

Heterotrophic Nutrition



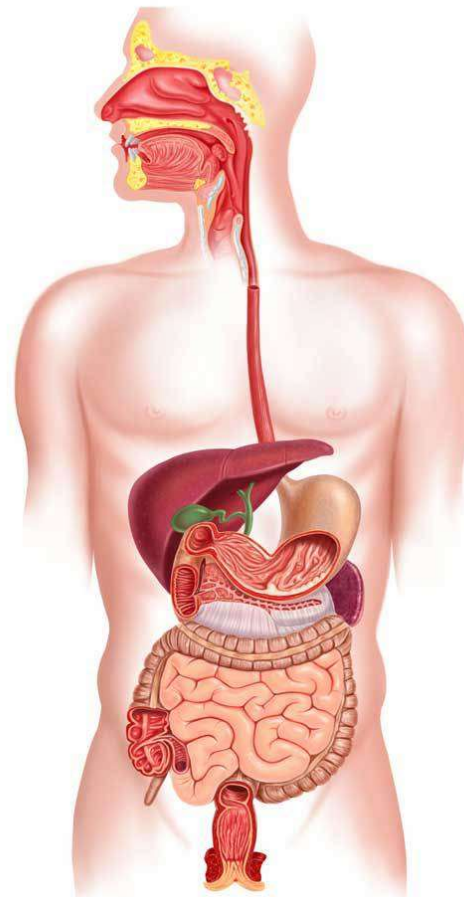
What is it??



Which human body system will help humans to perform the life process of NUTRITION?

The DIGESTIVE system!

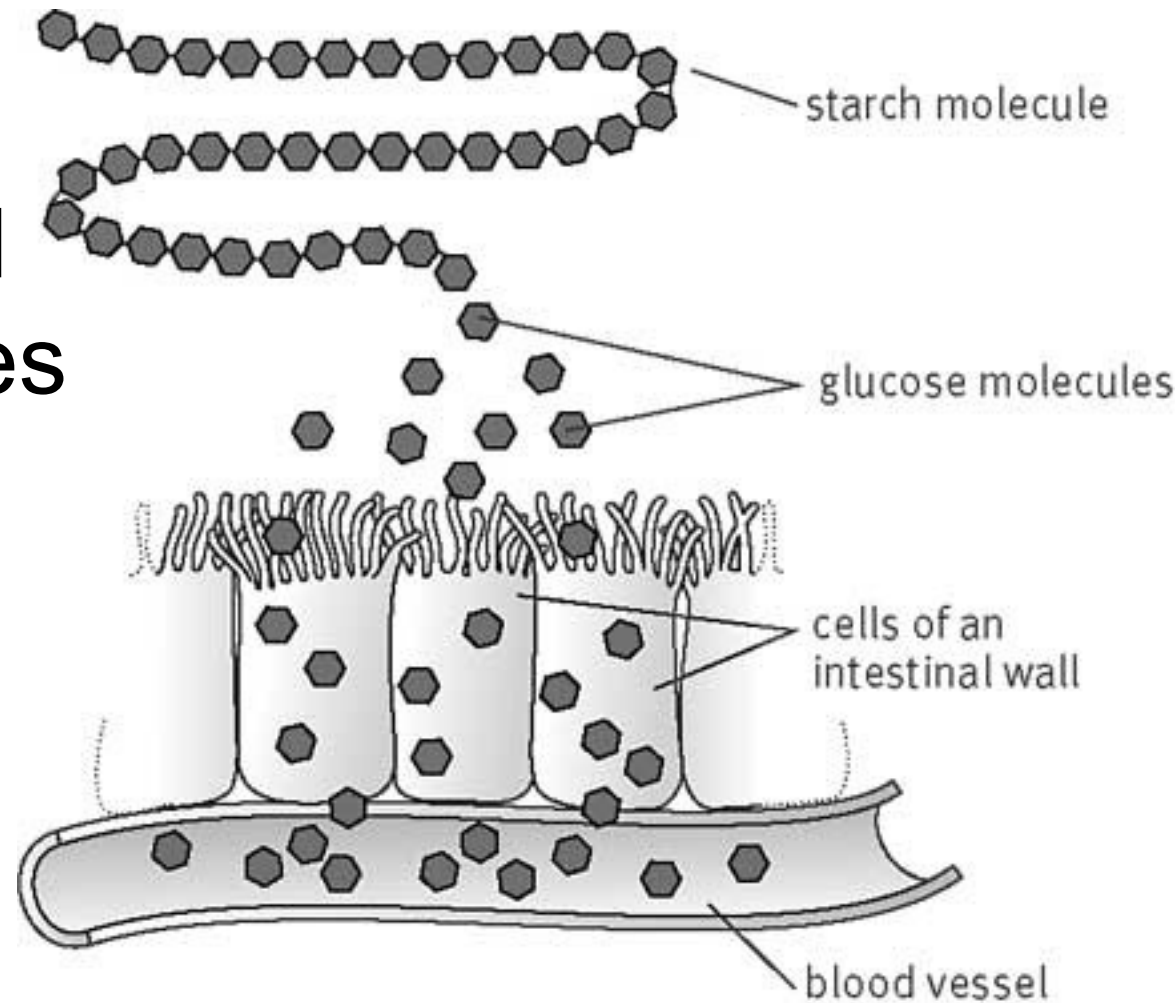
(My favorite!)



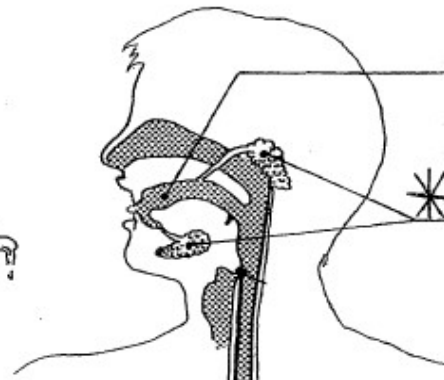
Human Digestive System

Main Function

- to break down food into smaller particles that can be absorbed into the blood and distributed for use by all body cells



1 – 6 is the path food travels



① **oral cavity**

* **salivary glands**

② **esophagus**

* **liver**

* **gall bladder**

③ **stomach**

* **pancreas**

Large intestine or colon

⑤

small intestine

④

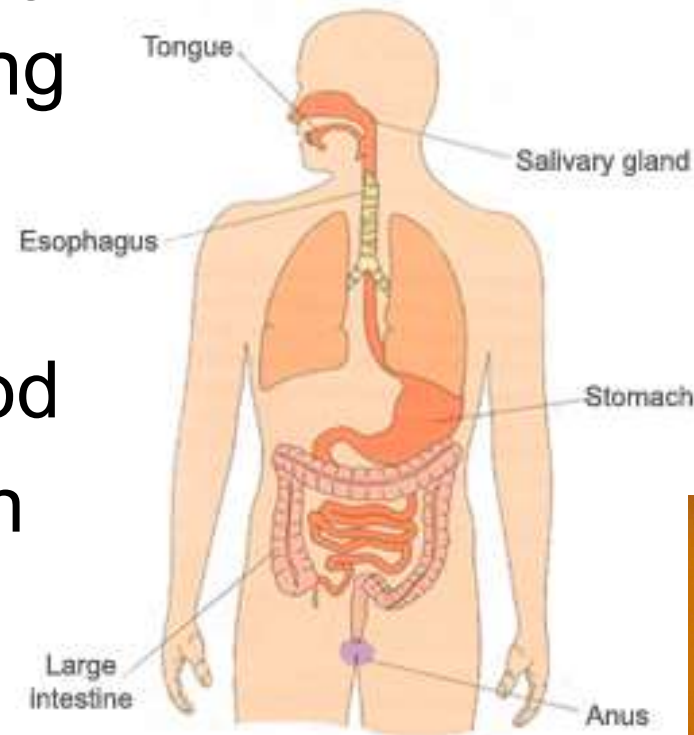
⑥ **rectum**



* are accessory organs (help digestion but food does not enter)

Heterotrophic Nutrition

- Obtaining nutrients from other sources by eating / absorbing
- In humans, involves 3 processes:
 - **Ingestion**- consuming food
 - **Digestion**- breaking down food
 - **Egestion**- releasing solid waste / feces (**not excretion!**)



What helps ALL body systems work?

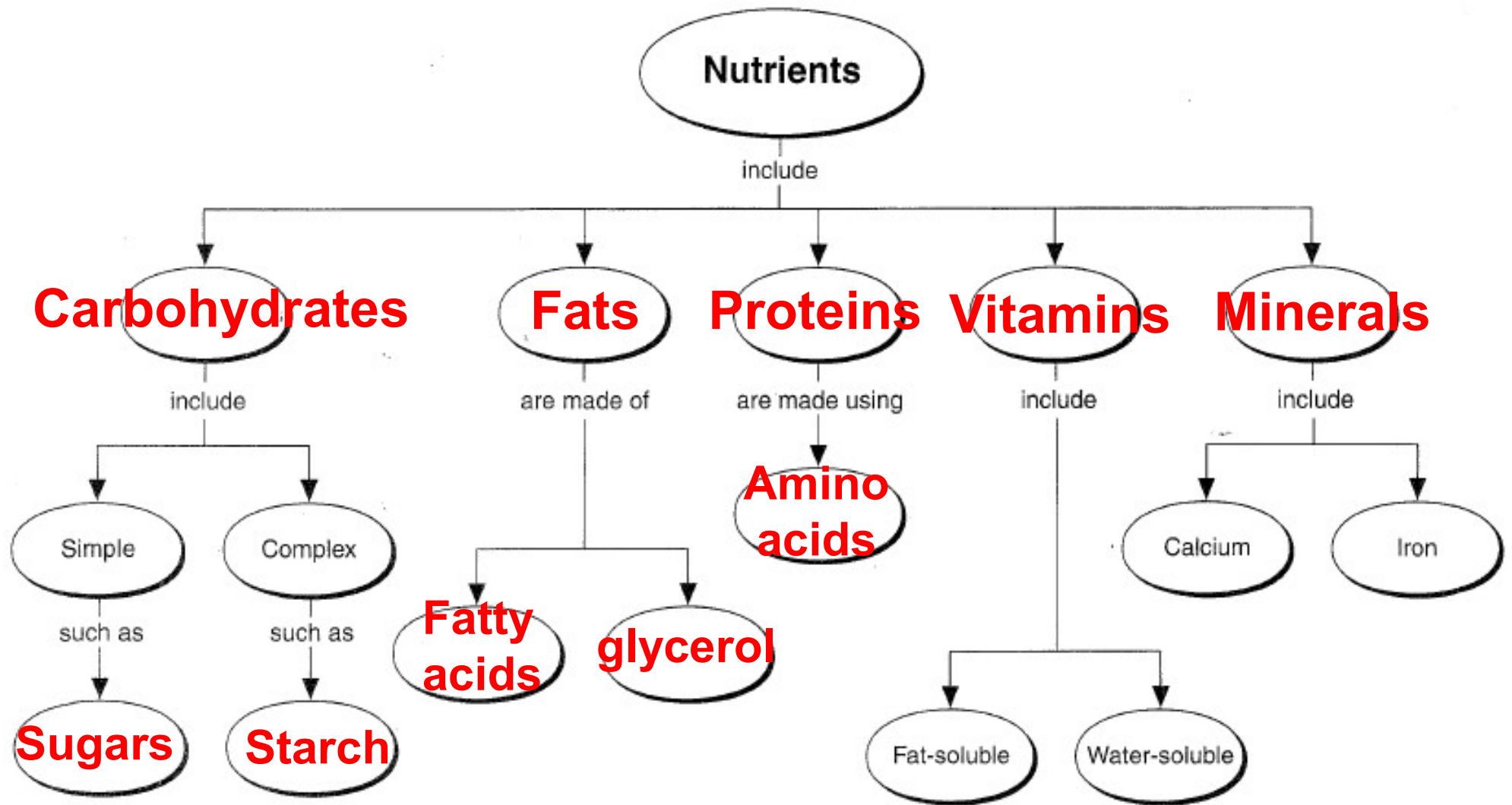
Proper Nutrition!

OLD WAY



NEW WAY!





6 Nutrients Found in Food

LARGE
molecules (**must**
DIGEST to
absorb)

Carbohydrates → simple sugars

Lipids → glycerol & fatty acids

Proteins → amino acids

SMALL
molecules
(absorbed without
digestion)

Vitamins **organic**

Minerals **inorganic**






Water

Vitamins –
organic
 molecules
 that often
 work with
 enzymes to
 regulate body
 processes

Vitamin	Sources	Function
A (retinol)	Yellow, orange, and dark green vegetables; dairy products	Important for growth of skin cells; important for night vision
D (calciferol)	Fish oils, eggs; made by skin when exposed to sunlight; added to dairy products	Promotes bone growth; increases calcium and phosphorus absorption
E (tocopherol)	Green leafy vegetables, seeds, vegetable oils	Antioxidant; prevents cellular damage
K	Green leafy vegetables; made by bacteria that live in human intestine	Needed for normal blood clotting
B ₁ (thiamine)	Whole grains, pork, legumes, milk	Normal metabolism of carbohydrates
B ₂ (riboflavin)	Dairy products, meats, vegetables, whole-grain cereal	Normal growth; part of electron transport chain; energy metabolism
Niacin	Liver, milk, whole grains, nuts, meats, legumes	Important in energy metabolism
B ₆ (pyridoxine)	Whole grains, meats, vegetables	Important for amino acid metabolism
Pantothenic acid	Meats, dairy, whole grains	Needed for energy metabolism
Folic acid	Legumes, nuts, green leafy vegetables, oranges, broccoli, peas, fortified bread and cereal	Coenzyme involved in nucleic acid metabolism; prevents neural-tube defects in developing fetuses
B ₁₂ (cyanocobalamin)	Meats, eggs, dairy products, enriched cereals	Coenzyme in nucleic acid metabolism; maturation of red blood cells
C (ascorbic acid)	Citrus fruits, tomatoes, red or green peppers, broccoli, cabbage, strawberries	Maintenance of cartilage and bone; antioxidant; improves iron absorption; important for healthy gums, tissue repair, and wound healing
Biotin	Legumes, vegetables, meat	Coenzyme in synthesis of fat; glycogen formation; amino acid metabolism
Choline	Egg yolk, liver, grains, legumes	Required for phospholipids and neurotransmitters

Minerals – inorganic elements on Earth and in our foods that our bodies need to develop and function normally

570 | **FIGURE 38-7 TYPES OF MINERALS**

Mineral	Sources	Function
Calcium	 Dairy products; salmon; sardines; kale; tofu; collard greens; legumes	Bone and tooth formation; blood clotting; nerve and muscle function
Phosphorus	Dairy products; meats; poultry; grains	Bone and tooth formation; acid-base balance
Potassium	 Meats; dairy products; many fruits and vegetables; grains	Acid-base balance; body water balance; nerve function
Chlorine	Table salt; processed foods	Acid-base balance; formation of gastric juice
Sodium	 Table salt; processed foods	Acid-base balance; body water balance; nerve function
Magnesium	Whole grains; green leafy vegetables	Activation of enzymes in protein synthesis
Iron	 Meats; eggs; legumes; whole grains; green leafy vegetables; dried fruit	Component of hemoglobin and of electron carriers used in energy metabolism
Fluorine	Fluoridated drinking water; tea; seafood	Maintenance of tooth structure; maintenance of bone structure
Iodine	Seafood; dairy products; iodized salt	Component of thyroid hormones
Zinc	 Meats; seafood; grains	Component of certain digestive enzymes

Dr. William Beaumont: The First GI Guy

In 1822, a French-Canadian fur trader named Alexis St. Martin was severely wounded. A shotgun blast tore open his abdominal wall and the stomach itself. The wound was as large as the palm of a man's hand!

Dr. Beaumont treated the wound, but he was repeatedly unsuccessful in fully closing the hole in St. Martin's stomach. For a while, the hole had to be covered with cotton to prevent food and drink from coming out! The hole in St. Martin's side was a permanent *open gastric fistula*, an opening about the size of a quarter, large enough that Beaumont could insert his entire forefinger into the stomach cavity!

This provided Beaumont with a unique opportunity to study digestive processes by looking right into St. Martin's stomach through the hole. Beaumont removed samples of gastric juice from St. Martin's stomach and soaked different foods with the juice. He saw that some foods were changed by the juice and others were not. He even dipped food samples attached to a string directly into the open hole of St. Martin's stomach and watched as they were digested!

Dr. William Beaumont: The First GI Guy

Question:

Dr. Beaumont noticed that the foods he dropped directly into Alexis St. Martin's stomach took an unusually long time to be digested. Why? What steps in the digestive process were missing?



**Chewing the food with the teeth
in the mouth**

2 Types of Digestion...

1. Mechanical digestion

Chewing

- teeth tear food
- tongue pushes food

Churning

- muscles lining walls squeeze and mix food



[Video - Gallagher clip \(start at 2:25\)](#)

2. Chemical digestion

- Enzymes and acids break down and change the molecules so they are small enough to pass into the blood and body's cells for use

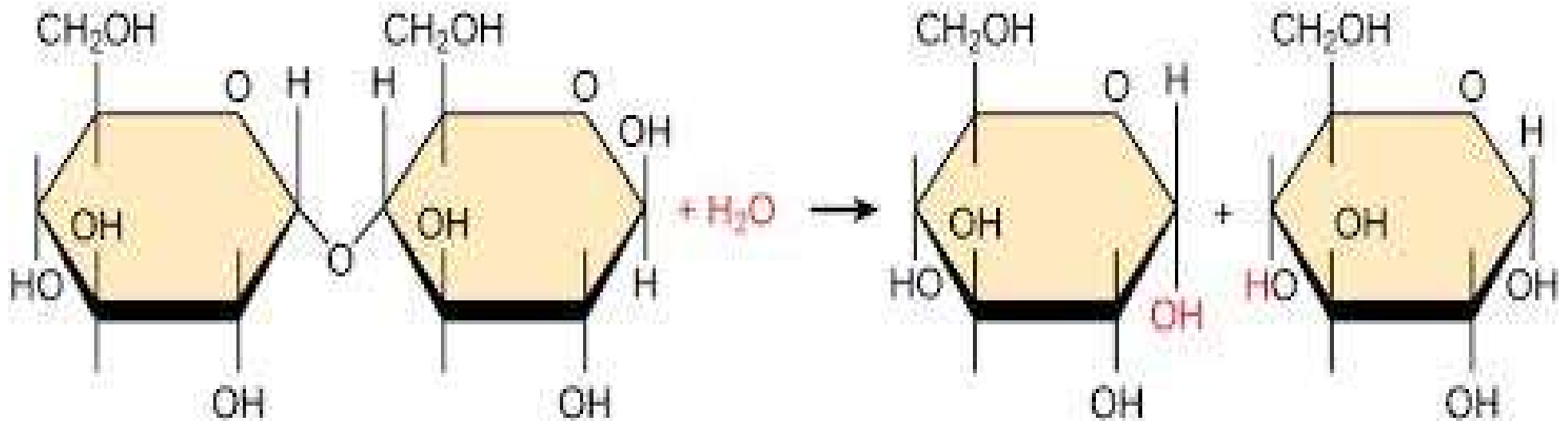


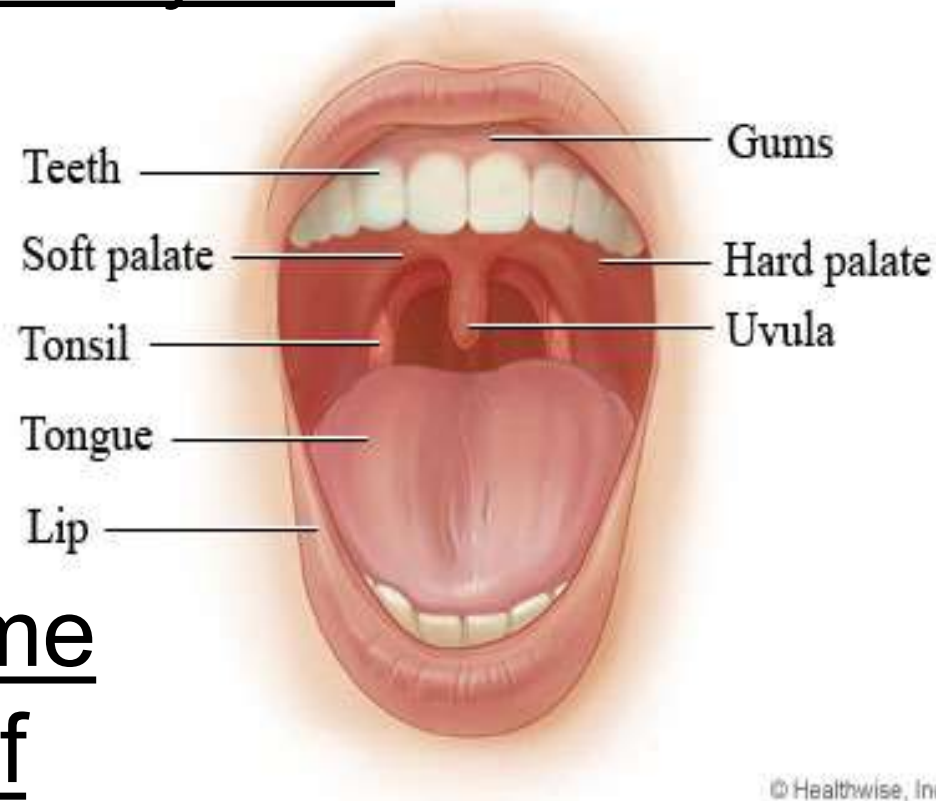
Table 1 Mechanical and Chemical Digestion

Description	Mechanical Digestion	Chemical Digestion
1. The <u>physical</u> changes that occur to food.	✓	
2. The <u>starch</u> in crackers is broken down into <u>simple sugars</u> .		✓
3. <u>Proteins</u> are changed to <u>amino acids</u> .		✓
4. <u>Large pieces</u> of food are broken down into <u>smaller pieces</u> .	✓	
5. The <u>chemical</u> changes that occur to food.		✓
6. Large <u>food molecules</u> are broken down into <u>smaller molecules</u> .		✓
7. Food is <u>torn apart</u> and <u>chewed</u> .	✓	
8. <u>Enzymes</u> are used to break down food molecules		✓

Major Anatomy & Physiology of the Human Digestive System

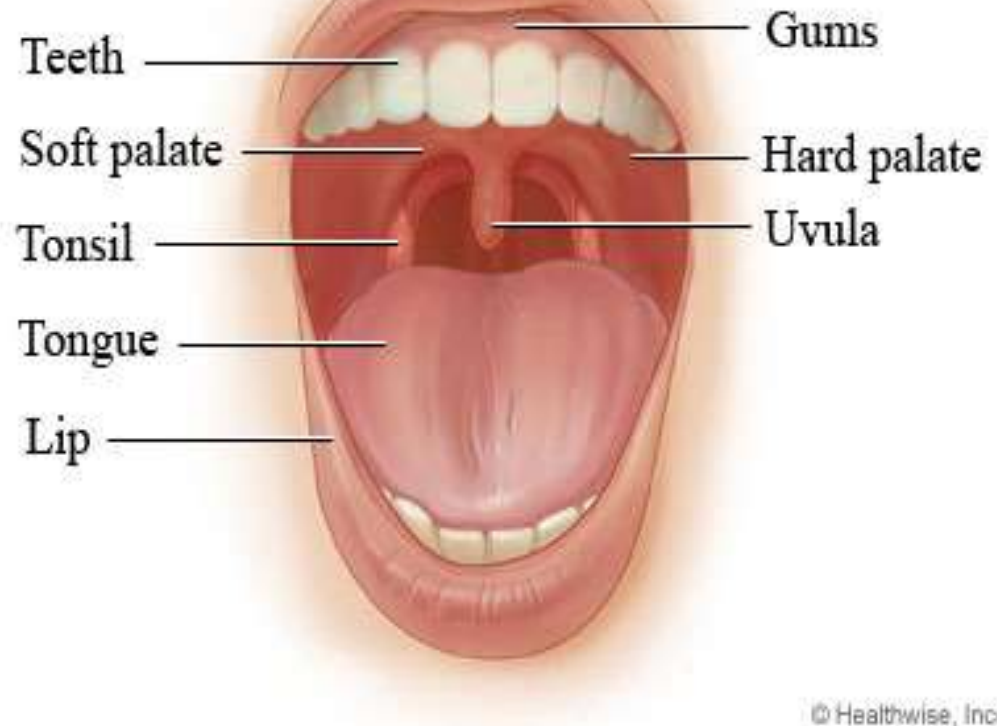
1. Mouth (oral cavity)

- Site of ingestion
- Begins digestion
 - salivary glands make salivary amylase (enzyme for chemical digestion of starch → sugar)



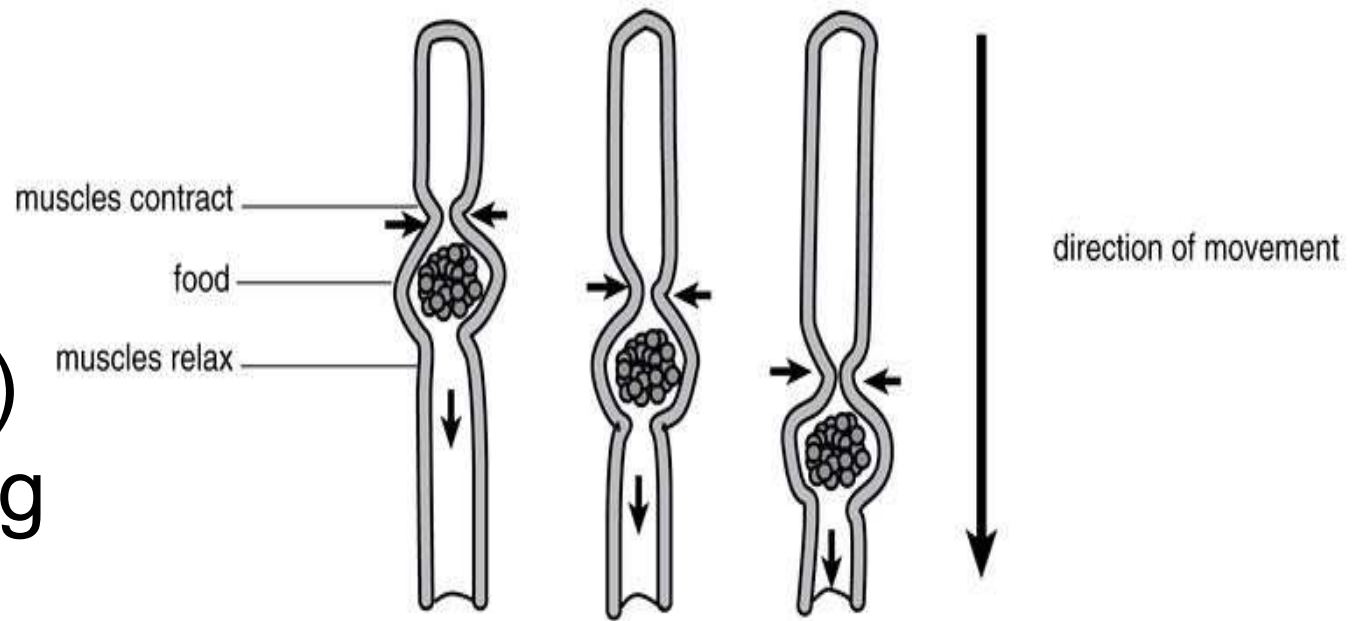
[Gleek Video](#)

- Teeth & Tongue
– mechanical digestion
- Uvula – “punching bag” shaped structure that blocks food from entering the nasal cavity



2. Esophagus (opening in pharynx / throat)

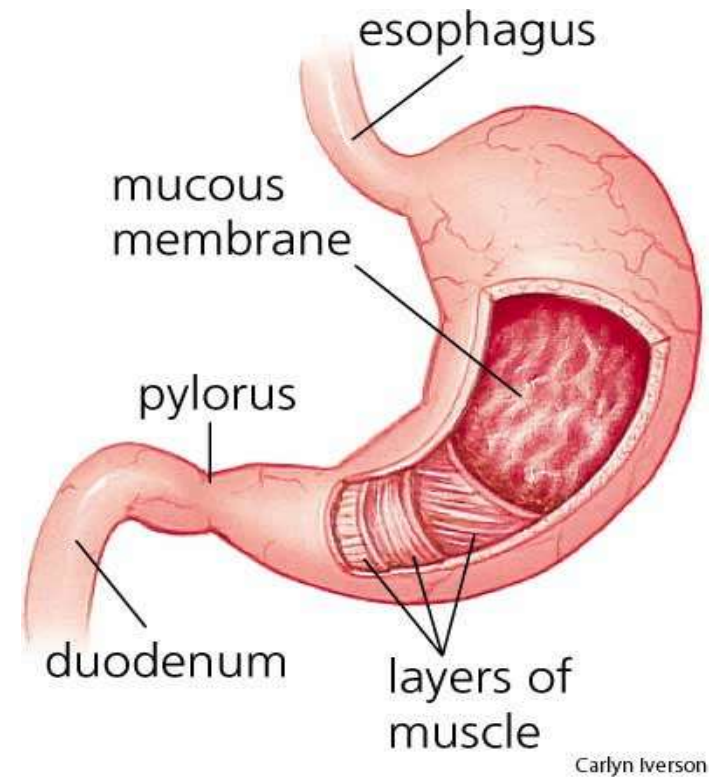
- tube connects mouth to stomach
- Peristalsis - muscular contractions push swallowed food down
- Epiglottis flap closes over trachea (airway) when swallowing to prevent choking



[Epiglottis animation - YouTube](#)

3. Stomach

- Muscular pouch
- Churns (mixes) food with gastric juices forming soupy mixture
 - **hydrochloric acid** and **pepsin** digest proteins into amino acids
- Lined with mucus to protect itself from acid
- Painful ulcers can form if this lining is damaged



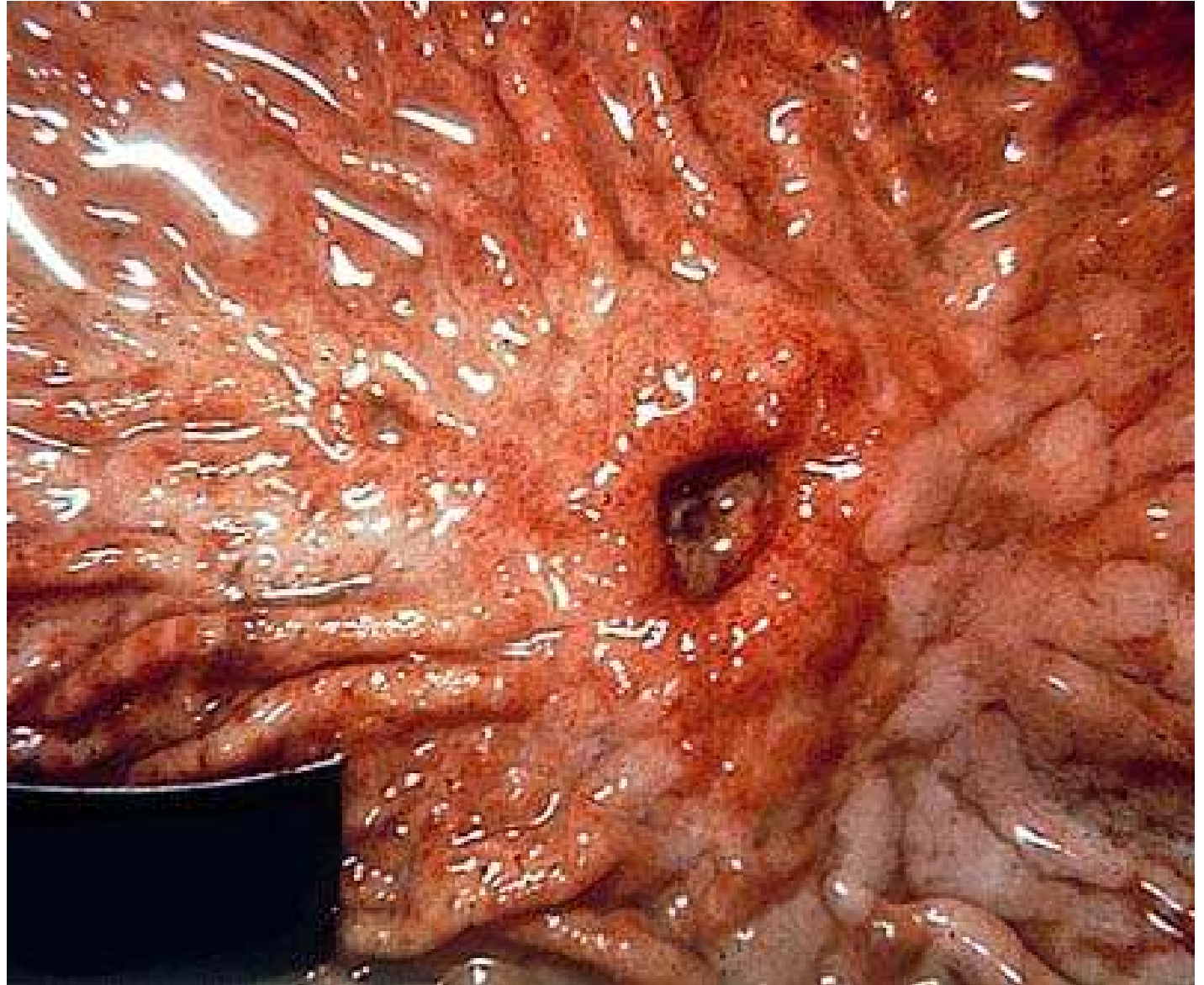
Peptic Ulcer (stomach ulcer)



Stomach ulcer

How did we
get an
actual
photograph
the inside
of a
stomach?

Endoscopy



How long is the human digestive system?

Up to **30 feet** long in adults!



4. **Small Intestine** - long, but narrower tube

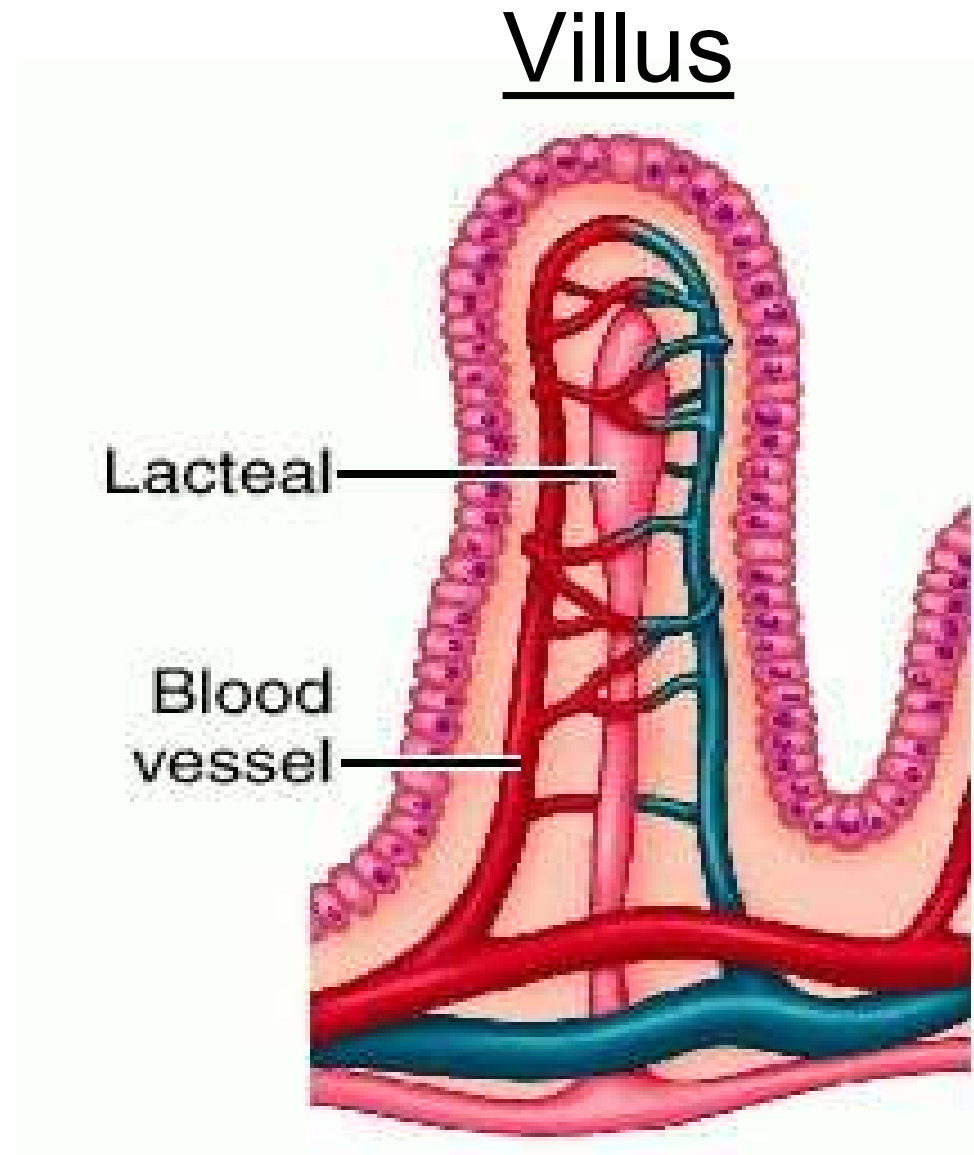
- most chemical digestion occurs here because it receives secretions (enzymes) from 3 accessory organs (liver, pancreas, gall bladder)
- **Absorbs** nutrients into bloodstream through villi
- **Villi**: finger-like projections lining the inside of tube
 - increased surface area to absorb nutrients

Villi



Blood vessels in the villi absorb nutrients so they can be transported to all of the cells of the body for use.

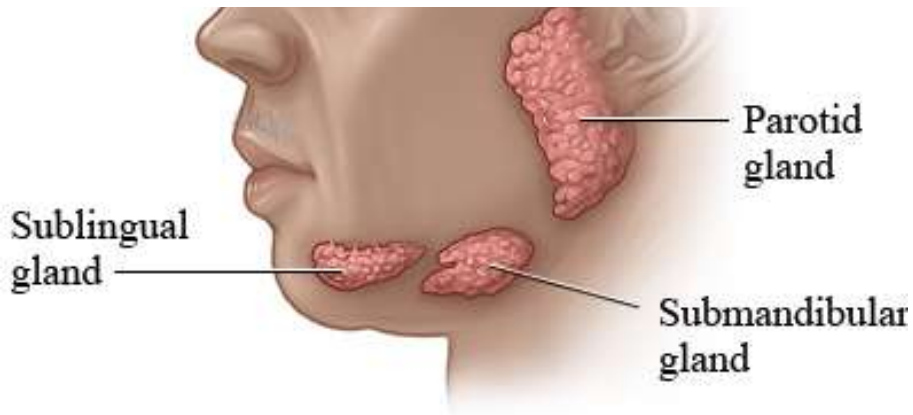
Ex. Glucose will be used by the body's cells to get energy during aerobic respiration.



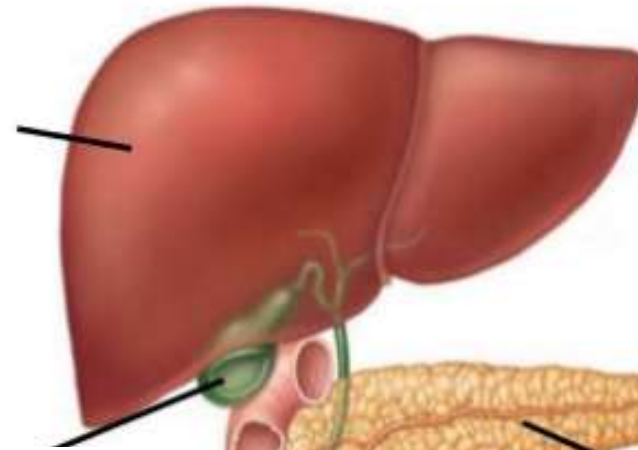
Accessory Organs

Organs that secrete (release) substances into the digestive tract but food does NOT pass directly through them

Salivary Glands

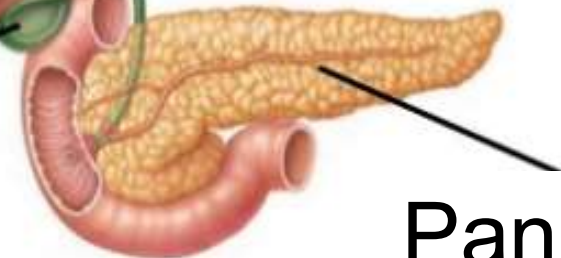


Liver



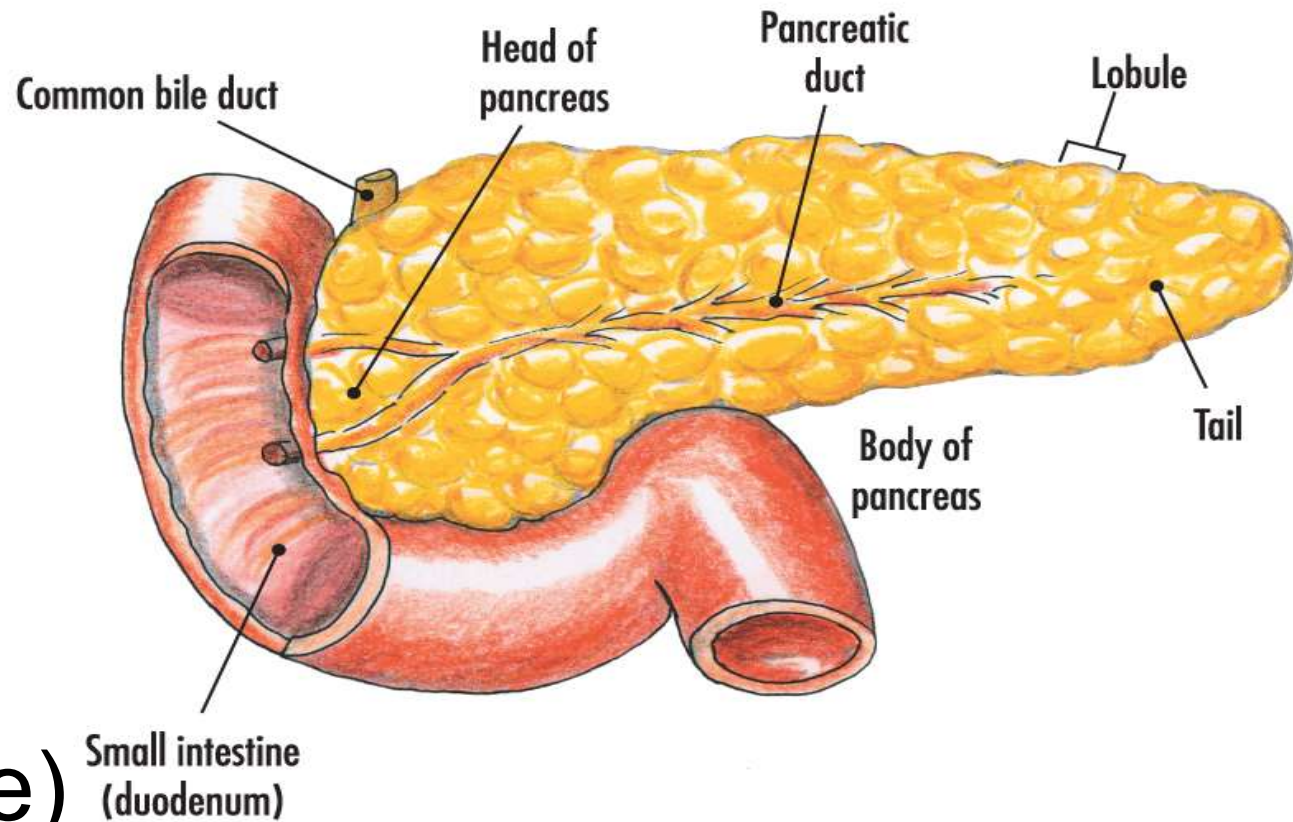
Gall Bladder

Pancreas



Pancreas

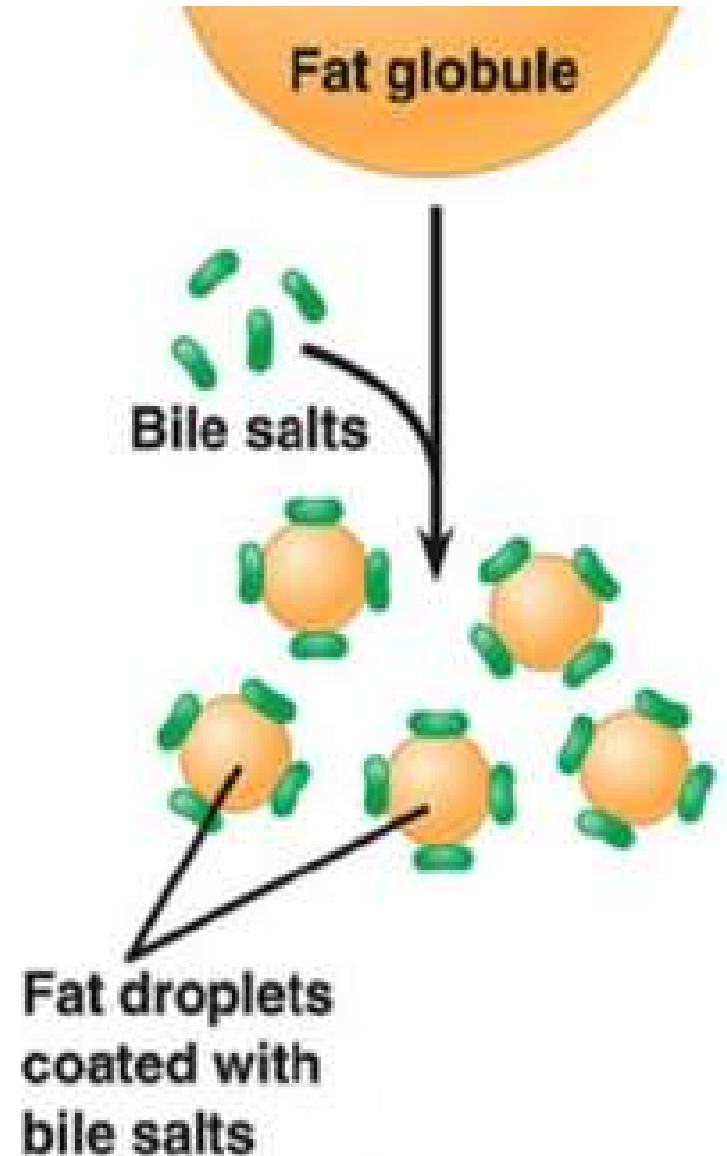
- Produces enzymes for chemical digestion (protease, amylase, lipase)



- secretes these enzymes into the small intestine

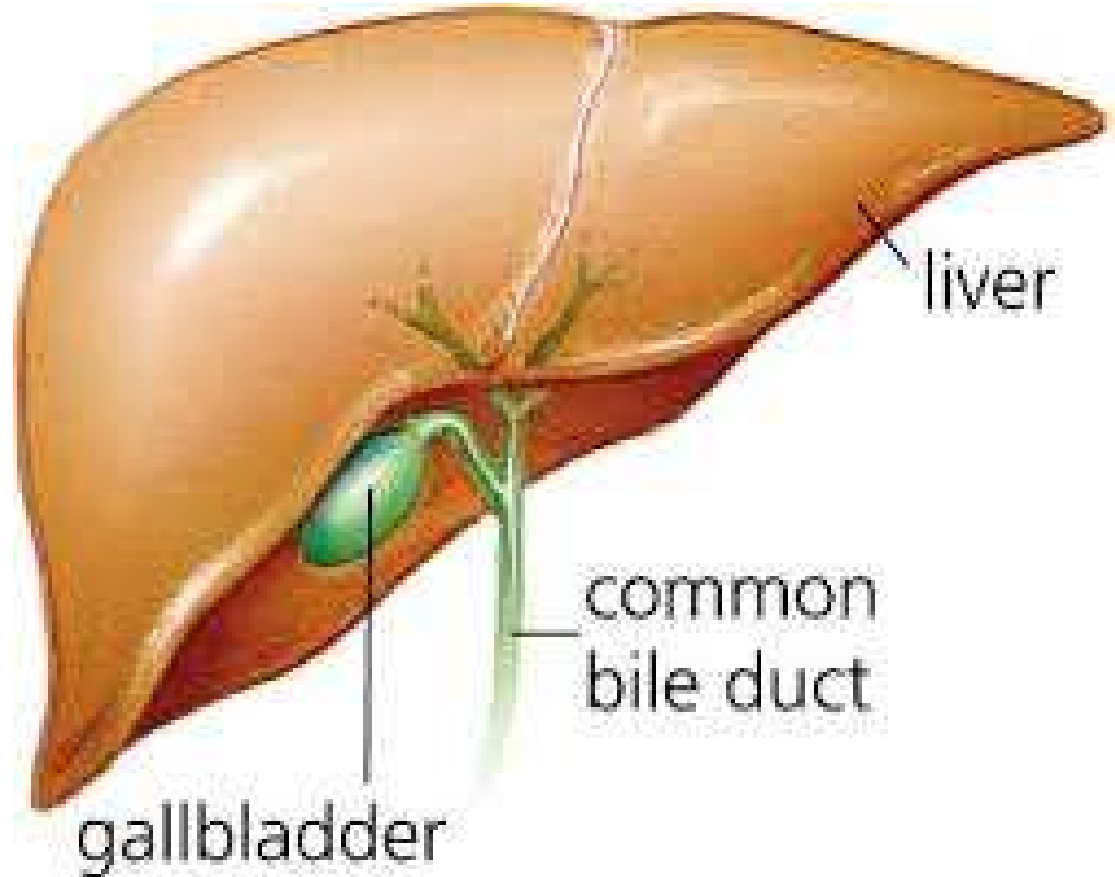
Liver

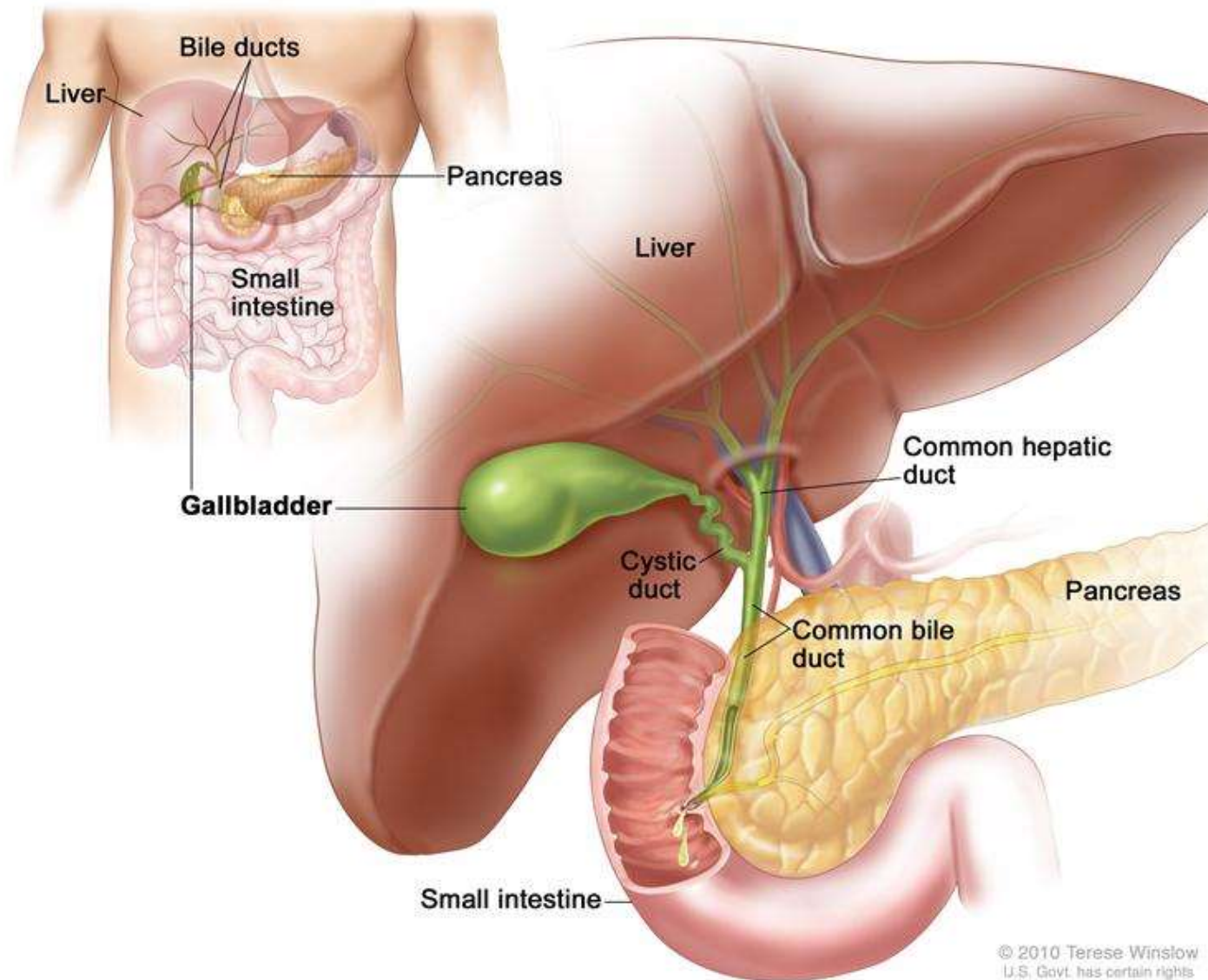
- Produces & releases **bile** to *emulsify* fat globules into smaller fat droplets (mechanical digestion)
 - Provides more surface area for enzymes to perform chemical digestion



Gall Bladder

- small pouch under the liver
- stores and releases bile made by the liver, into the small intestine





5. Large Intestine / Colon (shorter but wider tube)

- absorbs water from waste into the blood forming feces
- Contains helpful bacteria that produce vitamins
- Feces (undigested waste) is stored in the rectum then removed out the anus (egestion)

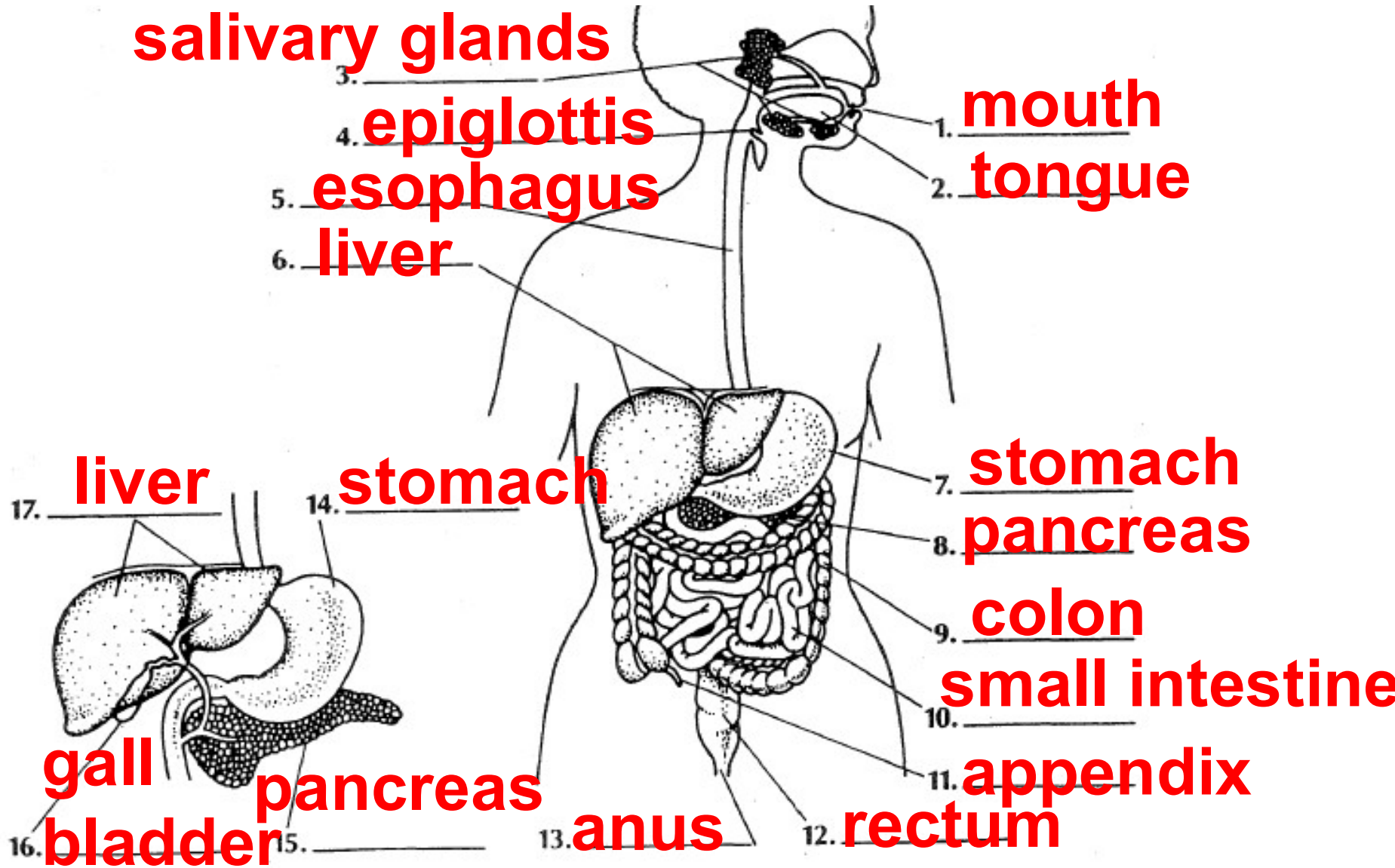
Appendix – dangling structure at the beginning of the colon

–helps some animals (not humans) digest cellulose (plant starch)

Malfunctions of the Large Intestine

If too much water is reabsorbed, feces will be hard and difficult to pass, leading to constipation

If not enough water is reabsorbed, feces will be watery, leading to diarrhea



Appendicitis (malfunction)

- An infection causing swelling and inflammation of the appendix
- Failure of Homeostasis:
 - Infection can spread if it bursts
- Treatment
 - Surgery to remove it
 - Antibiotics to treat infection



Introduction

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[Video -
laparoscopic
appendectomy](#)

Appendicitis

Appendicitis

