UNIT – II
DIGESTIVE SYSTEM

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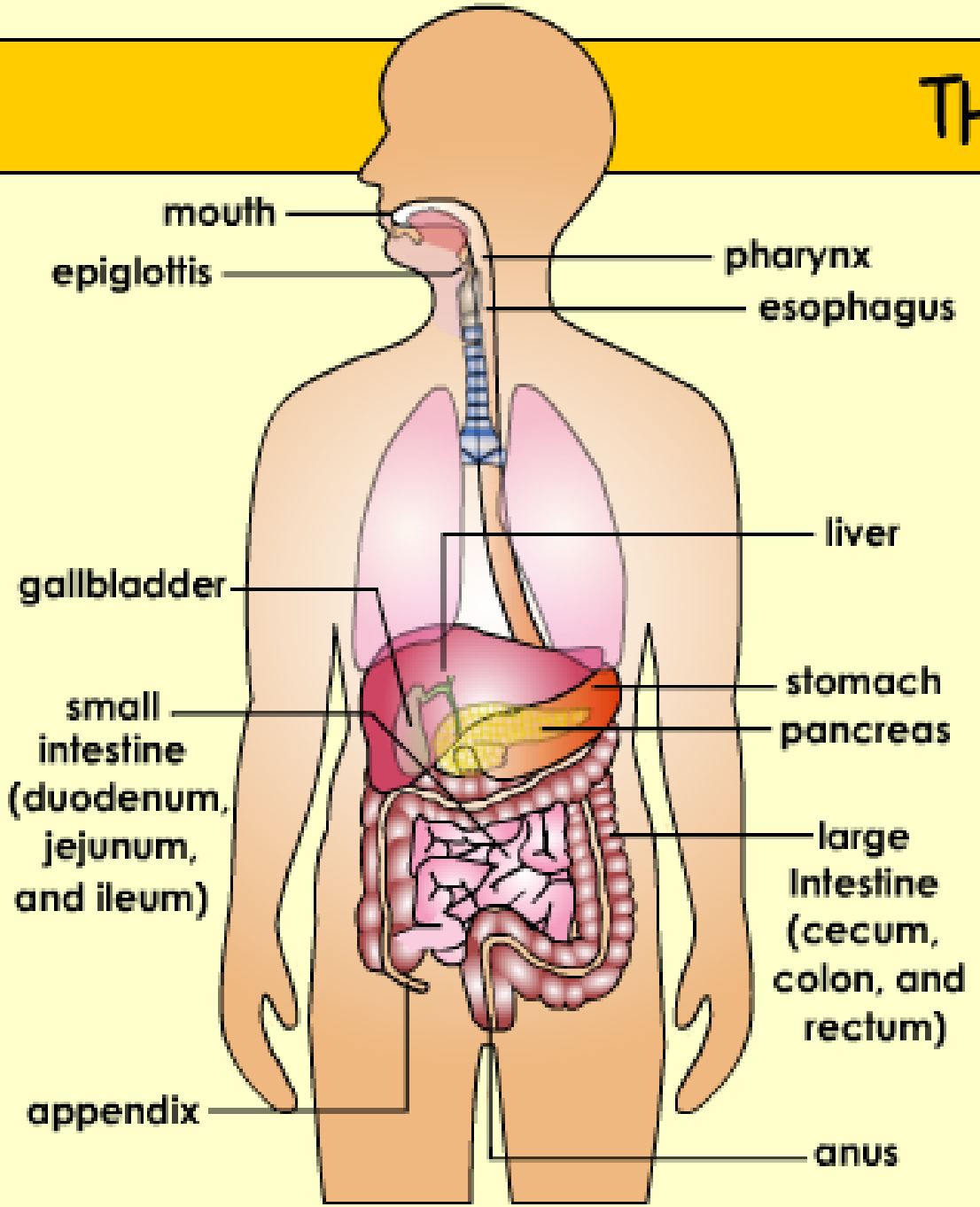
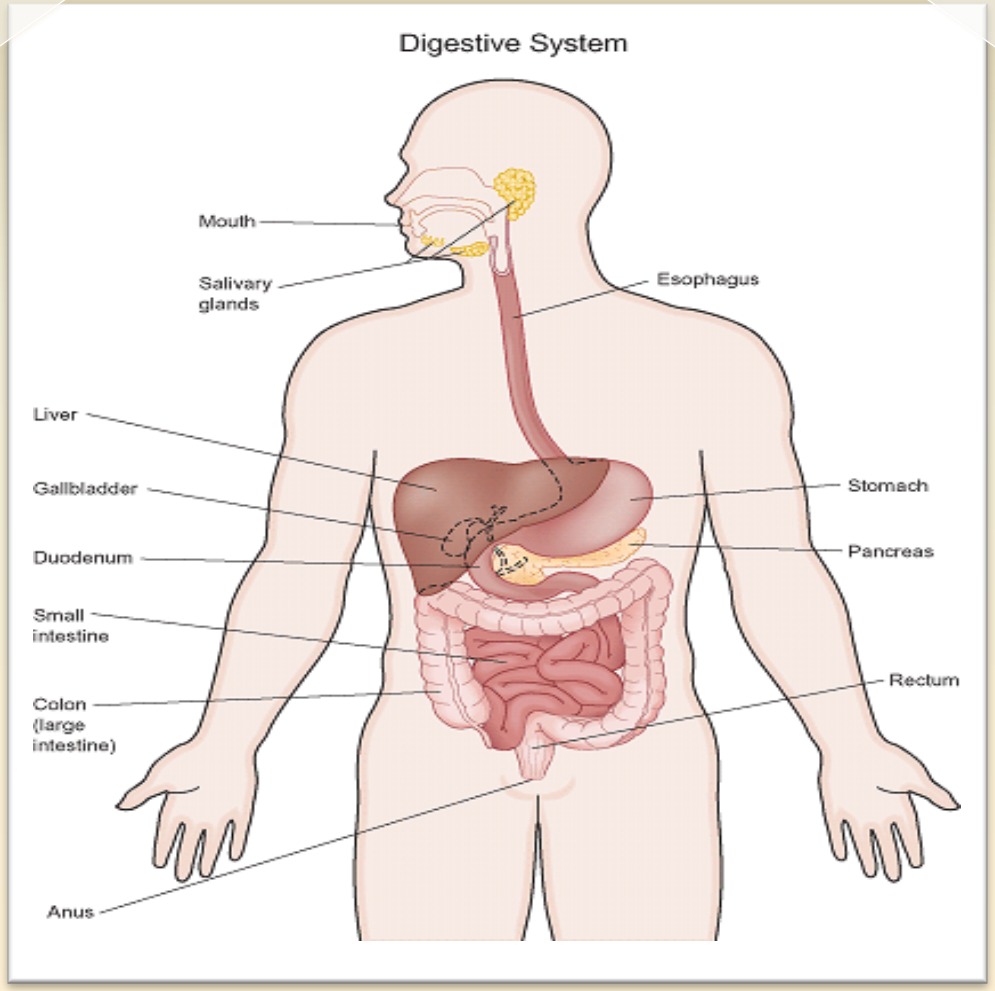
THE DIGESTIVE SYSTEM



DIGESTIVE BREAKDOWN

The digestive system consists of the parts of the body, working together, that help turn food and liquids into the building blocks and fuel the body needs.

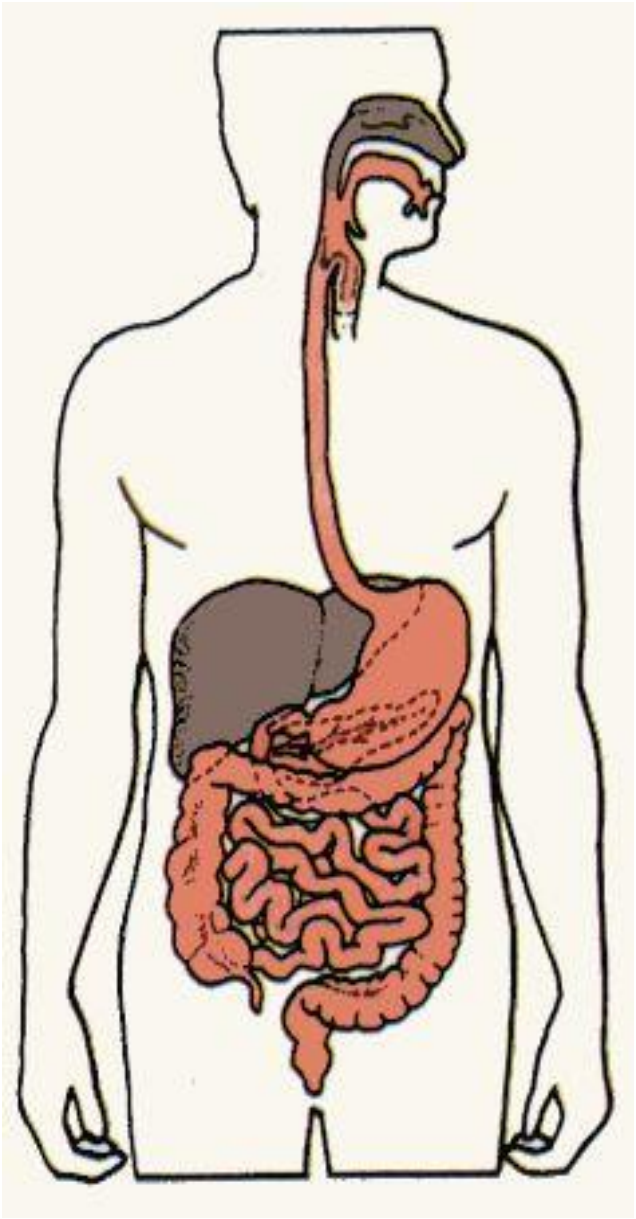
ROLL OVER THE LABELS TO FIND OUT MORE.

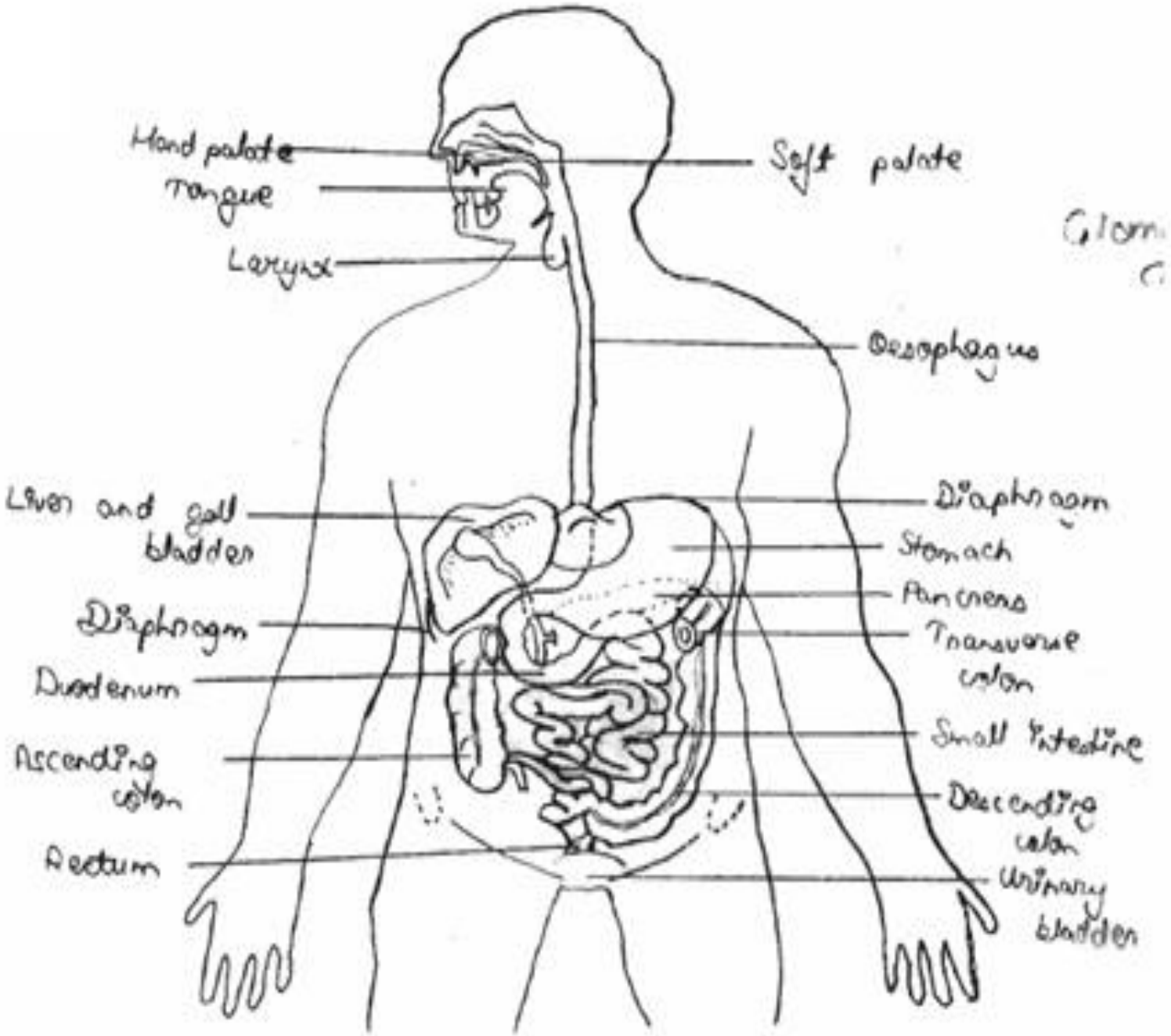


The digestive system is used for breaking down food into nutrients which then pass into the circulatory system and are taken to where they are needed in the body.

- **Digestion:**

  The conversion of complex food into simple form so that it is easily absorbed in the blood is described as digestion.




Hard palate
Tongue
Larynx
Soft palate
Oesophagus
Liver and gall bladder
Diaphragm
Stomach
Pancreas
Transverse colon
Small intestine
Descending colon
Urinary bladder
Diaphragm
Duodenum
Ascending colon
Rectum

1. Alimentary Canal

a. Mouth
b. Pharynx
c. Esophagus
d. Stomach
e. Small intestine
f. Large intestine

2. Accessory Digestive Organs

a. Teeth
b. Tongue
c. Salivary glands
d. Gall bladder
e. Liver
f. Pancreas

2 main groups of organs in the digestive system.

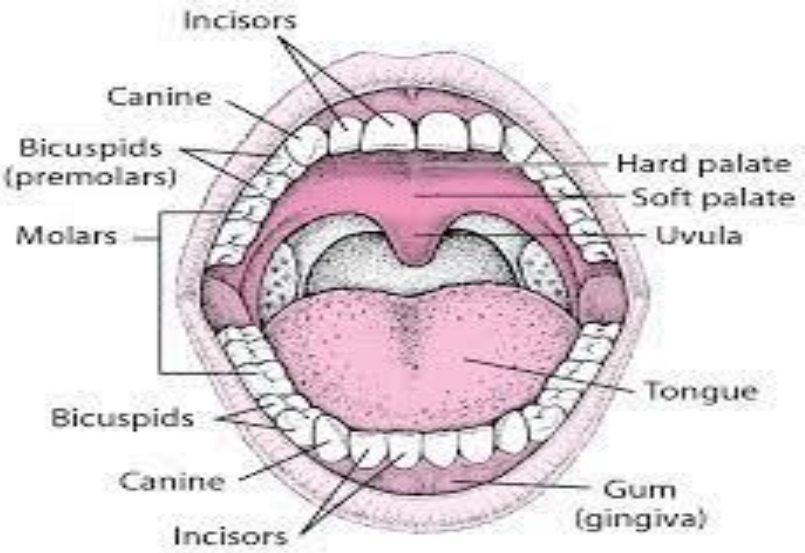
MOUTH

✓Is upper expanded portion which forms the beginning of alimentary canal.

- The important structure of mouth are:

a) Tongue

b) Teeth



TONGUE

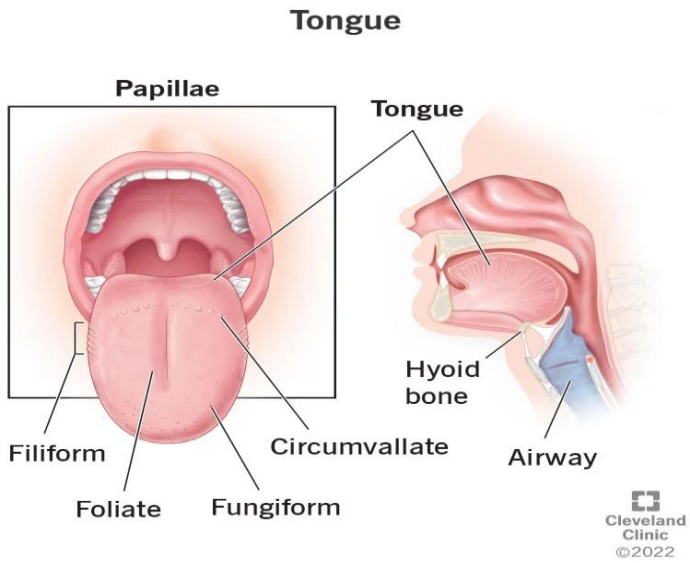
- Tongue lie in the floor of the mouth and it is attached to hyoid bone.
- Tongue contains: A root at which blood vessel and nerves pass.
- There are four types of taste bud present on the upper surface

a. Circumvallate papillae

b. Fungiform papillae

c. Filiform papillae

d. Folate papillae



TEETH

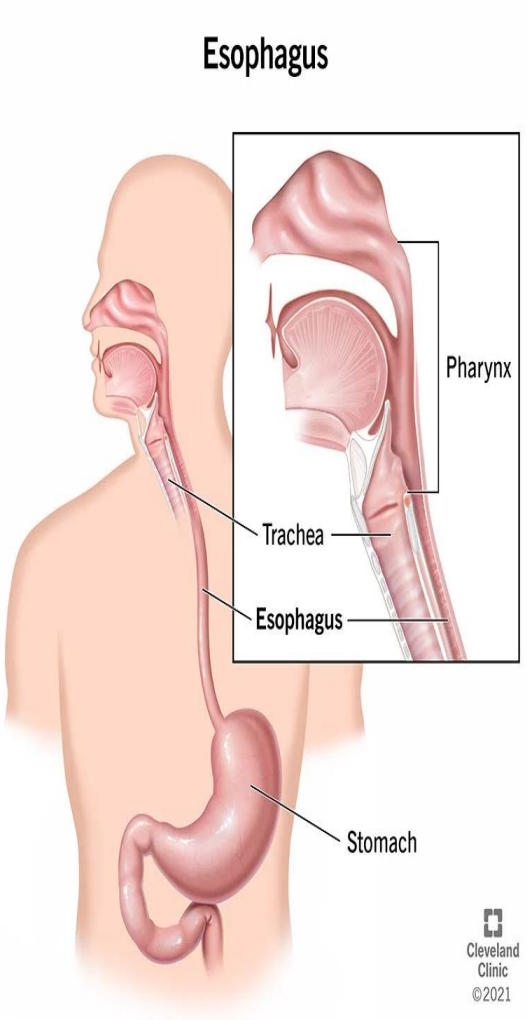
- Teeth are concerned with mastication (chewing)
- Depending on the age at which they are arises
- Teeth can be classified as-
- Permanent teeth - 32
- They are: 8 incisors, 4 canine, 8 premolars, 12 molars.

PHARYNX

- Nasopharynx - It is not the part of digestive system
- Oropharynx - It is situated posterior to oral cavity.
- Laryngopharynx - It is situated below the oropharynx and connected to the oesophagus.

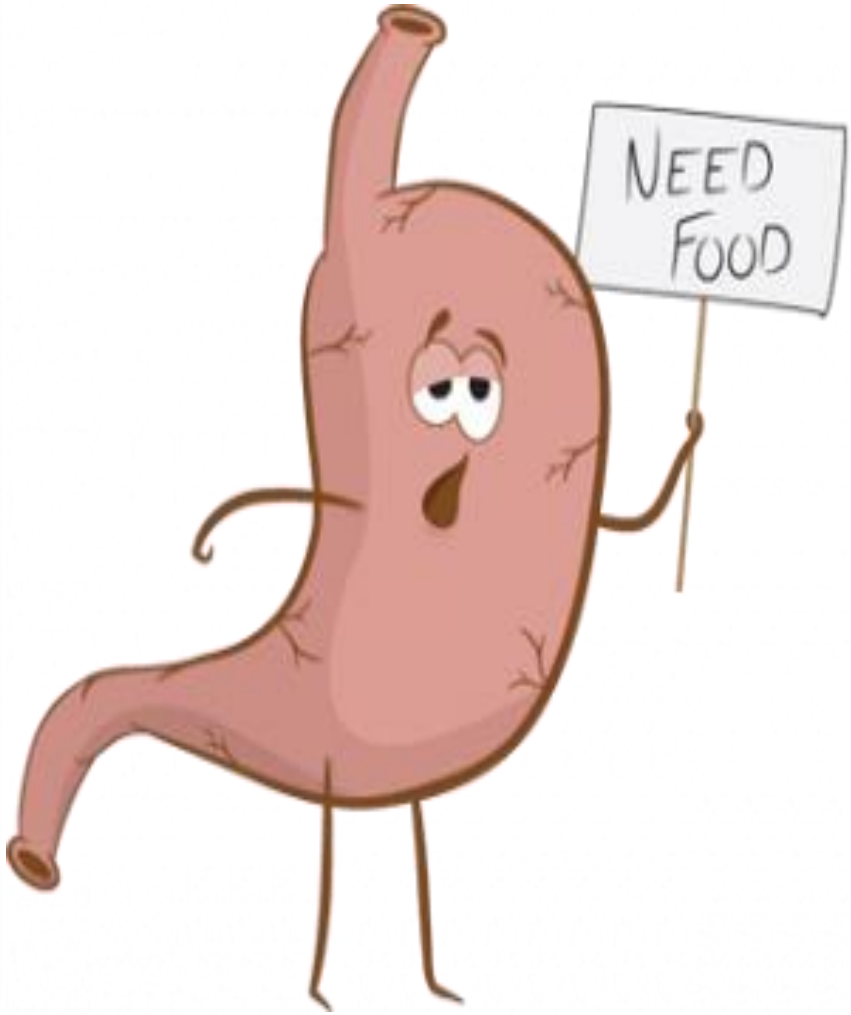
OESOPHAGUS

- It runs from pharynx to stomach.
- It is about 25 cm.
- It is a mucus muscular membrane lined tube.
- They perform peristalsis movement (involuntary rhythmic muscle contraction).



STOMACH

- J- shaped dilated portion of alimentary canal.
- Situated in the epigastric region of abdominal cavity.
- It is connecting organ between esophagus and duodenum.



STRUCTURE OF STOMACH

- Continuous with esophagus at cardiac sphincter above & with duodenum at pyloric sphincter below.

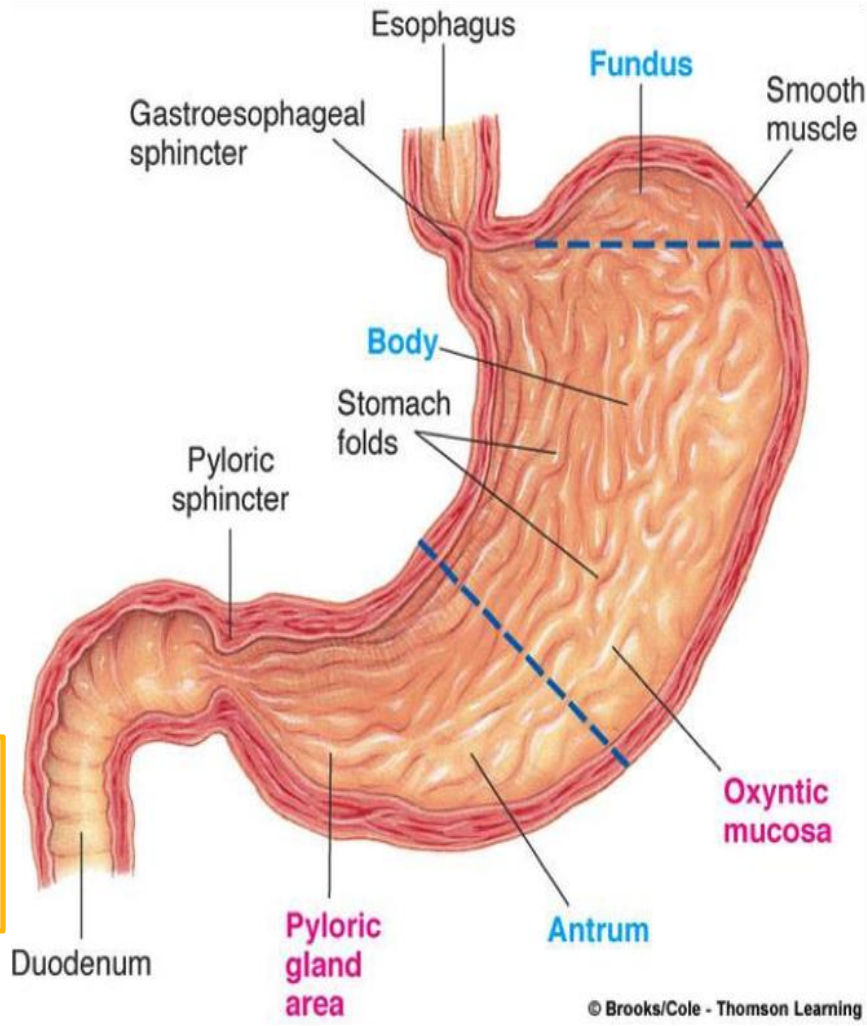
- Two curvatures:

Lesser

- Concave medial border of stomach.
- Complete J-shape.

Greater

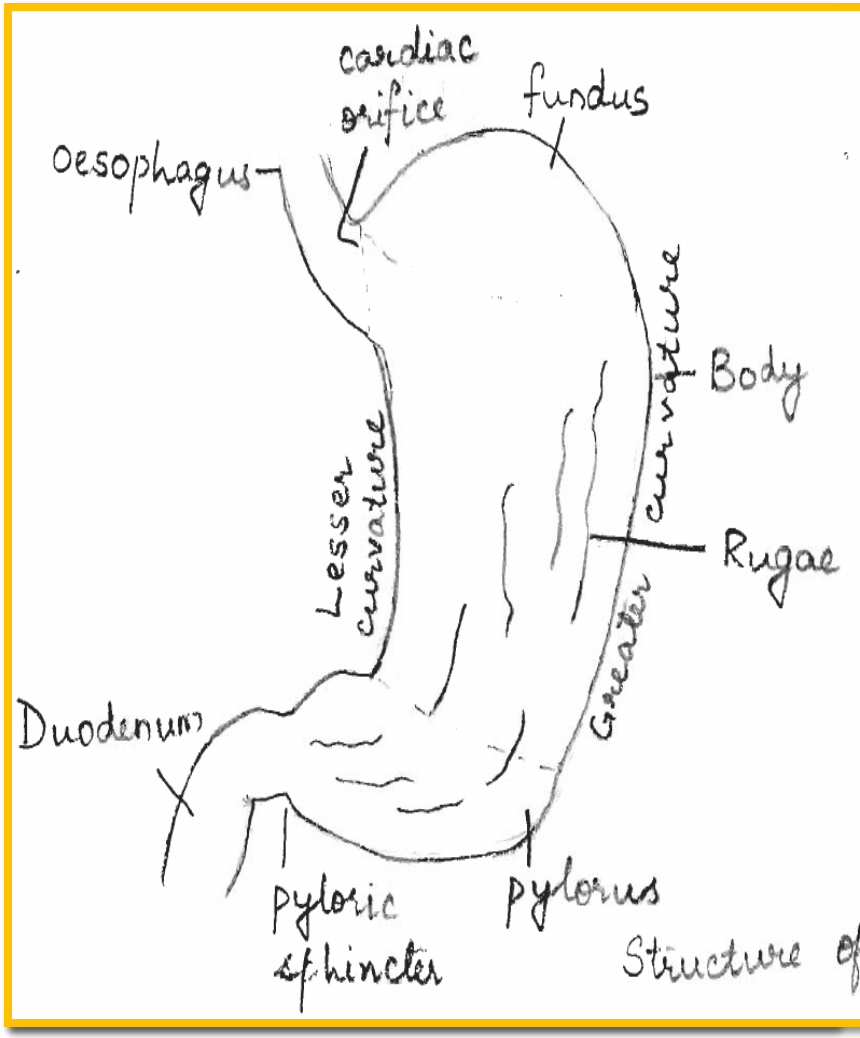
- Convex lateral border of stomach.



STRUCTURE OF STOMACH

- Stomach is divided into three regions:

1. **Fundus:** Rounded & superior portion.
2. **Body:** Large central portion inferior to fundus.
3. **Pylorus:** Region that connects to duodenum.



Two Parts:

P. Anthrum	P. Canal

STRUCTURE OF STOMACH

WALLS OF STOMACH:

1. The Serosa:

- Outermost covering of the stomach.
- Made up of simple squamous epithelium and areolar connective tissue.

2. The Muscularis:

- Located below serosa. Composed of 3 smooth muscle layers.
- Outer- Longitudinal muscles, Middle- circular, Inner- Oblique.

3. The Submucosa:

- It connects the mucosa to the muscularis.
- Made up of Areolar connective tissue.

4. The Mucosa:

- It is innermost layer of wall of stomach.
- Made up of Simple columnar epithelium cells.

FUNCTION OF STOMACH

1. Temporary storage of food:

- So that it allowing time for the digestive enzymes pepsin to act.

2. Mechanical digestion:

- Stomach mixes food with the gastric juice.

3. Chemical digestion:

- Pepsin converts proteins to polypeptides.

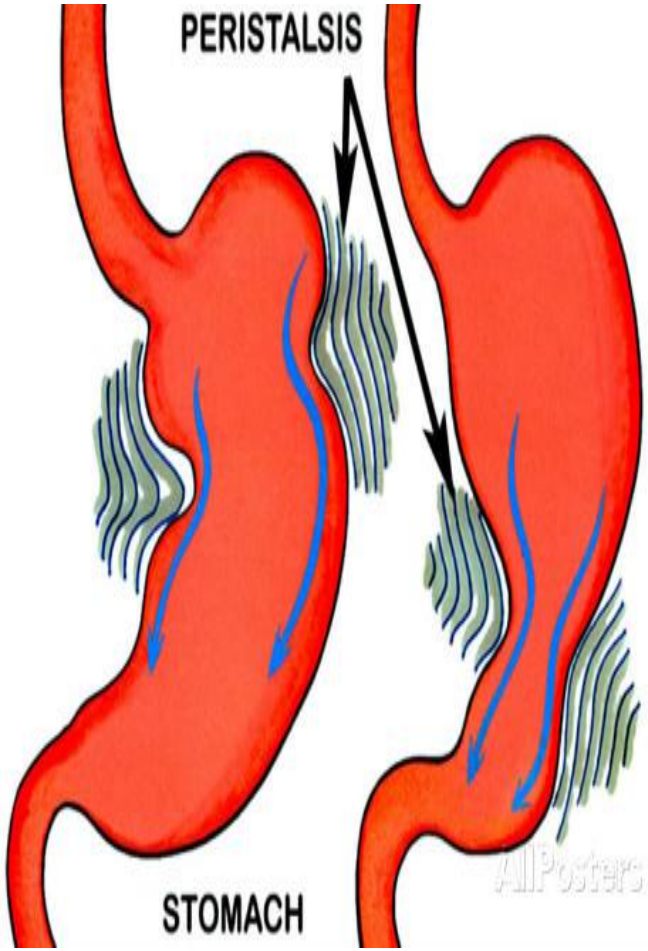
4. Limited absorption of water, alcohol and lipid soluble drugs :

5. Non specific defense :

- Strong acidic pH due to HCl kills the bacteria in food thereby providing protection.

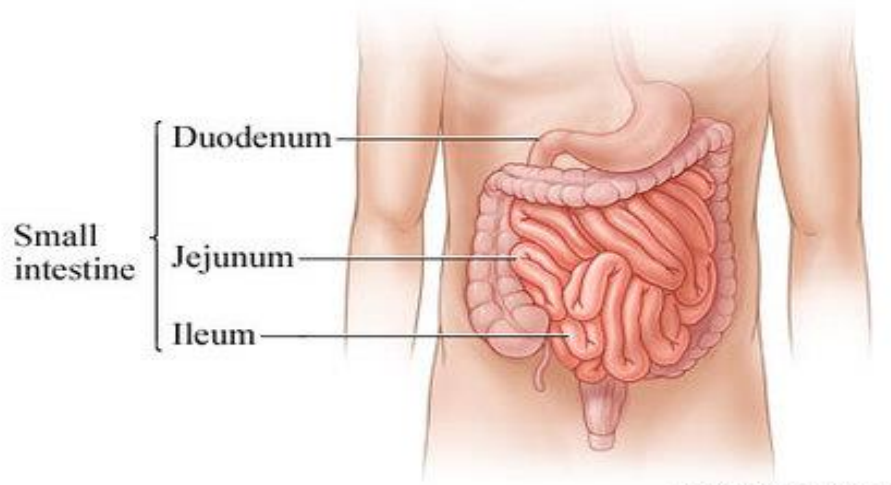
FUNCTION OF STOMACH

6. Intrinsic factor production for vit B_{12} absorption.
7. It causes secretion of about 1 to 2 litres of gastric juice every day.
8. Cardiac sphincter inhibit reflux of acid from stomach to esophagus.
9. Pyloric sphincter-
   - Passage of chyme from stomach to deodenum.
   - Prevent backflow of chyme from deodenum to stomach.



SMALL INTESTINE

- Small intestine is the part of alimentary canal which extended from the pyloric end of stomach to caecum (first part of large intestine).
- Following are the parts of small intestine-
  a. Duodenum
  b. Jejunum
  c. Ileum



DUODENUM

- It is C-shaped fixed structure which is attached to posterior abdominal wall by peritoneum. The bile duct and pancreatic duct open together at duodenum.

JEJUNUM

- It is the continuation of duodenum and it is the middle portion of small intestine.

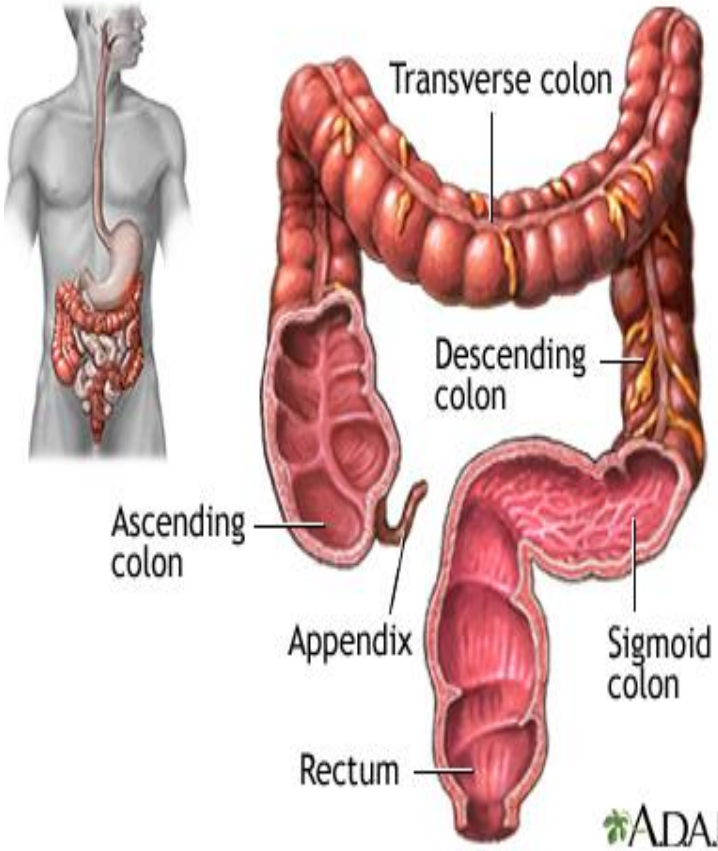
ILEUM

- It forms the last part of small intestine.

LARGE INTESTINE

- It extends from the end of ileum to rectum. Large intestine consist of following parts-

a. Cacum
b. Appendix
c. Ascending colon
d. Transverse colon
e. Descending colon
f. Sigmoid colon



FUNCTIONS OF LARGE INTESTINE

1. Digestion- This is carried out by microorganism of colon. They are act on the undigested and unabsorbed residue from small intestine.

2. Absorption- All carbohydrate, proteins and fat are already absorbed in small intestine. Only water and glucose are absorbed in the colon.

3. Secretion- Mucin is the only secretion. It lubricates the colon and facilitates the passage of fecal matter.

4. Excretion- Iron and some purgatives are excreted in large intestine.

RECTUM

- It occupies the lower posterior part of pelvis. It extends between sigmoid colon and anus. The lower part of rectum is dilated and it is called rectal ampulla.

ANUS

- It is a small canal measuring about one inch in length. The opening of anus is guarded(protect) by a sphincter called anal sphincter. This sphincter is under voluntary control.

FUNCTIONS OF DIGESTIVE SYSTEM

1. **Ingestion:** Taking foods and liquid into mouth i.e. Eating and drinking.

2. **Secretion:** Secrete about 7 liters of water, acid, buffers and enzymes into lumen.

3. **Mixing & Propulsion:**

   Alternating contractions & relaxations of smooth muscles mix and propel towards the anus (Motility & Peristalsis).

FUNCTIONS OF DIGESTIVE SYSTEM

4. **Digestion:**

Mechanical breakdown of food by mastication (Chewing).
Chemical digestion of food into small molecules by enzymes.

5. **Absorption:**

Digested food substances pass through the walls of alimentary canal into blood capillaries for circulation & use by body cells.

6. **Elimination:**

Food that can't be digested and absorbed are excreted from alimentary canal as faeces (Defecation).

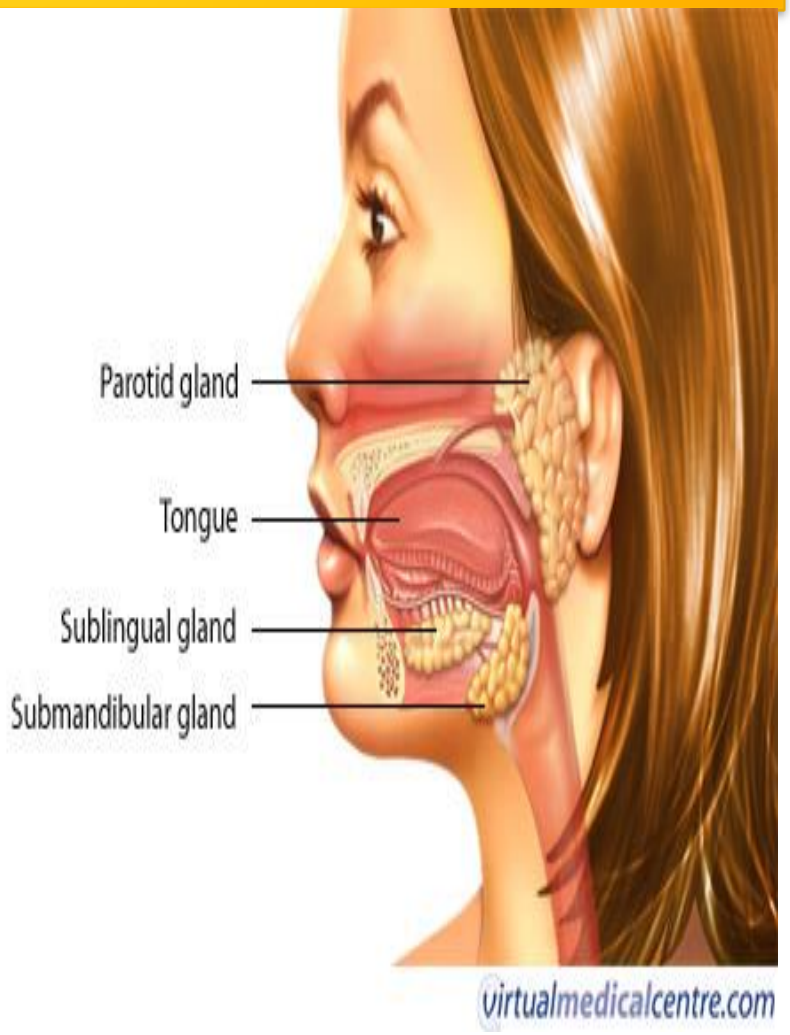
DIGESTIVE GLANDS

I. Salivary glands

1. **Parotid Glands-** One on each side of face just below auditory canal.

2. **Submandibular or Submaxillary glands-** One on each side of face under the angle of jaw.

3. **Sublingual glands-** Below the tongue.



SALIVA

pH- 5.8 -7.4. About 1.5 litres of saliva is produced daily.

- **Composition:**

1. Water
2. Mineral salts
3. Enzyme- Salivary amylase (Ptyalin)
4. Mucus
5. Lysozyme
6. Immunoglobulin
7. Blood clotting factors

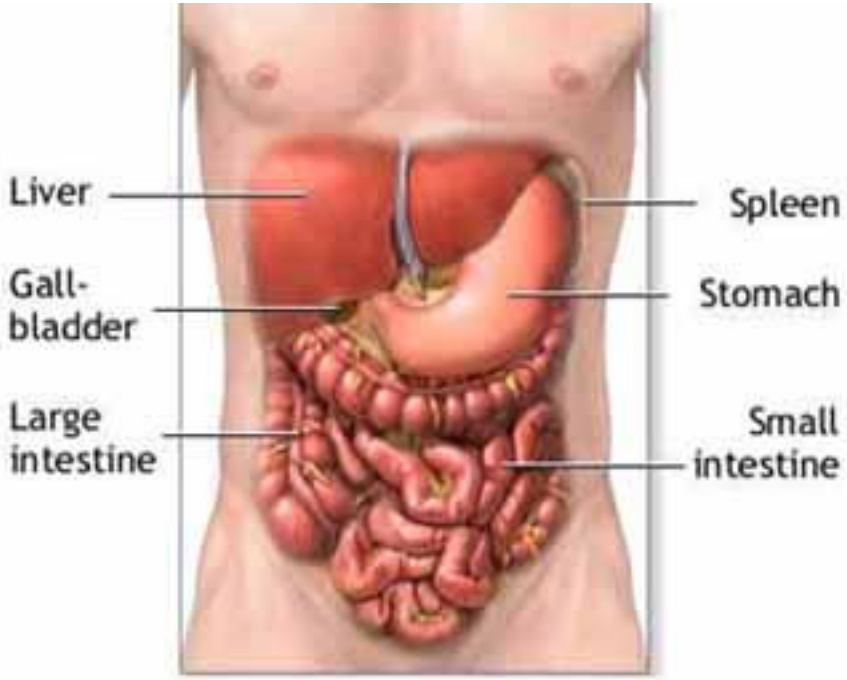
SALIVA

- **Functions:**

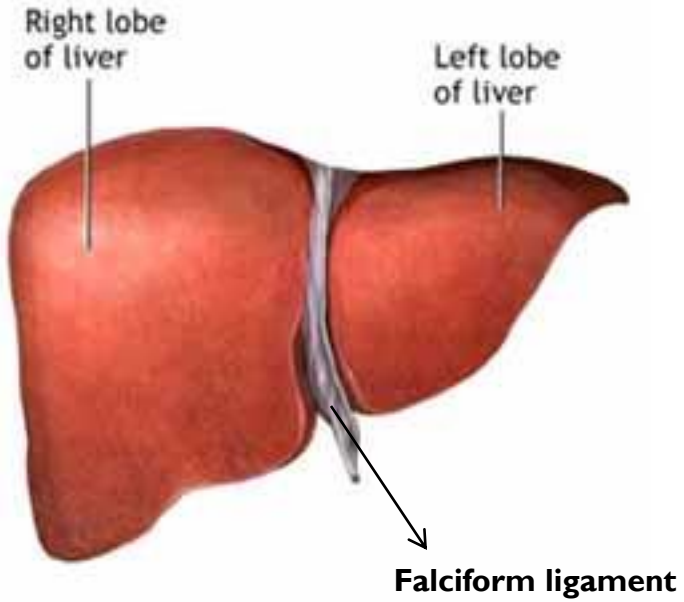
1. **Chemical digestion of polysaccharides -** the salivary amylase acts on the starch & reduces them to disaccharides.
2. **Lubrication of food.**
3. **Cleaning & lubricating the mouth.**
4. **Sense of Taste by lubrication of food.**

LIVER

- Largest gland in the body.
- Location: Uppermost part of abdominal cavity on right side beneath diaphragm.
- Four lobes- Right, left, Caudate and Quadrate.



Picture 1: Location of the Liver



Picture 2: Lobes of the Liver

FUNCTIONS OF LIVER

1. **Carbohydrate metabolism (Glycogenic function) -** The hepatic cells by the action of enzymes convert glucose into glycogen and it is then stored in the liver.
2. **Metabolism of fat-** Whenever energy is needed, the saturated stored fat is converted to a form in which it can be used to provide energy.
3. **Protein metabolism (Formation of urea) -** Hepatic cell by the action of the enzyme cause deamination of amino acid, i.e. amine group is set free which forms urea.

FUNCTIONS OF LIVER

4. **Formation of plasma protein & blood clotting factors.**
5. **Formation of RBCs in foetal life.**
6. **Destruction of RBCs** forming bile pigments and iron.
7. **Formation of heparin**, a natural anticoagulant in the blood.
8. **Storage:**

1) Glycogen 2) Fat soluble vitamins

3) Iron and copper 4) Vitamin B_{12}.

FUNCTIONS OF LIVER

9. **Maintenance of body temperature (Heat production)**– As a number of chemical reaction occur in the liver, heat is generated which is helpful in maintaining body temp.
10. **Excretion of toxic substance**-The toxic substances entering the body through alimentary canal are destroyed in liver.
11. **Inactivation of hormones**: Insulin, glucagon, cortisol, aldosterone, thyroid and sex hormones.

FUNCTIONS OF LIVER

12. **Secretion of bile**- Bile salts are helpful in digestion and absorption of fats by its emulsification.

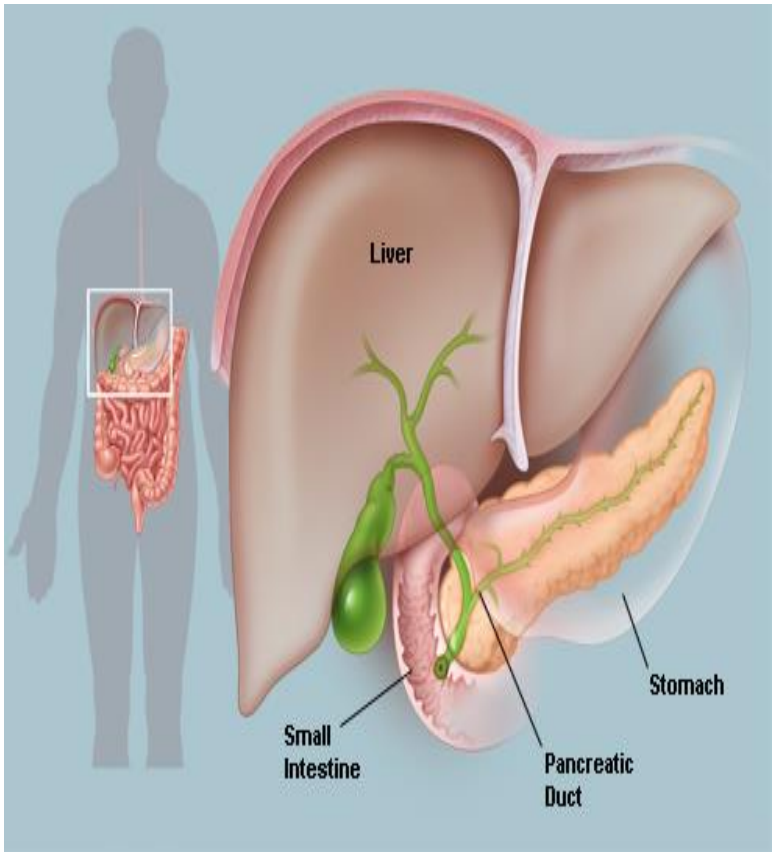
13. **Synthesis of vitamin A from carotene**: Carotene is the pro vitamin found in some plants, e.g. carrots and green leaves of vegetables.

BILE – SECRETION OF LIVER

pH- **7.6 -8.6. About 1.0 liter of bile is produced daily.**
Stored in the Gall bladder.

- Composition:

1. **Water (97.5 %)**
2. **Mineral salts**
3. **Mucus**
4. **Bile salts**
5. **Bile pigment (Bilirubin)**
6. **Cholesterol**



BILE – SECRETION OF LIVER

- **Functions:**

1. **Fat digestion**: Bile salts emulsify the fat.
2. **Absorption**: Bile salts help in the absorption of vit. K & digested fat.
3. **Excretion**: Some heavy metals, toxins, bacteria, cholesterol are excreted by bile.
4. **Bilirubin**: the waste product of RBC breakdown is passed to the intestine where it gets converted to urobilin & stercobilin . Urobilin is excreted in the urine & stercobilin is excreted in the faeces.

GASTRIC GLANDS

1. Mucous cells- It secrete the alkaline mucous for protecting the epithelium from hydrochloric acid.

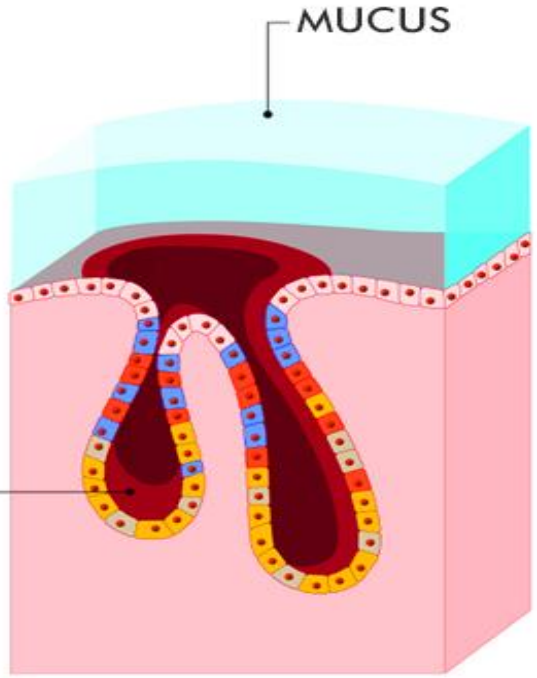
2. Parietal cells- It secrete hydrochloric acid, the acid activates release of pepsin for protein digestion. The acid also kills micro-organisms swallowed with the food.

3. Chief cells- It secrete pepsin, These cells are located in the fundus region.

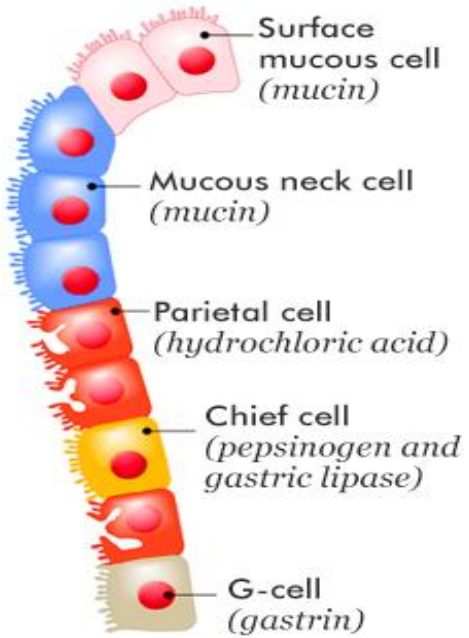
4. G-Cells- It secrete gastrin which stimulates the secretion of hydrochloric acid.

GASTRIC GLANDS

STOMACH



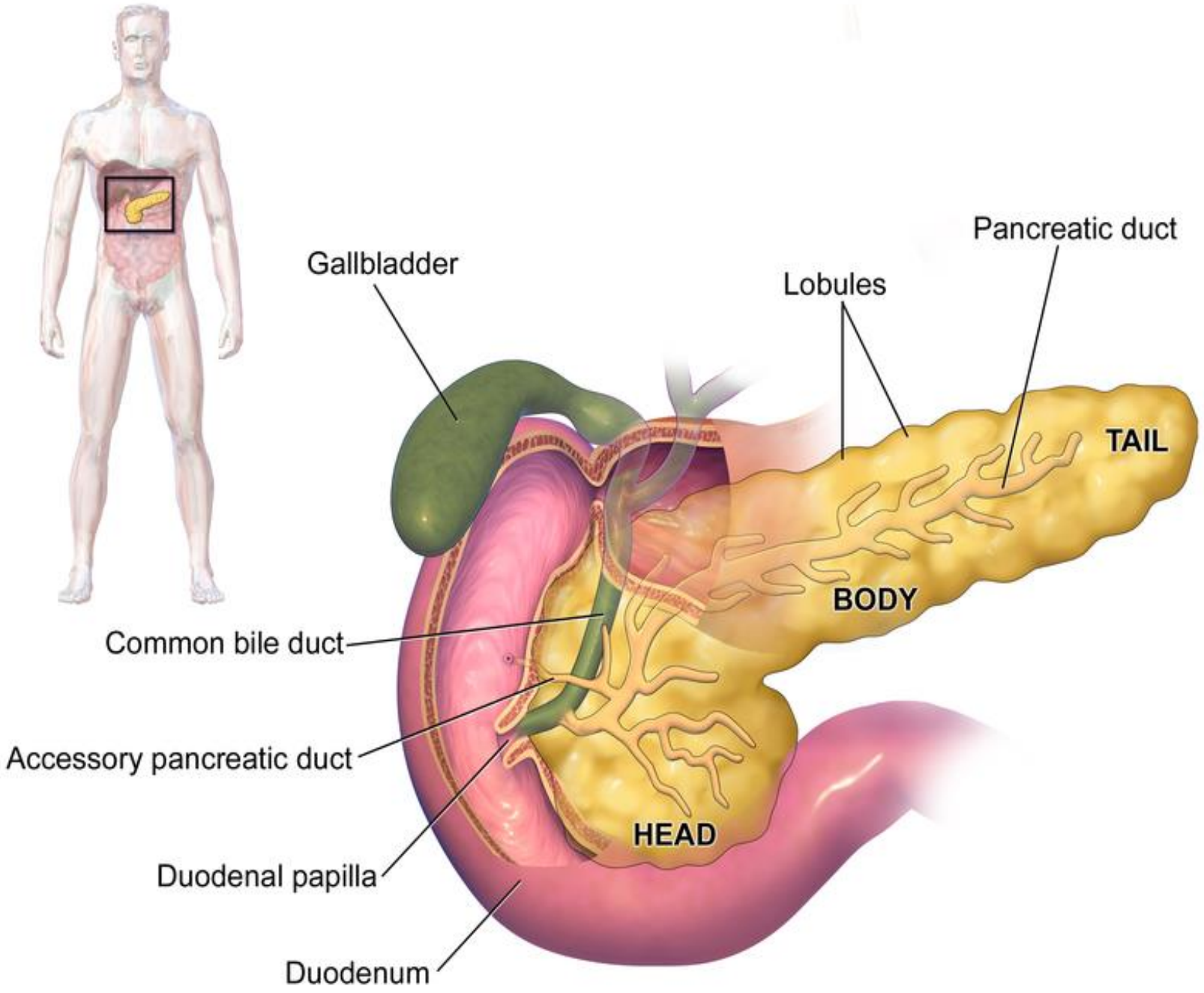
INTERIOR SURFACE OF STOMACH



DIGESTIVE EPITHELIUM

PANCREAS

- Second largest glands
- Heterocrine gland
- Secrete pancreatic juice
- Opens into the duodenum along with the bile duct.
- The bile duct and pancreatic duct open together into the duodenum as the common hepato pancreatic duct which is guarded(protect) by a Sphincter called Sphincter of Oddi.
- Two pats:
- exocrine (97%) – acini + ducts
- endocrine (3%) – islets


Gallbladder
Pancreatic duct
Lobules
TAIL
BODY
Common bile duct
Accessory pancreatic duct
HEAD
Duodenal papilla
Duodenum

EXOCRINE PANCREAS

- SOURCE OF ENZYMES

1. Strucutral unit - acinus
2. Acinus includes – acinicytes, secretory cells, centroacinar cells,
3. beginning of intercalated duct
4. Two zones in acinoctes

- homogenic
- zymogenic

1. Ducts produce fluid with bicarbonates Digestion in gut always accompanied with pancreatic juice production

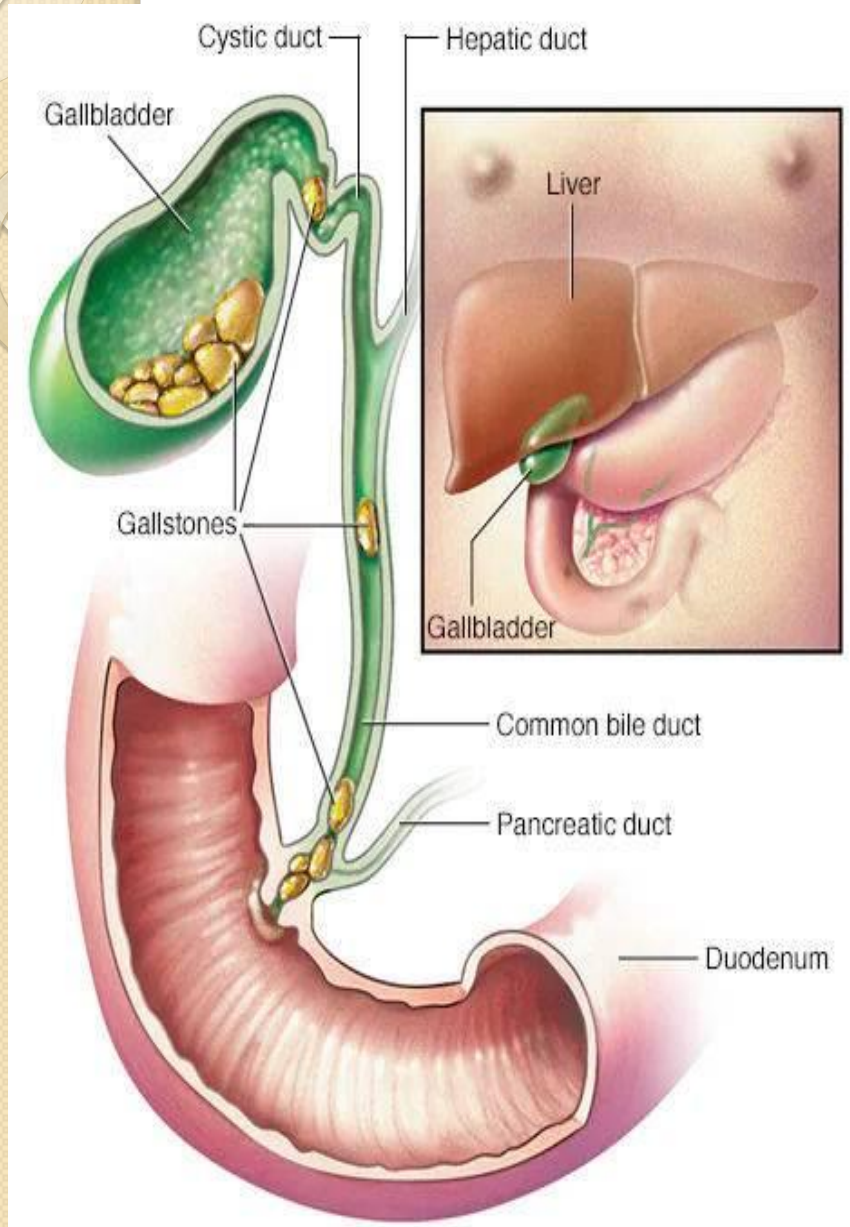
ENDOCRINE PANCREAS

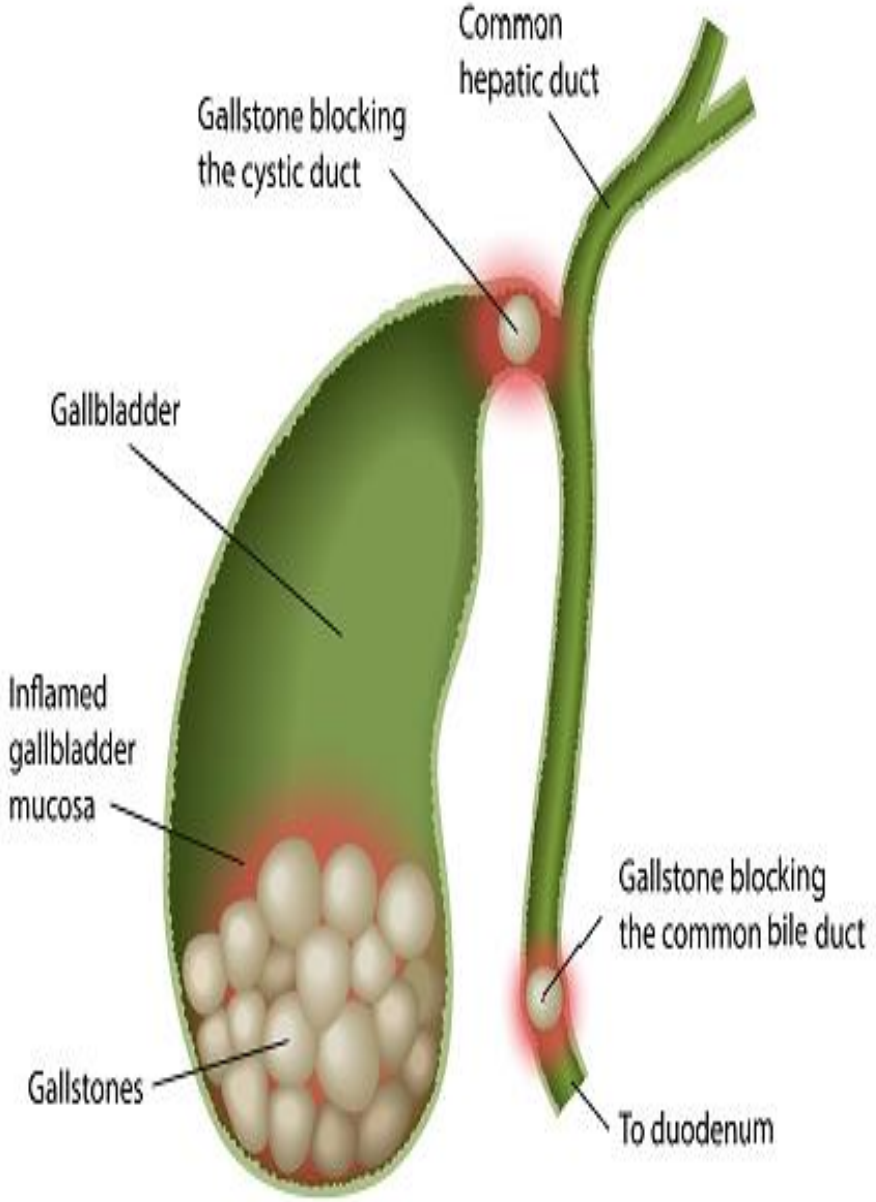
- a-cells – glucagone
- b-cells - insuline
- d-cells – somatostatine
- pp-cells – pancreatic polypeptide

GALL BLADDER

- It is sac like structure on the inferior surface of the liver.
- It is about 8 cm long and 4cm wide
- There are following three main parts of the gallbladder.

1. Fundus – Stores bile juices
2. Body – Begins to taper
3. Neck – Connect to cystic duct





SWALLOWING OR DEGLUTITION

- The Process by which swallowing of food is helped
- It also includes reflex action.
- Helped by movement of pharynx
- Closure of epiglottis to close larynx

STAGES OF DEGLUTITION

- Oral stage (Voluntary)
- Oro - Pharyngeal stage (Involuntary)
- Oesophageal stage

Deglutition (Swallowing)

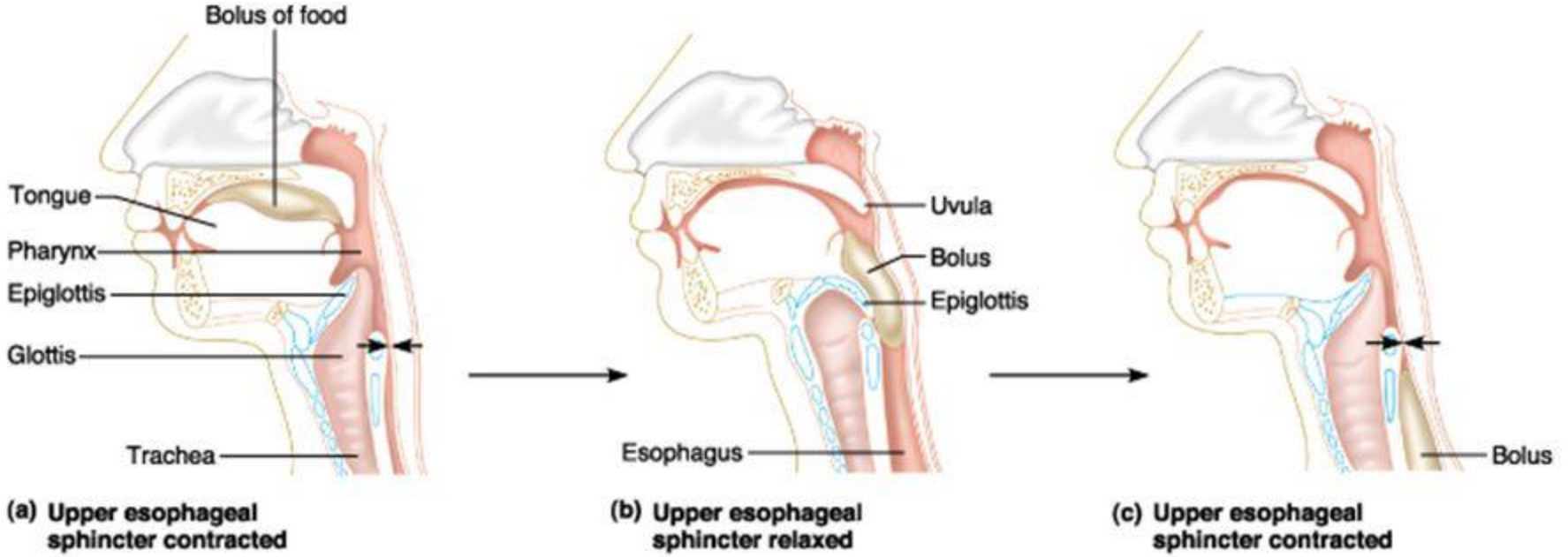
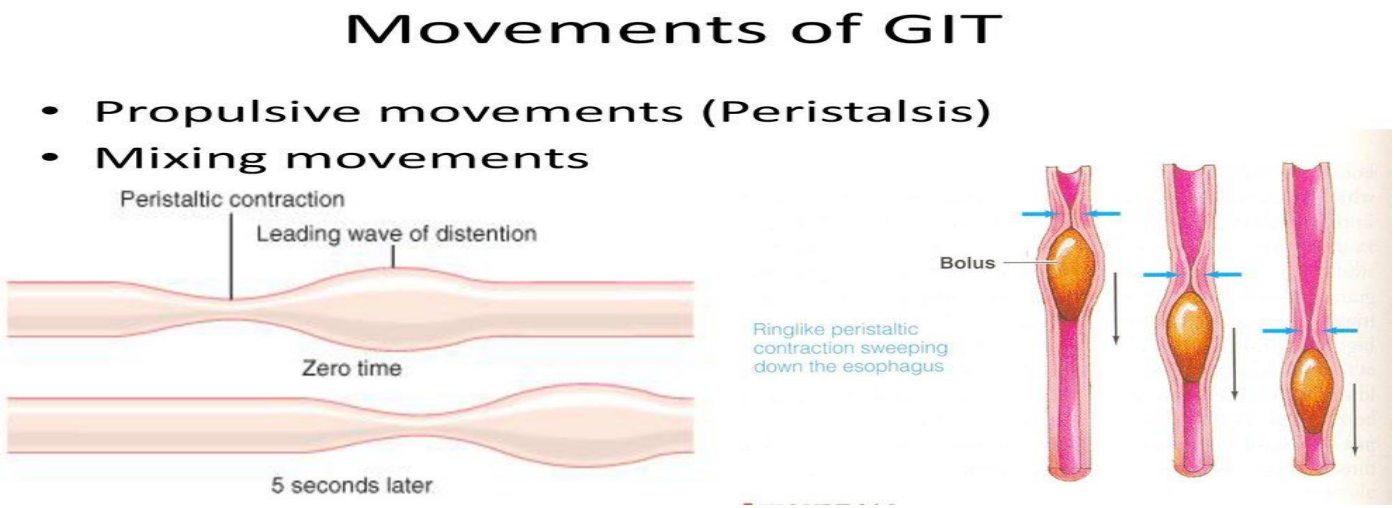


Figure 22.13a-c

MOVEMENTS OF GIT

1. Movements of the Stomach
   a. Stomach Filling
   b. Mixing of Stomach Contents
   c. Stomach Emptying
2. Movement in the Small Intestine
3. Movement in the Large Intestine



GASTRIC JUICE

- pH- **1-3. About 2 litres of gastric juice is produced daily.**

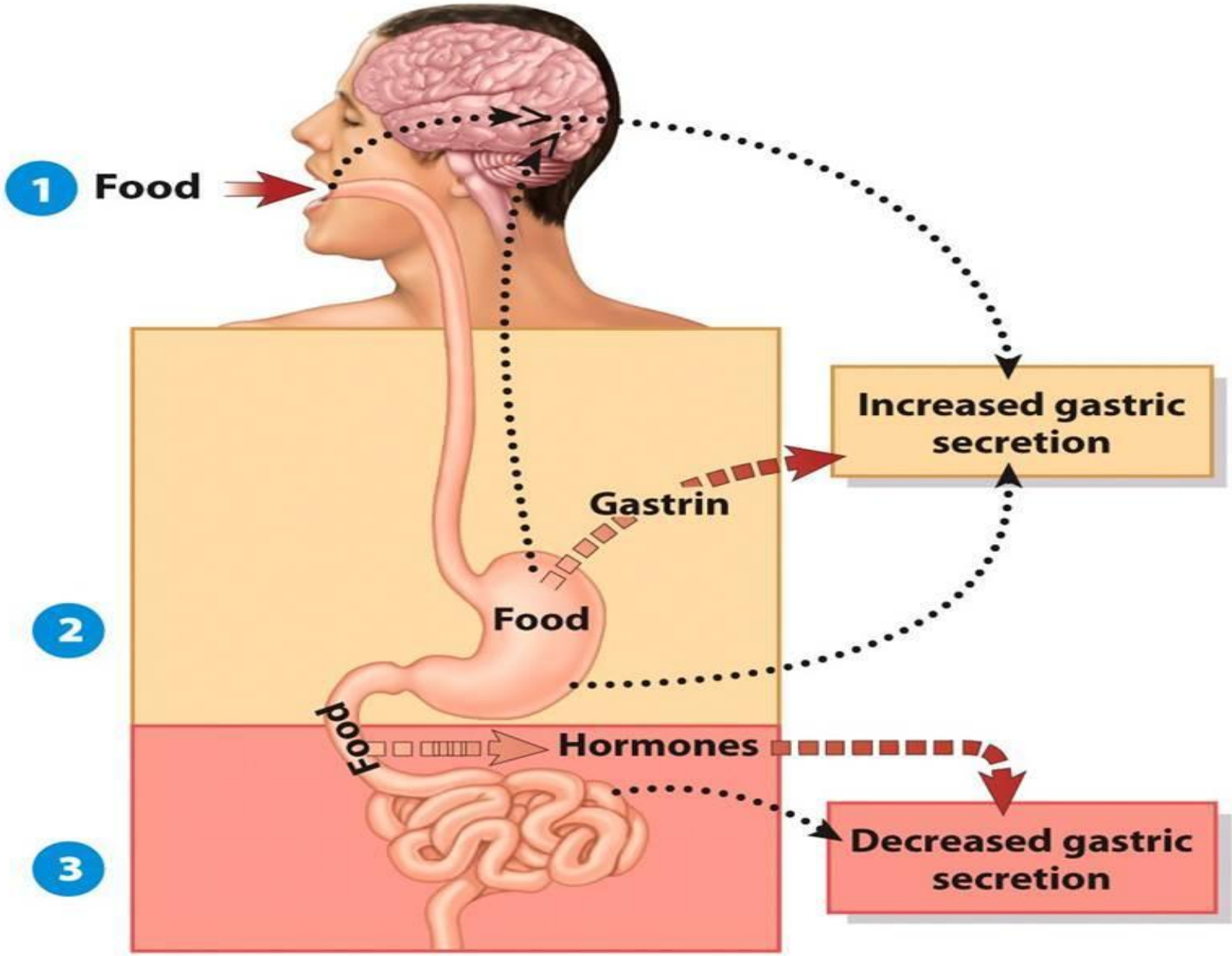
1. Water - Further liquefies food swallow
2. Enzyme- Gastric lipase - Hydrolyses emulsified fats to fatty acids.
3. Mucus - a)Prevent mechanical injury(cut, Punctured) to stomach by lubricating food, b)Prevent Chemical injury to stomach by gastric juice.
4. HCl - Kill ingested microbes, provide acidic environment for digestion.
5. Pepsinogen - Precursor of Pepsin, digestion of protein.
6. Intrinsic factor - Necessary for absorption of Vit. $B_{12.}$

PHASES OF GASTRIC SECRETION

- There are three phases of secretion of gastric juice

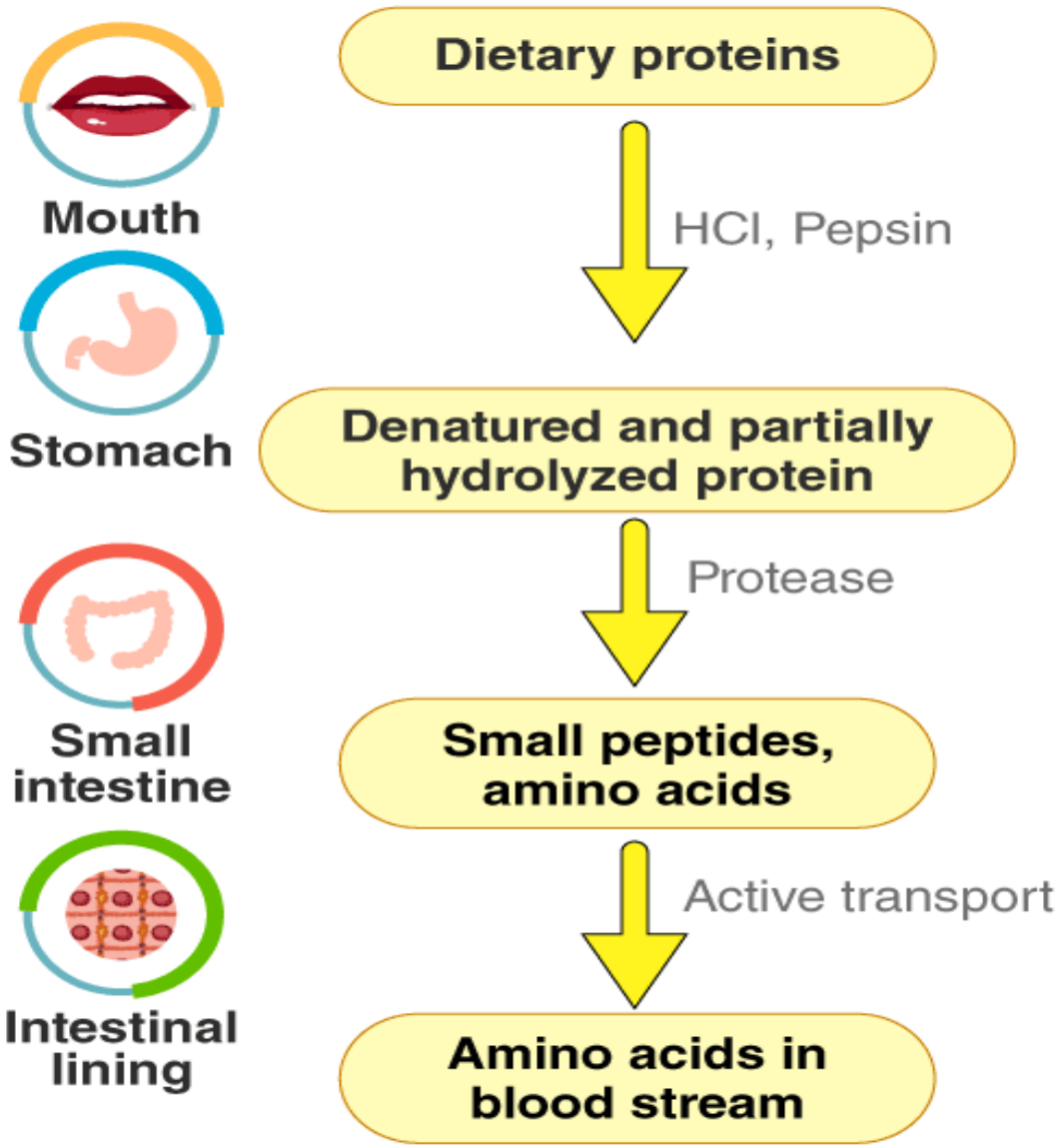
1. **Cephalic phase-** This flow(secretion) of juice occurs before food enters the stomach, especially while it is being eaten. it results from the smell or taste of food.
2. **Gastric phase-** When food enters the stomach, it stimulates the enteroendocrine cells in the pyloric antrum and duodenum to secrete hormone gastrin in blood.
3. **Intestinal phase-** When the partially digested contents of the stomach enter the small intestine slows down the secretion of gastric juice.

PHASES OF GASTRIC SECRETION



DIGESTION AND ABSORPTION OF NUTRIENTS

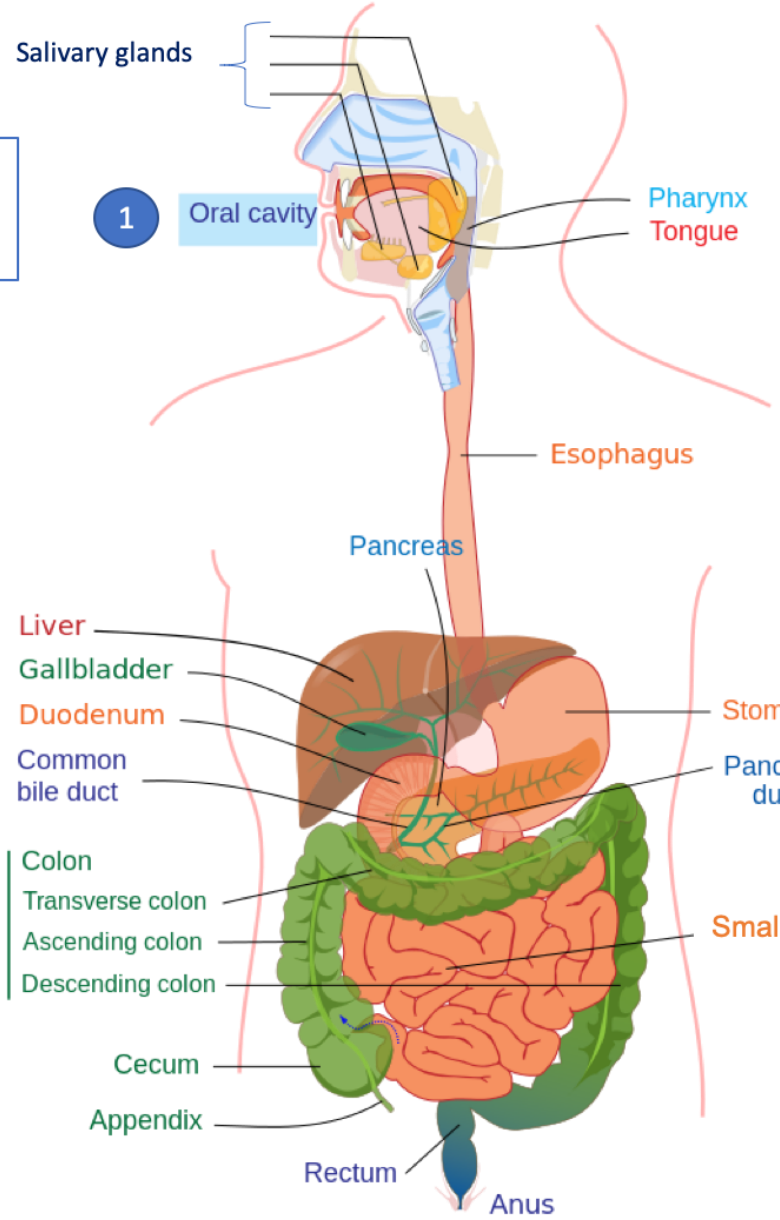
- Digestion is the process of breaking large insoluble food molecules into smaller molecules for absorption into the bloodstream.
- This process involves the use of many digestive fluids and enzymes such as saliva, mucus, and bile.
- Absorption is the process of the absorbing into the cells or across the tissues and organs through the process of diffusion or osmosis.


Dietary proteins
Mouth
HCl, Pepsin
Stomach
Denatured and partially hydrolyzed protein
Protease
Small intestine
Small peptides, amino acids
Active transport
Intestinal lining
Amino acids in blood stream

PEPSIN ROLE IN PROTEIN DIGESTION

- Pepsin is the principal enzyme involved in protein digestion. It breaks down proteins into smaller peptides and amino acids that can be easily absorbed in the small intestine.
- Once a protein source reaches your stomach, hydrochloric acid and enzymes called proteases break it down into smaller chains of amino acids.
- Amino acids are joined together by peptides, which are broken by proteases. From your stomach, these smaller chains of amino acids move into your small intestine.

1. MOUTH
- mechanical digestion (chewing)



2. STOMACH
- denaturation (HCl)
- enzymatic digestion (pepsin)

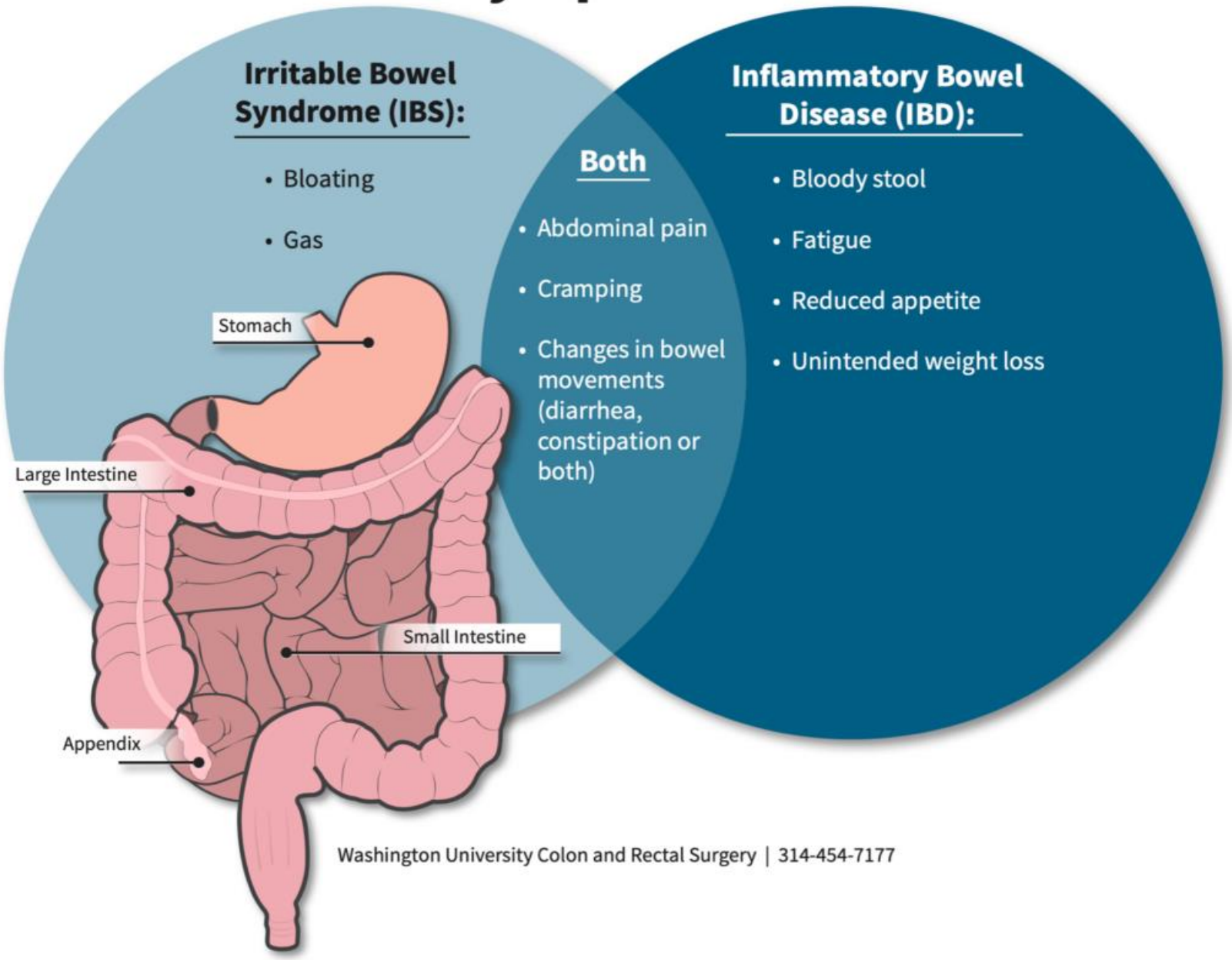
3. SMALL INTESTINE
- enzymatic digestion (chymotrypsin, trypsin, proteases)
- absorption of amino acids, di- and tripeptides

GIT DISORDERS

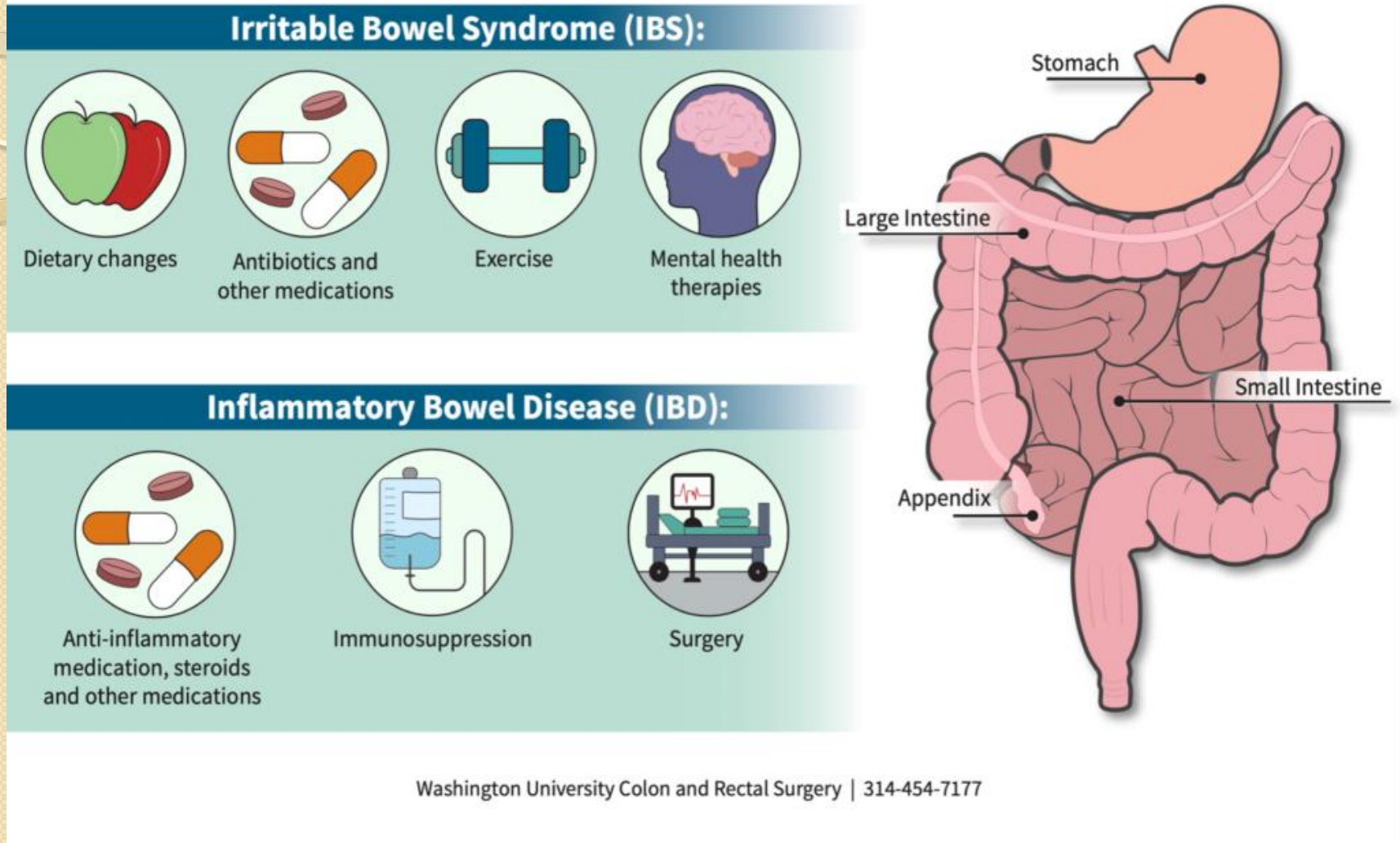
1. Inflammatory bowel disease (IBD) is a term that describes disorders involving long-standing (chronic) inflammation of tissues in your digestive tract.

- **Crohn's disease:** This type of IBD is characterized by inflammation of the lining of your digestive tract, which often can involve the deeper layers of the digestive tract.
- Crohn's disease most commonly affects the small intestine. However, it can also affect the large intestine and uncommonly, the upper gastrointestinal tract.

Symptoms:


Irritable Bowel Syndrome (IBS):
• Bloating
• Gas
Both
• Abdominal pain
• Cramping
• Changes in bowel movements (diarrhea, constipation or both)
Inflammatory Bowel Disease (IBD):
• Bloody stool
• Fatigue
• Reduced appetite
• Unintended weight loss
Stomach
Large Intestine
Small Intestine
Appendix
Washington University Colon and Rectal Surgery | 314-454-7177

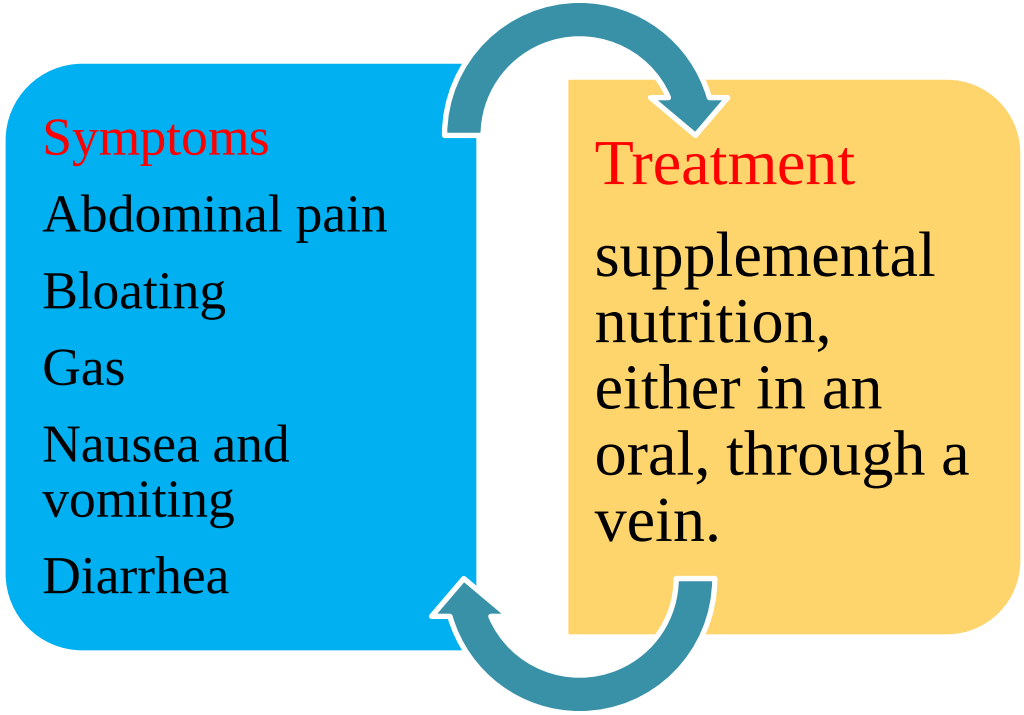
Treatment:



- Diclofenac and ibuprofen, prednisolone, cyclosporine

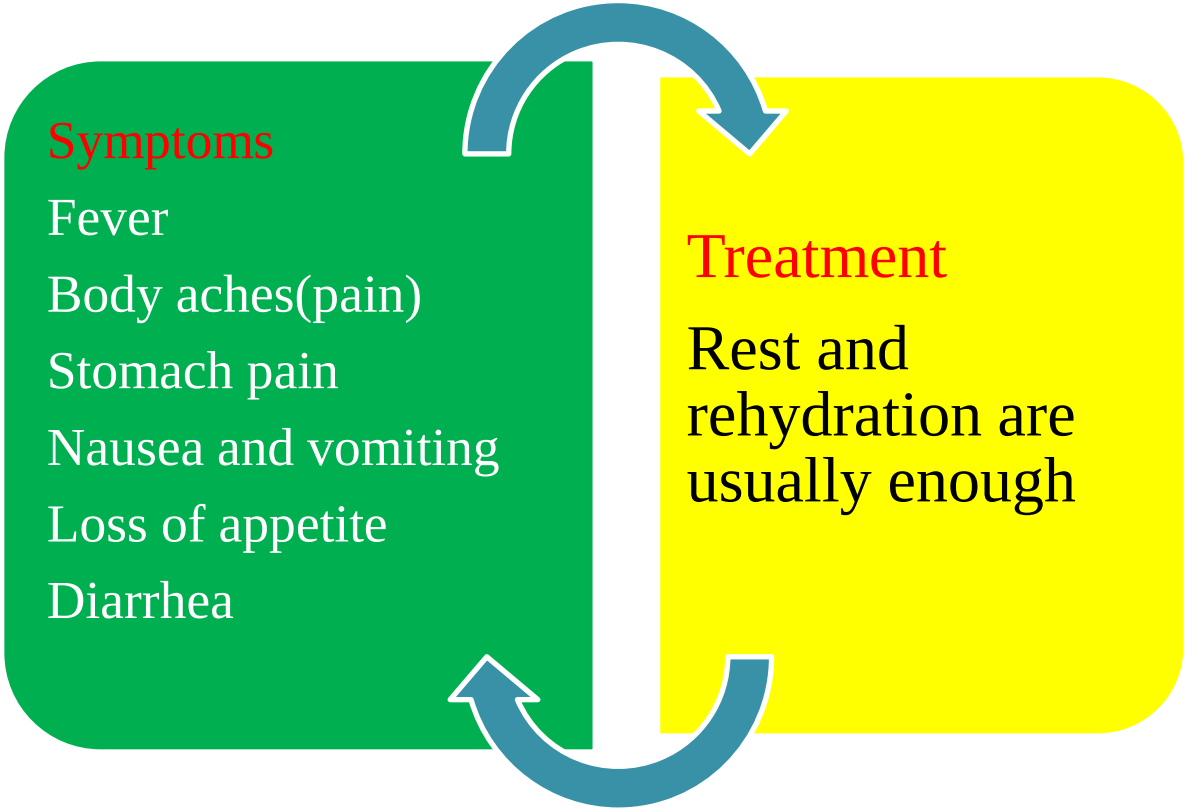
MALABSORPTION SYNDROME

- It is a state arising from abnormality in absorption of food nutrients across the gastrointestinal tract(GIT).



ENTERITIS

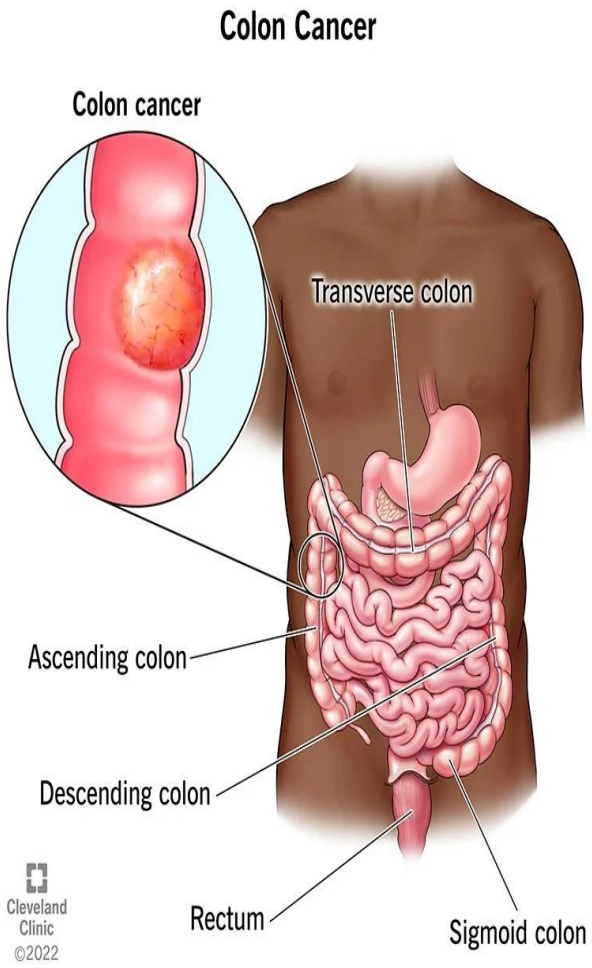
- Enteritis is inflammation of the small intestine



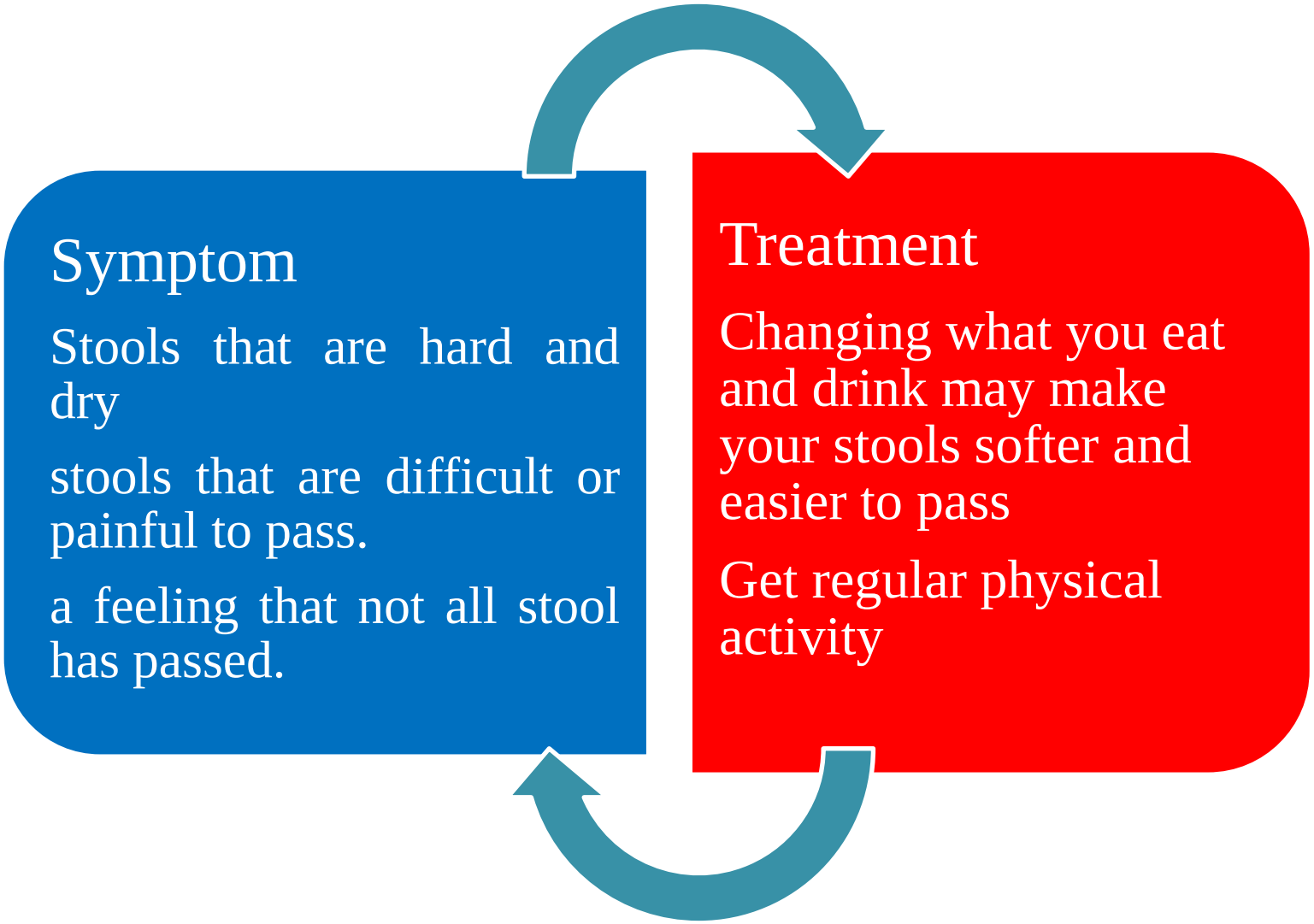
COLON CANCER

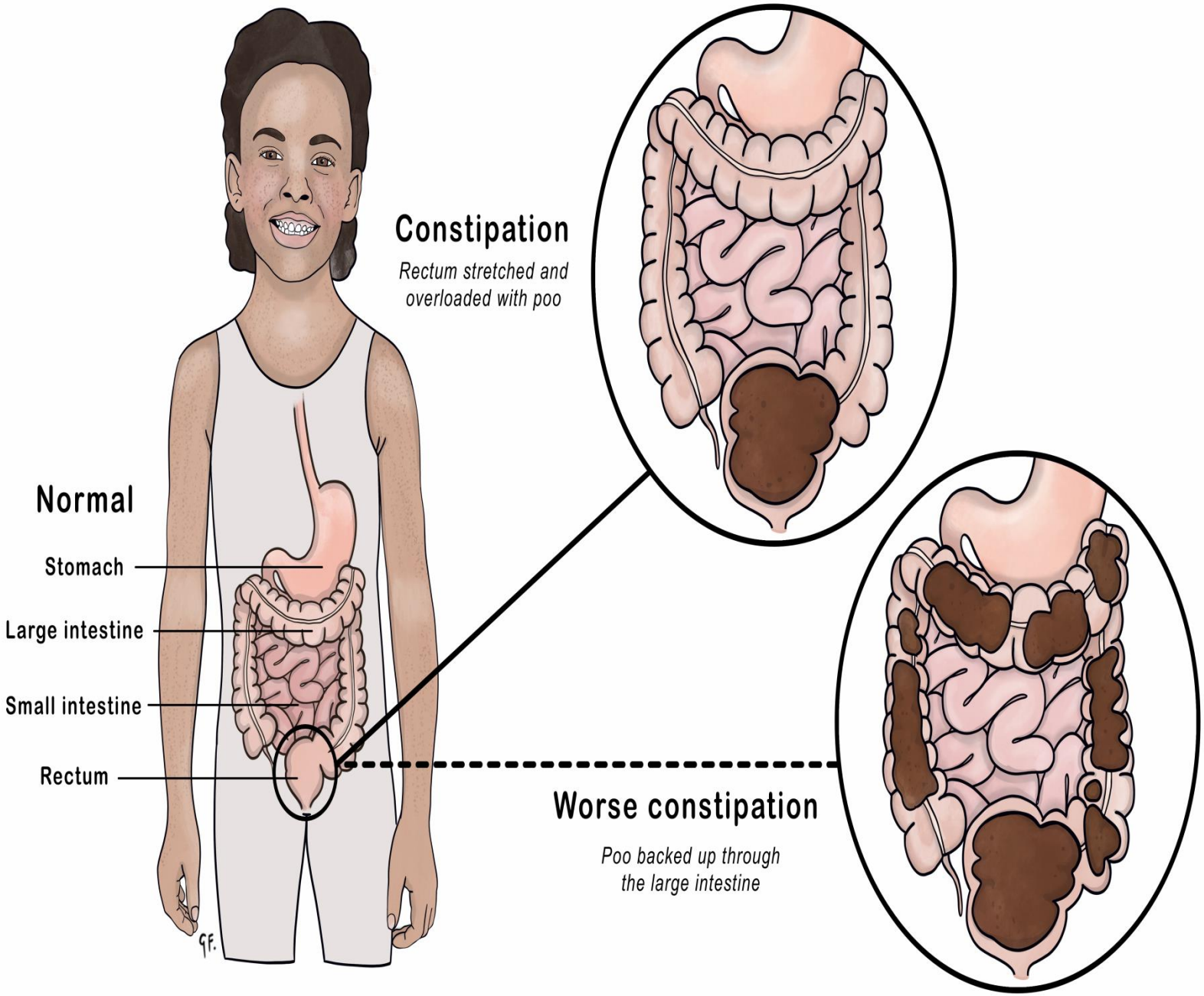
- Symptoms
- A change in bowel habits.
- Blood in or on your stool (bowel movement).
- Diarrhea, constipation, or feeling that the bowel does not empty all the way.
- Abdominal pain
- Weight loss and you don't know why.

- Treatments
- Surgery (removing the cancer in an operation)



CONSTIPATION




Constipation
Rectum stretched and overloaded with poo
Normal
Stomach
Large intestine
Small intestine
Rectum
Worse constipation
Poo backed up through the large intestine

PEPTIC ULCER

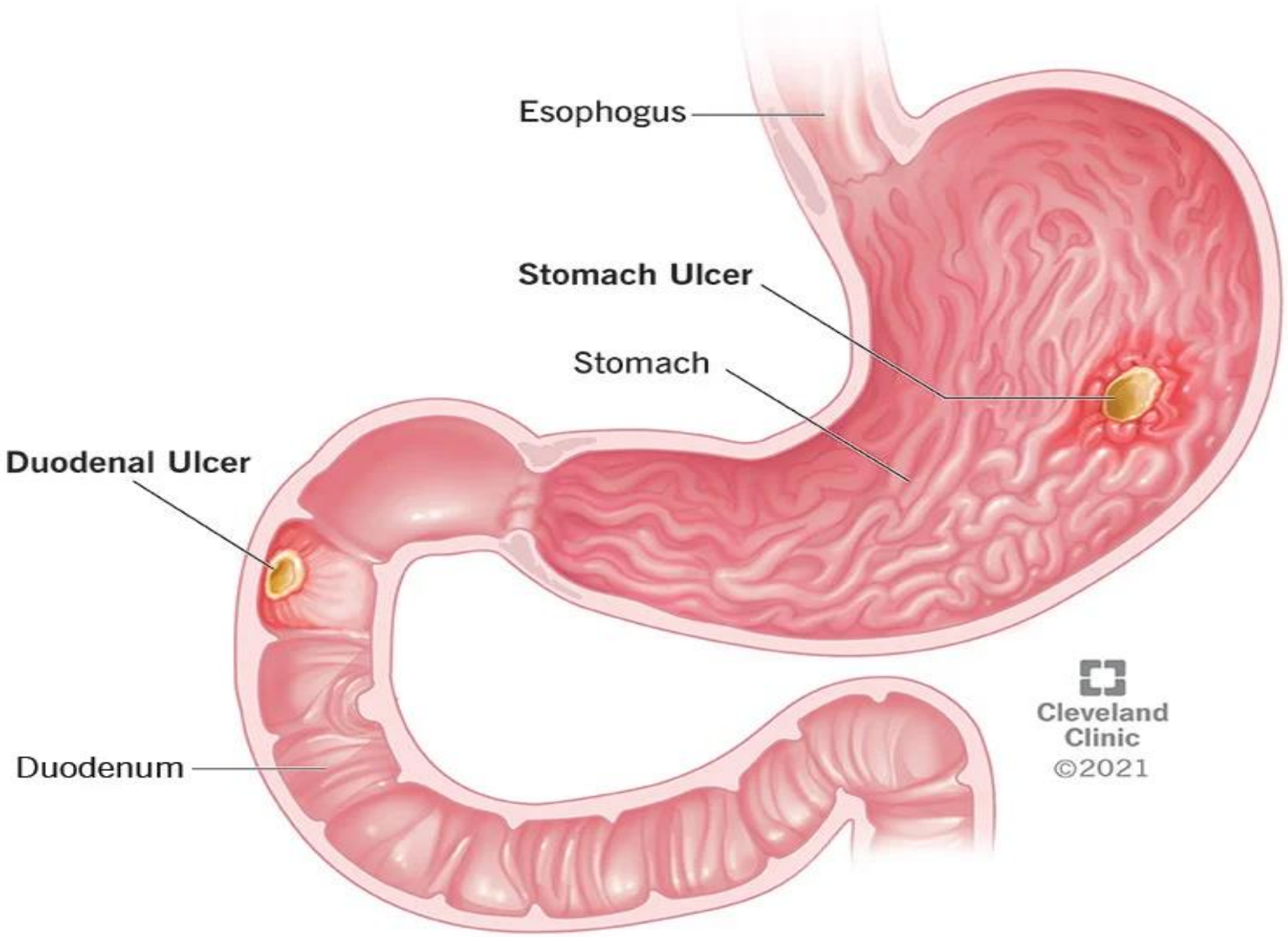
Symptoms

- pain
- feeling full too soon while eating a meal.
- nausea and vomiting

Treatment

- Proton pump inhibitors (PPI): These drugs reduce acid, which allows the ulcer to heal.(omeprazole and esomeprazole)
- Histamine receptor blockers (H2 blockers): These drugs also reduce acid production (cimetidine and famotidine)
- Antibiotics: These medications kill bacteria. (amoxicillin and ciprofloxacin)

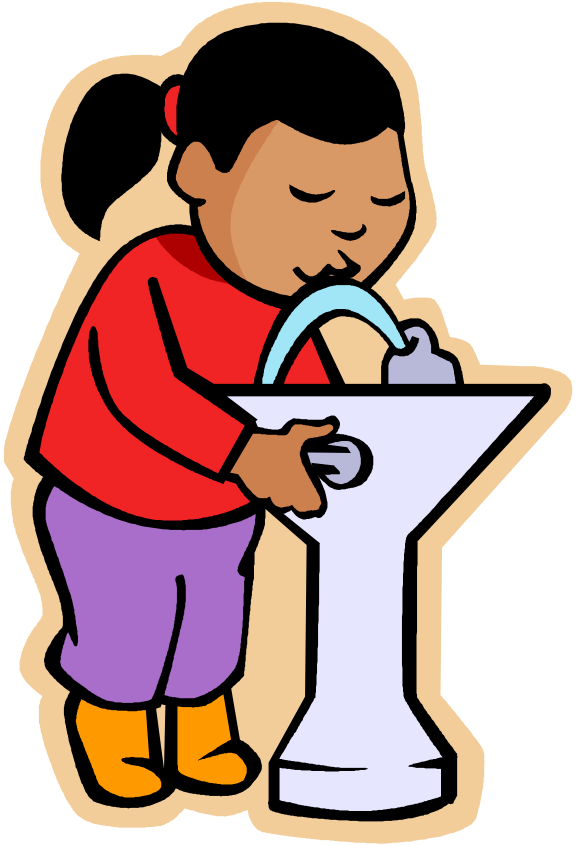
Stomach Ulcer



Healthy Habits

- Eat foods that are high in fiber like fruits and vegetables

- Drink plenty of water

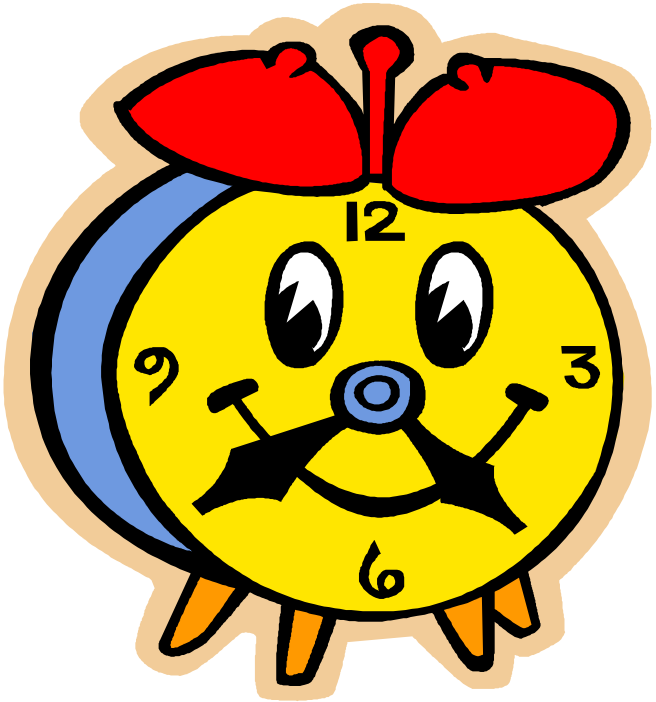


- Chew your food completely before you swallow

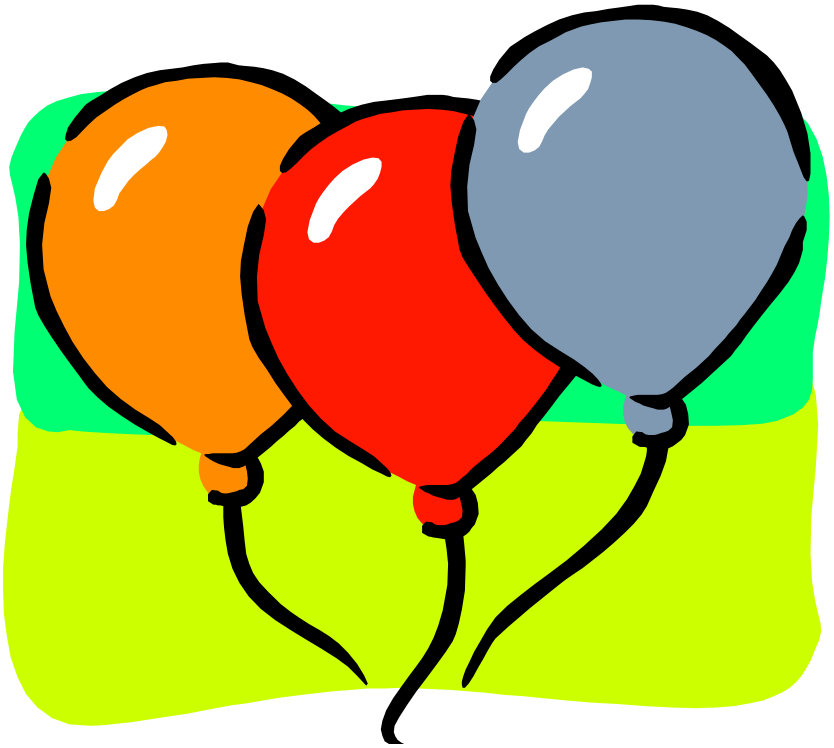
Avoid foods high in fat

Interesting Facts

- Food is in your digestive system for about 24 hours



- Your stomach stretches when you eat like a balloon being filled with air




THANK
YOU!

UNIT – II
ENERGETIC

Presented By

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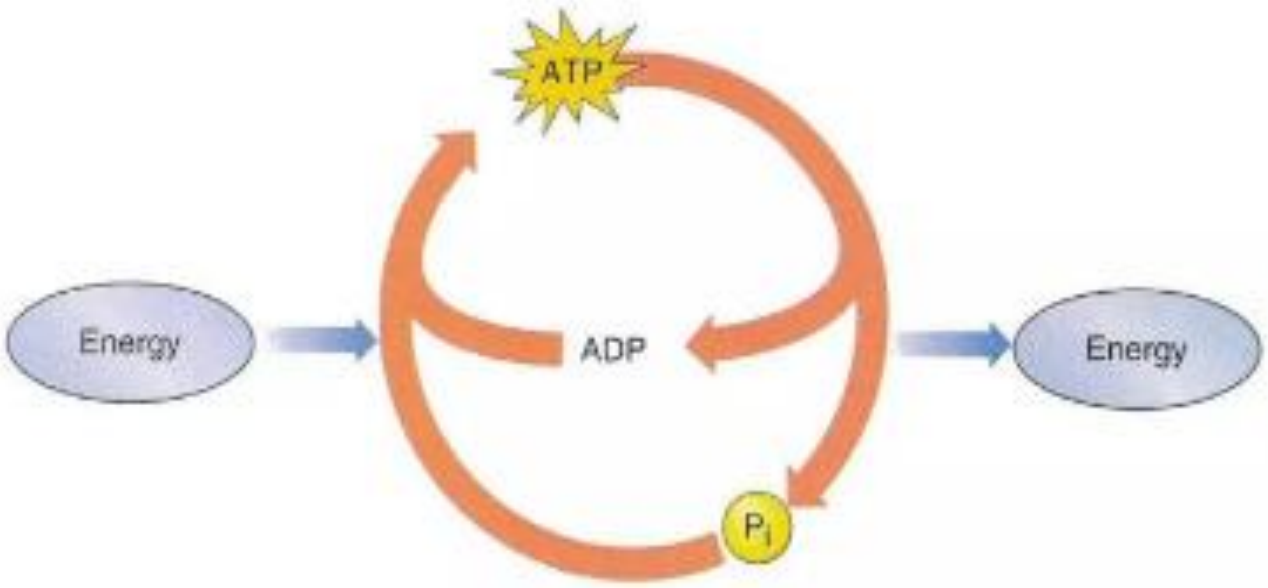
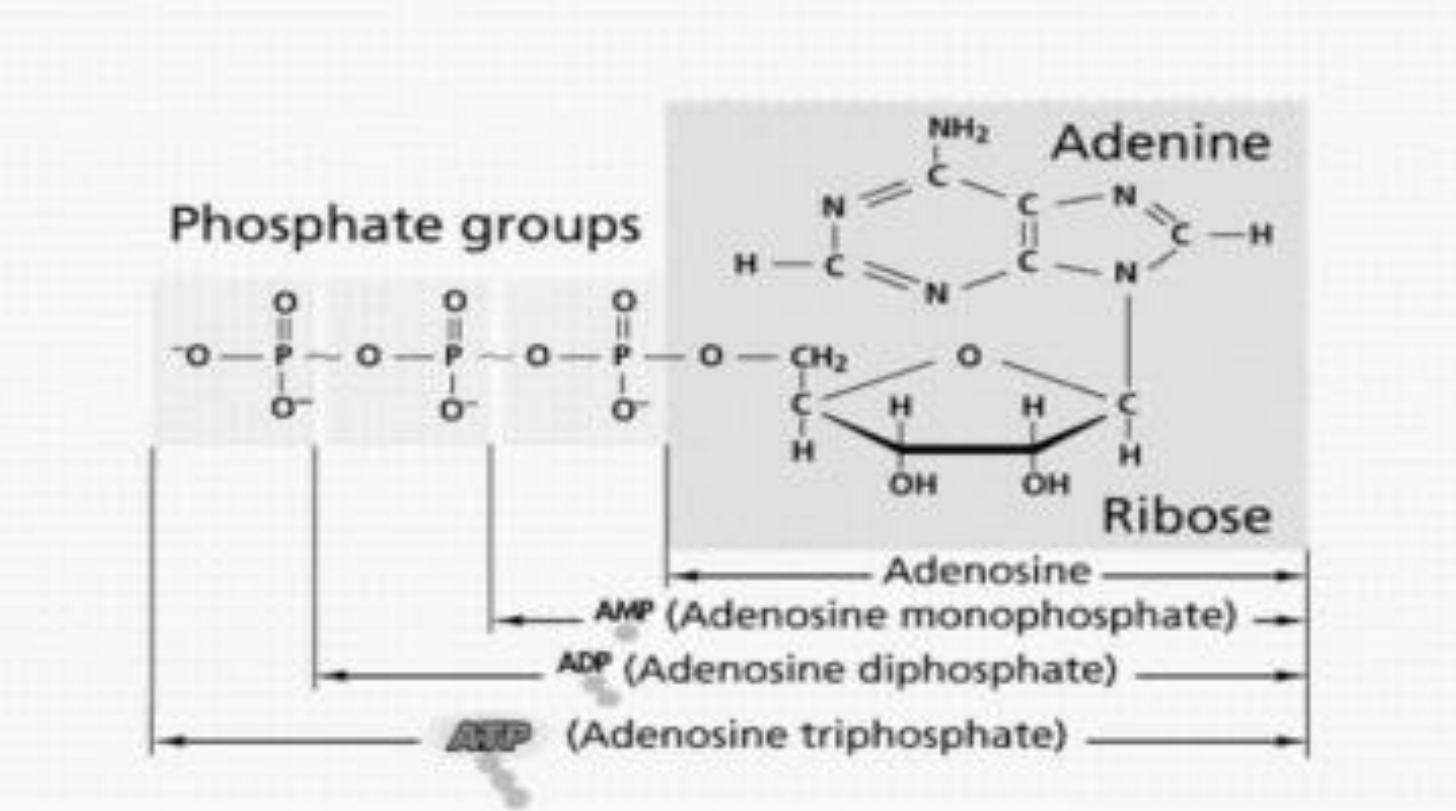
ATP

The nucleotide co-enzyme adenosine triphosphate (ATP) is the most important form of chemical energy in all cells.



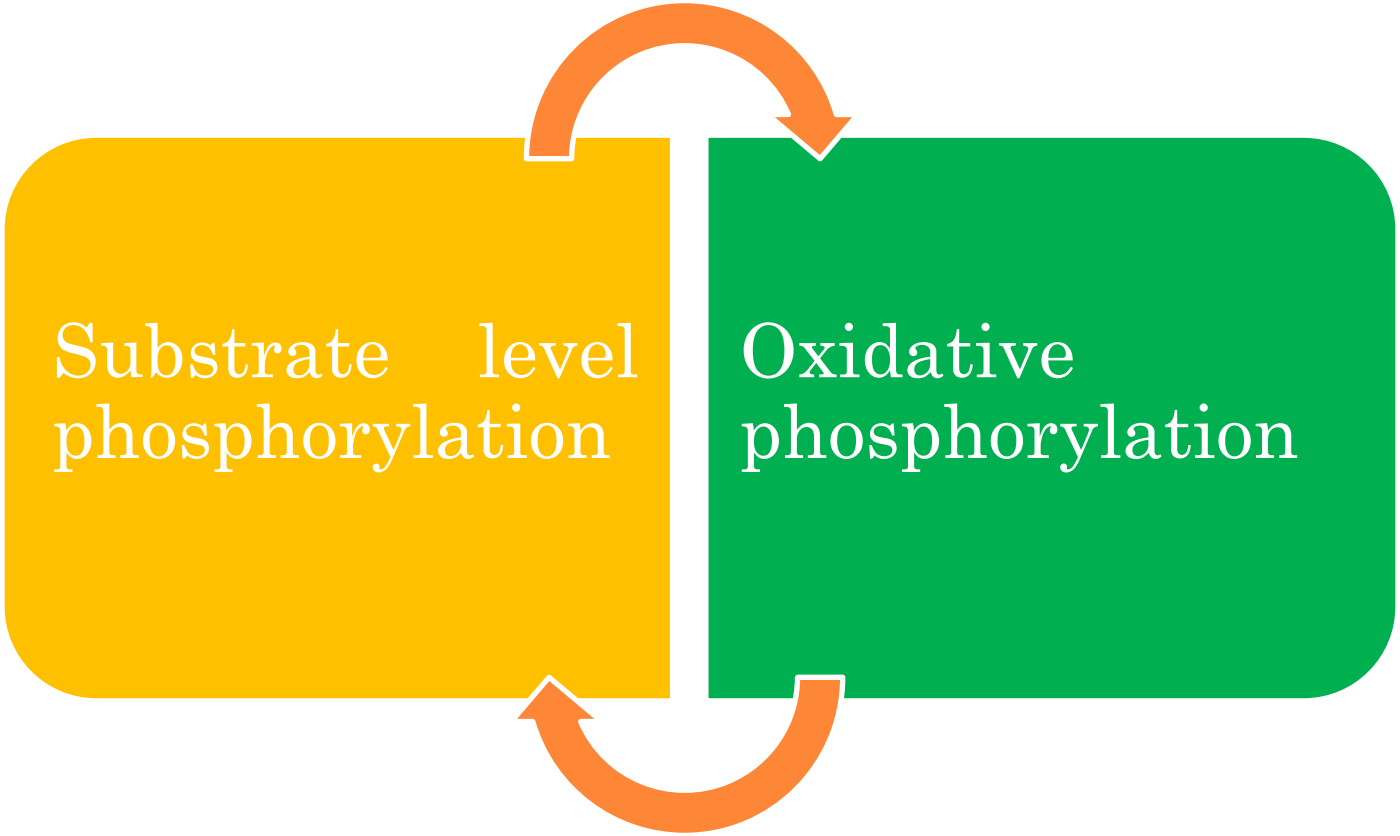
ATP- Structure

- ATP is a nucleoside triphosphate containing adenine, ribose, and three phosphate groups.



Mechanisms of ATP formation

- There are two basic mechanism involved for ATP formation-



1) Substrate level phosphorylation

- Involves phosphorylation of ADP to form ATP at the expense of the energy of the parent substrate molecule without involving the electron transport chain.

- Substrate is a high energy compound as compared to the product, the surplus energy is used for ATP formation.

2) ATP by Oxidative phosphorylation

- This process takes place in mitochondria and is energetically coupled to a proton gradient over a membrane.

- The H+ gradients established by electron transport chain are used by the enzyme ATP synthase as a source of energy for direct linking of an inorganic phosphate to ADP.

ATP Hydrolysis

- Adenosine attached to two or one phosphate residues is called Adenosine di and mono phosphate respectively.
- The symbol ~ indicates that the group attached to the bond, on transfer to an appropriate acceptor,
- Results in transfer of the larger quantity of free energy.
- For this reason, the term group transfer potential rather than "high-energy bond" is preferred .

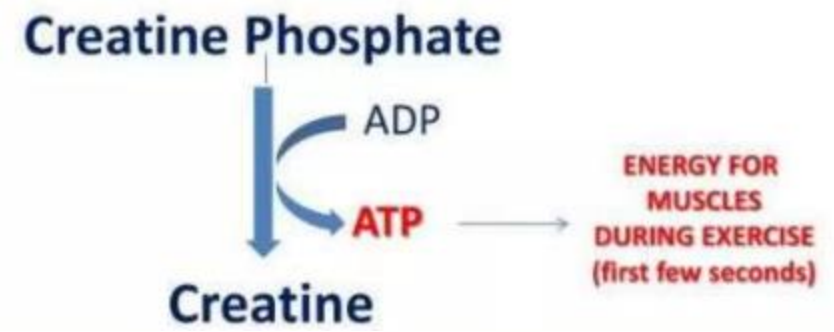
Roll of ATP

- The ATP is used for various cellular function, including transportation of different molecules across cell membranes.

- Function of ATP include supplying the energy required for the muscle contraction, circulation of blood, locomotion and various body movements.

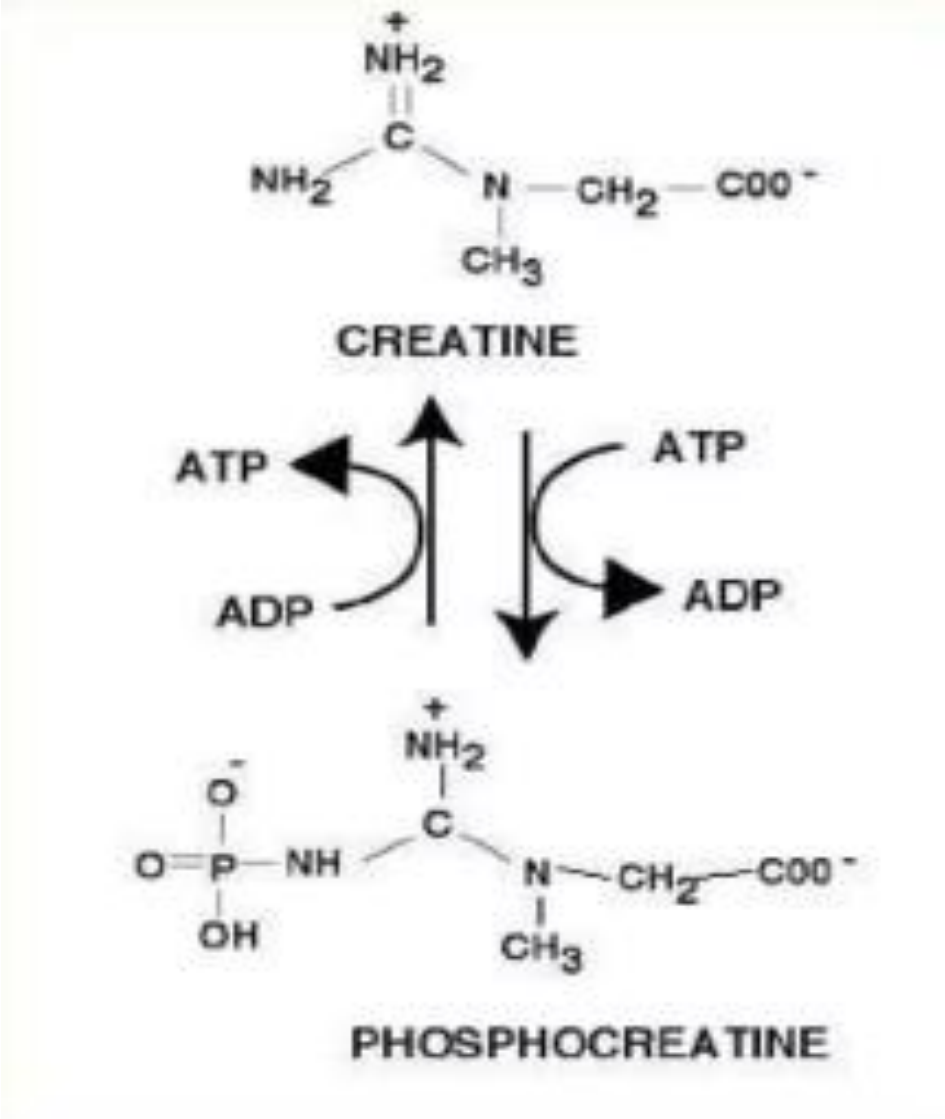
Creatinine Phosphate

- Creatine phosphate is a high-energy phosphate compound
- Act as a storage from of energy in the muscle
- Provide a small but, ready source of energy during first few seconds of intense muscular contraction
- The amount of creatine phosphate in the body is phosphate in the body is proportional to the muscle mass



- From liver, transport to other tissues
- 98% of creatine are present in skeletal & heart muscles
- In muscles, creatine is converted to the high energy source creatine phosphate (Phosphocreatine)

Formation of Creatinine Phosphate



Roll of Creatinine phosphate

- Creatine phosphate is used to convert ADP to ATP in the muscles.
- For the contraction of skeletal muscles.

Introduction of BMR

- Basal metabolic rate is the amount of energy per unit of time that a person needs to keep the body functioning at rest.

- Some of those processes are breathing, blood circulation, controlling body temperature, cell growth, brain and nerve function, and contraction of muscles.

- Food is the fuel source of the body, the ingested food undergoes metabolism to liberate energy required for the vital activities of the body

- Man consumes energy to meet the fuel demands of the three ongoing processes in the body
- i. Basal metabolic rate
- ii. Specific dynamic action
- iii. Physical activity

Basal Metabolic Rate

- BMR- minimum amount of energy required by the body to maintain life at complete physical and mental rest in post absorptive state.

- Several functions within the body occurs at basal condition

-Working of heart and other organs

-Conduction of nerve impulse

-GIT motility

-Ion transport across membranes.

Measurement of BMR

- BMR can be measured by the apparatus of Benedict and Roth (closed circuit device) or by Douglas bag method (open circuit device).

- The complete physical and mental rest (i.e, the patient should not have taken anything by mouth for the past 12hrs) and in a comfortable surrounding.

Normal values of BMR

- Adult man: 1600cal/day
- Adult woman: 1400cal/day
- A BMR value between -15% and +20% is considered normal


THANK
YOU