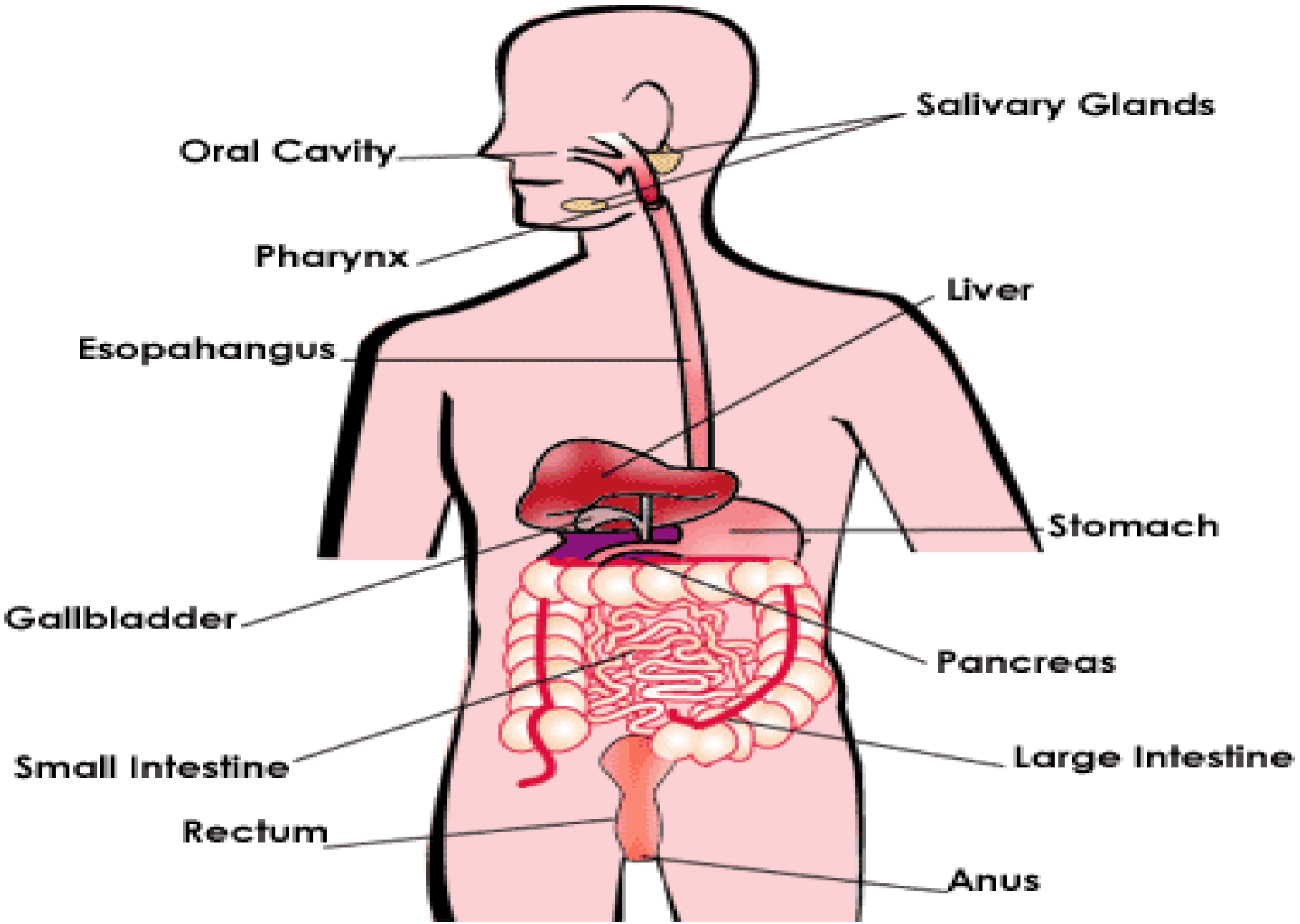
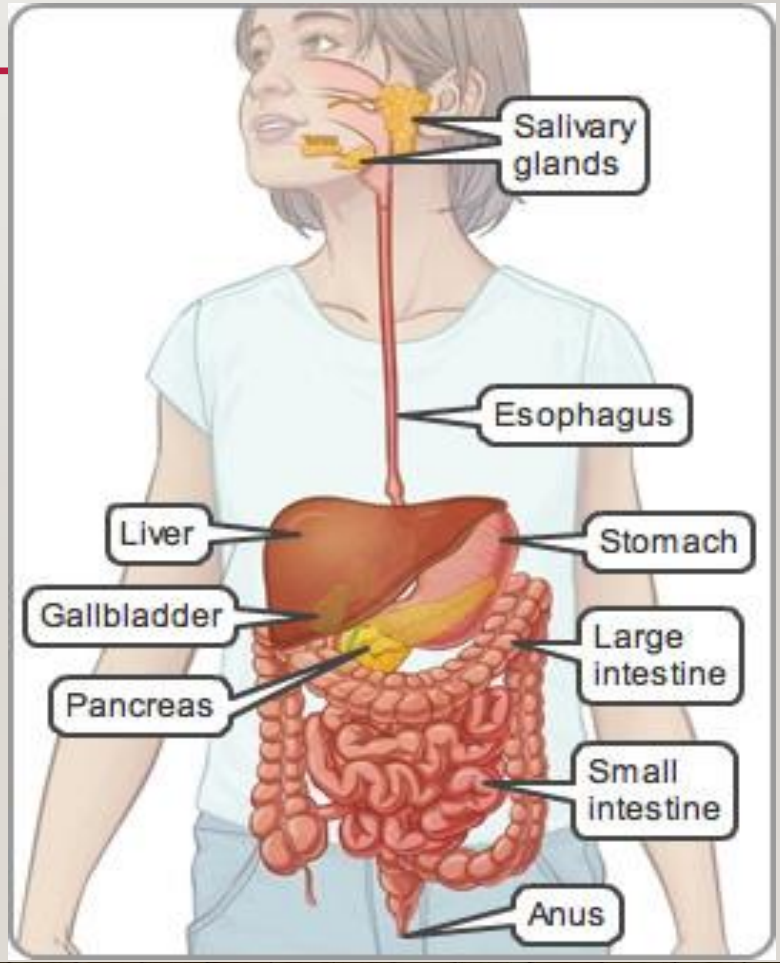
DIGESTIVE SYSTEM

THE DIGESTIVE SYSTEM

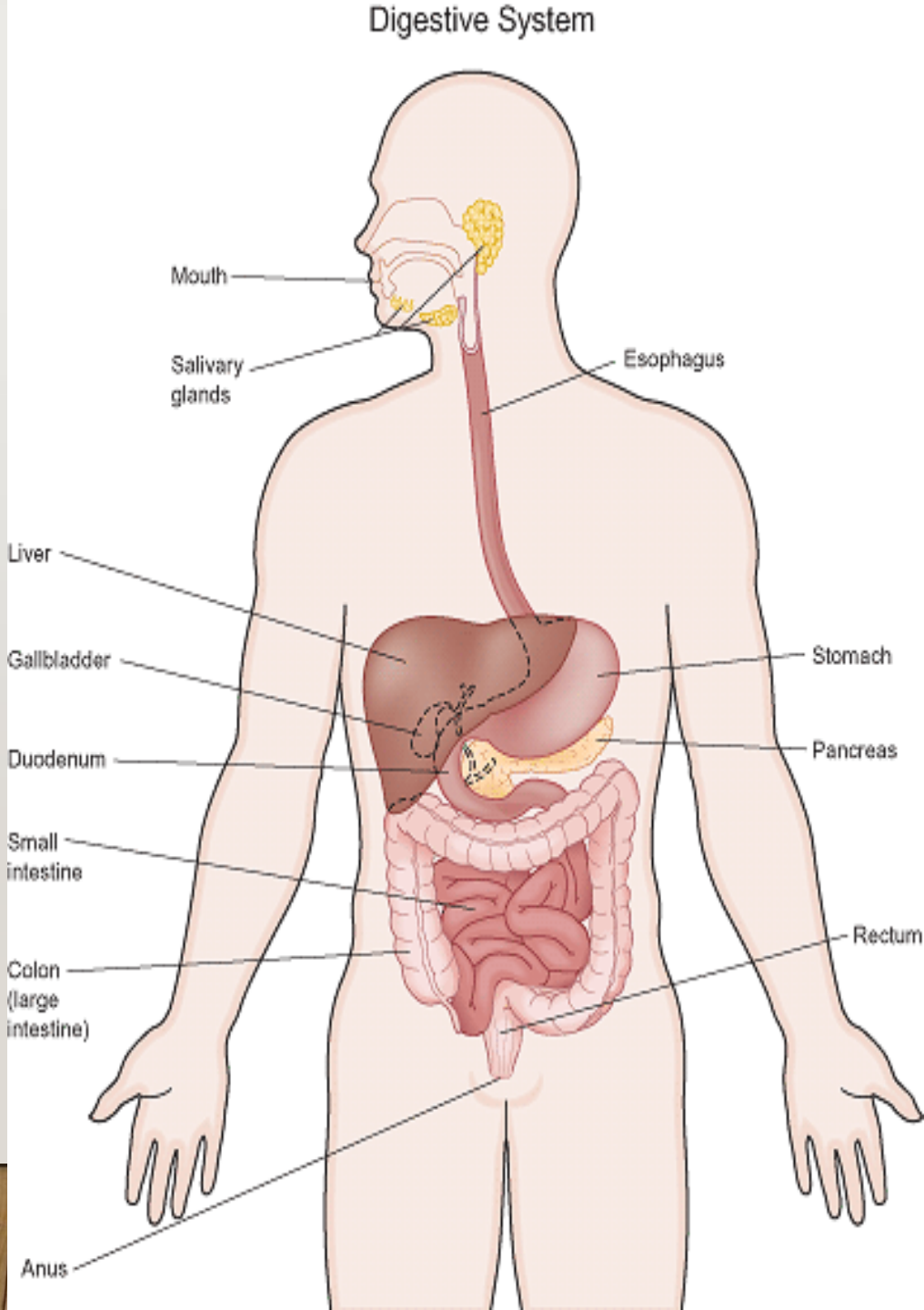


INTRODUCTION

- 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.



1. Ingestion: taking in food
2. Digestion: breaking down food into nutrients
3. Absorption: taking in nutrients by cells
4. Egestion: removing any leftover wastes



FUNCTIONS OF MOUTH

The mouth is the beginning of the digestive system, and, in fact, digestion starts here before you even take the first bite of a meal. The smell of food triggers the salivary glands in your mouth to secrete saliva, causing your mouth to water. When you actually taste the food, saliva increases.

Food begins its journey through the digestive system in the mouth, also known as “Oral Cavity. Inside the mouth are many accessory organs that aid in the digestion of food—the tongue, teeth, and salivary glands. Teeth chop food into small pieces, which are moistened by saliva before the tongue and other muscles push the food into the pharynx. The tongue moves the food around until it forms a ball called a “bolus”.

- The mouth is a cavity extending from the external skin to the pharynx. The mouth cavity has three parts:

i. The tongue: it is a muscular organ, which occupies the base of the mouth. The functions of the tongue are:

a. It is an organ of taste as it is richly supplied with sensory nerves, which end in the taste buds in the papillae at the upper surface.

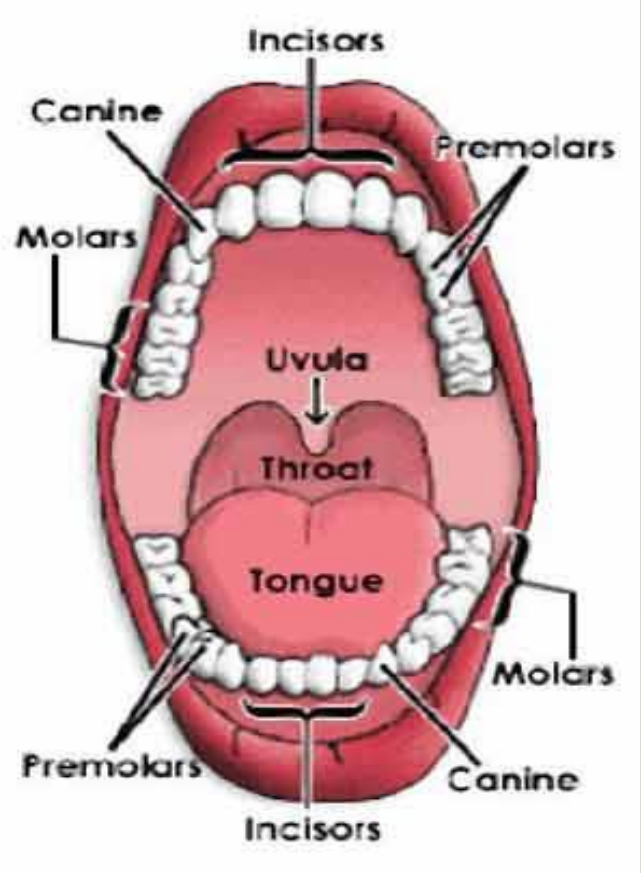
b. It helps in the mastication (chewing) of food

c. It helps in the swallowing.

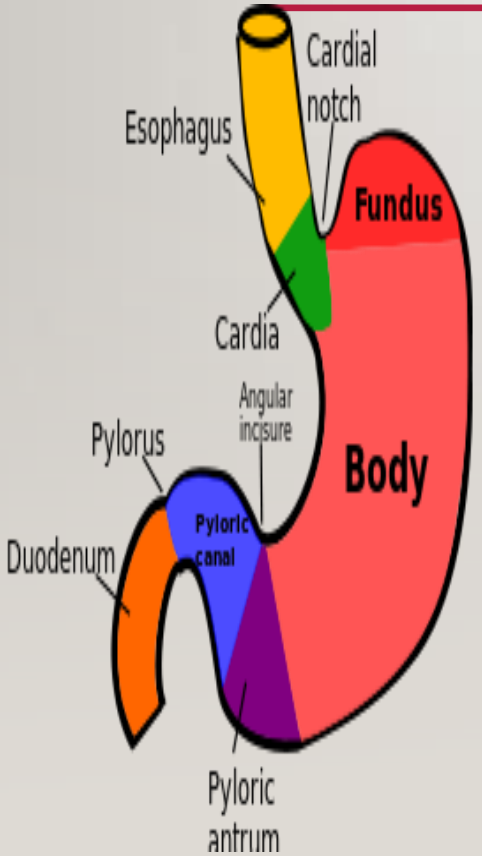
d. It helps in speech as it controls and changes the passage of air when we speak.

II) THE TEETH

- Begins when food enters the mouth.
- It is physically broken down by the teeth.
- Chemical breakdown is started by amylase, an enzyme in saliva that breaks down carbohydrates.



FUNCTIONS OF STOMACH



The stomach has folds called rugae and is a big muscular pouch which churns the bolus (Physical Digestion) and mixes it with gastric juice, a mixture of stomach acid, mucus and enzymes.

- The acid kills off any invading bacteria or viruses.
- The enzymes help break down proteins and lipids.
- The mucus protects the lining of the stomach from being eaten away by the acid.
- The digested bolus is now called chyme and it leaves the stomach by passing through the pyloric sphincter.

The Small Intestine

The small intestine has three parts:

1. Duodenum

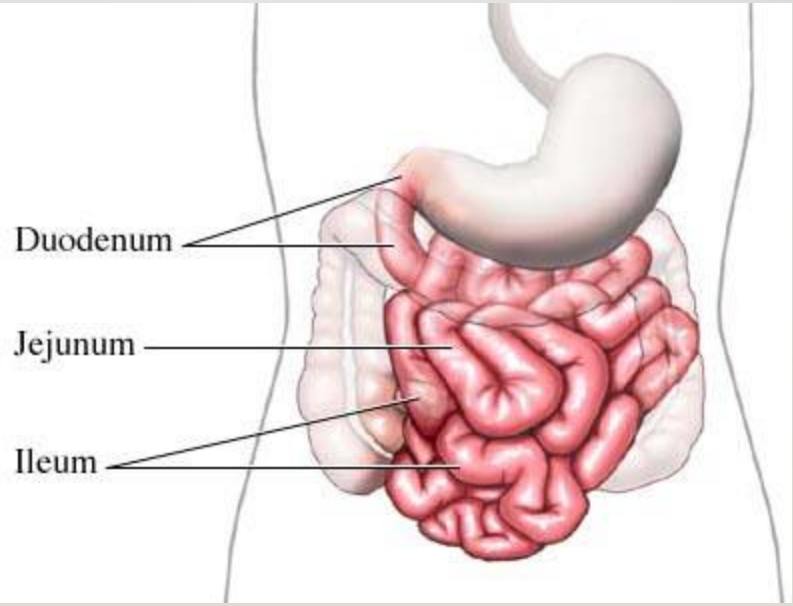
Bile, produced in the liver but stored in the gall bladder, enters through the bile duct. It breaks down fats.
The pancreas secretes pancreatic juice to reduce the acidity of the chyme.

2**. Jejunum**

The jejunum is where the majority of absorption takes place.
It has tiny fingerlike projections called villi lining it, which increase the surface area for absorbing nutrients.

3. Ileum

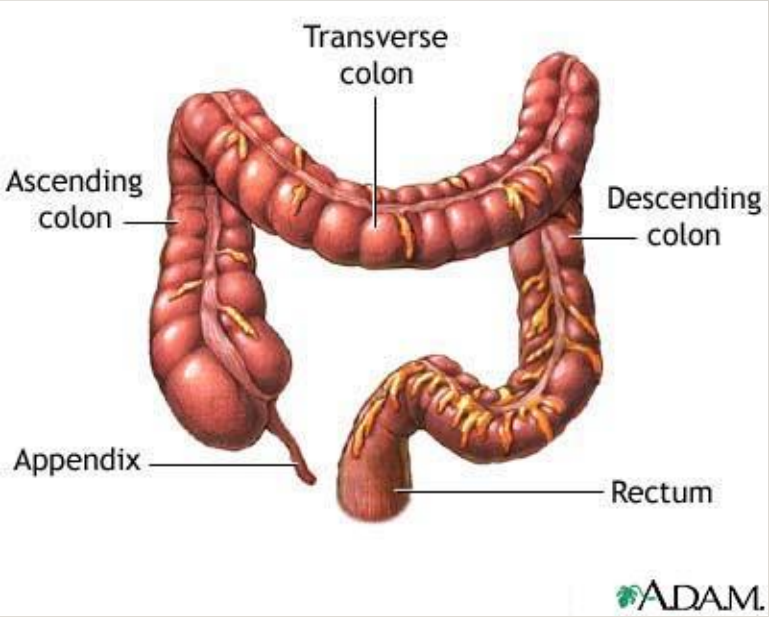
The last portion of the small intestine is the ileum, which has fewer villi and basically compacts the leftovers to pass through the caecum into the large intestine.



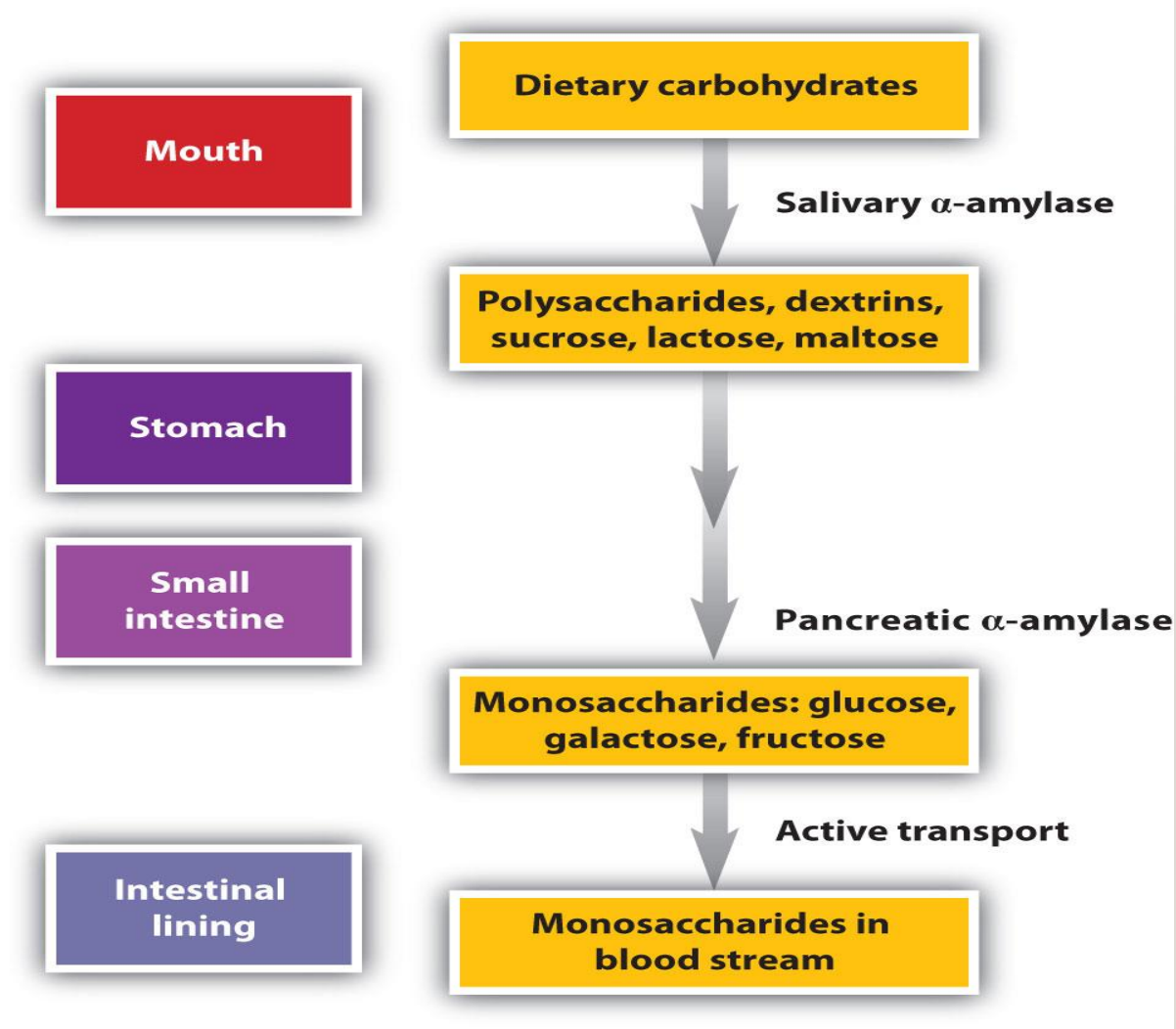
The Large Intestine

The large intestine (or colon) is used to absorb water from the waste material leftover and to produce vitamin K and some B vitamins using the helpful bacteria that live here.

All leftover waste is compacted and stored at the end of the large intestine called the rectum. When full, the anal sphincter loosens and the waste, called feces, passes out of the body through the anus.



Digestion of Carbohydrate



Digestion of Carbohydrate

The main objective of carbohydrate digestion is to hydrolyze the polysaccharides (starch, cellulose) and diasaccharides (sucrose, lactose) into the simplest form i.e. the monosaccharides. The enzymes present in various digestive juices participate in this process. The digestion of carbohyadrates in various parts of the digestive tract is as follows:

Mouth- the digestion of carbohydrates begins. The salivary glands present in the mouth produce saliva, which contains the following substance:

i. Water- it moistens the food

ii. Salts- makes the medium alkaline, which is ideal for carbohydrate digestion

iii. Ptyalin or salivary amylase:- it converts

Cooked starch → Maltose (disaccharide)

Oesophagus:

- No enzyme is produced
- Action of salivary amylase continues as the medium is alkaline
- Peristaltic movements help in the forward food movement

Stomach:

The action of salivary amylase continues in the cardiac end (upper part)

Most of the digestive action takes place in the pyloric end (lower part) and following substances mix into the food:

- Hydrochloric acid: it makes the medium acidic, digestion of carbohydrates is stopped.

- Gastric juice: produced by the glands present in the walls of the stomach and does not have any enzyme for carbohydrate digestion.

- Disaccharide sucrose present in the food is hydrolyzed to some extent due to the acidic medium.

Small Intestine:

1- Duodenum: following digestive juices mix into the food in this part of small intestine

a) Bile juice contains many salts that make the medium alkaline but has no enzyme

b) Pancreatic juice contains pancreatic amylase, an enzyme concerned with carbohydrate digestion

Pancreatic amylase-

Cooked & uncooked starch Maltose 

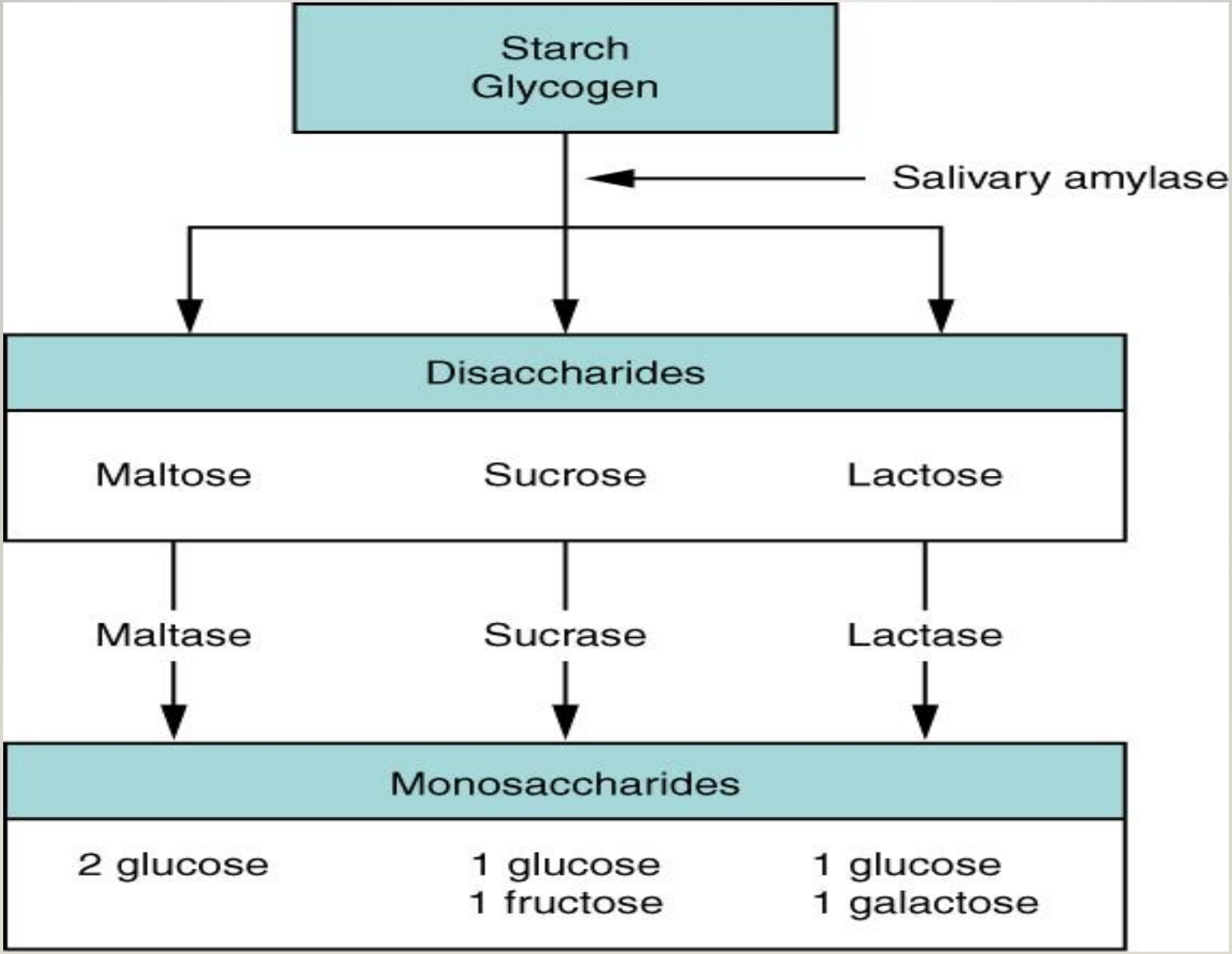
After the action of pancreatic amylase, all types of carbohydrates present in the food are in the form of disaccharides-starch in the form of maltose, milk sugar occurring naturally in the form of lactose and sugar in the food as sucrose.

c) Intestinal juices: produced by intestinal walls. Contains 3 enzymes which convert all types of disaccharides to simple sugars, monosaccharide. These enzymes are:

Sucrase

Maltase

Lactase


Starch
Glycogen
Salivary amylase
Disaccharides
Maltose
Sucrose
Lactose
Maltase
Sucrase
Lactase
Monosaccharides
2 glucose
1 glucose
1 fructose
1 glucose
1 galactose

2- Jejunum and ileum- in these parts of small intestine, the action of digestive enzymes that began in the duodenum is continued and the soluble nutrients obtained after digestion are absorbed.

DIGESTION OF PROTEINS

- The main purpose is hydrolysis of the protein into its smallest units i.e. amino acids.
- Besides dietary proteins, the protein coming into the gastro-intestinal tract includes the protein released from worn-out cells of the inner–lining of the lumen and from the breakdown of the digestive enzymes. Dietary protein is known as **Exogenous Protein** and the protein coming from within the digestive tract is known as **Endogenous Protein**. The digestion of protein in various parts of digestive tract is as follows:

1- Mouth:

- Saliva does not contain any enzyme related to protein digestion.
- The food is masticated and broken down into smaller pieces in the mouth so that the enzymes for protein digestion, produced in other parts of the digestive tract, can hydrolyze it.

2- Oesophagus: no enzyme is produced in this part.

3-Stomach:

In the upper part-No digestive juice

In the lower part- hydrolysis of protein starts where following juices take part in protein digestion:

i) HCl: it makes the medium in stomach acidic, suitable for protein digestion. It activates the enzyme related to protein digestion pepsinogen, present in gastric juice.

ii) Gastric Juice: it contains the following

a) Pepsinogen: this is present in inactived form

Converted into its active form i.e. pepsin by HCl, which is produced by pleasant sensations of the food.

Pepsin enzyme is very active in an acidic medium. It breaks down

Long & complex chain protein

Peptones (smaller polypeptides)

b) Renin: present in children only. Hydrolyses milk protein, caesin only.

4-Small intestine: duodenum is especially important in protein digestion. Following digestive juices mix into the food in this part of the digestive tract:

i. Bile juice: it makes the medium alkaline but does not contain any enzyme.

ii. Pancreatic juice: contains following enzymes related to protein digestion:

a) Trypsinogen (inactive form)

b) Chymotrypsinogen (inactive form)

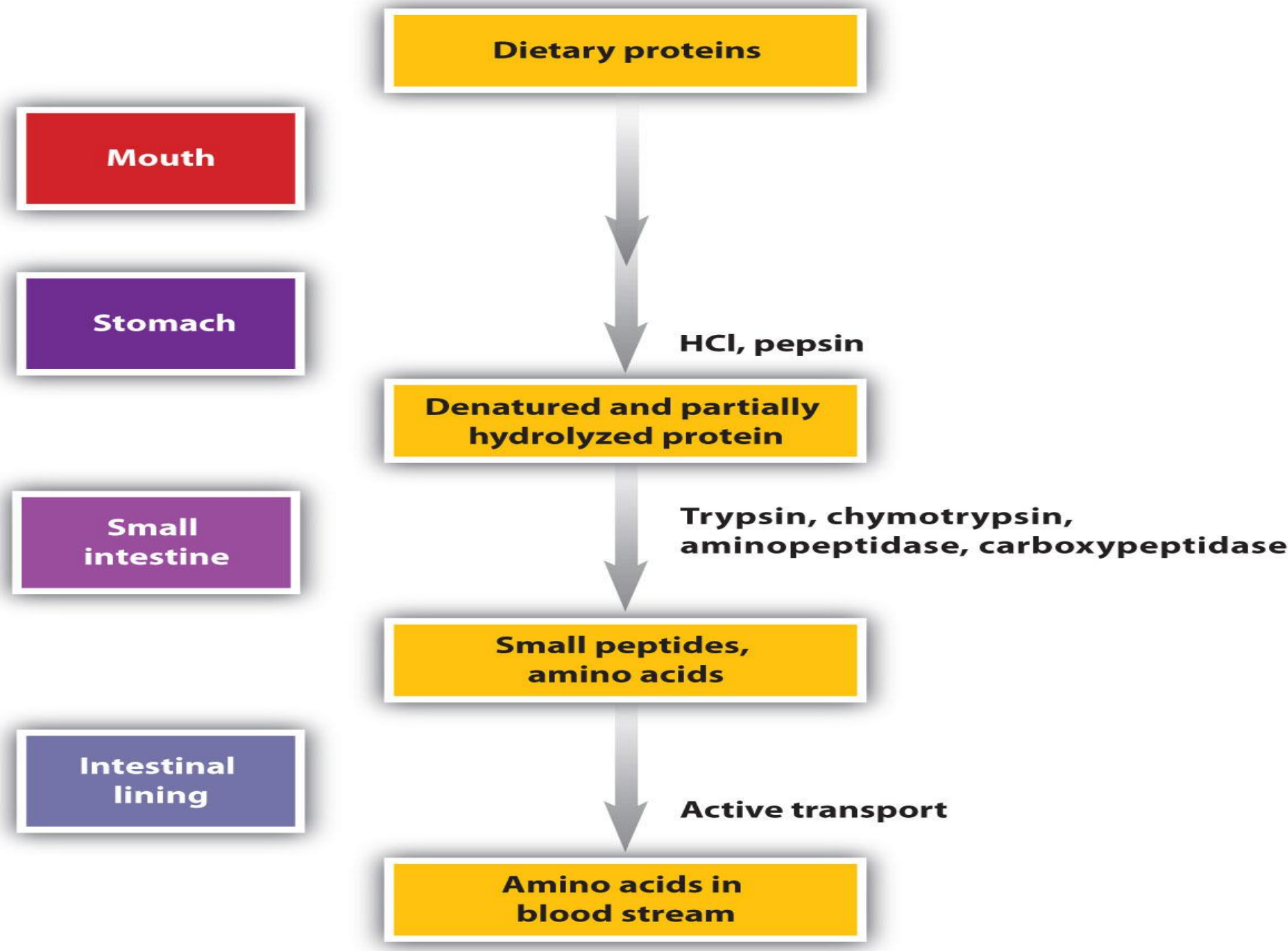
c) Caboxypetidases

- Trypsinogen is converted into its activated form, trypsin by an enzyme enterokinase present in the intestinal juice. The trypsin enzyme converts chymotrypsinogen to chymotrypsin. They convert peptones or large polypeptides formed in the stomach into smaller polypeptidases, dipeptidases and tripeptidases.

iii) Intestinal juice: produced by glands present in intestinal walls. It contains enzymes related to protein digestion:

a) Enterokinases
b) Aminopolypeptidases
c) Tripeptidases
d) Dipeptidases

Enterokinase converts trypsinogen to its active form trypsin. Aminopolypeptidases, Tripeptidases and Dipeptidases break the polypeptide chains further into tripeptides, then dipeptides, then to amino acids which are end products of protein digestion.


Dietary proteins
Mouth
Stomach
HCl, pepsin
Denatured and partially hydrolyzed protein
Small intestine
Trypsin, chymotrypsin, aminopeptidase, carboxypeptidase
Small peptides, amino acids
Intestinal lining
Active transport
Amino acids in blood stream

PROTEIN DIGESTION

I. Gastric digestion

Hcl
pepsin
Rennin
gelatinase

ends in proteoses, peptones & large polypeptides

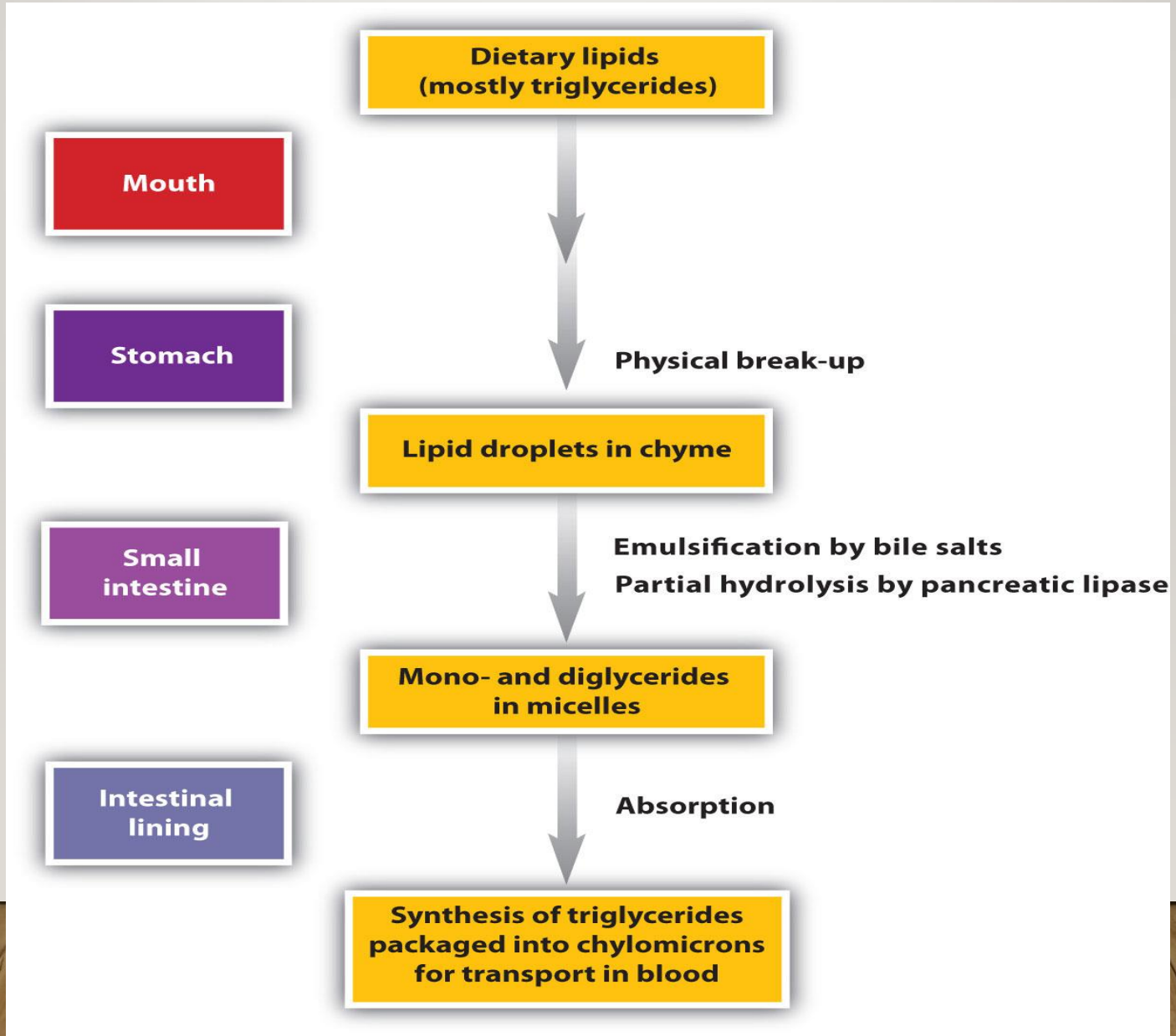
II. Intestinal digestion

Pancreatic juice

Intestinal juice

ends in complete digestion of protein into amino acids

Digestion of Fats



DIGESTION OF FATS

- Fat present in the diet is mainly in the form of **triglycerides.** Small amounts of cholesterol and phospholipids are also present.
- The purpose of fat digestion is to convert all types of fat present in the diet to its simplest form i.e. fatty acids and glycerol.
- The digestion of fat in various parts of the digestive tract is as follows:

1-Mouth: no enzyme related to fat digestion is produced in the mouth. The food is masticated, moistened and pushed forward from the mouth.

2-Oesophagus: no enzyme is produced in this part of the digestive tract. The food is carried to the stomach through peristaltic movements.

3-Stomach: in the pyloric end of the stomach, gastric juice mixes into the food, which contains an enzyme, gastric lipase related to fat digestion.

Digestion of fat is not much in the stomach due to the acidic medium.ony the hydrolysis of egg yolk, cream etc.

Presence of fat in the diet reduces gastric motility, therefore fat rich foods stay in the stomach for a longer time.

4-Small intestine- the first part of S.I. is of much significance in fat digestion.

The presence of fat stimulates the intestinal wall, as a result cholecystokinin hormone is produced.

This hormone stimulates the gall bladder to contract. As a result, bile juice that is stored in it, reaches the duodenum. Bile juice helps in the digestion and absorption of fat in many ways:

i. It emulsifies the fat and prepares it for enzyme action.

ii. It makes the medium of the chyme alkaline, which helps in fat digestion.

iii. It increases the mobility or peristalsis of the food in S.I.

iv. It solublizes the fat soluble vitamins and helps in their absorption.

Pancreatic juice: contains pancreatic lipase enzyme, which is for fat digestion.

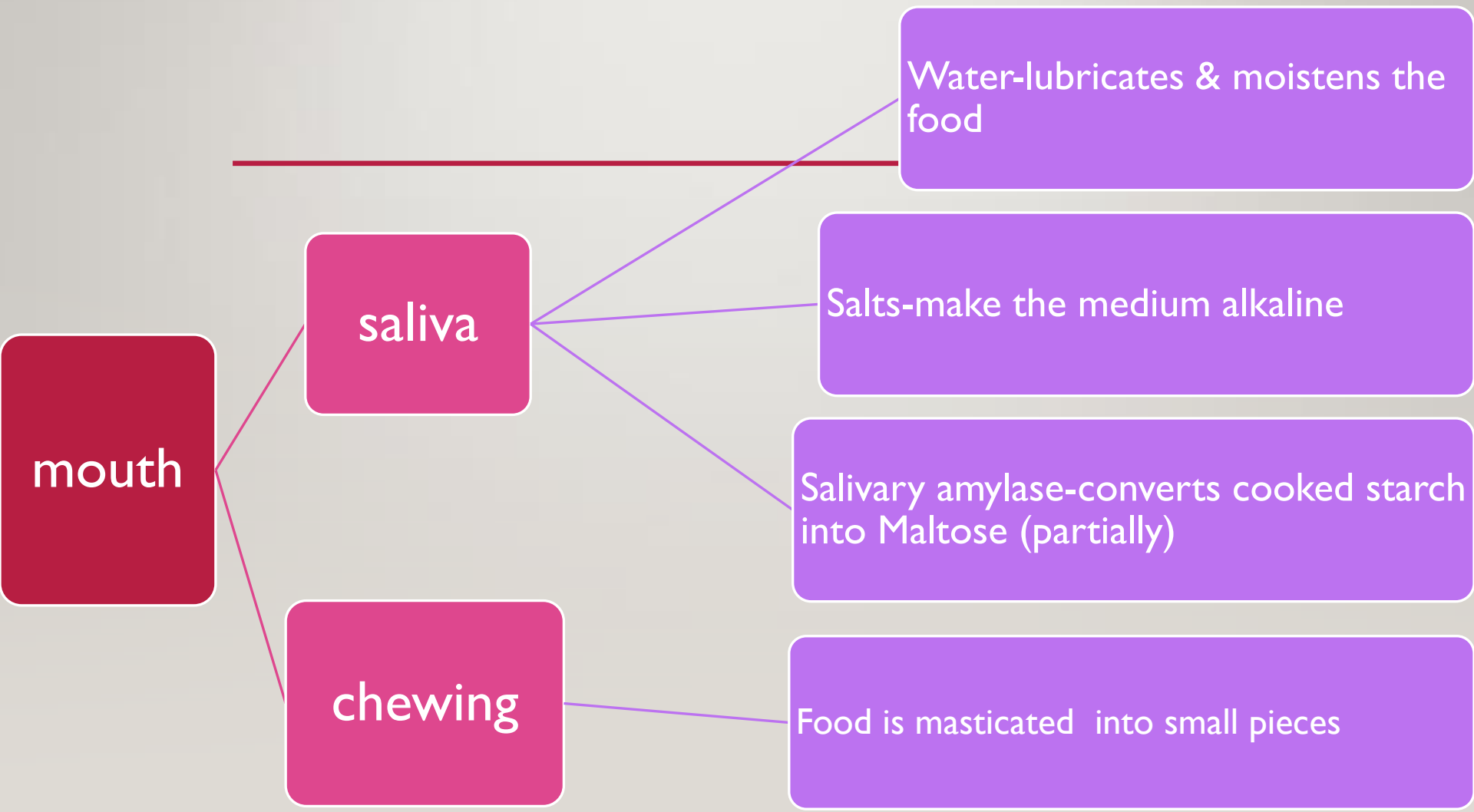
Breaks down fat into fatty acids and glycerol which are end products of fat digestion due to the alkaline medium.

However fat is not completely converted to fatty acids and glycerol. Due to incomplete digestion, some of it is found in diglyceride and monoglyceride form. Thus end products of fat digestion, present in small intestine for absorption are, fatty acids, glycerol, mono and diglycerides.

PROCESS OF DIGESTION

Digestion brings physical and chemical changes in the food. i.e. the large tough pieces of food are broken down to smaller particles. The changes occurring during digestion are of two types:

1. Mechanical (physical form of food changes)
2. Chemical


mouth
saliva
chewing
Water-lubricates & moistens the food
Salts-make the medium alkaline
Salivary amylase-converts cooked starch into Maltose (partially)
Food is masticated into small pieces

2-OESOPHAGUS- no enzyme is produced. Action of salivary amylase continues.

3-STOMACH :-

A. Cardiac end - no enzyme is produced. Action of salivary amylase continues

B. Pyloric end -

i. **HCl**

ii. **Gastric juice**

HCl:-

- It makes the medium alkaline
- Action of salivary amylase stops
- Converts pepsinogen to active pepsin
- Kills bacteria
- Increase solubility of Ca and Fe.

Gastric juice:-

Pepsinogen pepsin: proteins peptones

(inactive) (active)

Renin (only in children)- breaks down milk protein casein

Gastric lipase-not very active in acidic medium. Converts fat partially to fatty acids and glycerol.

4-Small intestine

a. Duodenum

b. Jejunum & ileum

Duodenum

i- Bile juice (from liver)-contains no enzyme. Makes the medium alkaline and facilitates fat digestion

ii-pancreatic juice (from pancreas):

Trypsinogen

Chymotrysinogen

Pancreatic amylase

Pancreatic lipase

iii-Intestinal juice (from intestinal wall)

THE END