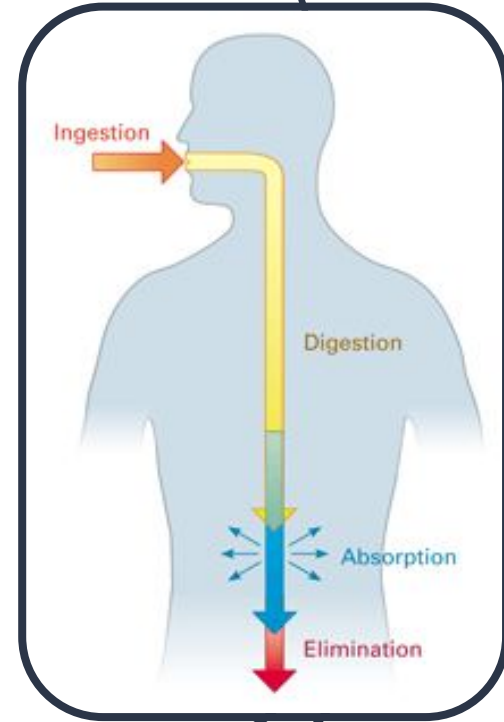


# 9.3 INTRO TO DIGESTION

P. 406 - 407

# FOUR STEPS IN DIGESTION

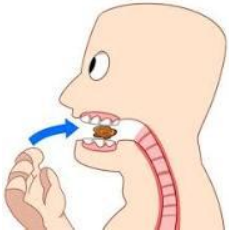
1. Ingestion
2. Digestion
3. Absorption
4. Elimination



# FOUR MAIN STEPS IN DIGESTION

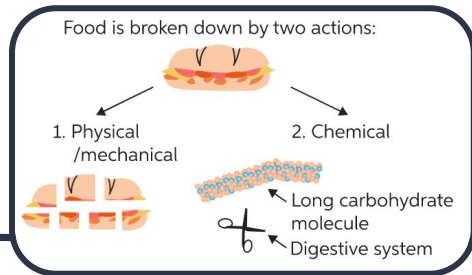
## INGESTION

The taking in of nutrients.



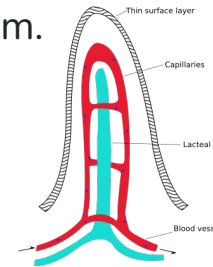
## DIGESTION

The physical and chemical breakdown of complex food molecules into smaller molecules.



## ABSORPTION

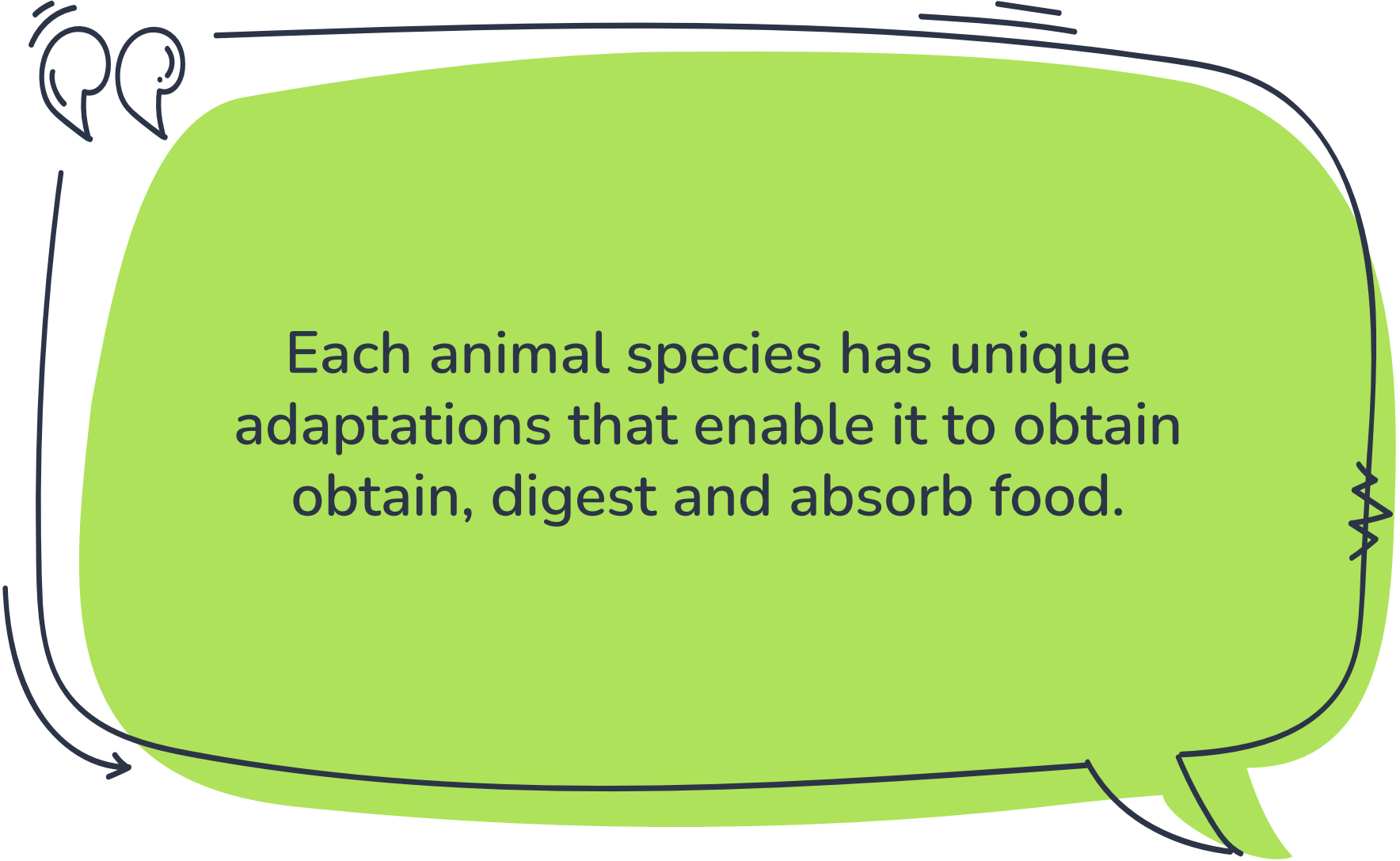
The transfer of digested nutrients from the digestive system to the bloodstream.



## ELIMINATION/EGESTION

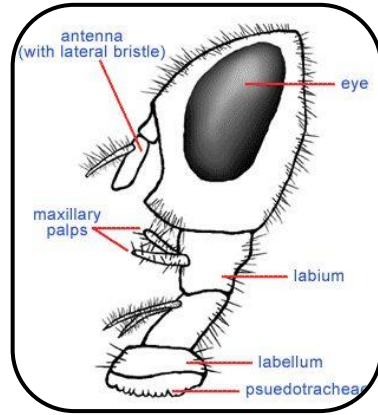
The removal of waste food materials from the body.



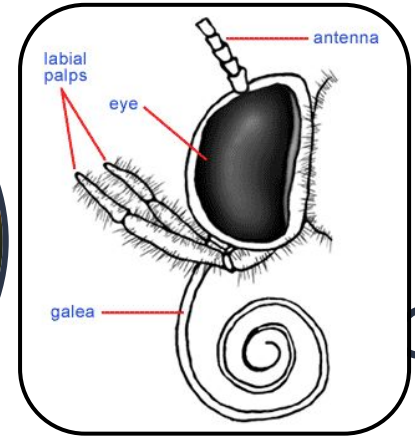


Each animal species has unique adaptations that enable it to obtain obtain, digest and absorb food.

# SPECIALIZED SYSTEMS



- X Flies have a sponge-like lobe to suck up liquids.

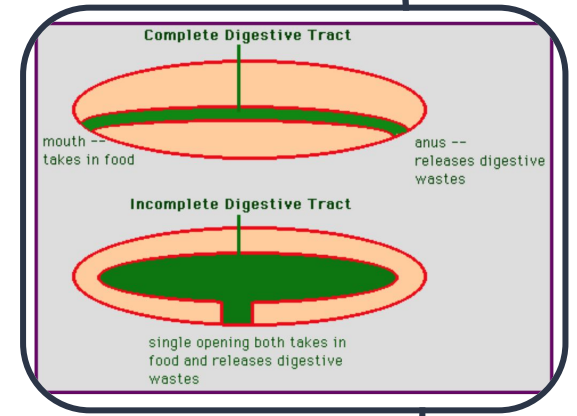


- X Butterflies have a coiled tube to suck nectar

# THE TWO TYPES OF DIGESTIVE SYSTEMS

**Incomplete** - E.g. Jellyfish

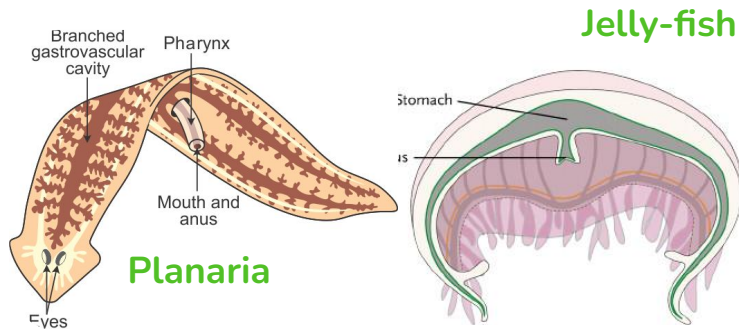
**Complete** - E.g. Earthworm



# WHAT'S THE DIFFERENCE? COMPLETE VS. INCOMPLETE

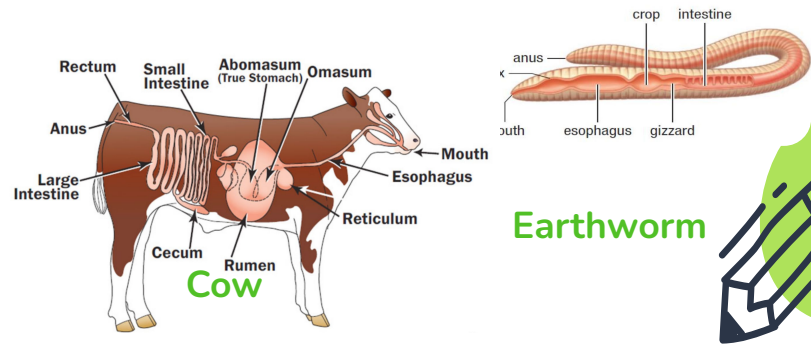
## Incomplete Digestive System

A system with **one** opening. Considered a “sac-like” digestive cavity.



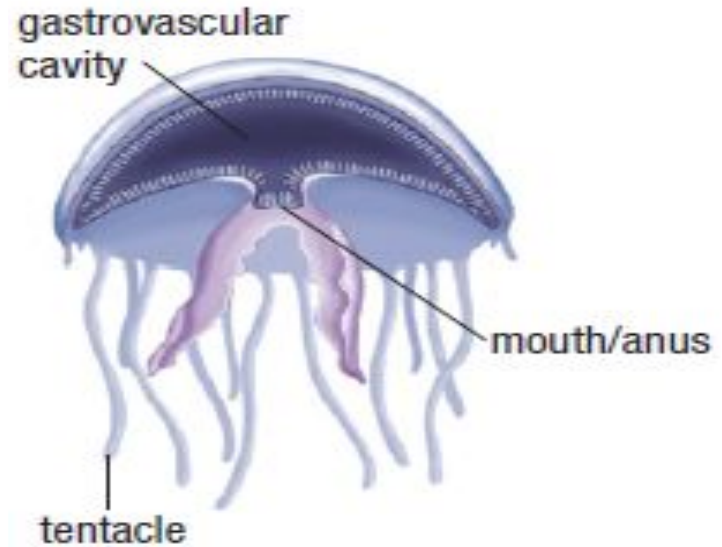
## Complete Digestive System

A system with two openings. Considered a “tube-like” digestive cavity.

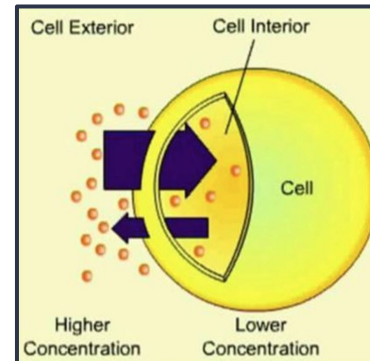


## INCOMPLETE SYSTEM: THE JELLYFISH

- ✗ Nutrients are absorbed by cells lining the cavity and diffuse into all other cells



**Figure 2** Jellyfish have a single opening through which food is taken in and waste is expelled.

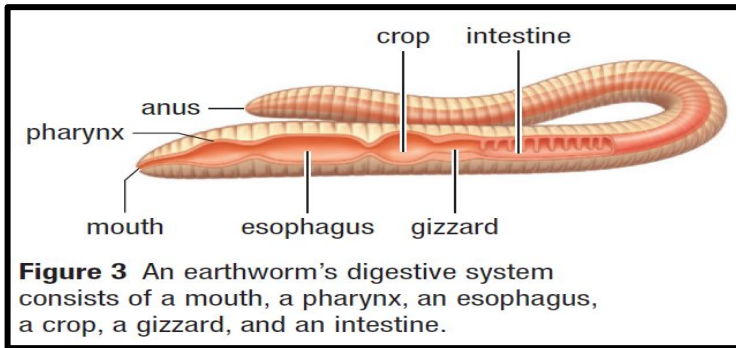


### Diffusion:

Nutrients move from areas of high concentration to areas of low concentration. Through this process, all cells, even those furthest from the cavity, receive nutrients needed for survival.



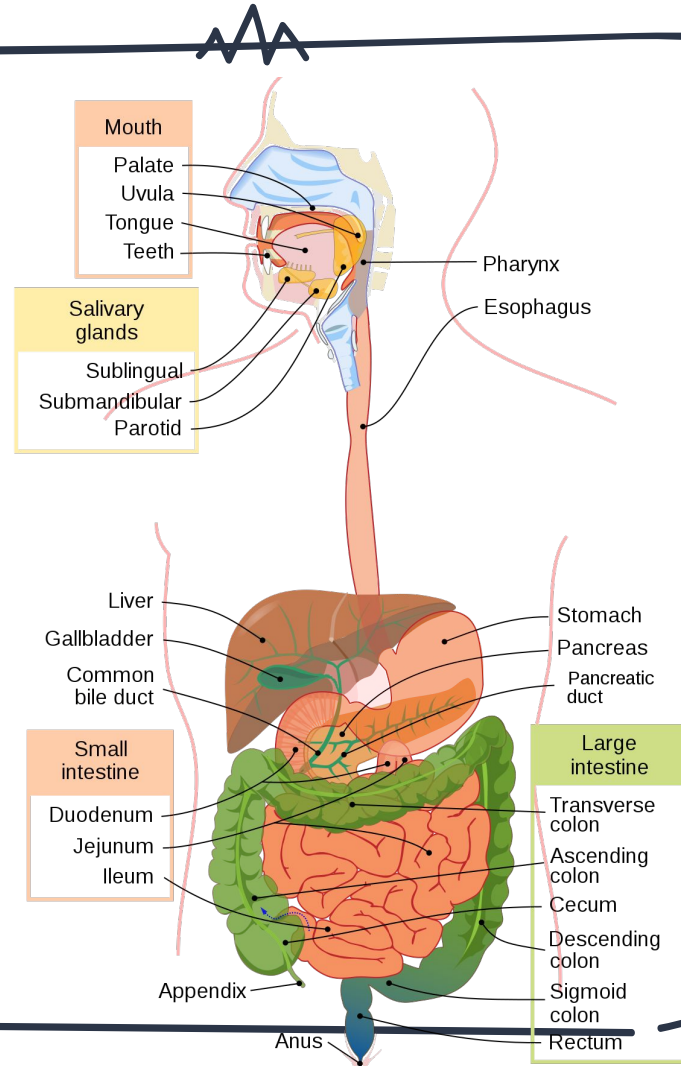
## COMPLETE SYSTEM: THE EARTHWORM

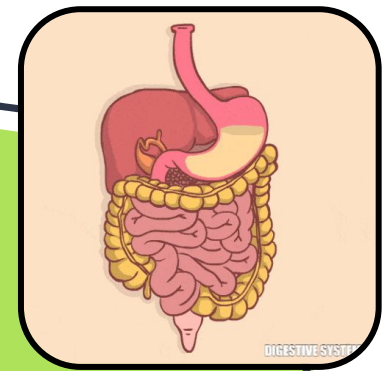


- X Food ingested in mouth travels through the pharynx and into the esophagus.
- X The esophagus then pushes the food into the crop for temporary storage.
- X Physical breakdown of the food is carried out by the gizzard.
- X The food particles pass into the intestine and are chemically broken down into smaller molecules to be absorbed by the cells lining the intestine
- X Any undigested waste is eliminated through the anus.

The human digestive system is a complete system and is known as the gastrointestinal (GI) tract.

Digestion is a carefully controlled and coordinated process that involves enzymes, hormones and nerves.





How does the length of your digestive system compare to your height?

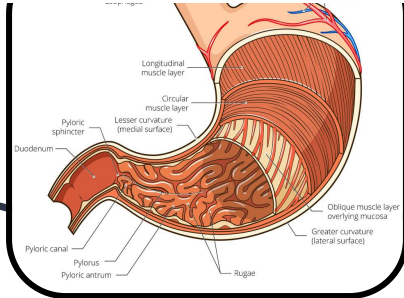
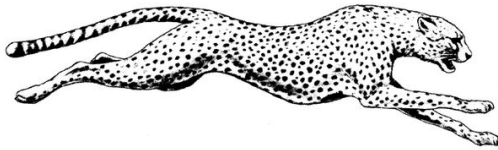
Your digestive system is 3 times your height for maximal absorption of nutrients!



# HOW DOES THE \_\_\_\_\_ SYSTEM CONNECT TO THE DIGESTIVE SYSTEM?

## Musculoskeletal

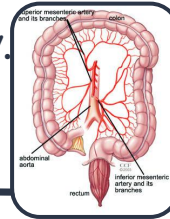
Presence of muscle and bone allows animals to catch, ingest and digest food food.



## Cardiovascular

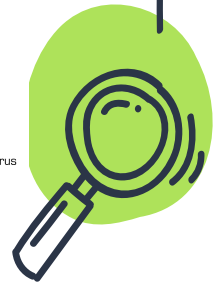
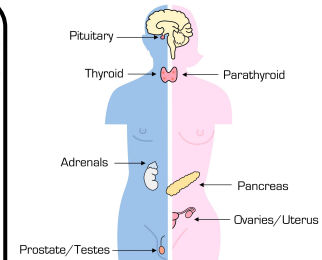
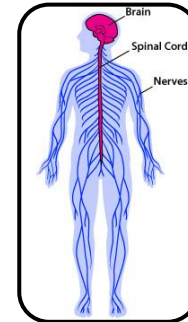


The circulatory system transports oxygen and other materials to the digestive organs. It also carries nutrients from the digestive system to all the tissues of the body.



## Nervous & Endocrine

The nervous and endocrine systems regulate the actions of the digestive organs.



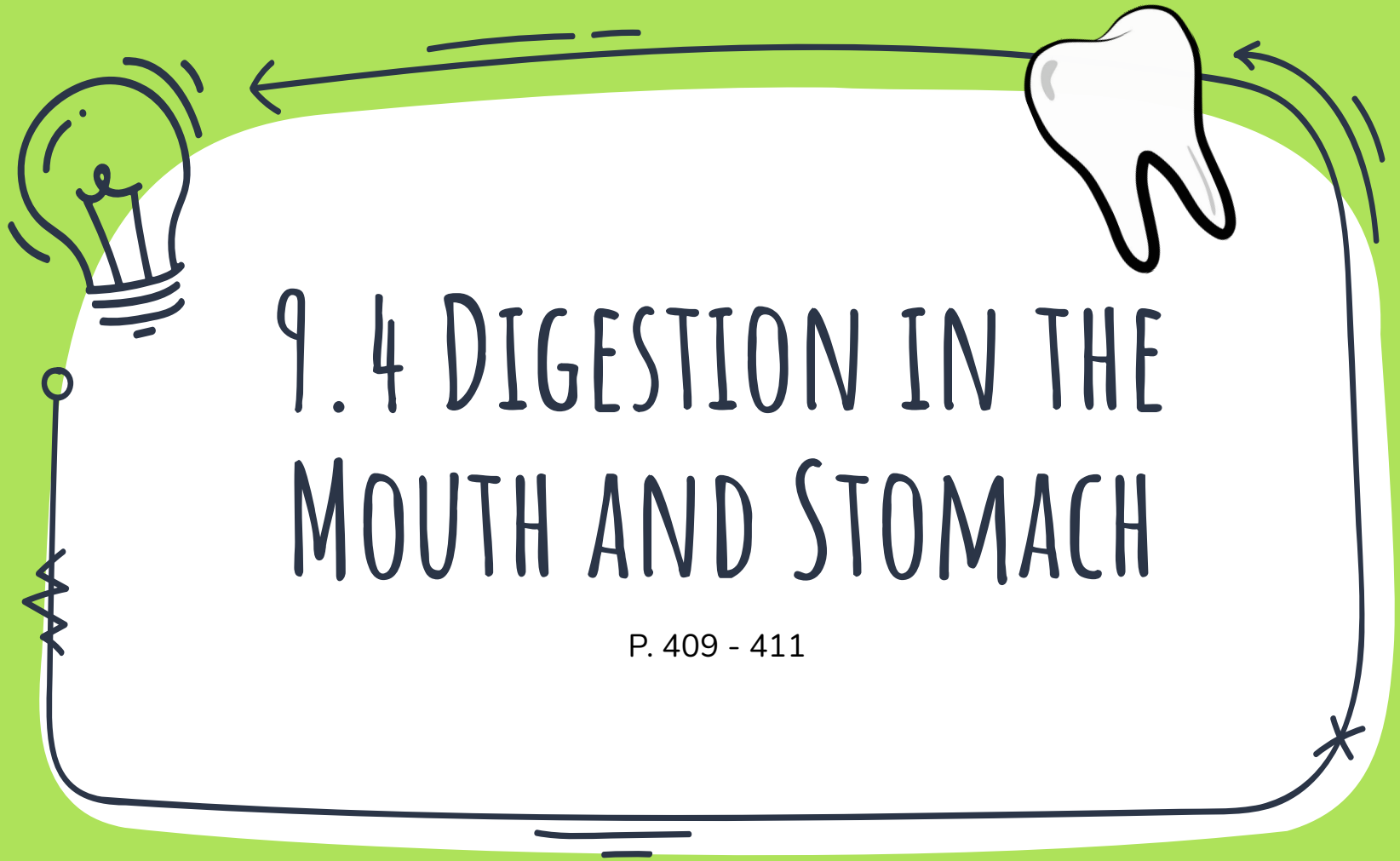
# SUMMARY

## 9.3 Summary

- The digestive systems of animals vary depending on several factors, including the size, complexity, and diet of the organism.
- The human digestive system is a complete digestive system and has four major functions: ingestion, digestion, absorption, and egestion.

### Homework

P. 407 # 1, 2, & 3

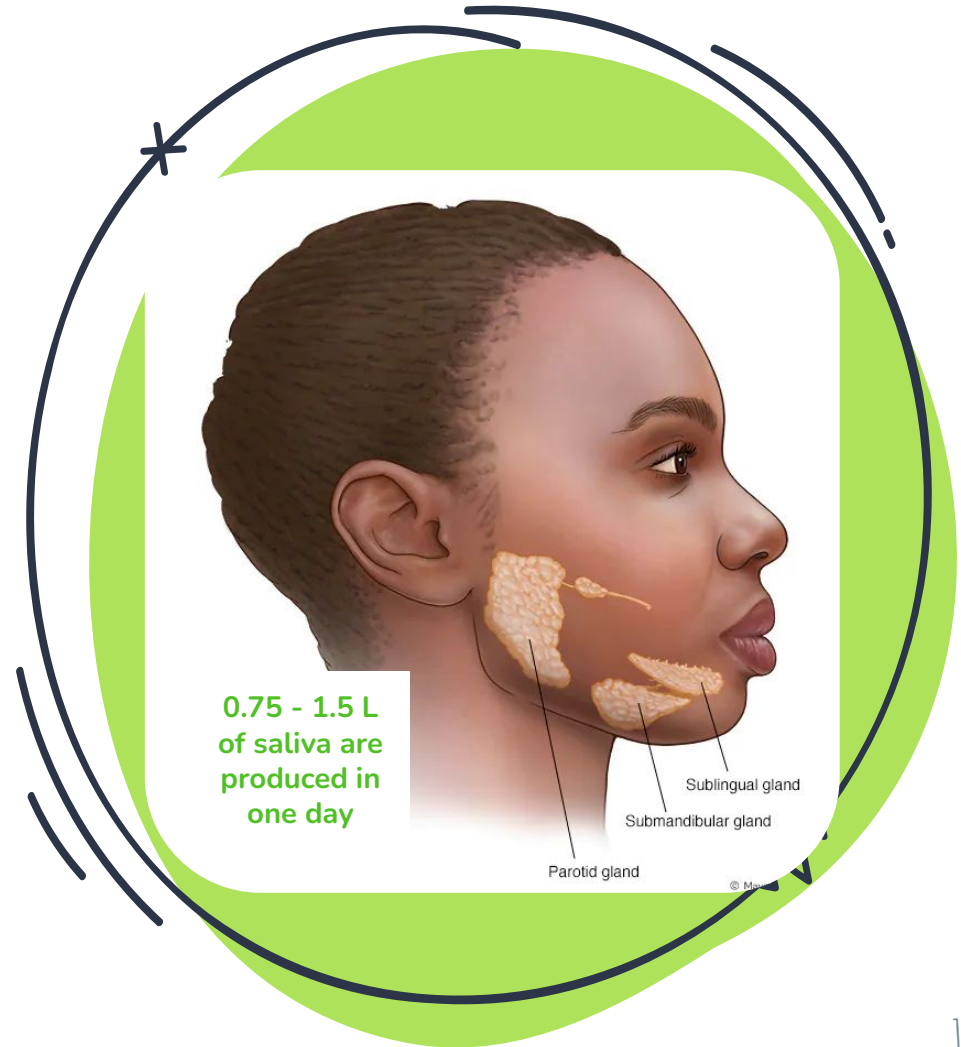


# 9.4 DIGESTION IN THE MOUTH AND STOMACH

P. 409 - 411

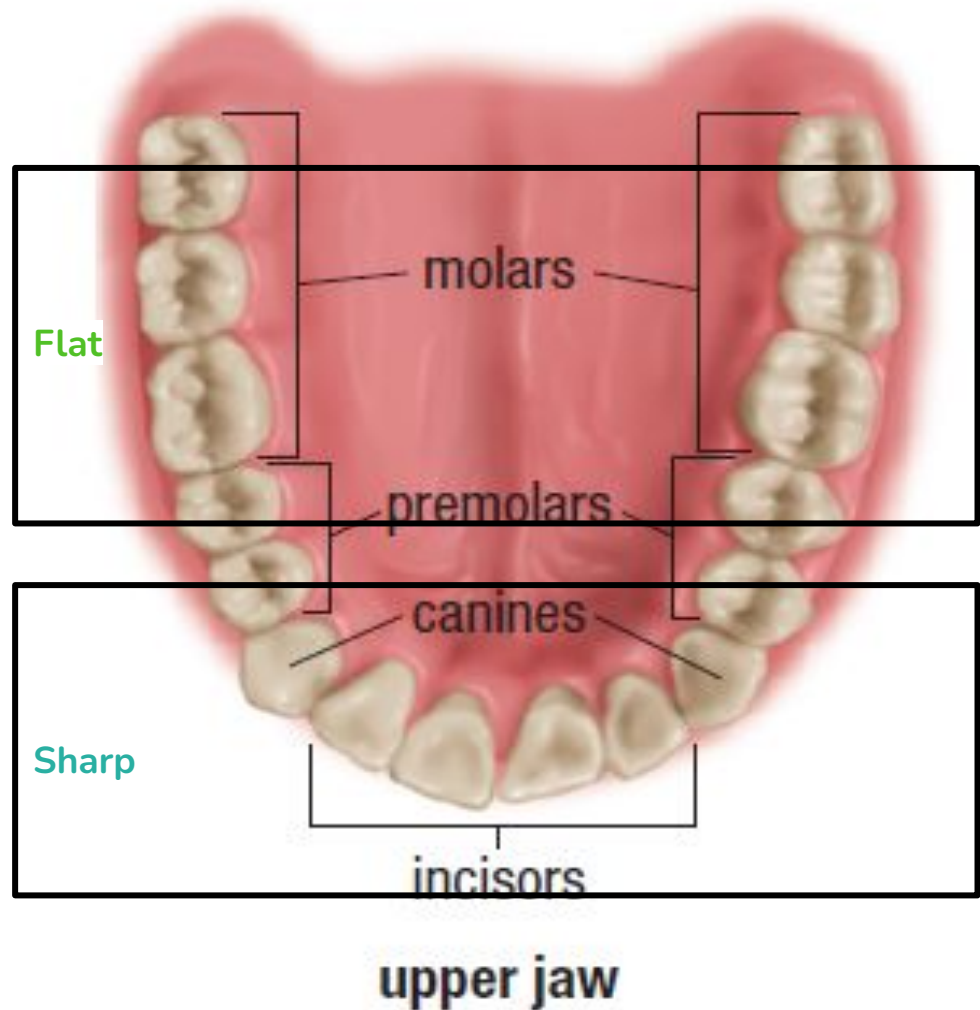
# THE MOUTH

- X In humans, digestion **begins** in the mouth.
- X Meer sight, smell or taste of food, causes secretion of saliva via salivary glands
- X Saliva is watery and contains enzymes and mucus
  - X **Amylase** enzyme starts **chemical digestion of carbohydrates** in mouth
  - X **Mucus** is a lubricant to help in swallowing



# THE MOUTH

- X Food is **broken down** into smaller pieces by the teeth (physical/mechanical digestion).
- X **Flat teeth** - grind and crush food
- X **Sharp teeth** - grab and cut food





# HERBIVORE OR CARNIVORE?

The **type of teeth** an animal has is directly related to its **diet**.

## Herbivores

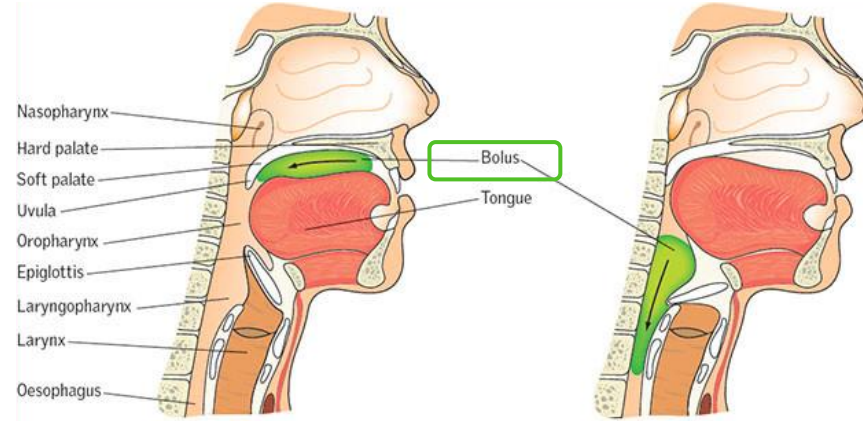
Mammalian **herbivores** have **many molars** for chewing plant matter



## Carnivores

Mammalian **carnivores** have **canine teeth** that allow them to grab and kill prey.

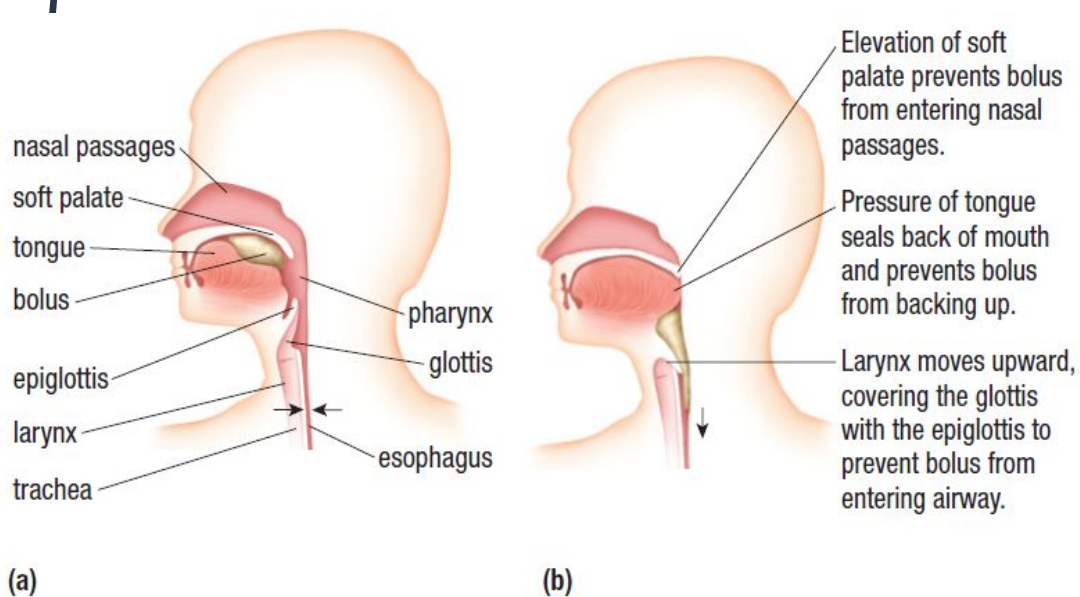




# BOLUS

Term used to describe **food** that has been **chewed** in the mouth and **mixed** with **saliva**.

# SENDING FOOD DOWN THE RIGHT TUBE (ESOPHAGUS)

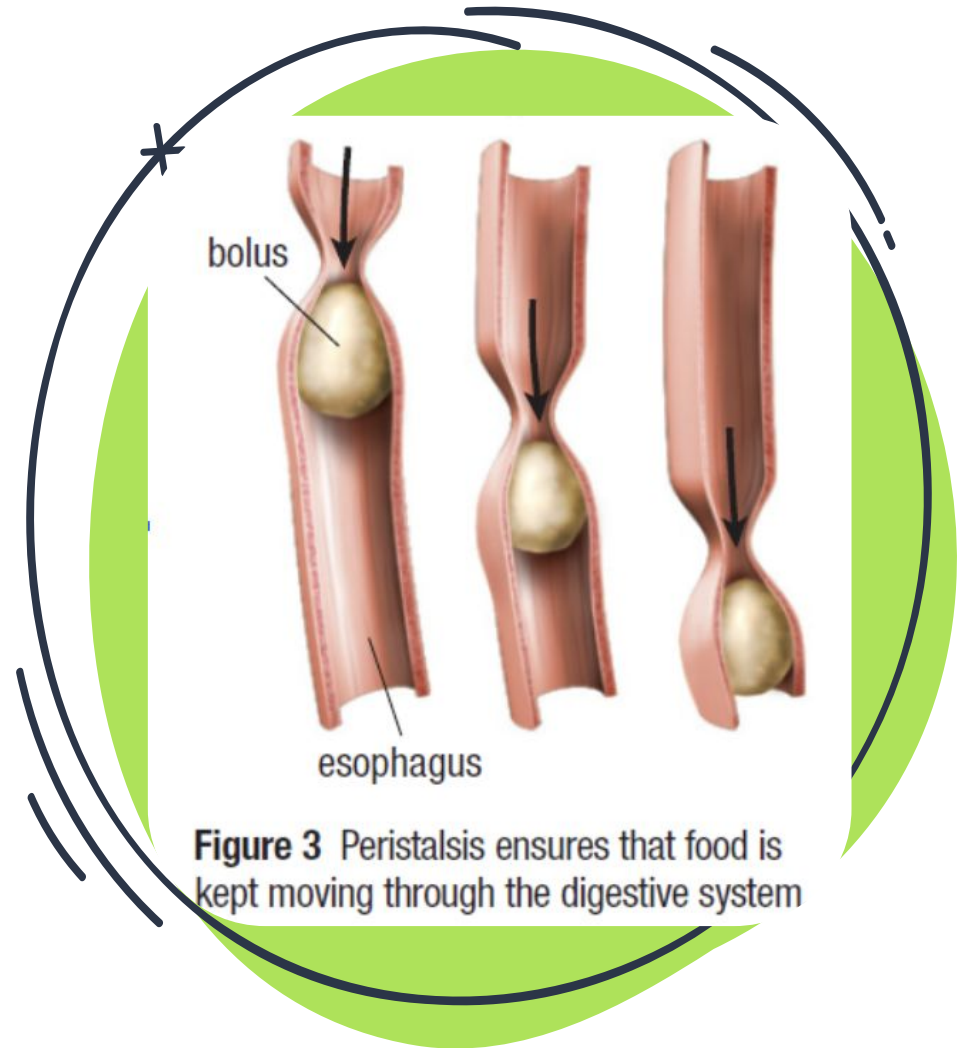


**Figure 2** (a) Structures of the mouth, pharynx, and esophagus involved in the swallowing reflex  
(b) Motions that seal the nasal passages, mouth, and trachea during the swallowing reflex

1. Soft palate raises to seal nasal passages.
2. Tongue pressure prevents backwards movement of food.
3. Larynx moves up sealing glottis with epiglottis

# DOWN THE ESOPHAGUS

The **food stretches** the walls of the esophagus, **activating** the **smooth muscles** to undergo rhythmic, wave-like **contractions** called **peristalsis**

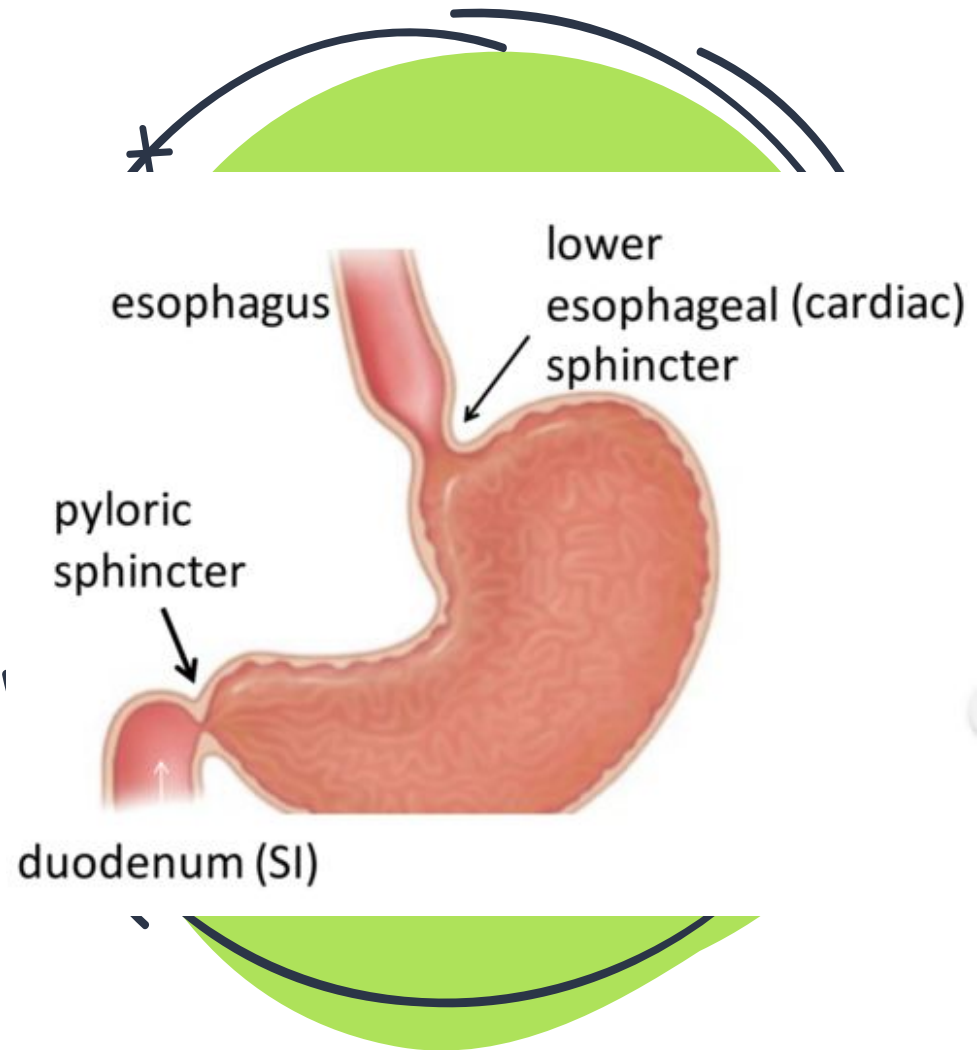


**Figure 3** Peristalsis ensures that food is kept moving through the digestive system

# SPHINCTERS

Sphincters are **circular muscles** that **relax** to **open** or **contract** to close a passage in the body.

- X Ensure the bolus moves in the right direction (forward)

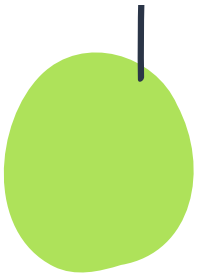
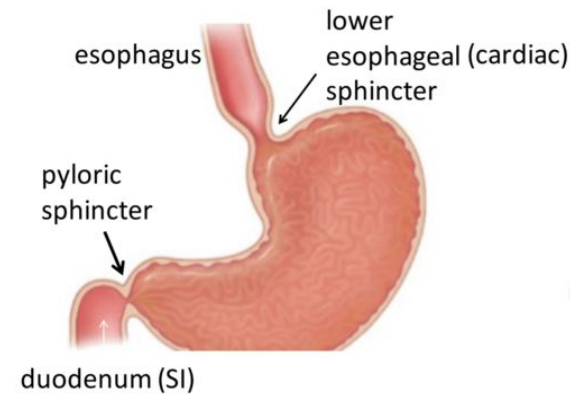


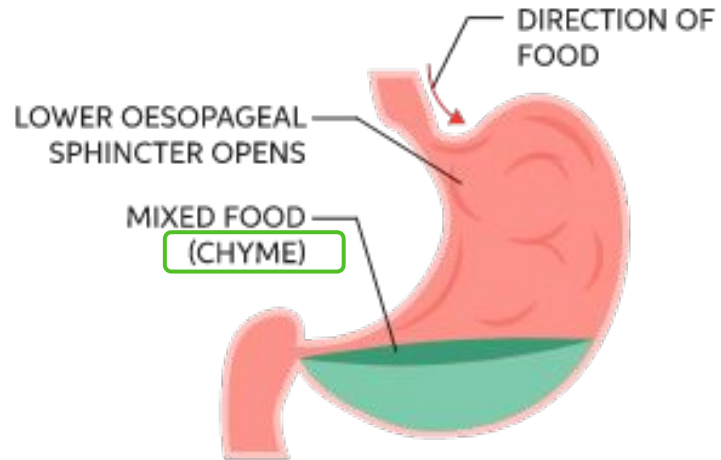
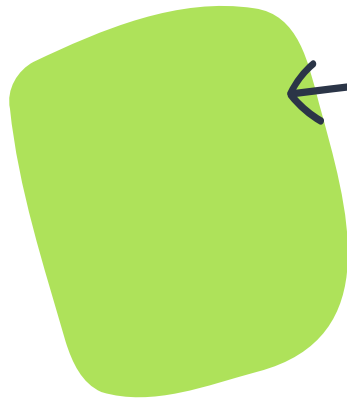
# MORE ON SPHINCTERS

X The **gastroesophageal sphincter** (cardiac sphincter) is located where the **esophagus** joins the **stomach**.

- X When open - bolus enters the stomach
- X When closed - prevents chyme (in stomach) from moving backwards into esophagus (acid reflux)

X The **pyloric sphincter** is located between the exit point of the **stomach** and the first part of the small intestine (**duodenum**)



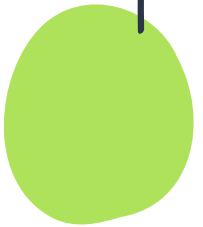


# CHYME

Term used to describe **food** in a **semisolid** state once **mixed** with acidic gastric juice in the stomach.

# THE STOMACH

- X The stomach is an organ where food is **temporarily stored** (stretches to hold up to 2 litres)
- X Physical (mechanical) digestion occurs
  - X Churning of stomach
- X Limited chemical digestion occurs
  - X **Protein is partially digested** in stomach (by activated enzyme **pepsin**)

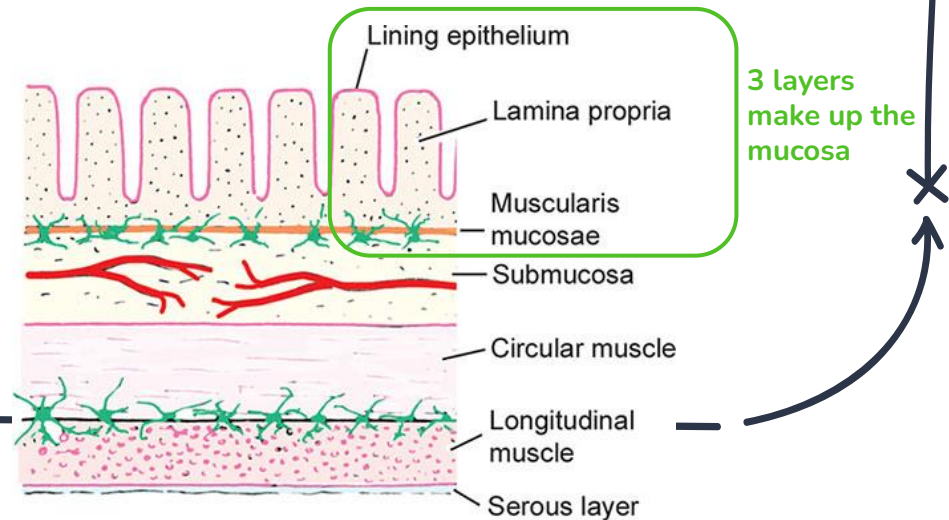
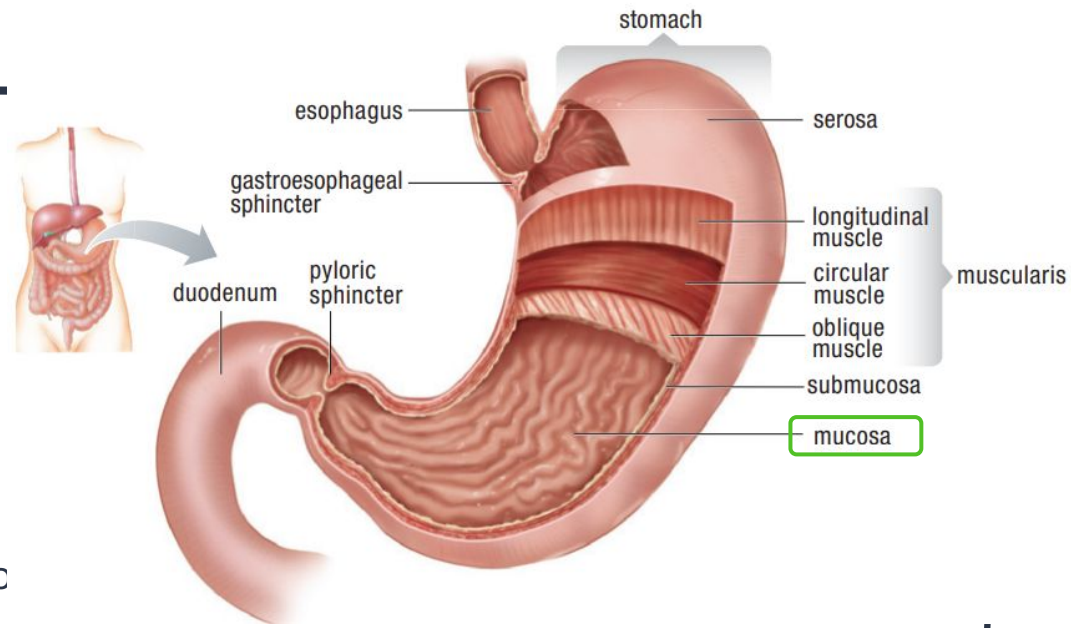




# 4 LAYERS OF THE STOMACH

## Mucosa -

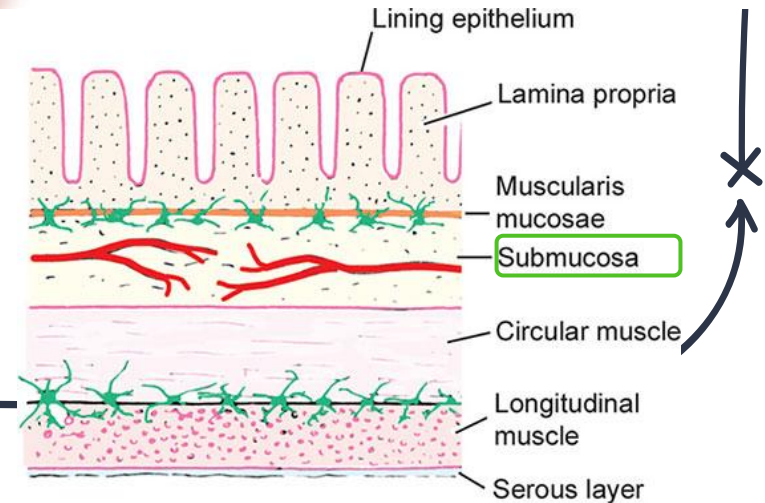
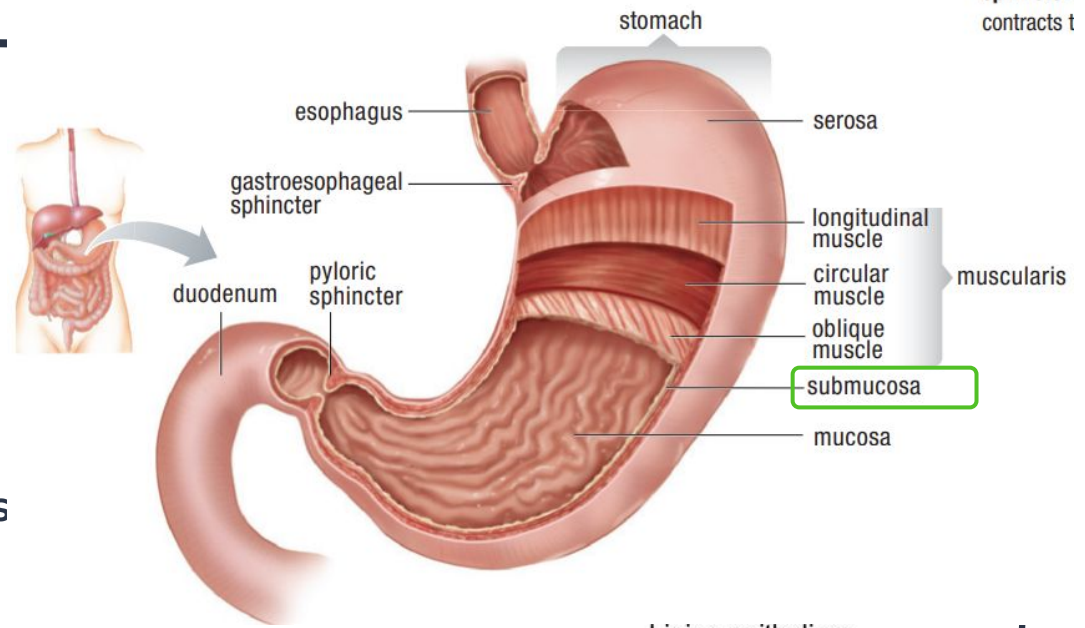
- X Innermost layer is extensively folded
- X secretes gastric juice (mixture of enzymes, acid, and mucus)
- X cells divide rapidly to heal any damage (it's replaced every 3 days!)



# 4 LAYERS OF THE STOMACH

## Submucosa -

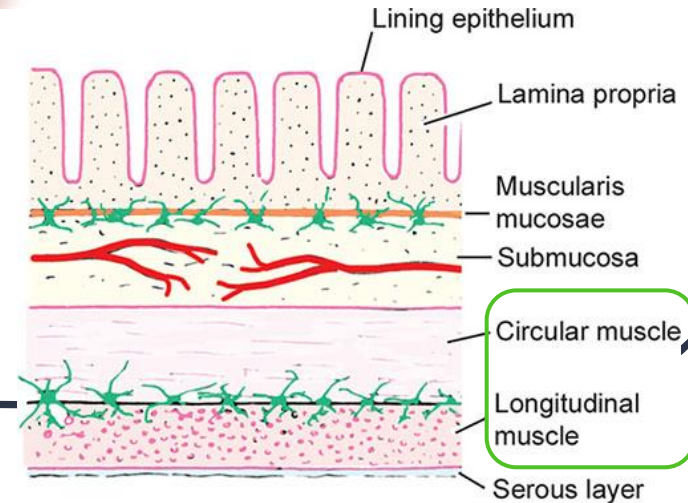
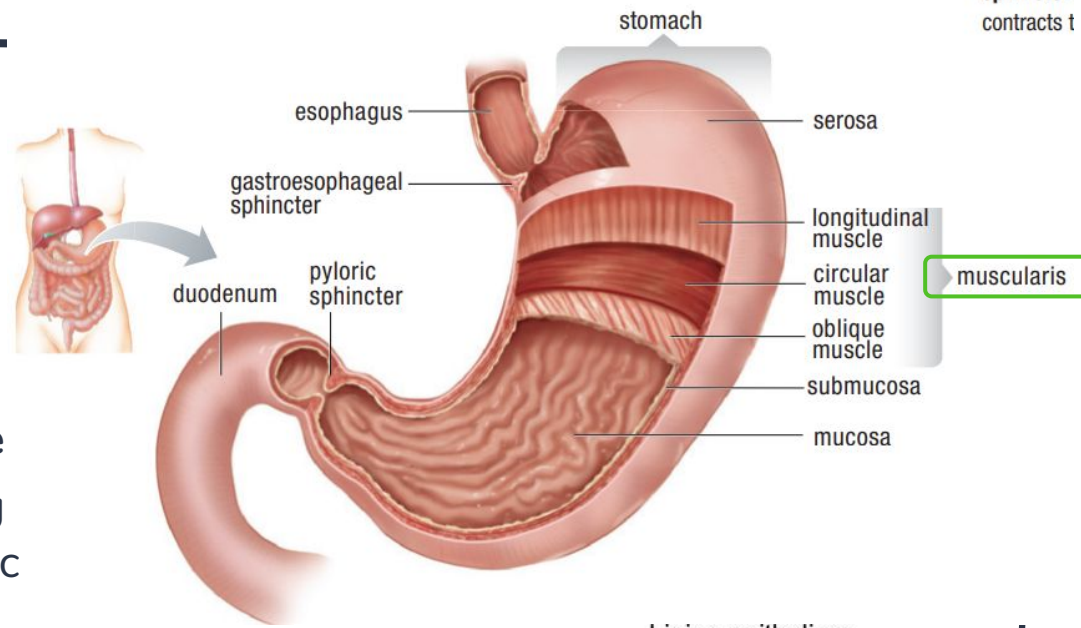
- X Layer of connective tissue
- X Contains network of **nerves** and **blood vessels**
  - X Nerves - signal contractions
  - X Blood vessels - supply blood (oxygen and nutrients) to layers of stomach



# 4 LAYERS OF THE STOMACH

## Muscularis -

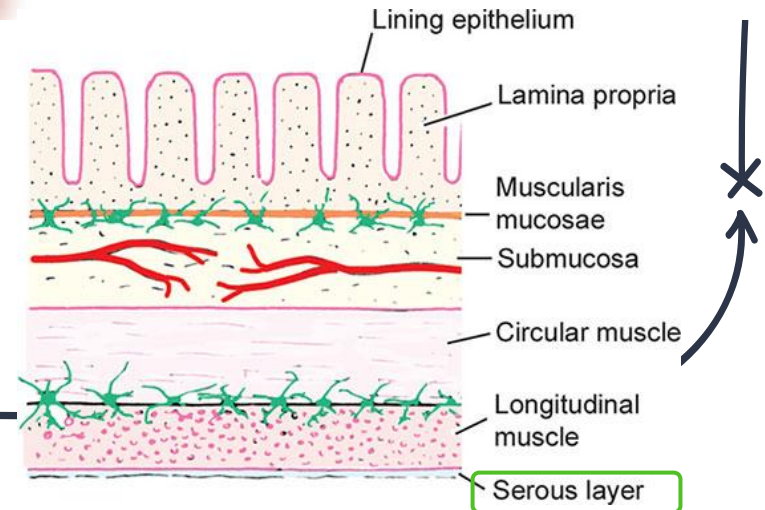
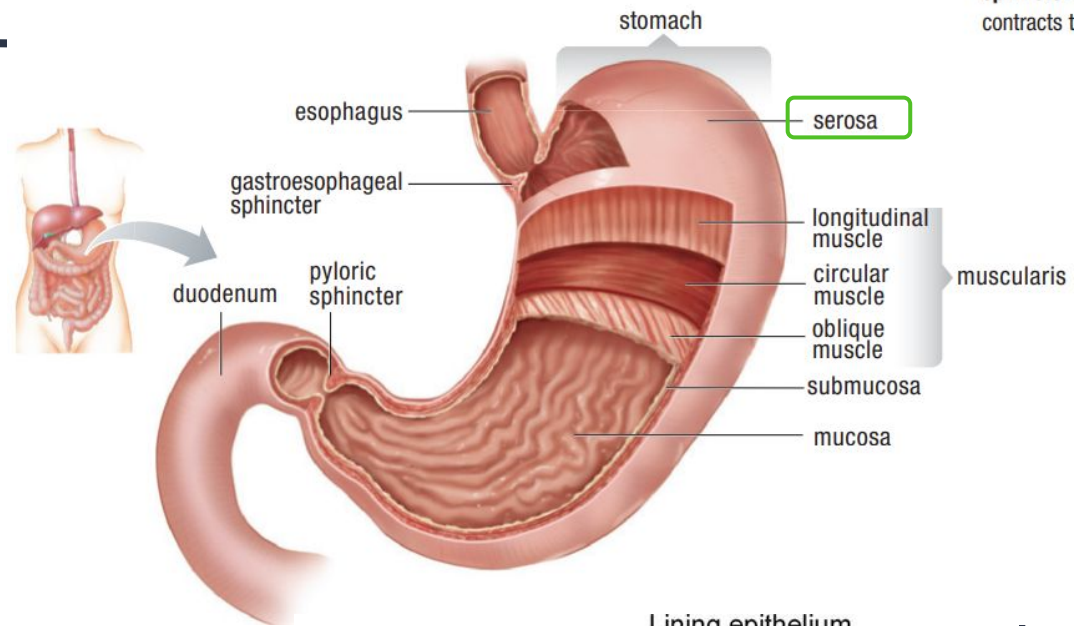
- X Consists of **smooth muscle**
- X Muscle allows for **churning** (mixing) of food with gastric juices
- X Mixture (food + gastric juice) is referred to as **chyme**



# 4 LAYERS OF THE STOMACH

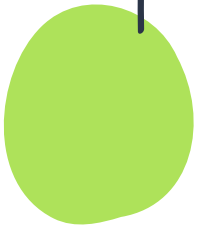
## Serosa -

- X Smooth, outermost layer
- X Secretes lubricating fluid (prevents friction between organs)



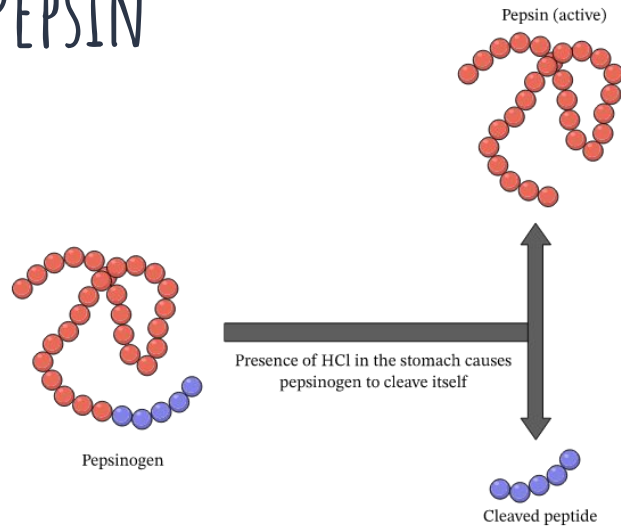
# THE STOMACH

- X **Nerves** detect presence of food → signal causes **gastrin** (hormone) to be released into **bloodstream**
- X **Gastrin** travels to **gastric cells** in the stomach and causes release of **gastric juice**
  - X The millions of gastric glands release 2L of gastric juice per day (cumulatively)
- X Gastric juice is **acidic** (pH ~ 2). The acid:
  - X kills harmful microorganisms
  - X stops amylase from functioning (no more chemical digestion of carbohydrates)
  - X activates enzyme pepsinogen (allowing for chemical digestion of proteins)



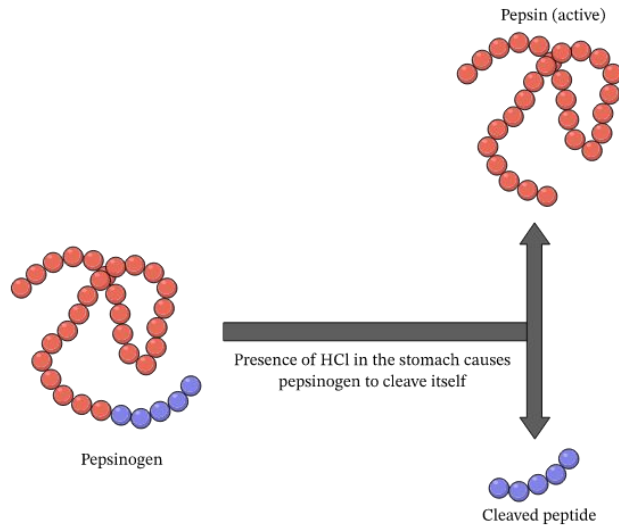


# PEPSINOGEN BECOMES PEPSIN



- X **Pepsinogen** (inactive enzyme) is secreted in the stomach
- X In acidic conditions (due to food causing release of gastric juices), pepsinogen is **converted** to **pepsin** (active enzyme)
- X Pepsin is a **protein digesting** enzyme
- X Pepsin breaks down proteins into separate amino acids

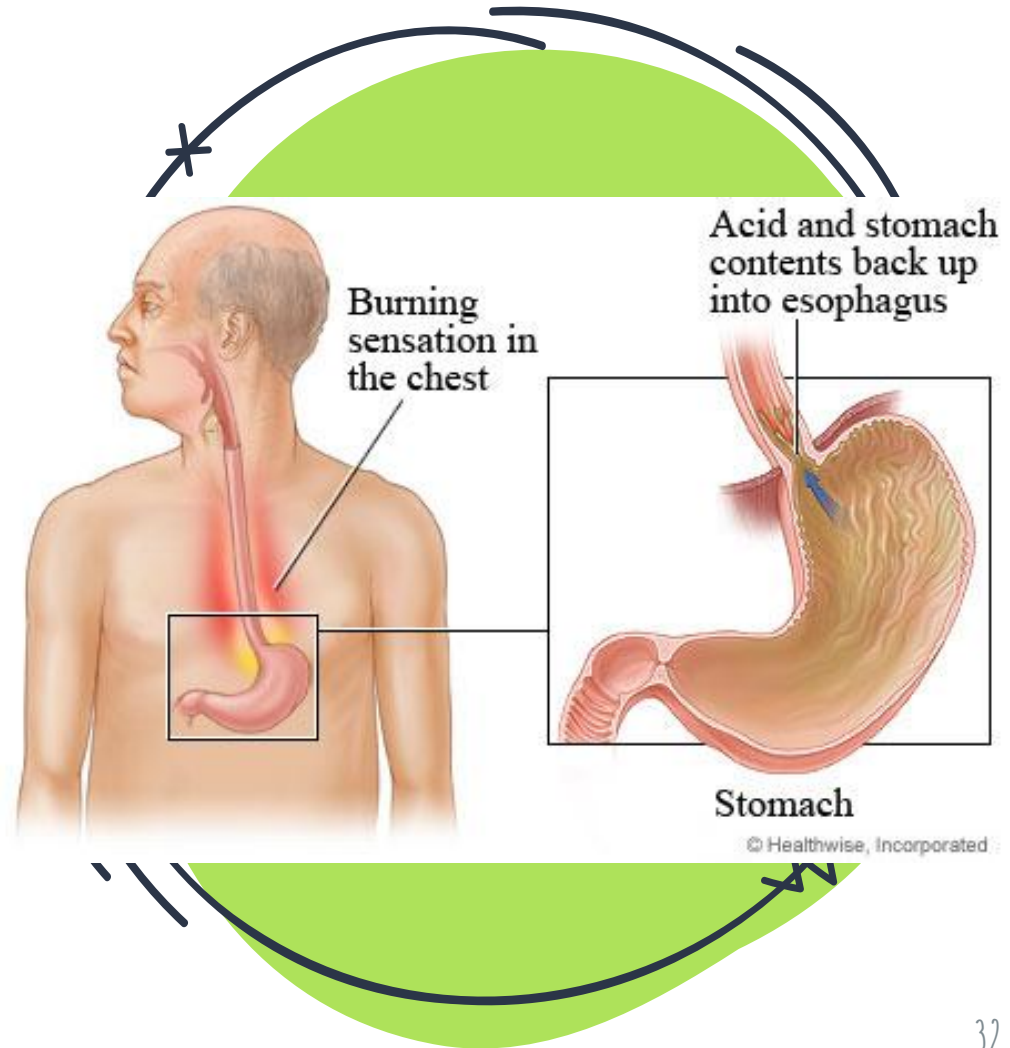
# ACTIVATING PEPSINOGEN INTO PEPSIN: SAFETY MECHANISM



- X Having pepsin only be active in acidic conditions is a **safety mechanism**
- X The stomach secretes acid (in response to presence of **food**) that activates pepsinogen. **Proteins** from **meal** are digested.
- X If pepsin was activated in all conditions, it would digest the proteins that make up the stomach when there is no food present

# ACID REFLUX

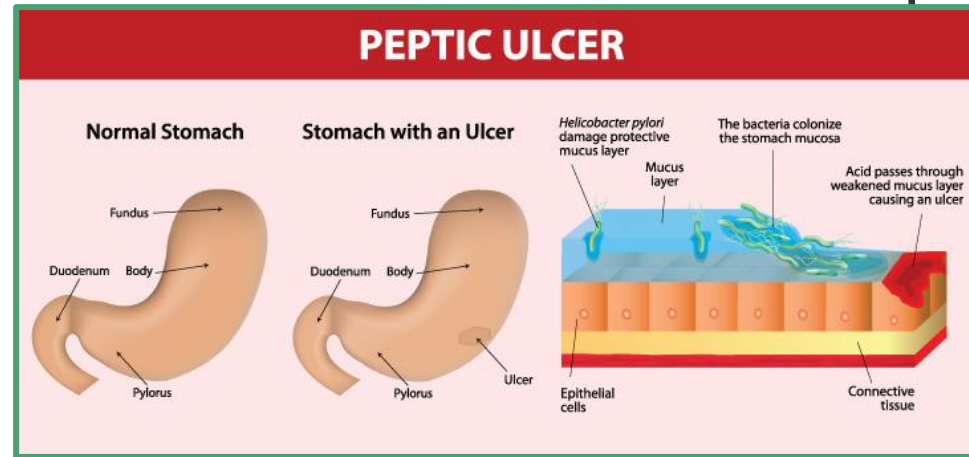
- X Incomplete closing of gastroesophageal sphincter results in **acid** contents of stomach entering **esophagus**
- X Causes burning sensation (heartburn)
- X Risk factors:
  - Overfilled stomach
  - Smoking





# HELICOBACTER PYLORI: PEPTIC ULCERS

- X An ulcer is an **open sore** in the lining of the stomach
- X Can be caused by the presence of **H.Pylori** (bacteria)
- X H. Pylori **prevents** mucus-producing cells from **producing enough mucus** to protect the stomach lining
- X As a result, **acid passes through** weakened mucus layer forming an **ulcer**



## MORE ON *H. PYLORI*

- x *H. pylori* may be transmitted through **food or water**, but the bacteria have also been found in the **saliva** of people with ulcers
- x Stomach acid is strong enough to kill **most** bacteria that enter the stomach.
  - x *H. Pylori*, however, can **withstand** this highly acidic environment. How?
    - Secretes acid neutralizing enzymes and burrows through mucosa
- x **Antibiotics** can successfully eliminate *H. Pylori*



# SUMMARY

## 9.4 Summary

- The act of swallowing moves the chewed food from the mouth, through the esophagus, where wave-like contractions, called peristalsis, move the food to the stomach.
- The process of digestion starts in the mouth, with the physical breakdown of food by the teeth. Chemical digestion also starts in the mouth, with the action of amylase, an enzyme found in saliva.
- The stomach is an organ where food is temporarily stored and chemical digestion continues.
- Gastric juice provides the necessary acidic environment for enzymes to function. It also kills most of the bacteria or other micro-organisms that enter the stomach.
- Mucus present in gastric juice helps protect the stomach from acid damage.
- Gastrin is the major hormone that regulates acid secretion in the stomach.
- Pepsinogen is secreted in the stomach and is converted to pepsin, a protein-digesting enzyme, when exposed to the acid present in gastric juice.
- An ulcer is an open sore in the lining of the stomach caused by the presence of *H. pylori* bacteria in the stomach.

## Homework

P. 411 # 1, 2, 4 & 5