The Digestive Process Begins

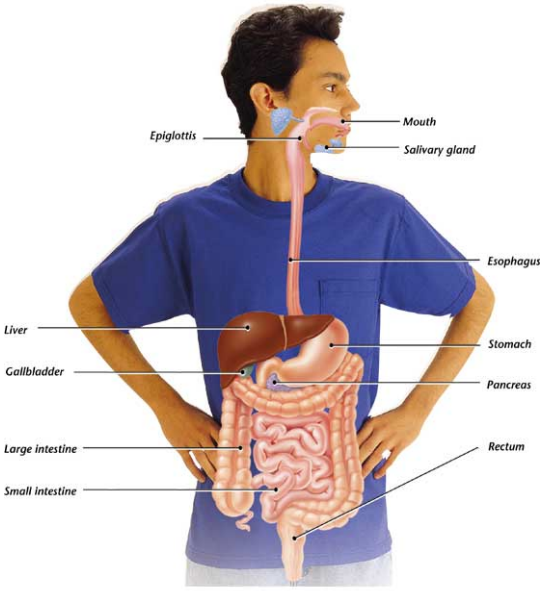
In June of 1822, nineteen-year-old Alexis St. Martin was wounded in the stomach while hunting. William Beaumont, a doctor with the United States Army, saved St. Martin's life. However, the wound left an opening in St. Martin's stomach that never closed completely. Beaumont realized that by looking through the opening, he could observe what was happening inside St. Martin's stomach.

Beaumont observed that milk changed chemically inside the stomach. He hypothesized that chemical reactions inside the stomach broke down foods into smaller particles. To test his hypothesis, Beaumont removed liquid from St. Martin's stomach. He had the liquid analyzed to determine what materials it contained. The stomach liquid contained an acid that could break down foods into simpler substances.

Functions of the Digestive System

Beaumont's observations helped scientists understand the role of the stomach in the digestive system. The digestive system has three main functions. **First, it breaks down food into molecules the body can use. Then, the molecules are absorbed into the blood and carried throughout the body. Finally, wastes are eliminated from the body.**

The process by which your body breaks down food into small nutrient molecules is called **digestion**. There are two kinds of digestion—mechanical and chemical. In mechanical digestion, foods are physically broken down into smaller pieces. Mechanical digestion occurs when you bite into a sandwich and chew it into small pieces. In chemical digestion, chemicals produced by the body break foods into their smaller chemical building blocks. For example, the starch in bread is broken down into individual sugar molecules.



After your food is digested, the molecules are ready to be transported throughout your body. **Absorption** is the process by which nutrient molecules pass through the wall of your digestive system into your blood. Materials that are not absorbed, such as fiber, are eliminated from the body as wastes.

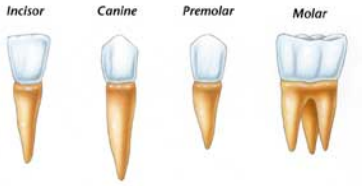
The digestive system is about nine meters long from beginning to end. As food moves through the digestive system, the processes of digestion, absorption, and elimination occur one after the other in an efficient, continuous process.

The Mouth

Have you ever walked past a bakery or restaurant and noticed your mouth watering? Smelling or even just thinking about food when you're hungry is enough to start your mouth watering. This response isn't accidental.

Your body is responding to hunger and thoughts of food by preparing for the delicious meal it expects. The fluid released when your mouth waters is called **saliva** . Saliva plays an important role in both the mechanical and chemical digestive processes that take place in the mouth.

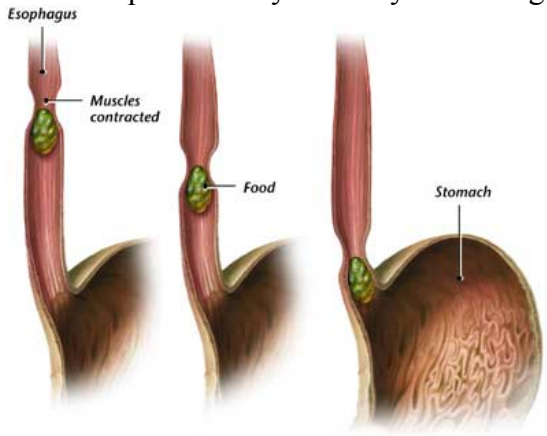
Mechanical Digestion The process of mechanical digestion begins as you take your first bite of food. Your teeth carry out the first stage of mechanical digestion. Your center teeth, or incisors, cut the food into bite-sized pieces. On either side of the incisors are sharp, pointy teeth called canines. These teeth tear and slash the food in your mouth into smaller pieces. Behind the canines are the premolars and molars, which crush and grind the food. As the teeth do their work, saliva mixes with the pieces of food, moistening them into one slippery mass.



Chemical Digestion Like mechanical digestion, chemical digestion begins in the mouth. If you take a bite of a cracker and roll it around your mouth, the cracker begins to taste sweet. It tastes sweet because a chemical in the saliva has broken down the starch in the cracker into sugar molecules. Chemical digestion—the breakdown of complex molecules into simpler ones—has taken place. Chemical digestion is accomplished by enzymes. An **enzyme** is a protein that speeds up chemical reactions in the body. The chemical in saliva that digests starch is an enzyme. Your body produces many different enzymes. Each enzyme has a specific chemical shape. Its shape enables it to take part in only one kind of chemical reaction. For example, the enzyme that breaks down starch into sugars cannot break down proteins into amino acids.

The Esophagus

If you've ever choked on food, someone may have said that your food "went down the wrong way." That's because there are two openings at the back of your mouth. One opening leads to your windpipe, which carries air into your lungs. Usually, your body keeps food out of your windpipe. As you swallow, muscles in your throat move the food downward. While this happens, a flap of tissue called the **epiglottis** seals off your windpipe, preventing the food from entering. As you swallow, food goes into the **esophagus** , a muscular tube that connects the mouth to the stomach. The esophagus is lined with mucus. **Mucus** is a thick, slippery substance produced by the body. In the digestive system, mucus makes food easier to swallow and to be moved along.



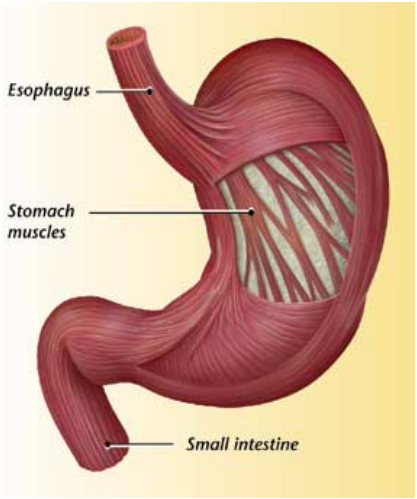
Food remains in the esophagus for only about 10 seconds. After food enters the esophagus, contractions of smooth muscles push the food toward the stomach. These involuntary waves of muscle contraction are called **peristalsis**. The action of peristalsis is shown below. Peristalsis also occurs in the stomach and farther down the digestive system. These muscular waves keep food moving in one direction.

The Stomach

When food leaves the esophagus, it enters the **stomach**, a J-shaped, muscular pouch located in the abdomen. As you eat, your stomach expands to hold all of the food that you swallow. An average adult's stomach holds about 2 liters of food.

Most mechanical digestion occurs in the stomach. Three strong layers of muscle contract to produce a churning motion. This action squeezes the food, mixing it with fluids in somewhat the same way that clothes and soapy water are mixed in a washing machine.

The Stomach The stomach walls produce mucus. Mucus protects the stomach from its own acid and enzymes. The stomach has powerful muscles that help grind up food.



While mechanical digestion is taking place, so too is chemical digestion. The churning of the stomach mixes food with digestive juice, a fluid produced by cells in the lining of the stomach.

Digestive juice contains the enzyme pepsin. Pepsin chemically digests the proteins in your food, breaking them down into amino acids. Digestive juice also contains hydrochloric acid, a very strong acid. This acid would burn a hole in clothes if it were spilled on them. Without this strong acid, however, your stomach could not function properly. First, pepsin works best in an acid environment. Second, the acid kills many bacteria that you swallow along with your food.

Since the acid is so strong, you may wonder why it doesn't burn a hole in your stomach. The reason is that digestive juice also contains mucus, which coats and protects the lining of your stomach. In addition, the cells that line the stomach are quickly replaced when they are damaged or worn out.

Food remains in the stomach until all of the solid material has been broken down into liquid form. After 1-3 hours after you finish eating, the stomach completes mechanical digestion of the food. By that time, most of the proteins have been chemically digested into shorter chains of amino acids. The food, now a thick liquid, is released into the next part of the digestive system. That is where final chemical digestion and absorption will take place.

Some Digestive Enzymes and Secretions

Source of Enzyme or Secretion	Enzyme or Secretion	Action
Mouth	Salivary amylase (enzyme)	Breaks down starches into sugar
Stomach	Pepsin (enzyme)	Breaks down proteins into shorter chains of amino acids
	Hydrochloric acid (secretion)	Provides an acid environment for pepsin; kills bacteria
Pancreas	Amylase (enzyme)	Continues the breakdown of starch
	Trypsin (enzyme)	Continues the breakdown of proteins
	Lipase (enzyme)	Breaks down fats
Liver	Bile (secretion)	Breaks down fats
Small intestine	Peptidase (enzyme)	Continues the breakdown of proteins
	Maltase (enzyme)	Converts remaining sugars into glucose