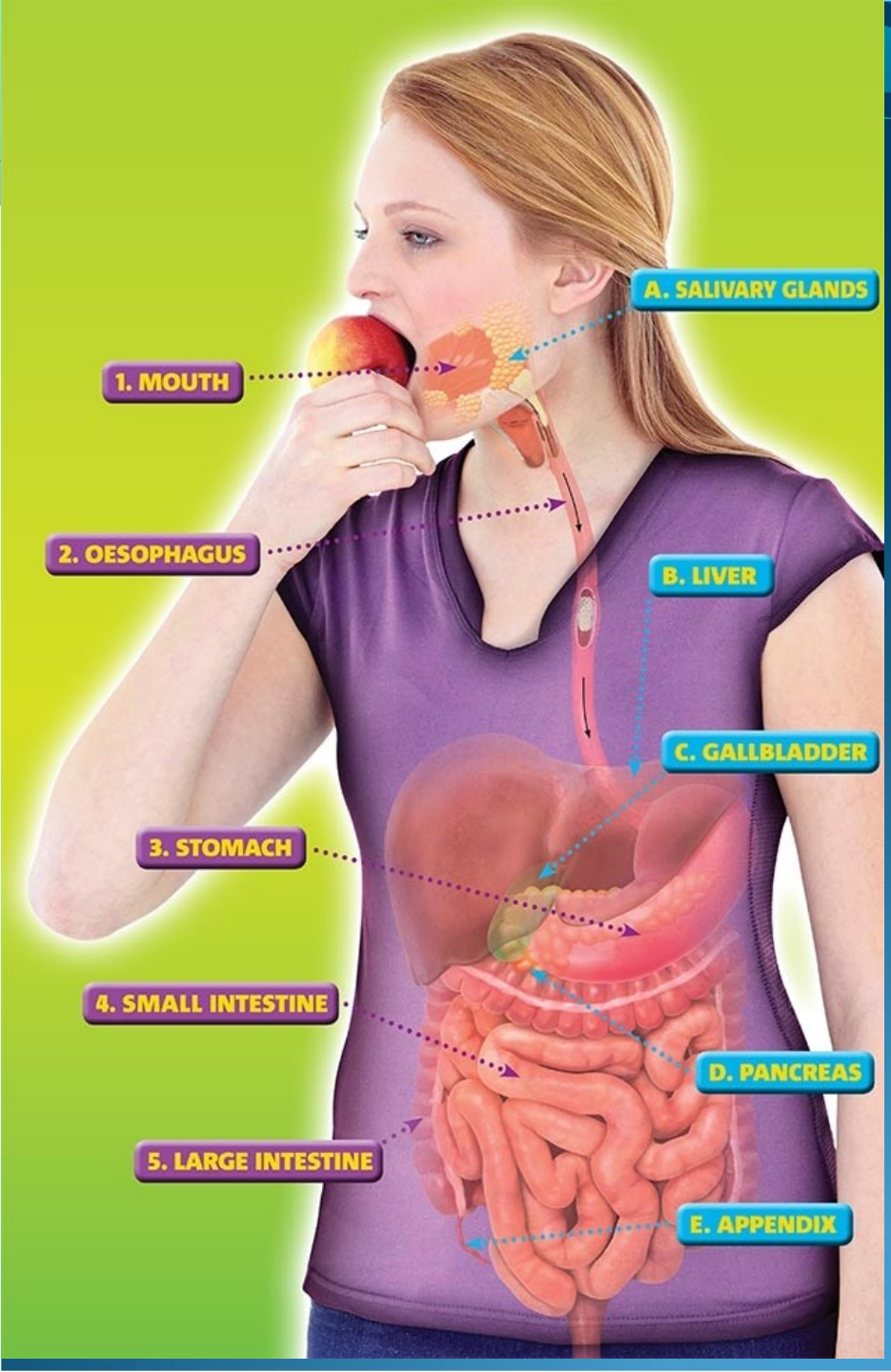
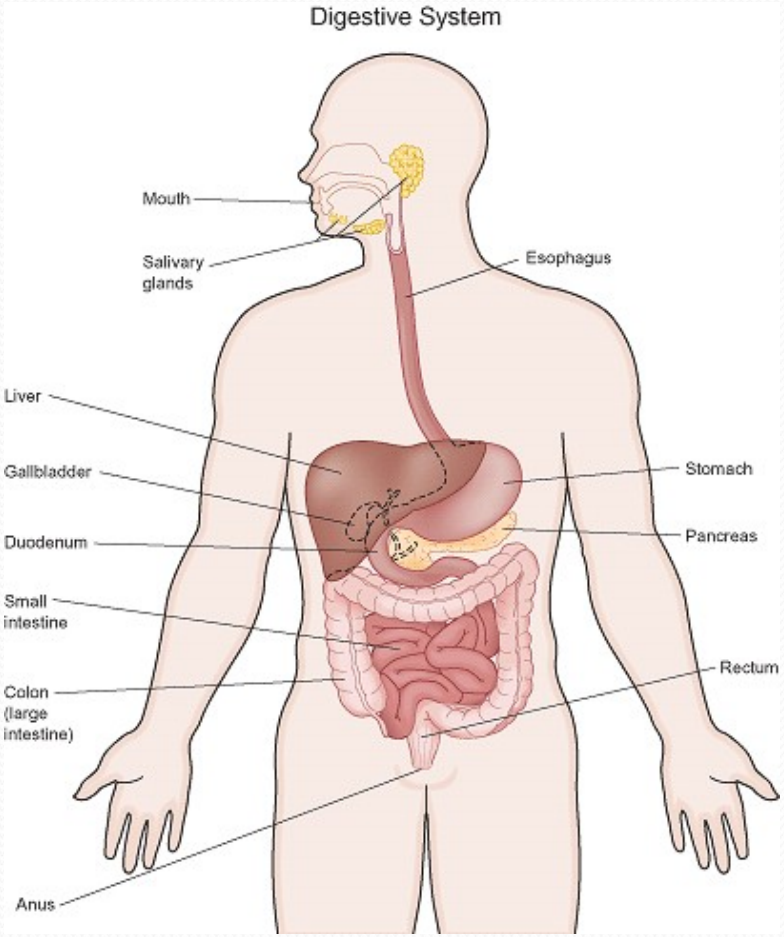


The Digestive System

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.



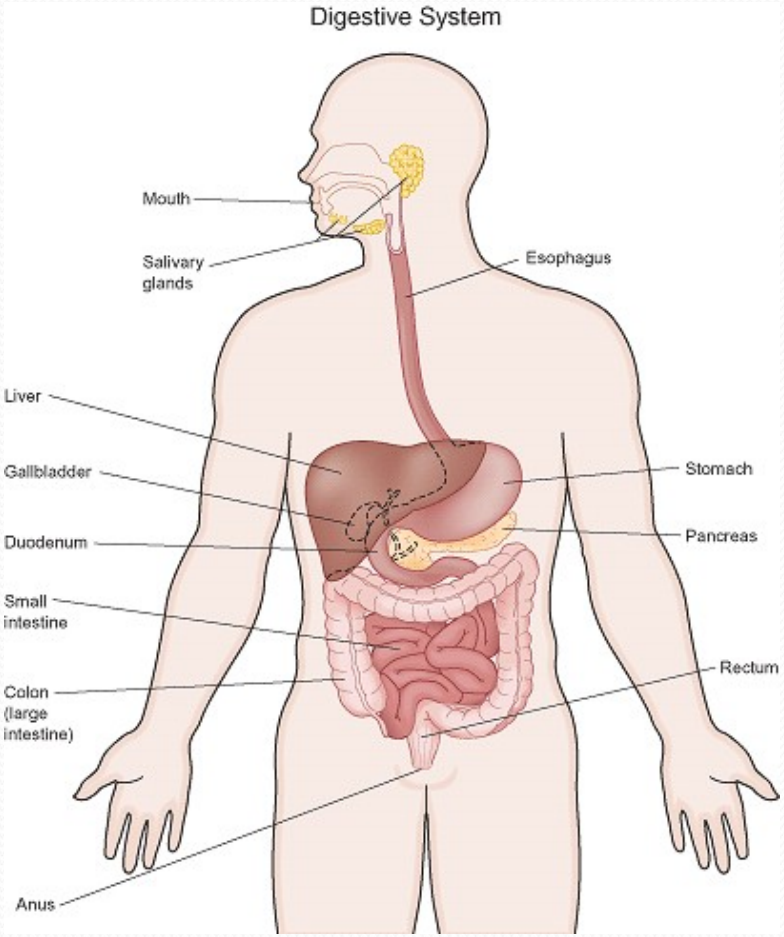
Functions of the Digestive System

- Ingest food
- Break down food into nutrient molecules
- Absorb molecules into the bloodstream
- Rid the body of indigestible remains

Introduction

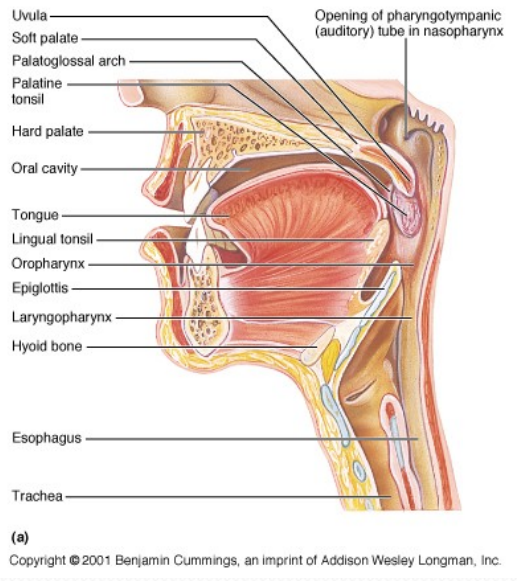
- There are four stages to food processing:

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

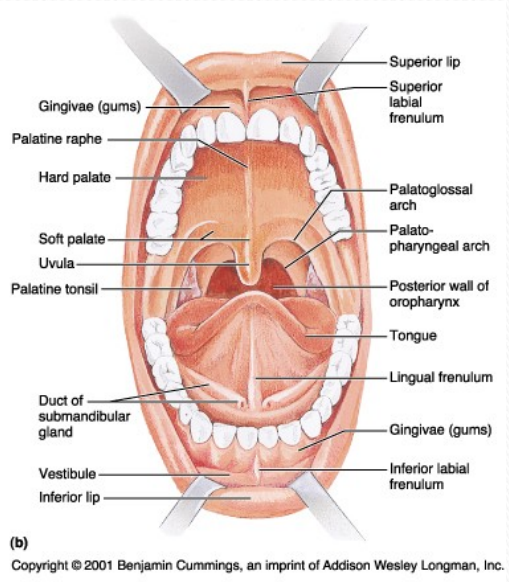


Mouth

- Teeth mechanically break down food into small pieces. Tongue mixes food with saliva (contains amylase, which helps break down starch).

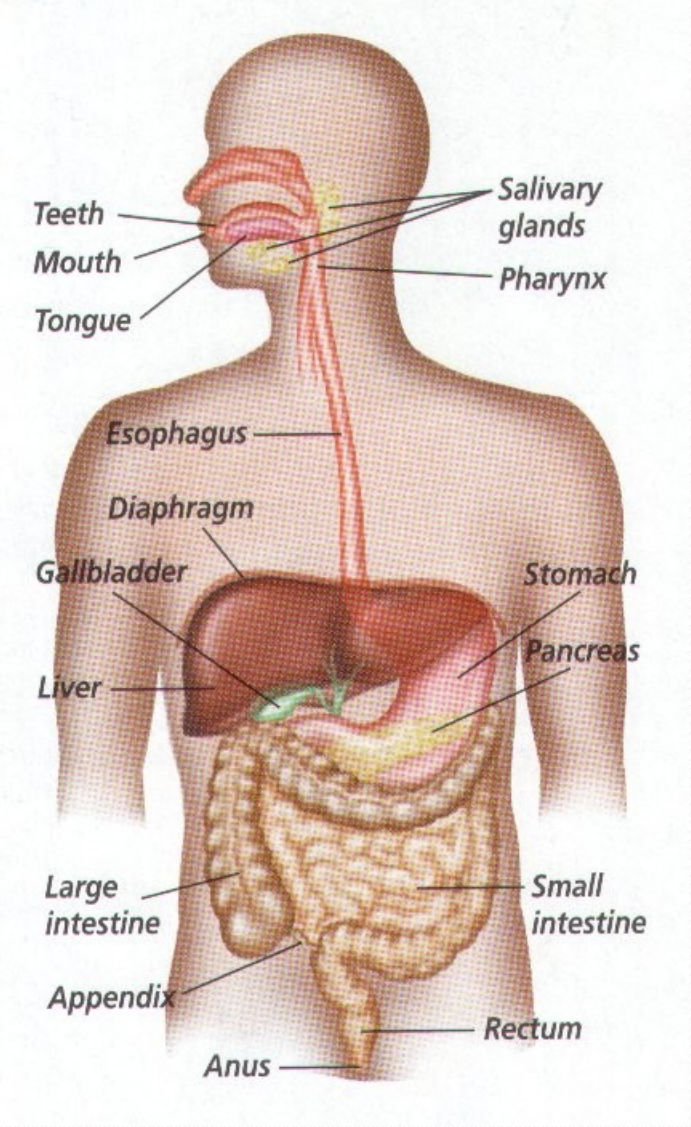


- Epiglottis is a flap-like structure at the back of the throat that closes over the trachea preventing food from entering it.



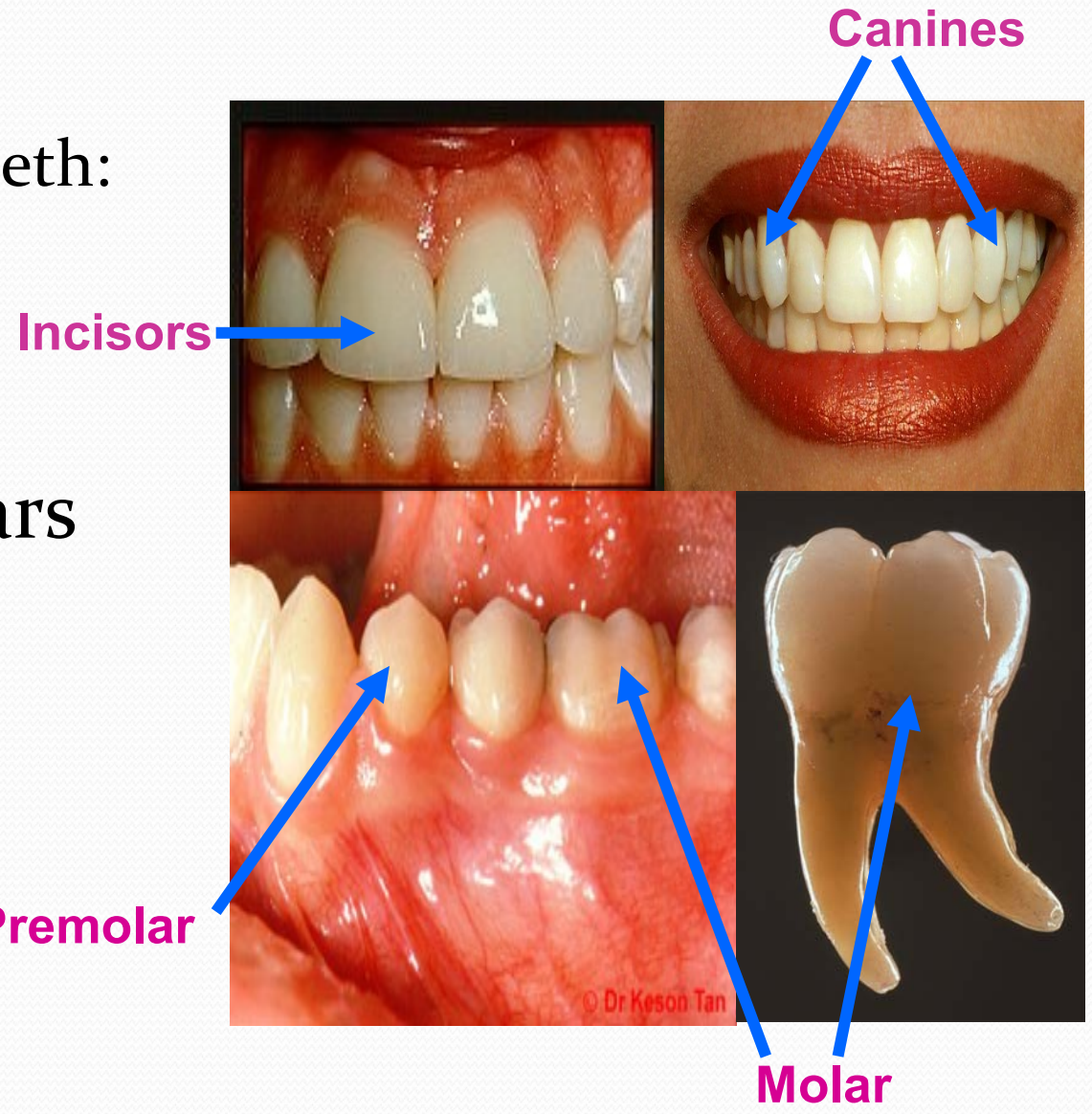
Parts of the Digest

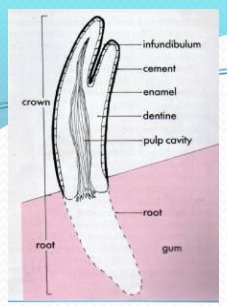
- **Teeth:** Grinds your food.
- **Salivary Glands:** Produce the saliva in your mouth.
- **Tongue:** Helps to push food into your esophagus.



Teeth

- Four types of teeth:
  1. Incisors
  2. Canines
  3. Pre – Molars
  4. Molars



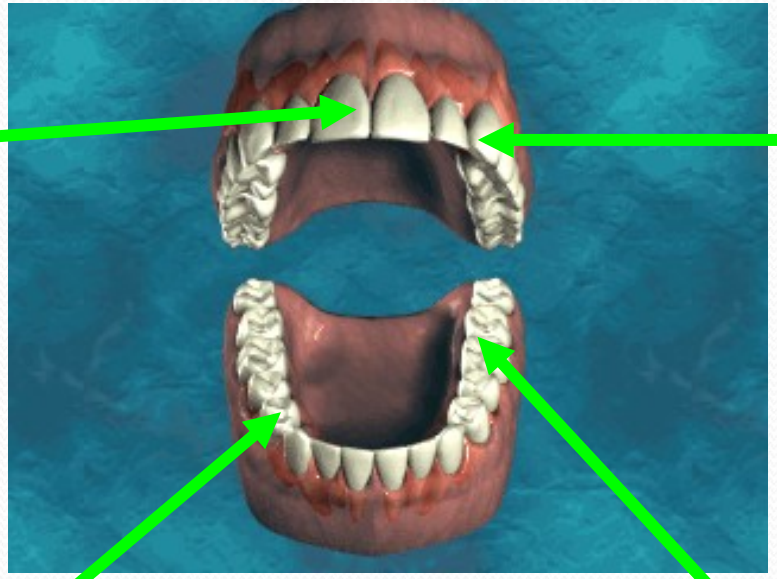


Biting and Cutting

Incisor

Grasping and Tearing

Canine



Grinding and Crushing

Pre - Molar

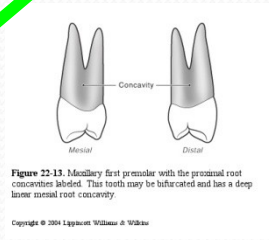


Figure 22-13. Maxillary first premolar with the proximal root concavities labeled. This tooth may be bifurcated and has a deep linear mesial root concavity.

Grinding and Crushing

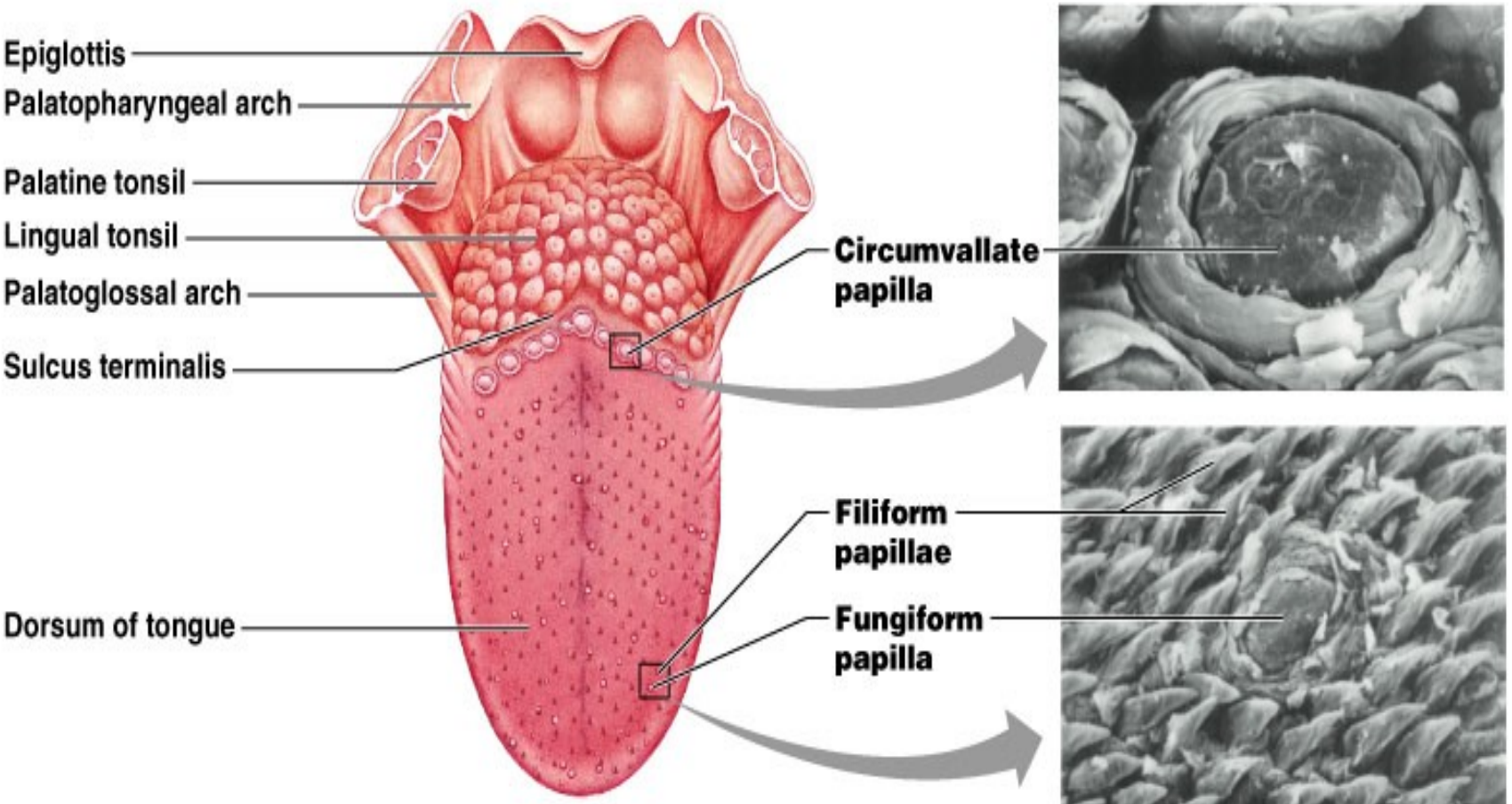
Molar

- The tongue is not only one muscle.
- It is a group of muscles, and it is also what we use to taste food with.

Can you really “swallow” your tongue? Explain.

- No you can not. The reason is because of the thin layer of tissue that connect your tongue to the bottom of your mouth called the frenulum. Your tongue is also attached to the front and sides of the pharynx.

Anatomy of the Tongue



Taste

The tongue can detect five basic tastes:

- *bitter;*
- *salt;*
- *sour;*
- *sweet;*
- *umami.*

Taste may be described by association with a particular food, e.g. meaty, minty or fruity.

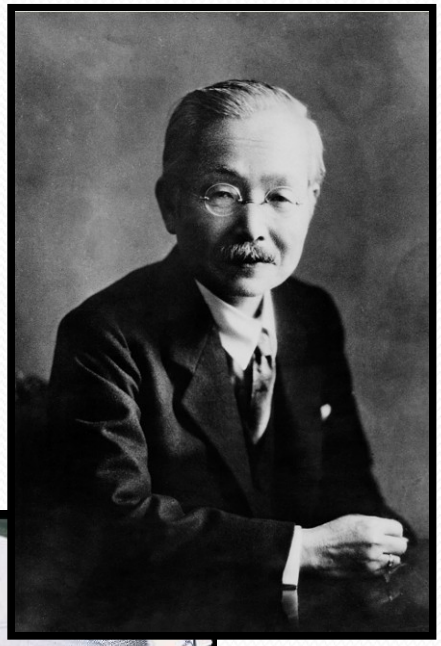
The intensity can also be recorded, e.g. mild or strong Cheddar.

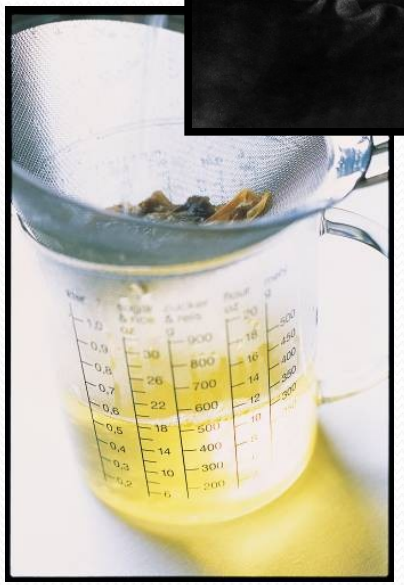
What is umami?

Umami is a savoury taste, often known as the fifth taste. It is a subtle taste and blends well with other tastes.

It was discovered by Dr Kikumae Ikeda, from Tokyo Imperial University, Japan, in 1908. He undertook research into Dashi, a traditional Japanese stock made from kombu (kelp).

Umami has its own distinct savoury taste, often associated with ripe tomatoes and cheese.



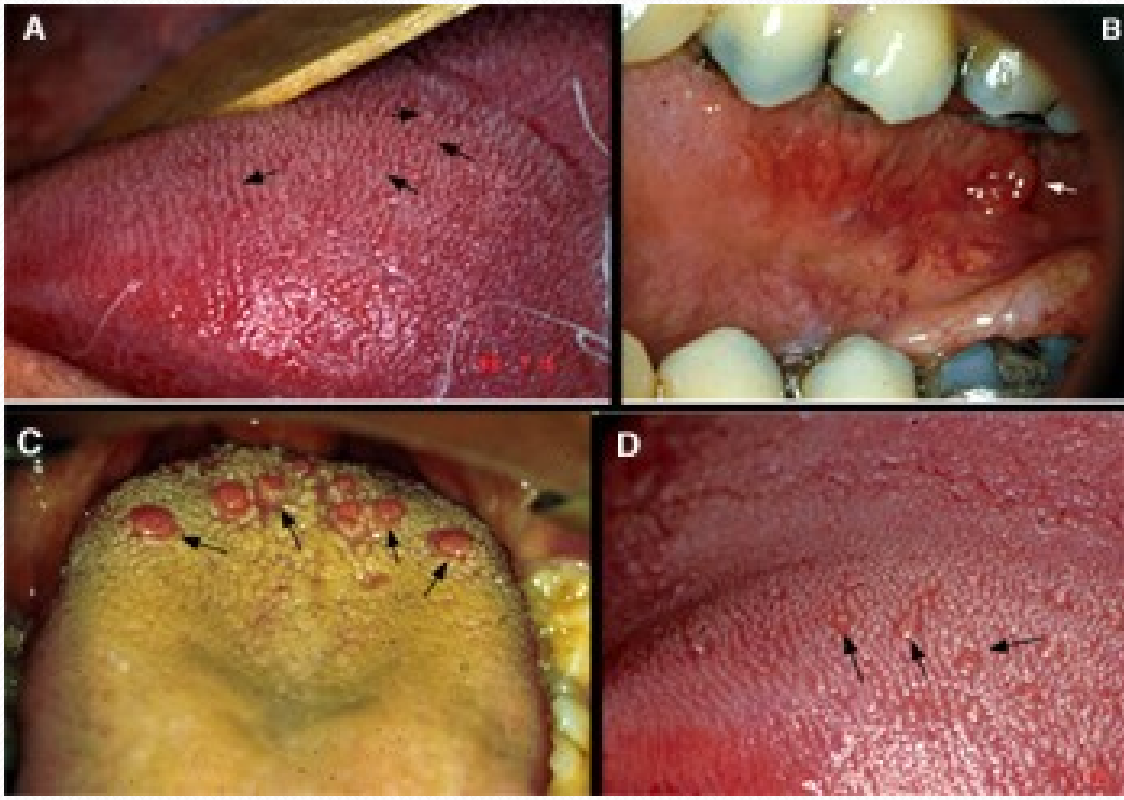


When you look at your tongue in the mirror you can see raised areas or “bumps”. What are these raised areas called?

- These raised areas are called papillae.

8. Name and describe the 3 different types of papillae.

- The 3 different types of papillae are:
- fungiform which are the larger ones located in the front of the tongue;
- filiform which are the smaller ones in the front;
- vallate which are the large ones in the back, there are only 8 to 10 of these.



Papillae have 2 purposes. Describe them.

- The purpose of the papillae is to grip the food and with the taste buds they contain.
- They also “taste” the food.


ZIOBITS

Why won't you eat it?

Science behind picky eaters

A person with an increased number of tastebuds is able to taste foods with greater intensity. These supertasters can distinguish even the slightest taste variation and their sensitivity to taste is often misread as picky eating.

Normal
Even distribution of papillae across the surface of the tongue.

Supertaster
Almost completely covered with papillae

Problematic Foods for Supertasters

Alcohol
Beer and spirits create a burning sensation when ingested.

Broccoli
Raw green vegetables including cabbage and spinach are very bitter.

Coffee
Caffeinated drinks seem bitter and overwhelm the palate.

Grapefruit Juice
Citrus juices are often avoided because of their acidity.

Chili Peppers
Peppers and spices are avoided because of their intensity.

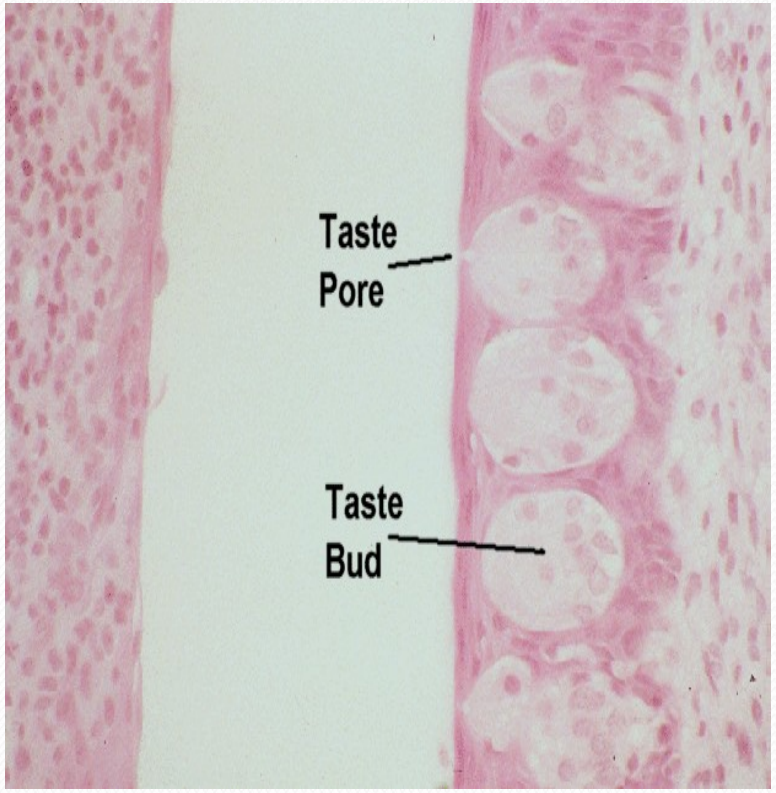
What is the difference in the structure between a younger person's tongue and an older person's tongue? How does this affect the sense of taste?

- A younger person has more taste buds than an older person, about 2 times as much.

- The reason for this is because as a person gets older the taste cells don't get replaced like they do when you are younger.

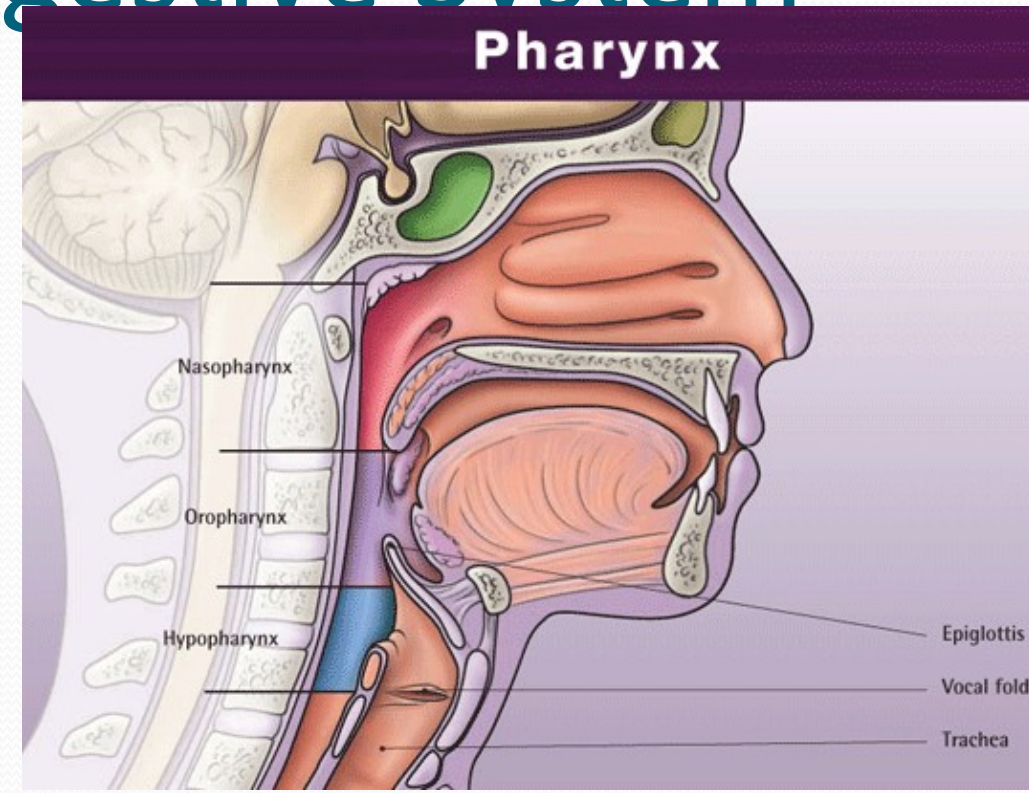
So, can you actually see taste buds with the naked eye? Explain.

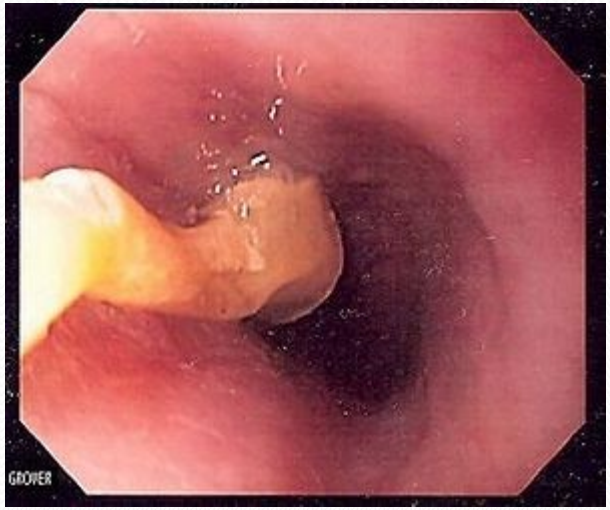
- No, you see the papillae, and within the papillae are the
  taste bubs, and
  about 100 receptors
  or "taste" cells make
  up each taste bud,
  so you actually see
  many in one papillae.



The Human Digestive System

- The tongue pushes food around until it forms a ball called a bolus.
- The bolus is passed to the pharynx (throat) and the epiglottis makes sure the bolus passes into the esophagus and not down the windpipe!





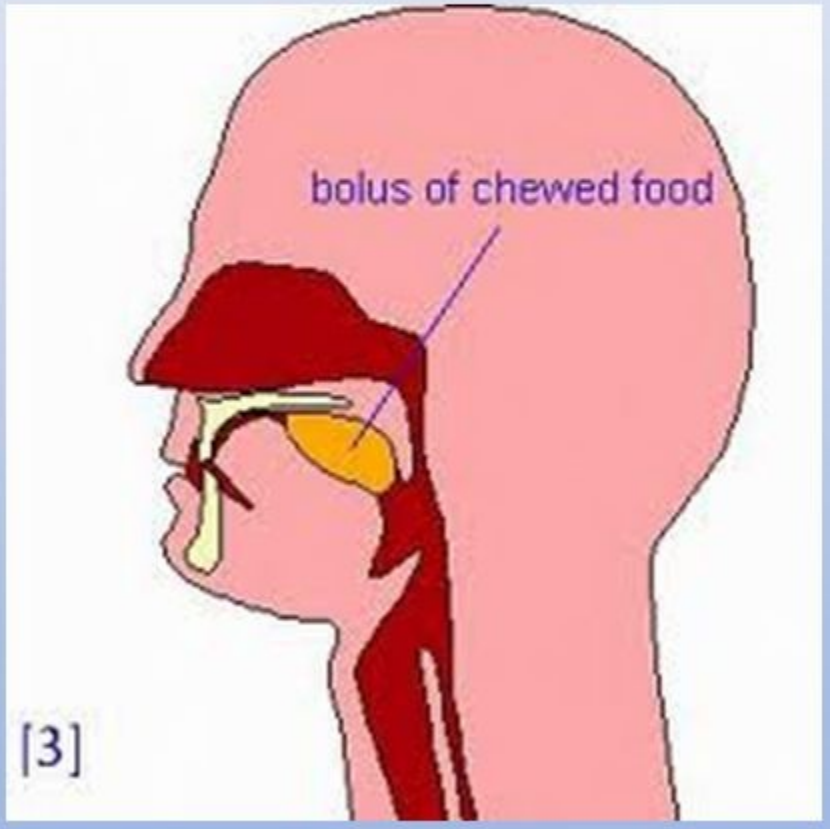
Functions of Saliva

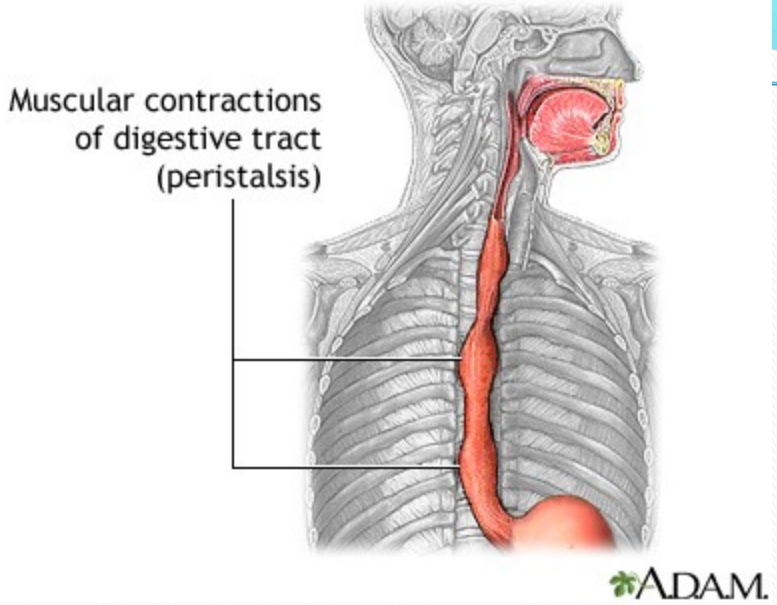
- Saliva helps prevent the deteriorative processes in the mouth in several ways:

1. It moistens food
2. It begins digestion
3. It adjusts salt appetite
4. The flow of saliva helps wash away pathogenic bacteria.

The Esophagus

- The muscular tube through which food passes from the mouth to the stomach
- As you chew, your tongue helps mould your food into a mass called a bolus that then gets pushed to the back of your mouth
- When you swallow, the bolus enters the top of the esophagus
- The opening of the esophagus lies next to the opening of your windpipe
- To prevent food from going down the wrong tube, the opening of your trachea is closed by the epiglottis (valve) when you swallow





The Human Digestive System

- The bolus passing down the esophagus by peristalsis.
- Peristalsis is a wave of muscular contractions that push the bolus down towards the stomach.

Peristalsis Waves

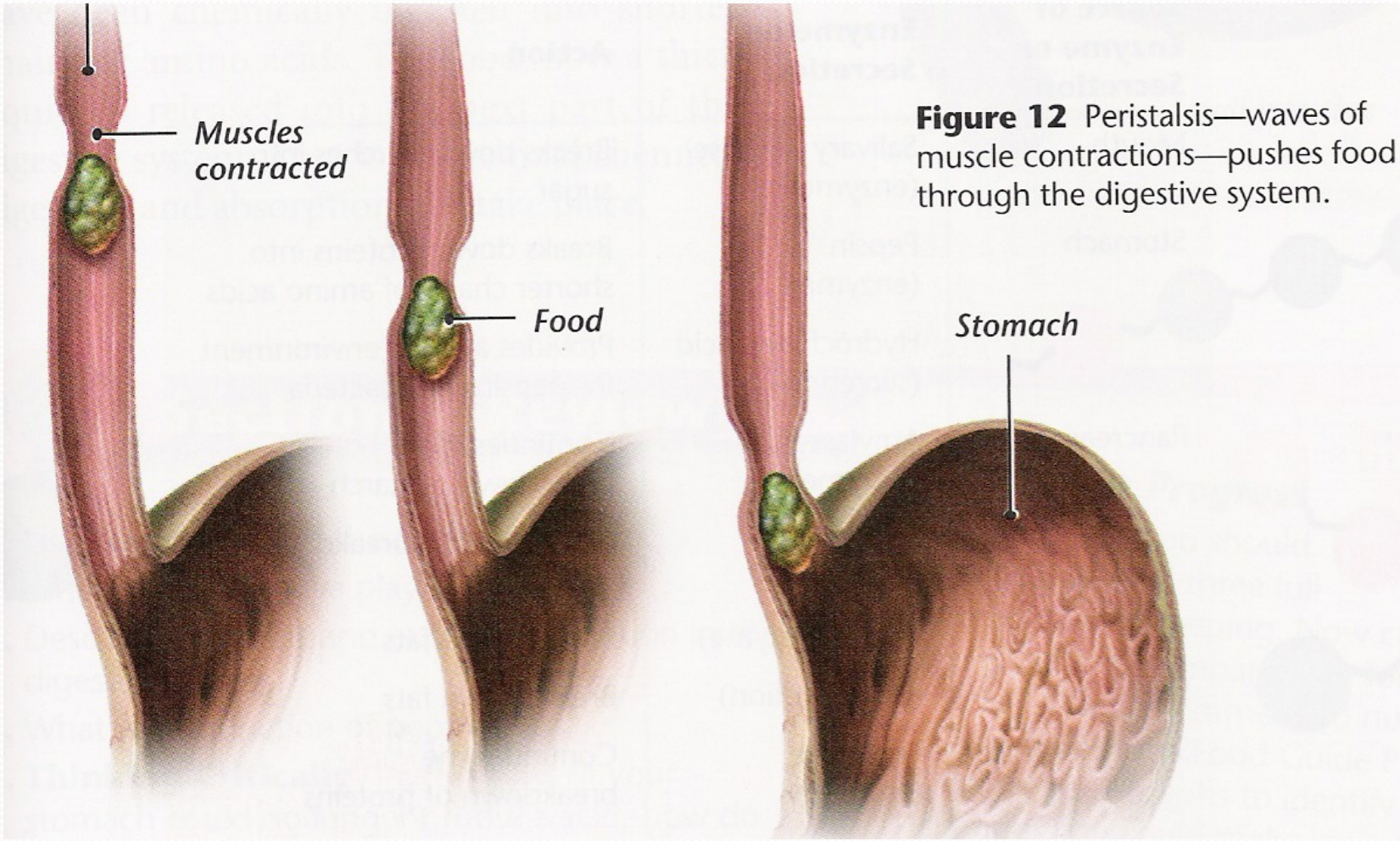
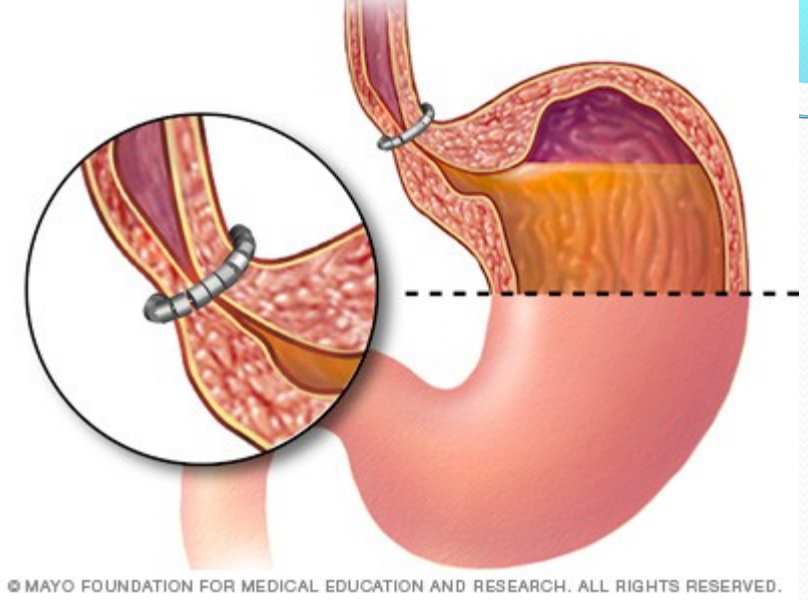
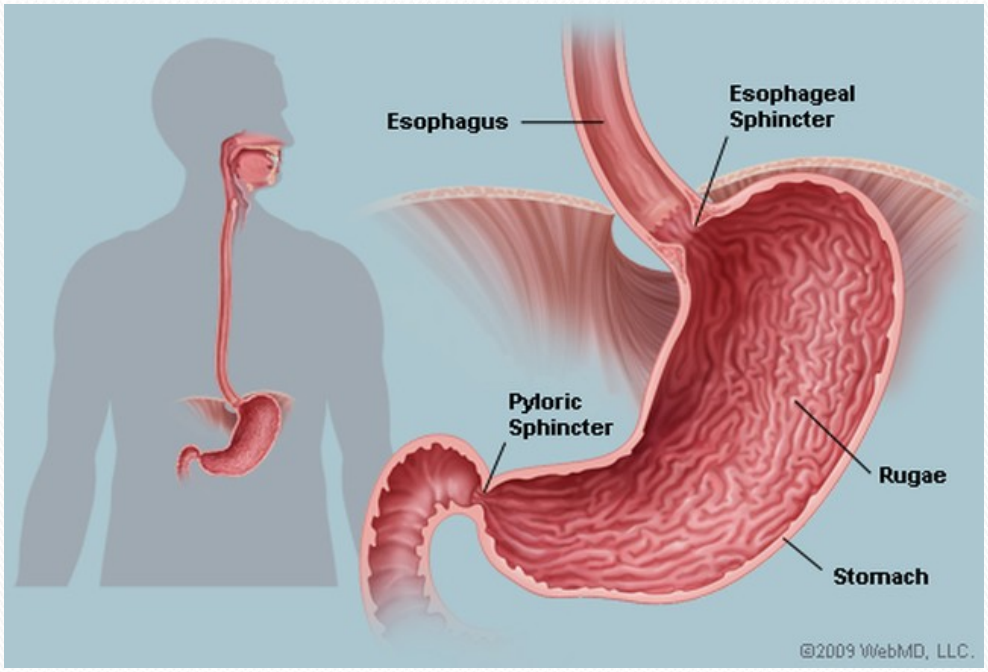


Figure 12 Peristalsis—waves of muscle contractions—pushes food through the digestive system.

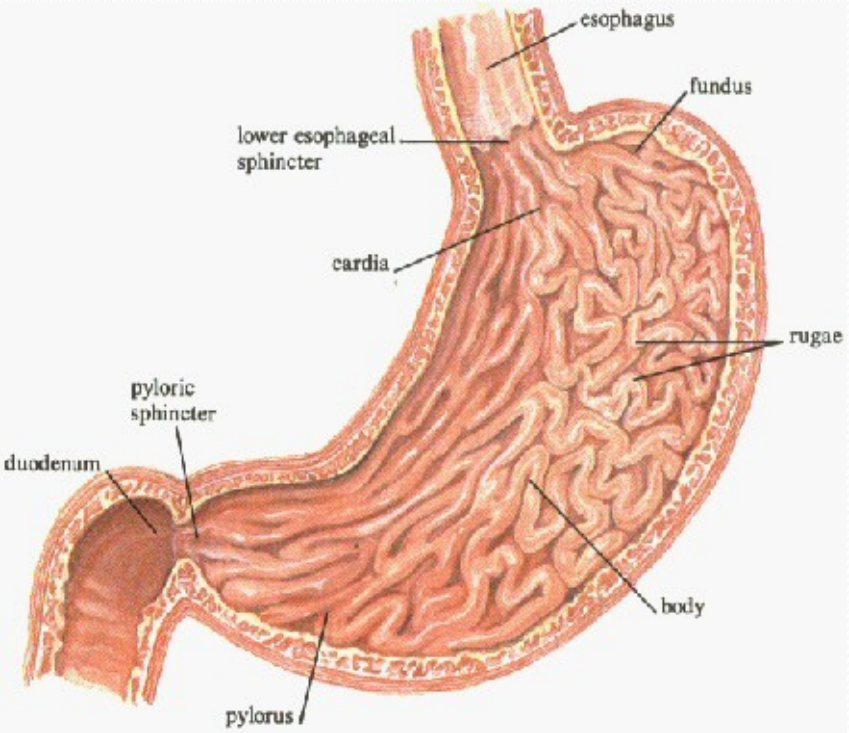


- To enter the stomach, the bolus must pass through the esophageal sphincter, a tight muscle that keeps stomach acid out of the esophagus.



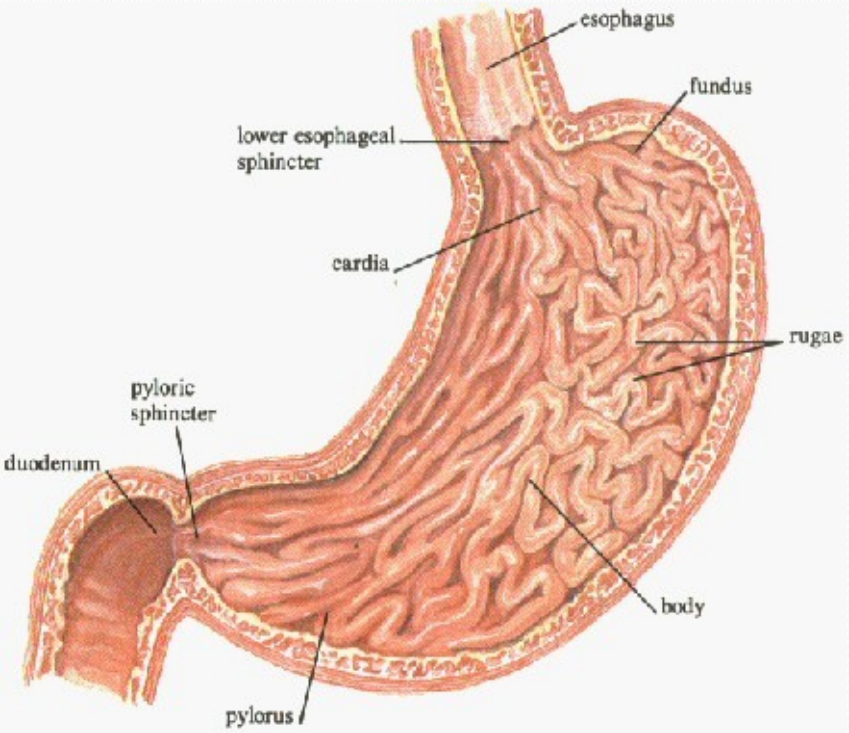
The Human Digestive System

- The stomach has folds called and is a big muscular pouch which turns the bolus and mixes it with gastric juice, a mixture of stomach acid, mucus and enzymes.



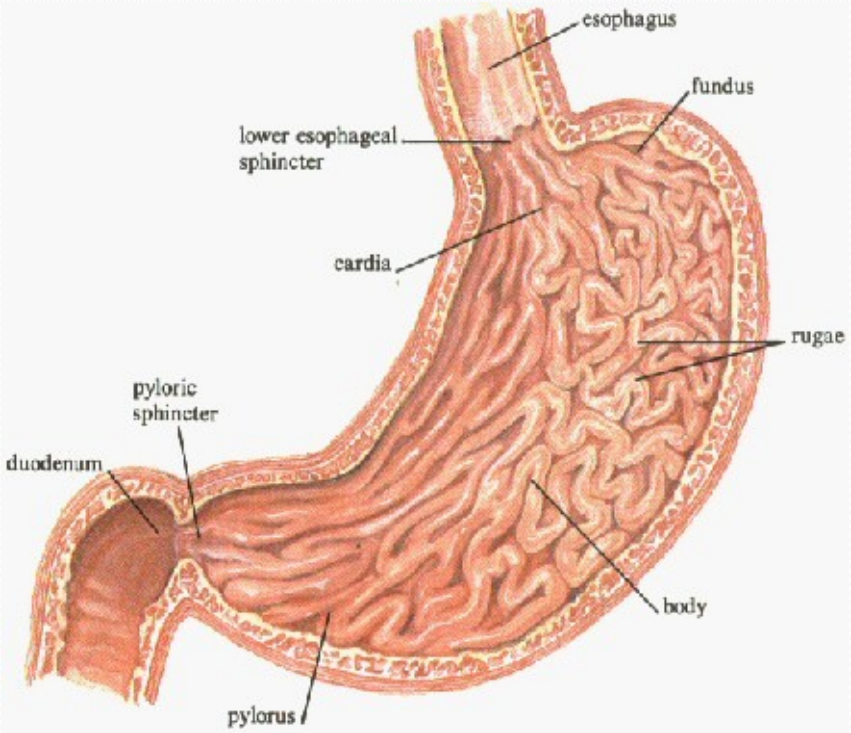
The Human Digestive System

- 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 Human Digestive System

- The stomach does do some absorption too.
- Some medicines (i.e. aspirin), water and alcohol are all absorbed through the stomach.
- The digested bolus is now called chyme and it leaves the stomach by passing through the pyloric sphincter.



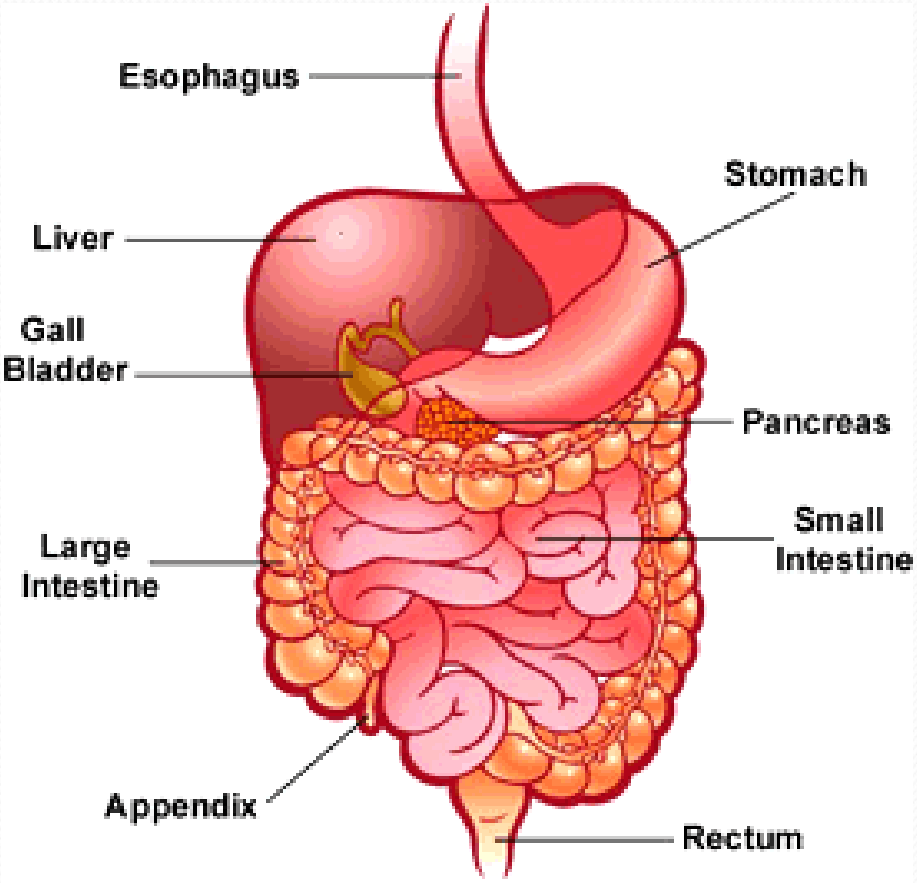
The Human Digestive System

- Chyme is now in the small intestine.

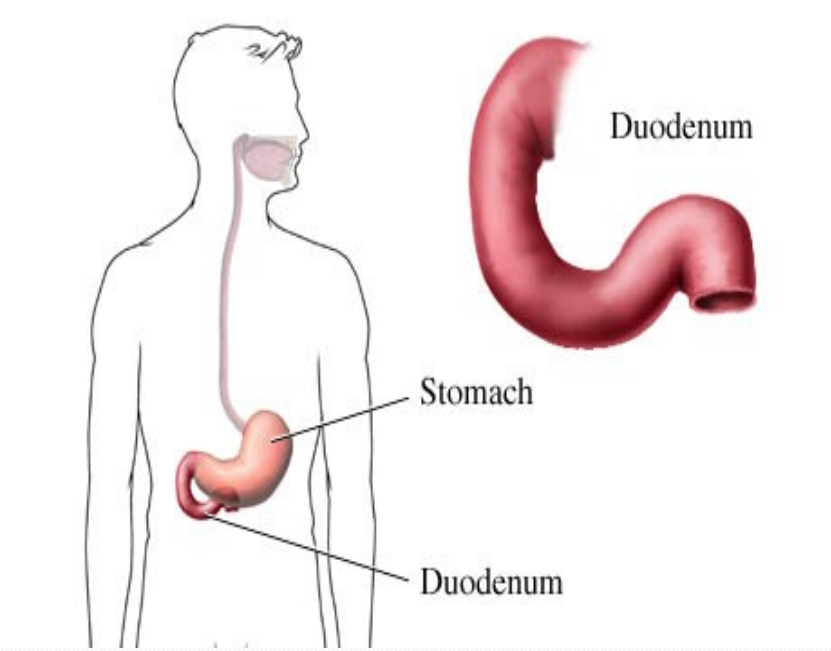
90% of absorption occurs here.

- The liver and pancreas help the small intestine to maximize absorption.

- The small intestine is broken down into three parts:



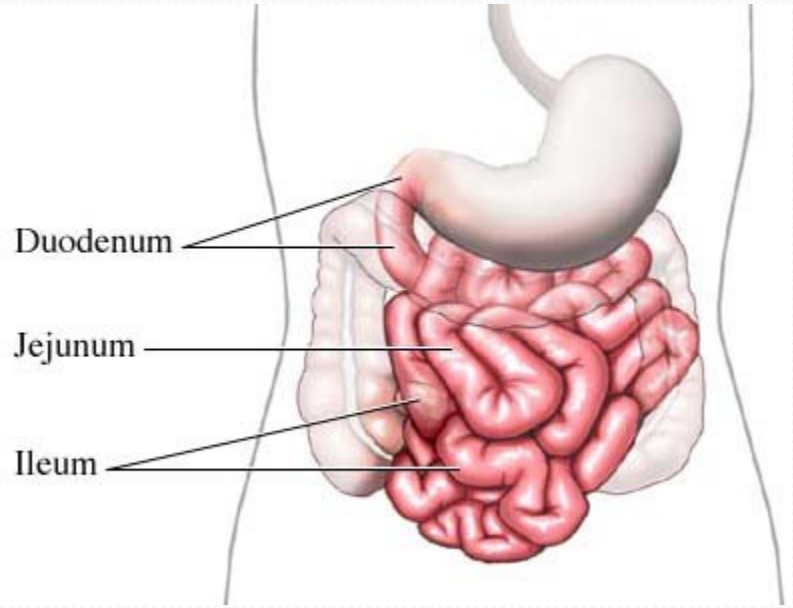
- **Duodenum:** The tube that runs from the stomach to the small intestine.



The Human Digestive System

2. Jejunum

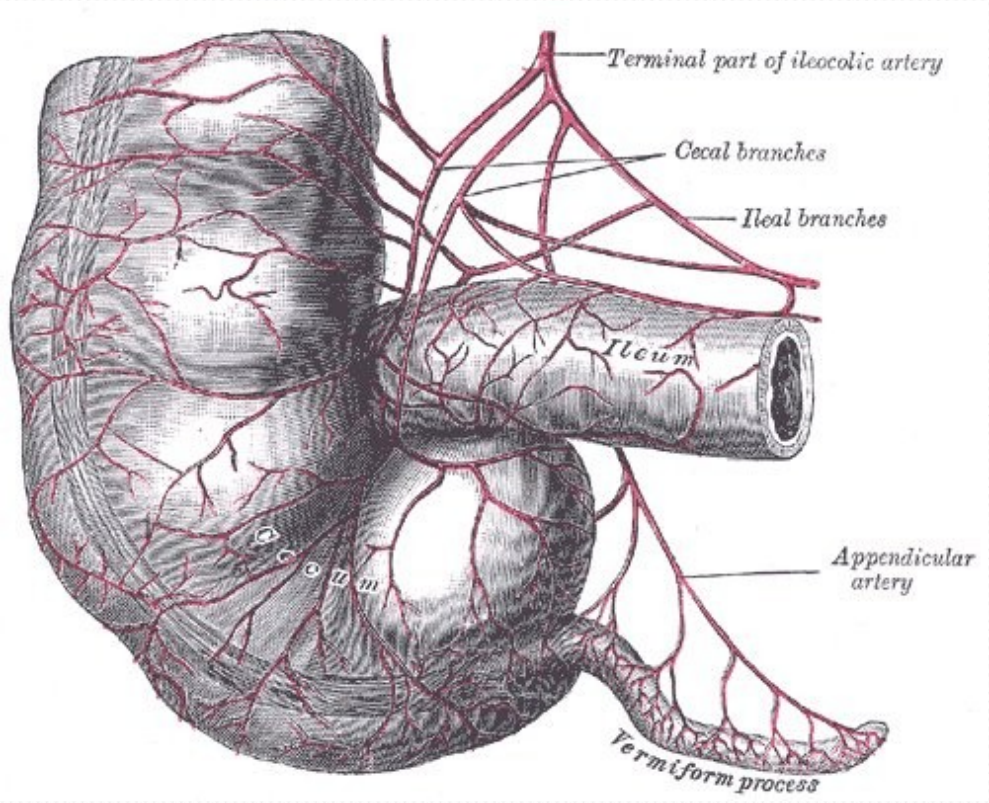
- The jejunum is where the majority of absorption takes place.



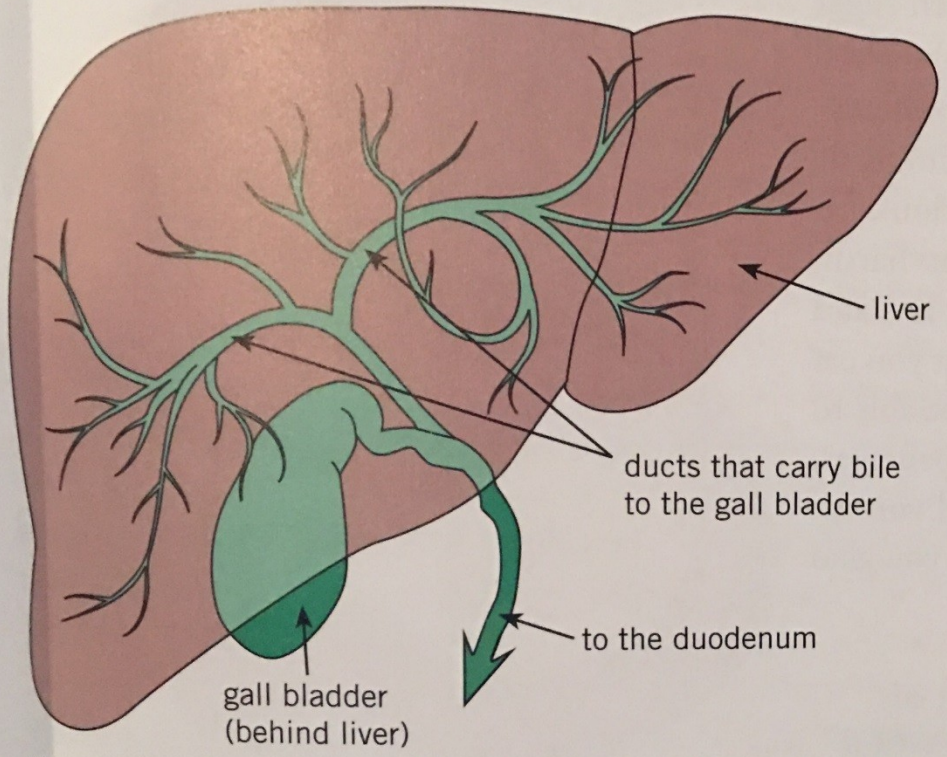
The Human Digestive System

3. Ileum

- The last portion of the small intestine is the ileum, compacts the leftovers to pass through into the large intestine.



Take a moment to tell someone what you learned about the stomach and the small intestine.



Your liver has many functions, but one that is directly related to digestion is the making of bile, which is stored in the gall bladder.

Living Liver

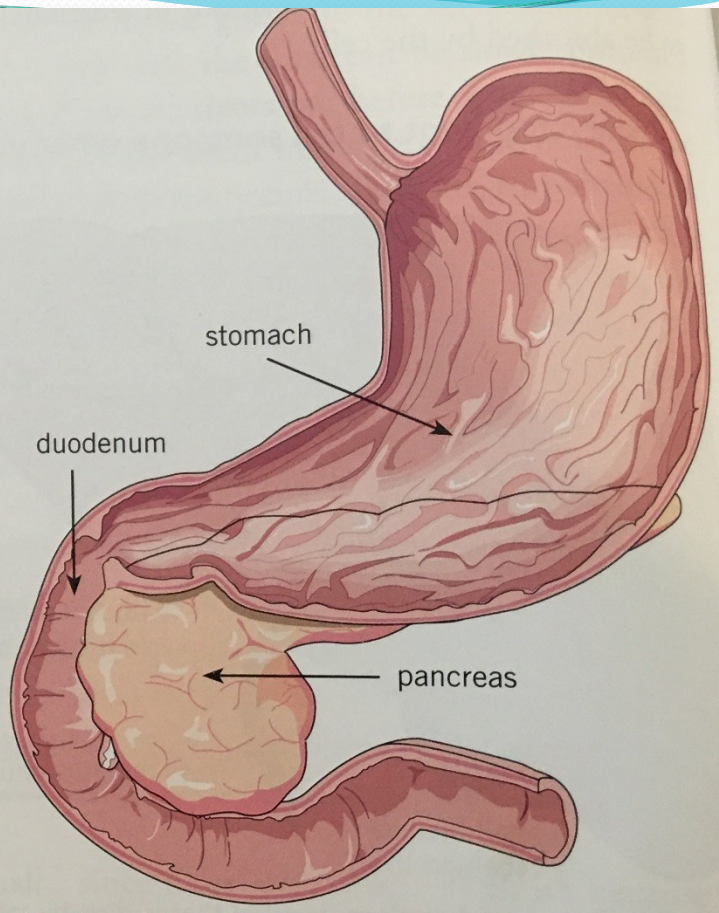
Once the nutrients are absorbed into the bloodstream, they pass through the **liver**. The liver has many important roles in the body. In the liver, nutrients are processed and then either stored or distributed throughout the body. The main thing the liver stores is glucose. This is the little sugar molecule your cells (especially your brain cells) rely on for energy. If you have a lot of glucose in your body, your liver strings the little glucose molecules together to make **glycogen** (gly' kuh jen). When your body runs low on glucose (like between meals), the liver breaks the glycogen back down into many glucose molecules and sends them into your bloodstream. The liver also stores various vitamins and minerals, including iron.

The liver is like a huge chemical factory. One of the chemicals it makes is called **bile**, and it is a very important chemical for the digestive process. After being made in the liver, it is delivered to the gall bladder so it can be stored and concentrated. As the chyme goes into the small intestine, the **gall bladder** then releases concentrated bile into the duodenum. What does bile do for you? Well, bile helps break down fats! Fats don't mix well with water, so in a watery mixture like chyme, they form large clumps. Bile breaks those large clumps into smaller clumps that are easier for your small intestine to digest. You can do the same thing!

Pancreas Potential

Another organ used for digestion is your **pancreas** (pan' kree us). It produces hormones as well as digestive juices. One hormone it makes is insulin, which controls how much sugar is in your blood (we call that your blood sugar level). We'll discuss insulin in a later lesson. The pancreas also produces **pancreatic juice**, which is secreted into the small intestine when chyme arrives. This juice has two main functions. It neutralizes the acid in the chyme, making it far less harsh, and it contains important enzymes that help to digest fats and break down proteins and starches. Since much of what you eat (meats, fruits, vegetables) contains cells, you need to be able to break down the contents of these cells. Without a pancreas, your body would not be able to break down the food you eat and give the nutrients to the rest of your body. Aren't you glad God gave you a pancreas?

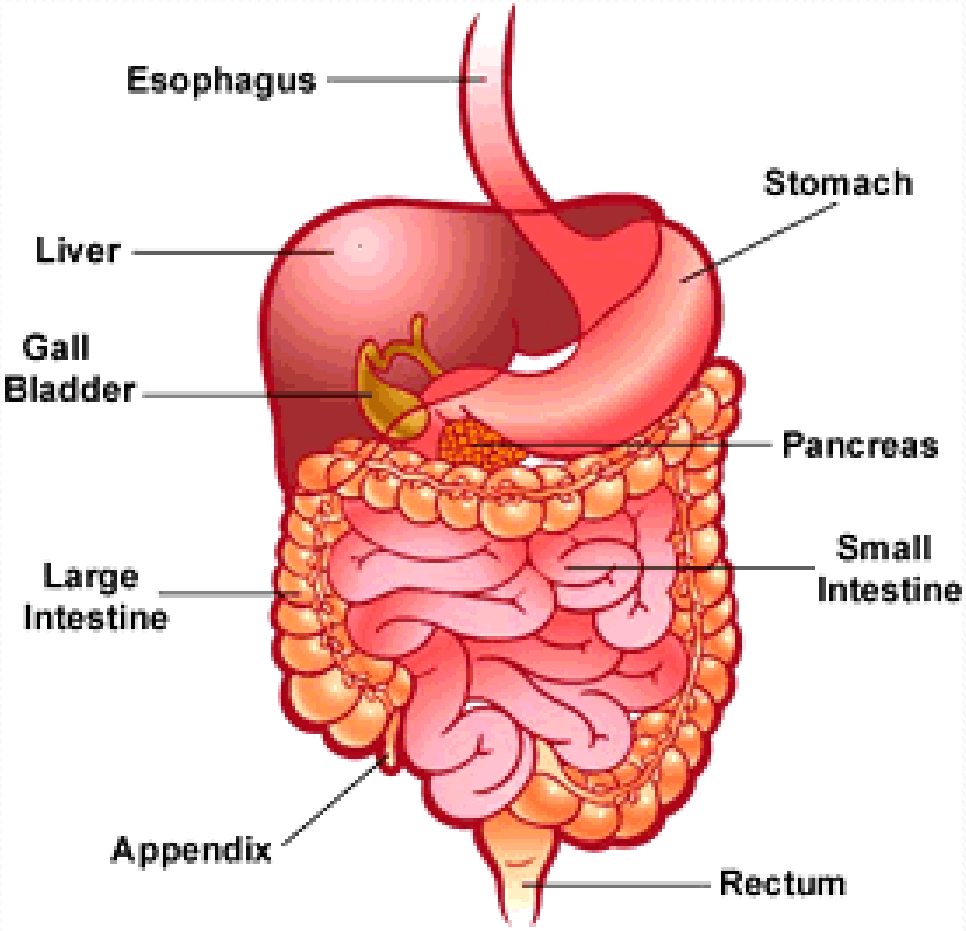
Now you've learned all about the first part of digestion. Explain what each organ you've learned about does for your body. Don't forget the teeth, saliva, stomach, small intestine, liver, and pancreas.



One function of the pancreas is to inject pancreatic juice into the duodenum.

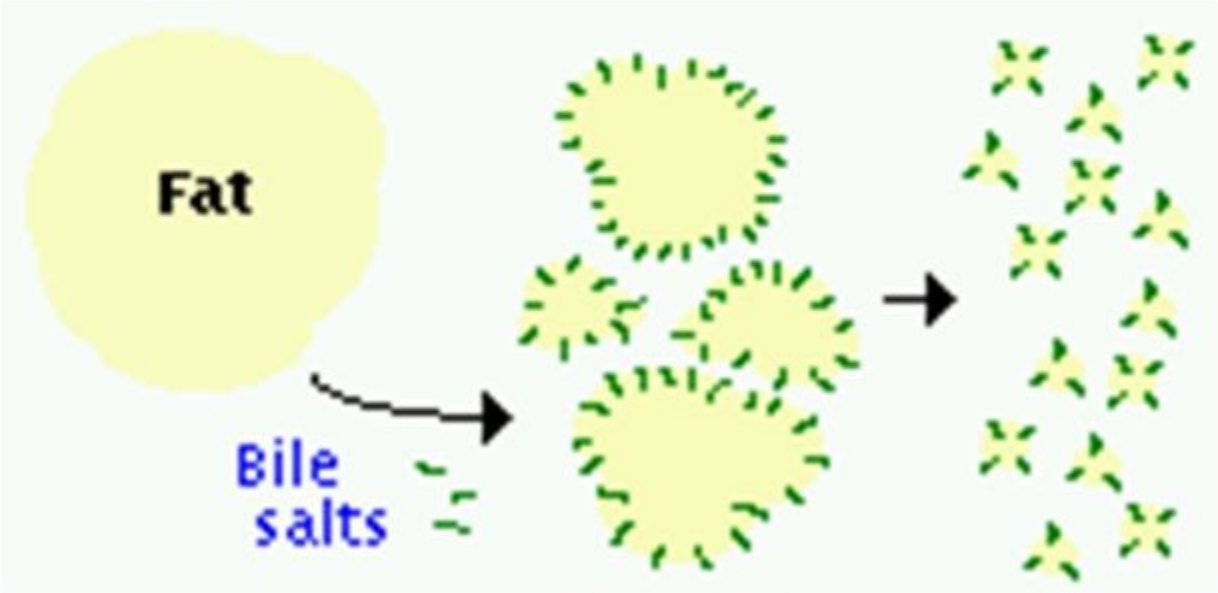
Bile, produced in the liver but stored in the gall bladder, breaks down fats.

- The pancreas secretes a juice to reduce the acidity of the chyme.



BILE

Bile contains bile acids, which are critical for digestion and absorption of fats



All Bile does is **EMULSIFICATION:** Breaks large fat globules into smaller fat droplets

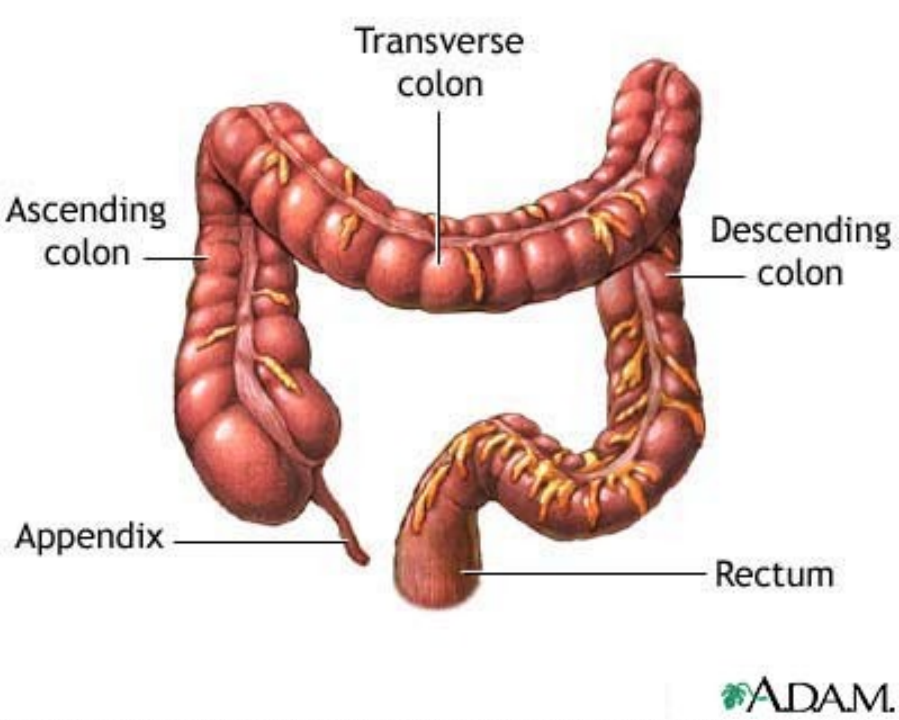
Bile does not contain enzymes: Mechanical Digestion

Try This!

Pour some cooking oil (which is just a kind of fat) into a bowl of water. Notice that there are large globs of oil floating on the water. Now, use a fork to whisk the oil a bit in the bowl. Do you see that the drops of oil are smaller? Now add some liquid dishwashing soap and whisk the oil, water, and soap together. Let the bowl sit for a while and come back every now and then to check on it. Once all the bubbles are gone, notice the difference. You should see a lot of very tiny drops of oil now, because the soap acted like bile, breaking the fat into tiny clumps that are much smaller than they were before.

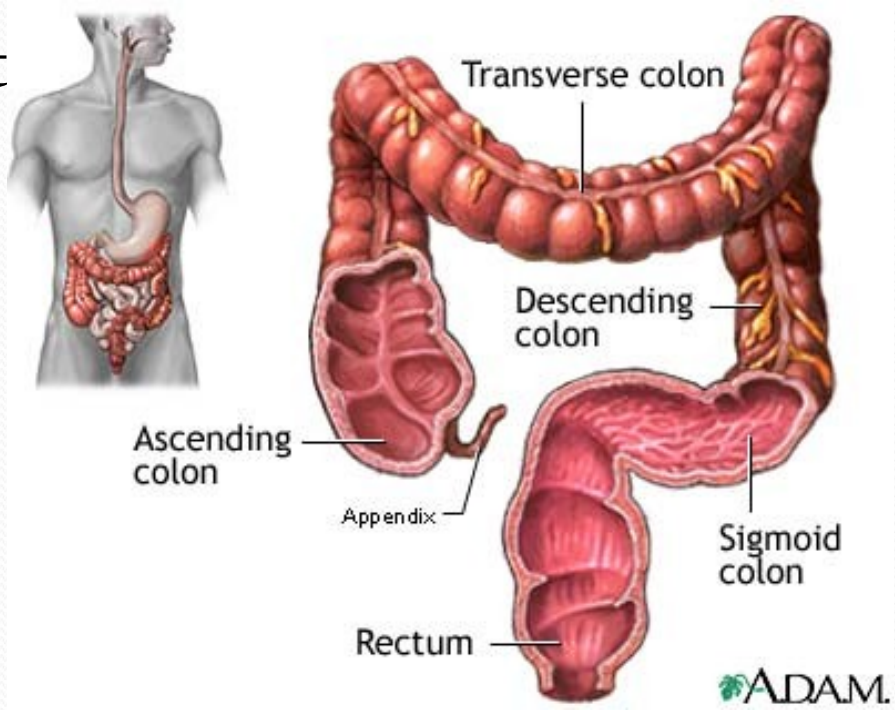
The Human Digestive System

- 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.



The Human Digestive System

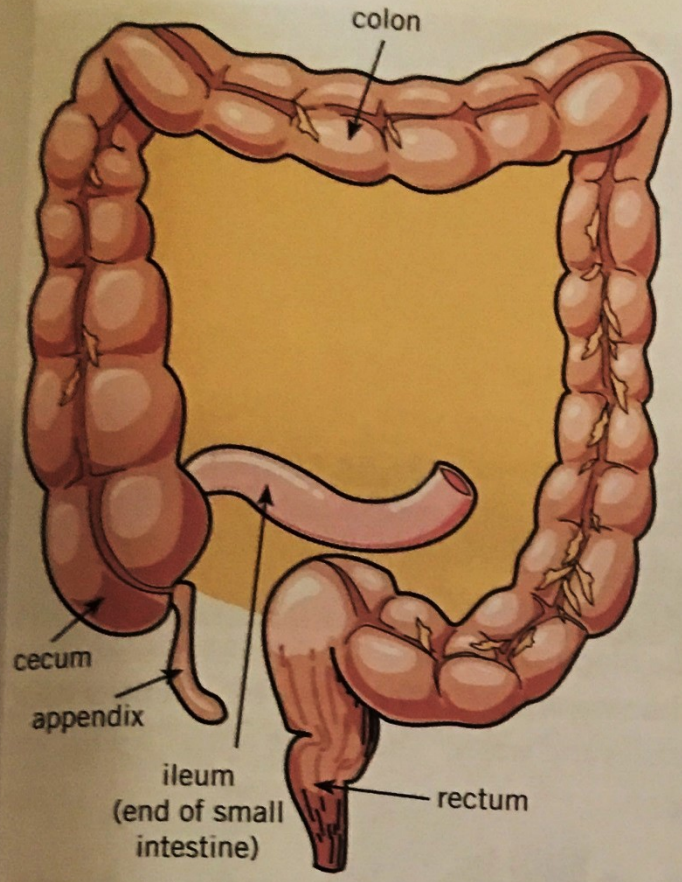
- All leftover waste is compacted and stored at the end of the large intestine called the rectum.
- When full, the anal sphincter loosens and the waste passes out of the body .



Large Intestine

So now your piece of pizza is about to leave the small intestine, but it doesn't look anything like that cheesy slice you put in your mouth about six hours ago. At the meeting point between the small and large intestines you find the **ileocecal** (ill ee oh see' kul) **sphincter**, which opens and closes to let the liquid chyme from the small intestine enter the large intestine.

The large intestine has three parts: the **cecum** (see' kum), the **colon** (kol' un), and the **rectum** (rek'



Your large intestine receives chyme from your small intestine and pulls out water and salts to put into your body.

tum). Its main job is to form the chyme into **feces** (fee' seez). Feces are the waste material that we evacuate into the toilet. In order to make feces, the large intestine removes the water from the chyme. This water is absorbed through the wall of the large intestine into the blood stream. Almost five cups of water (1 liter) are sent from the large intestine into the bloodstream every day. Now you would think that water from your large intestine would contaminate your body, but when the large intestine pulls it from the chyme, it only pulls clean water and some salts, both of which are good for your body. So basically, the large intestine is drying up your food so you can use the water that was in it!

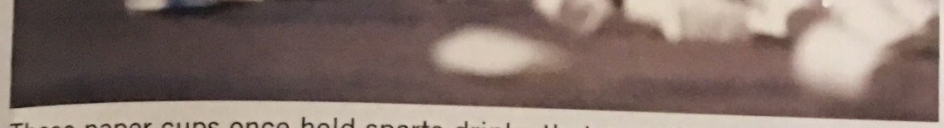
Here is the interesting part. You see, living in the large intestine are millions upon millions of friendly bacteria. Now remember, some of these microscopic creatures cause illness, but not all of them! You have a **symbiotic** (sym bye' ah tik) relationship with some of them. If you studied zoology, you may remember what symbiotic relationships are. They are relationships where two living things work together to benefit one another. Have you ever hosted guests at your house? Well, you are hosting the friendly bacteria in your colon right now. Say hello to your guests! You both benefit from their presence in your colon. You benefit because these friendly bacteria digest some otherwise indigestible things in the chyme, and in doing so, they produce vitamins that are absorbed by

The most significant vitamin these bacteria produce is vitamin K. Without vitamin K, you would bleed to death when you cut yourself. Vitamin K helps your blood to clot. Vitamin K is also present in some foods you eat, such as broccoli and spinach. The intestinal bacteria synthesize some B vitamins as well. Not only do you benefit from this relationship, but the bacteria benefit as well, because they have a place to live with lots of food. You're a good host! Interestingly, these friendly bacteria remain friendly only if they remain in the colon. If they travel elsewhere in the body, they can cause serious illness. Fortunately, this is rare.

The wormlike tube on the cecum is called the **appendix**. For a long time, scientists didn't know what its role was in the body, and some actually thought it had none. Of course, anyone who understands that we are made by God knows that He wouldn't make something in our body that was useless! Thus, creation scientists always thought it had a job in the body. Well, in 2007 at least one of its jobs was discovered. Remember those friendly bacteria? The appendix provides a safe place for them to hide when your body gets an illness that could kill them. You see, some diseases you get are bad for your friendly bacteria. So they hide out in the appendix until the illness is gone, and then they go back to living in your intestine and making vitamins for you! This allows you to recover from those kinds of illnesses much more quickly.

Did you ever wonder why beans can cause gas to form in your intestines? It's because beans contain complex carbohydrates, which are very resistant to being broken down by your digestive system. The bacteria in your intestines can digest these carbohydrates, but in doing so they release several different gasses, which can cause some rather embarrassing side effects. We call this side effect **flatulence** (flach' uh lentz). Some people are better at digesting beans than others. I'll say no more on this subject!

As wavelike muscle movements continue to move the chyme through the large intestine, more and more water is removed. This can take anywhere from half a day to three days, depending on your diet. A diet high in **fiber** (plant material that you can't digest) speeds up the process. Since the chyme moves more quickly through the large intestine, less water is removed from it, so it stays reasonably soft. This means that a diet high in fiber



These paper cups once held sports drinks that marathon runners used to replenish their water and salts. When you run and sweat for a long time, you lose too much water and salt, which must be replenished. You can see from the number of cups that a lot of runners needed water and salts!

What Do You Remember?

What is the white outer layer of your tooth called? What is the layer right below that called? What is the hardest substance in your body? Name a few things saliva does for you. What is the name of the pipe that food goes down after you swallow it? How do your stomach and esophagus keep from getting burned by your own stomach acid? What is the food called when it enters the small intestine? What happens in the small intestine? Which organ is like a huge chemical factory? What do the kidneys do?

Notebooking Activities

In addition to writing down all the fascinating facts you learned about the digestive and renal systems, you will create a comic strip of the digestion process. A comic strip is simply a series of boxes with different actions happening in each box. You will animate, or bring to life, a piece of food. You can choose any food you wish. Follow it as it goes from your plate and through your digestive system. Imagine that the food has feelings. How does it react to each of the stages of digestion? Express all that in your comic strip.