Review: How is your body organized?

tissue

↓

organ

↓

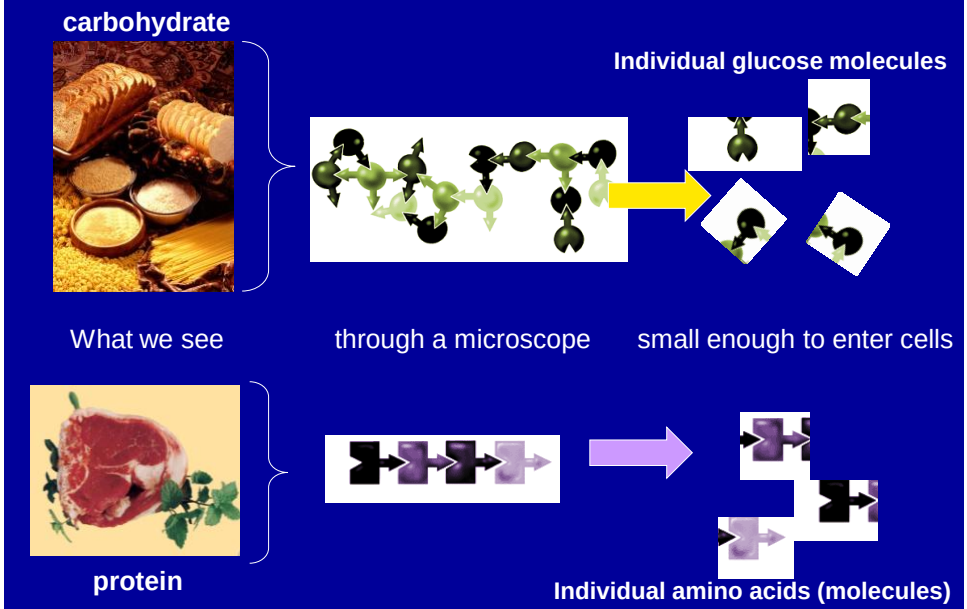
system

- Similar cells are grouped together to form a **tissue** (epithelial, nervous, muscle, connective)
- different tissues are grouped together to form **organs** (ex. stomach)
- organs that work together to perform a specific function make up a **system** (ex. digestive system→ includes organs such as stomach and intestines)

What is the function of your digestive system?

- The cells in your body need a source energy in order to function
- The food you eat provides your cells with chemical energy (stored in the chemical bonds of the food molecules)
- The function of your digestive system is to break down food into pieces (molecules) that are small enough to enter your cells, so that they may be used as an energy source.

How small is small enough?



There are two types of digestion:

1) Mechanical digestion = physical change
2) Chemical digestion = chemical change

Mechanical Digestion

- physical breaking down of food into smaller pieces
- Teeth and stomach do this job

Chemical Digestion

- breaking apart of the chemical bonds that hold the molecules of food together
- digestive enzymes secreted by the mouth, stomach and pancreas do this job

Organs of the Digestive System

- Each organ of your digestive system has a specific job in the process of digestion

1) Mouth
   - Salivary glands
2) Esophagus
   - Epiglottis
3) Stomach
4) Small intestine
5) Liver
6) Gallblader
7) Pancreas
8) Large intestine
9) Rectum
10) Anus

1) Mouth:

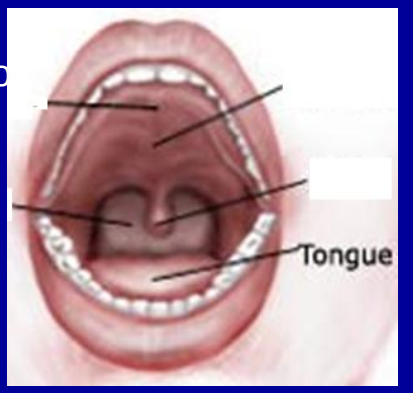
breaks down food mechanically and chemically

TONGUE: pushes food into grinding teeth and puts food into the right position for swallowing

LIPS: hold in food and saliva

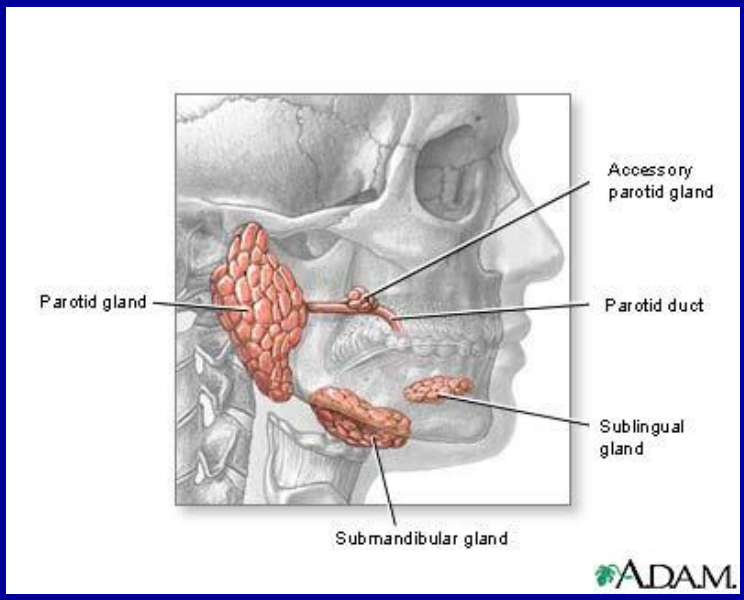
TEETH: tear apart, cut, crush, and grind food

SALIVA: is the watery fluid in your mouth that moistens your food, making it easier to swallow



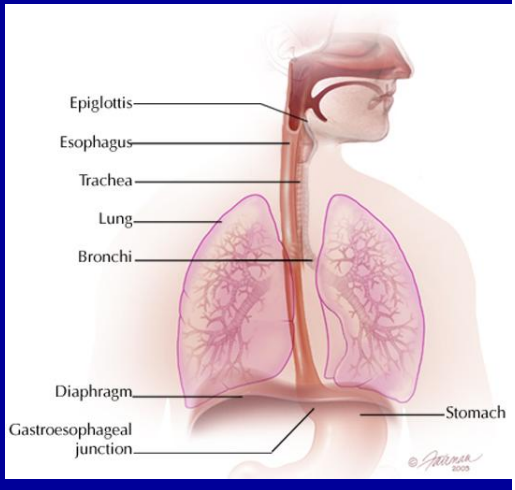
Glands in the Mouth

- A gland is an organ that produces secretions
- There are three pairs of salivary glands in your mouth:
  - parotid glands
  - Sublingual glands
  - Submandibular glands
- Each day the salivary glands secrete 1-1.5 L of saliva into the mouth
- Saliva contains an enzyme called salivary amylase that is responsible for the digestion of carbohydrates
- The enzymes contained in saliva also prevent the growth of bacteria in your mouth



2) Esophagus:

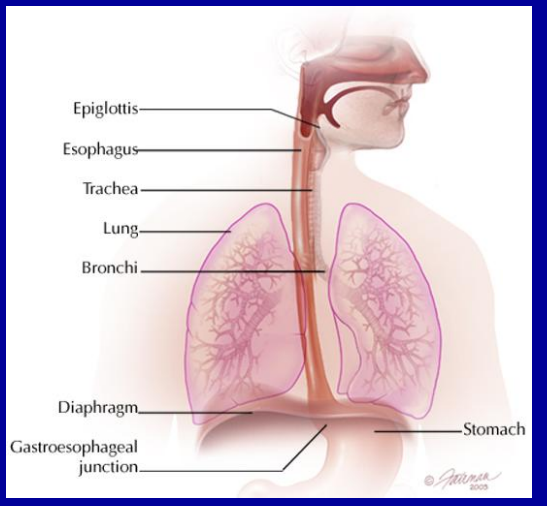
- The esophagus is an elastic, muscular tube that carries food to your stomach
- The trachea carries air to your lungs; it is not part of your digestive system



Your esophagus

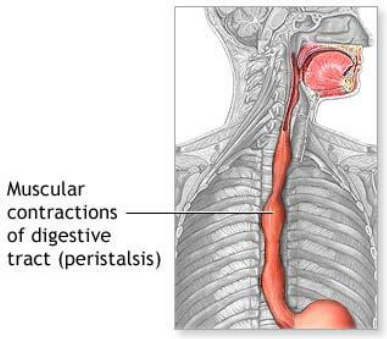
How does your body keep food or liquid from entering the trachea?

- When you swallow, a fleshy flap of tissue called the **epiglottis** automatically covers the opening of the trachea.
- Food then moves down your esophagus to your stomach



How does food get from your mouth to your stomach?

- The walls of the esophagus are lined with muscles.
- As these muscles contract from the top (near your mouth) to the bottom (near your stomach) food is pushed toward your stomach.
- This motion is known as **peristalsis**



Answers

1) What is the main function of your digestive system?

The main function of the digestive system is to break down food into substances small enough to enter your cells.

2) What is a gland?

A gland is an organ or group of cells that produce secretions.

3) What are two functions of your saliva?

The saliva in your mouth contains an enzyme called salivary amylase that breaks down carbohydrates. Saliva also kills bacteria in your mouth.

Answers

4) What are the names of the two tubes at the back of your throat? What purpose do each of these serve?

The esophagus is carries food to your stomach and the trachea carries air to your lungs.

5) What purpose does the epiglottis serve?

During swallowing the epiglottis automatically covers the opening of the trachea so that food or liquid enters the esophagus.

6) How does food move down the esophagus to your stomach? What is the scientific name for this process?

Food moves through the esophagus when muscles that run around it contract. This motion is known as peristalsis.

Answers

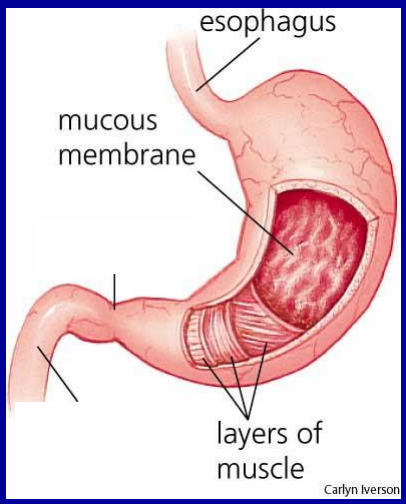
7) What is the difference between mechanical and chemical digestion?

Mechanical digestion is the breaking down of food into smaller pieces by the action of the teeth or stomach

Chemical digestion is the breakdown of large food particles into smaller ones by the action of digestive enzymes such as the ones in saliva.

3) Stomach

- Food in your mouth travels down your esophagus to your stomach
- The stomach is like a thick balloon made of muscle
- It can stretch to hold as much as 2L of food and it shrinks when it's empty
- Like your mouth, your stomach breaks down food both mechanically and chemically



Mechanical Digestion in the Stomach:

- The powerful muscles in the stomach contract and squeeze the food within it
  → called churning
- These contractions help mix food in the stomach with the gastric juice which it produces
- This fluid contains digestive enzymes and is responsible for chemical digestion in the stomach
- After a few hours, the food in the stomach has transformed into a liquid like substance called chyme

Chemical Digestion in the Stomach

- The stomach contains glands that secrete gastric juices which moisten food and perform chemical digestion
- The fluid produced by your stomach is made up of :
  1) pepsin (a digestive enzyme)
  2) hydrochloric acid (HCl)

Composition of Gastric Juice

1) <u>pepsin:</u>
   -a digestive enzyme
   -breaks down proteins into chains of amino acids

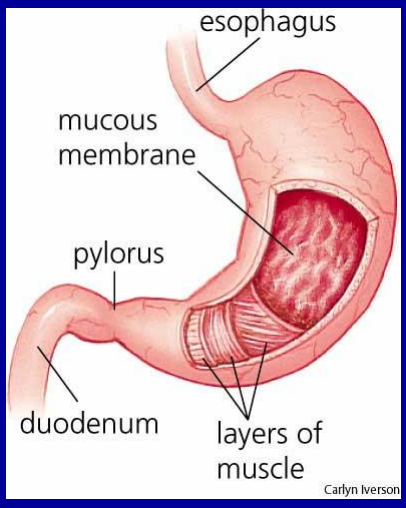
2) <u>hydrochloric acid (HCl):</u>
   - provides an acidic environment for pepsin to break down proteins (accelerates chemical reaction)
   - pH <2

The role of Mucus in the Stomach

- The stomach is coated by a layer of mucus which protects it against the acidic gastric juices
- Without this protective lining, the hydrochloric acid would digest the walls of the stomach.

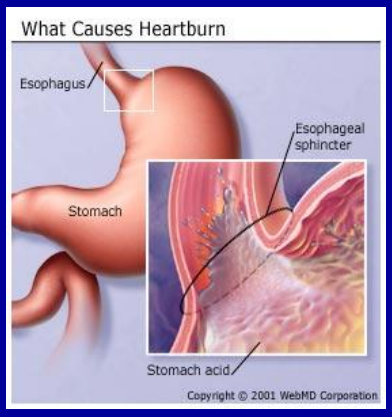
How does your stomach control the movement of food into your intestines?

- A circle of muscle is located at the bottom of your stomach → pyloric sphincter or pylorus
- This muscle usually stays closed, keeping food in your stomach
- When food needs to be released into the small intestine the pyloric sphincter opens to allow the food to pass through



What is heartburn?

- When the stomach becomes too full it can push the acidic contents of the stomach upward, into the lower part of the esophagus.
- The esophagus and pharynx do not have a layer of mucus like the stomach and thus are not protected against acid.
- The acid rushing up into the esophagus causes a burning pain felt in the middle of your chest near your heart…..
- This is known as “heartburn”.



Practice Questions

a) What 2 structures of your digestive system does food pass through immediately after swallowing it?

Esophagus, stomach

b) What do your stomach and a balloon have in common?

They both can stretch like a balloon.

c) What 2 digestive processes do your mouth and stomach have in common?

They both perform mechanical and chemical digestion.

d) What 2 substances are produced by your stomach and what are their functions?

pepsin: breaks down proteins

HCl: provides an acidic environment for pepsin to function optimally

Practice Questions

e) Why is it that you feel a burning sensation in your throat after vomiting?

Because the acid in your stomach is burning your esophagus and pharynx as they do not contain a mucus coating to protect themselves against the acid.

f) How does your stomach control the movement of food into your intestines?

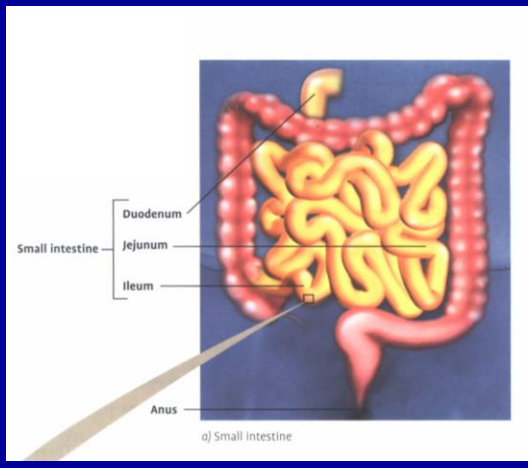
A muscle called the pyloric sphincter remains closed and opens only briefly to allow food to pass through into the small intestines.

g) What is heartburn?

Heartburn is a pain you feel in your chest that is a result of acid from your stomach entering your esophagus.

The Small Intestine (SI)

- The small intestine is attached to the stomach and is divided into three sections:
  1) The duodenum (connected to the stomach)
  2) The jejunum (middle portion)
  3) The ileum (connected to the large intestine)



The Small Intestine and Digestion

Q: Breaking down of carbohydrates (sugar) begins where?

- in your mouth (enzyme: salivary amylase in saliva)

Q: Breaking down of proteins begins where?

- in your stomach (enzyme: pepsin)

- but, resulting molecules are still too large for your cells to absorb and use!!!
- so, proteins, fats and sugars must be further mechanically and chemically digested in your small intestine

Digestion of Food in the SI

- When food enters the small intestine three substances are secreted into it:

1) Bile secreted by the gall bladder (but produced in the liver)

Bile aids in the mechanical digestion of fats.

2) Intestinal juices secreted by glands that line the walls of the small intestine

3) Pancreatic juices secreted by the pancreas

These 2 juices contain enzymes that complete the chemical digestion of carbohydrates, proteins and fats in the SI

5) Liver (organ):

- Is the largest organ in the human body
- Produces 1L of bile each day

Bile

- Green fluid produced by the liver and stored in the gall bladder
- Breaks up (emulsifies) fat particles in the SI

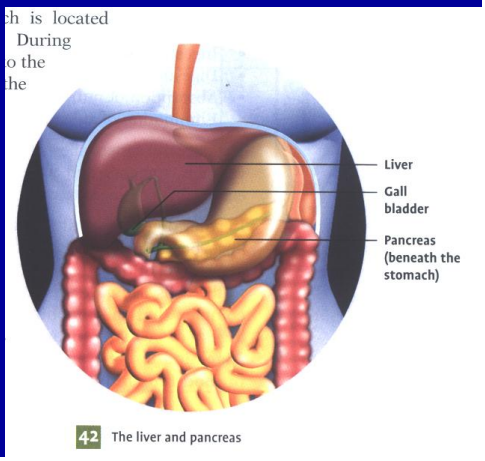
6) Gall bladder (organ)

- Stores bile and releases it into the duodenum (SI) when necessary

7) Pancreas (organ):

-Secretes 1.3 L of pancreatic juices into the SI each day

-Secretes insulin (hormone that breaks down sugar)



Mechanical Digestion in the SI

- Food is also churned in the SI just like in the stomach
  - This is necessary to mix the chyme with the digestive juices of the SI
- Food advances throughout the SI through peristalsis just like in the esophagus

Digestion of Fat in the SI

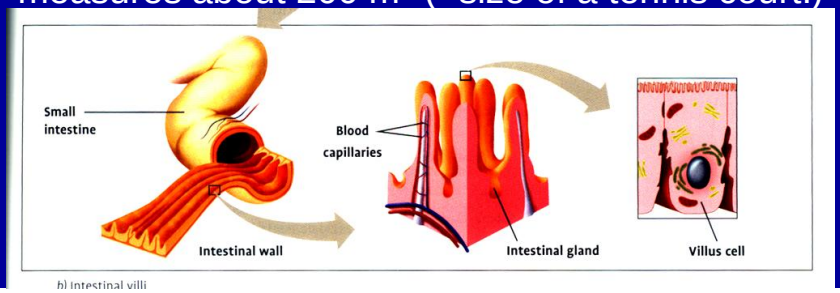
- The chyme that leaves your stomach and enters the SI contains water and fat.
- Water and fat do not mix, they coalesce
  - This means the fat floats to the surface of the water
- Bile is required to separate the fat molecules from the water molecules.
  - This is called emulsification
- Emulsified fat molecules have only been mechanically digested as bile does not contain enzymes and only separates molecules from each other.
- Emulsified fat molecules then mix with digestive juices (in the SI) containing enzymes which digest the fat chemically.

Chemical Digestion is Complete!

- Chemical digestion of food ends in the small intestine.
- All of the complex molecules have been transformed into simple molecules.
- These simple molecules are now small enough that they may pass through the walls of the small intestine into the blood.
  - This process is called absorption

The Inner Surface of the Small Intestine

- The inner surface of the small intestine is lined with folds called intestinal villi
- These folds increase the surface area between the small intestine and the food particles that pass through it so more absorption of nutrients may occur
- Stretched out, the surface of the intestinal wall measures about 200 m^2 (~size of a tennis court!)



b) Intestinal villi

Practice Questions

1) What are the names of the 3 sections of the small intestine?
2) How is the inner lining of the small intestine special and why is this important to digestion?
3) What three substances does the small intestine contain and which organs or cells are responsible for secreting each of these substances?
4) What 3 nutrients are digested in the small intestine and what are the names of their individual components?
5) What is the function of bile, where is it produced and where is it stored?
6) What hormone does the pancreas produce?
7) What process does the stomach and the small intestine have in common? What about the esophagus and the small intestine?

Practice Questions

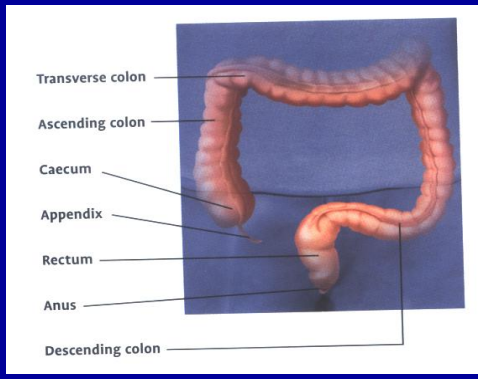
1) What are the names of the 3 sections of the small intestine?
   - Duodenum, jejunum, ileum
2) How is the inner lining of the small intestine special and why is this important to digestion?
   - It contains many folds called villi which increase the surface area between the small intestine and the chyme passing through it. This allows for more absorption nutrients.
3) What three substances does the small intestine contain and which organs or cells are responsible for secreting each of these substances?
   - intestinal juices are secreted by glands that line the walls of the small intestine
   - bile is secreted by the liver
   - pancreatic juices are secreted by the pancreas

Practice Questions

4) What 3 nutrients are digested in the small intestine and what are the names of their individual components?
   - carbohydrates → glucose
   - proteins → amino acids
   - fats → glycerol and fatty acids
5) What is the function of bile, where is it produced and where is it stored?
   - The function of bile is to emulsify fats found in the chyme.
   - It is produced by the liver but stored in the gall bladder
6) What hormone does the pancreas produce?
   - Insulin
7) What process does the stomach and the small intestine have in common? What about the esophagus and the small intestine?
   - The small intestine and the stomach are both the site of mechanical digestion (churning action) and they also both the site of chemical digestion (action of enzymes)

The Large Intestine (or colon)

- The large intestine is a muscular tube that is about 1.5 m in length and 6.5 cm in diameter
- It is also called the colon
- No villi line it's inner surface
- It is made up of cells that secrete mucus
  - This mucus lubricates the inner walls of the colon to facilitate the passage of solid residue



Function of the Large Intestine

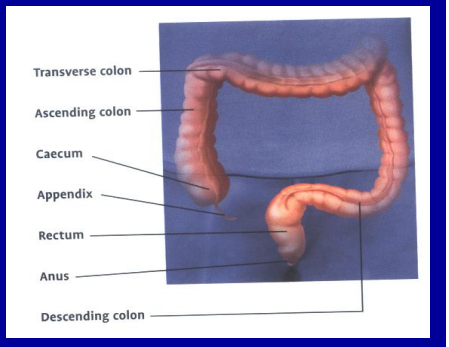
- Once the remains of the chyme leave the small intestine they enter the large intestine.
- This mixture is now mainly composed of water and waste material that cannot be digested.
- There are 2 main functions of the large intestine:
  - Absorption of water
  - Elimination, or removal of wastes from your body
- The wastes you eliminate are called feces.

Water Absorption and the Colon

- The cells of the colon absorb 1.5L to 1.8 L of water from the waste materials every day.
  - This makes the feces drier
  - The water is then reused by your body
- Feces are produced by bacteria that grow and reproduce in your large intestine.
- Feces are composed of:
  - Undigested residue (dietary fiber)
  - Remains of broken down cells (RBC make it brown)
  - Nutrients that have not been absorbed (mainly fats- which make it float)
  - Bacteria (which can cause urinary tract infections)
  - A small amount of water (if diarrhea, a lot of water)

Elimination and the Colon

- The last part of the colon is called the rectum.
- When the feces reach the rectum, the rectum expands to hold and store the feces until they are eliminated
- When the rectum is full, your nerves signal to your brain that you need to push the feces out of your body.
- The feces leave through an circular muscle called the anus



Answers

1) In your own words, define absorption.

Absorption is the process by which substances, such as nutrients, enter the cells that line the wall of the small intestine.

2) Where in your digestive system does absorption of nutrients occur?

The mixture that enters the large intestine is made up of mainly of water and waste material that cannot be digested.

Answers

3) Where is your digestive system does absorption of water occur?

The main function of the large intestine is elimination which is the removal of wastes from your body

4) What do the cells that line the colon secrete and what is the function of this substance?

Feces are produced by bacteria that grow and reproduce in your large intestine. They come out dry because the cells of the large intestine absorb water from the waste materials every day.

Answers

5) What is the function of the rectum?

   The function of the rectum is to store feces.

6) What is the anus?

   The anus is a circular muscle that opens in order to excrete feces from the rectum.