The Digestive System

In 1822, a man named Alexis St. Martin was wounded in the stomach. Dr. William Beaumont saved St. Martin's life. The wound, however, left an opening in St. Martin's stomach that never healed completely. Beaumont realized that by looking through the opening in St. Martin's abdomen, he could observe what was happening inside the stomach. Beaumont observed that food changed chemically inside the stomach. He hypothesized that chemical reactions in the stomach broke down foods into smaller particles. Beaumont removed liquid from St. Martin's stomach and analyzed it. The stomach liquid contained an acid that played a role in the breakdown of foods into simpler substances.

Beaumont's observation helped scientists understand the role of the stomach in the digestive system. The digestive system has three main functions: to break down food into molecules the body can use, to absorb these food molecules into the blood so that it can be carried throughout the body, and to help eliminate waste from the body.

Your body is like a car; without fuel, the car cannot go very far. Your body needs fuel to function properly. It gets this fuel from the foods that you eat. Humans are classified as consumers, that is, we need to eat plants or other animals for our food. From our food, we get three things: energy to keep us going, materials to build our bodies, and materials to rebuild or replace parts of our bodies (such as skin and blood).

The process by which our food is broken down into smaller, usable parts that our cells can use is called digestion. The system that digests our food is the digestive system. Our digestive system is made up of five connected organs commonly known as the digestive tract (or gastrointestinal tract). Your digestive tract is over 30 feet long! The process of digestion can be referred to as either being mechanical digestion (physically breaking food into smaller parts) or chemical digestion (using chemical to break food molecules into smaller chemical building blocks).

Digestion begins in the mouth. Both mechanical and chemical digestion occurs here. In your mouth you have teeth to chew and mechanically break down food, and a tongue to move the food around and enjoy the flavor. Along with your teeth and tongue, you have salivary glands under your tongue. They make saliva, a watery fluid that helps to moisten the food you are eating, making it softer and easier to swallow. Your saliva contains enzymes called salivary amylase that help to begin chemically breaking down your food into simpler starches or sugars. You can produce as much as two to three pints of saliva every day!

Once you swallow the food from the mouth, it enters a muscular tube called the esophagus.
The esophagus is about 25 centimeters long and empties into your stomach. It is also lined with mucus to help the food move downwards easily. When you are not swallowing, the esophagus flattens out. It will stretch to allow food you have chewed to pass through. As you swallow, involuntary muscles contract and relax pushing your food toward your stomach through a process called peristalsis.

Attached to the end of the esophagus is your stomach. This looks like a J-shaped pouch. When food enters the stomach, it mixes with gastric juices that contain enzymes, acids (including hydrochloric acid) and mucus. Some of the enzymes are called pepsin, a protein that breaks down proteins and fats. These enzymes aid in more chemical digestion of the food. The mucus helps to protect your stomach from the acids and enzymes from being attacked itself. Your stomach is a muscular pouch that is a temporary holding spot for your food. It can expand to hold the food that you eat.

The stomach has many folds which are able to open up and stretch out more and more as food arrives. The average stomach can hold about 4 liters (1 gallon) of food when full. The food stays in your stomach for two to six hours during which mechanical digestion takes place as well as the food, acid and enzymes are mixed together by contractions of the smooth muscles that line the stomach (much like a washing machine washes your clothes). The resulting mixture of food and gastric juices is called chyme.

Even though you have broken down the food into usable pieces, your body still needs to get this into your cells. After the chyme leaves the stomach, it enters the small intestine. This name refers to the width of the tube, not the length. The small intestine is about 2.5 centimeters wide but over seven meters (21 feet) long and is two-thirds of digestive system. The small intestine is folded many, many times like an accordion so that it can fit in your abdomen. In the small intestine, digestive juices from the pancreas are added to the chyme. These juices help to break down carbohydrates, proteins and fats. Gastric juices made by the small intestine also help to neutralize the acids from the stomach. Bile, made by your liver and stored in your gall bladder, helps to break fats down into even smaller parts.
In the small intestine, digestion of food is completed. Nutrients are broken down into molecules that are small enough to be used by body cells. Food is moved through the small intestine by the process of peristalsis, just like in the esophagus. Inside the many folds of your small intestine are millions of tiny, finger-like projections called villi. Villi are surrounded by tiny blood vessels known as capillaries. The nutrients are broken down into small enough pieces that they can enter the capillaries into the circulatory system where they will be carried throughout the body to where the fuel is needed.

After the major nutrients from the food are broken down and removed by the small intestine into the bloodstream, waste materials and fiber remains in your digestive system. This then moves into your large intestine. Your large intestine is more than twice the width of the small intestine at almost 6 centimeters, but only 1.5 to 2 meters (4-6 feet) long. In the large intestines, water that may still be in the food mixture can be absorbed by the blood vessels and carried to body cells to be used. The remaining undigested semi-solid waste (feces) then moves through the large intestines (again through the process of peristalsis) and is stored in the rectum until it is full and the waste can be removed from the body.

Between 1.3 and 2.6 gallons of water from food, drink and other sources circulate through your digestive system daily.
The Digestive System: A Concept Map

MECHANICAL DIGESTION - physically breaking food down into smaller parts

DIGESTIVE SYSTEM - process of changing food into smaller parts the body can use for fuel

CHEMICAL DIGESTION - breaking food down into small building blocks using chemicals

Mouth
- teeth
- tongue
- saliva
- enzymes

Esophagus

Stomach
- acids
- enzymes
- mucus
produce chyme

Small Intestine

Nutrients absorbed into blood

Large Intestine
- excess water absorbed by blood
- rectum - stores waste until removed by body

Pancreas
- produces enzymes that break down carbohydrates, proteins, and fats

Gallbladder
- stores bile from liver

Liver
- creates bile which breaks down fats

Wells 2006