Name_____

The Digestive System

Purpose: To describe how food moves through the digestive system. To identify the parts of the digestive system.

Background Information: Food provides us with fuel to live, energy to work and play, and the raw materials to build new cells. All the different kinds of food we eat are broken down by our digestive system and moved to every part of our body by our circulatory system.

The **digestive system** is a series of hollow organs joined in a long, twisting tube from the mouth to the anus. Inside this tube is a lining called the **mucosa**. In the mouth, stomach, and small intestine, the mucosa contains tiny glands that produce juices to help digest food.

Two solid organs, the **liver** and the **pancreas**, produce digestive juices that reach the intestine through small tubes.

It is important to remember that parts of other organ systems (for instance, nerves and blood) play a major role in the digestive system.

The **digestive system** works together to break down the chemical components of food into small nutrients that can be absorbed by cells to create energy for the body. This system also builds and replaces cells and tissues, which are constantly dying.

Digestion is the process by which food and drink are broken down into their smallest parts so that the body can use them to build and nourish cells and to provide energy. It involves the mixing of food, its movement through the digestive tract, and chemical breakdown of the large molecules of food into smaller molecules. Digestion starts in the mouth, when we chew and swallow, and is finished in the small intestine. The chemical process changes with different kinds of food.

Movement of Food Through the System

The large, hollow organs of the digestive system contain *muscle* that the organ walls move. The movement of organ walls can push food and liquid and can mix the contents within each organ.

The movement of the esophagus, stomach, and intestine is a muscle action called **peristalsis**. The action of peristalsis looks like an ocean wave moving through the muscle. The muscle of the organ produces a narrowing and then pushes the narrowed portion slowly down the length of the organ. These waves of narrowing push the food and fluid in front of them through each hollow organ.

Mouth
Teeth bite off and chew food into a soft mush that is easy to swallow. Chewing mixes the food with saliva, from the 6 salivary glands around the mouth and face, to make it moist and slippery, so it can move down the digestive tract easily. Although we are able to start swallowing by choice, once the swallow begins, it becomes involuntary and is then under the control of the nervous system.

Esophagus
The esophagus is a muscular tube. It takes food from the throat and pushes it down through the neck, and into the stomach. It moves food by the waves of **muscle contraction** called peristalsis.

Stomach
The stomach has thick muscles in its wall. These muscles **contract** to mash the food into a sloppy soup. The stomach lining produces strong digestive juices. These start **chemical reactions** in food, breaking down **macromolecules** into smaller molecules and dissolving its nutrients. The stomach really has three mechanical tasks to do.
First, the stomach must **store the swallowed food and liquid**. This requires the muscle of the upper part of the stomach to relax and accept large amounts of swallowed food.
The second job is to **mix up the food, liquid, and digestive juic**e produced by the stomach. The lower part of the stomach mixes these materials by its muscle action.
The third task of the stomach is to **empty its contents** slowly into the small intestine.

Pancreas
The pancreas, like the stomach, makes powerful digestive juices called **enzymes,** which help to digest food further as it enters the small intestines. Food does not actually move through the pancreas.

Gall Bladder
This small baglike part is tucked under the liver. It stores fluid called **bile**, which is made in the **liver**. As food arrives in the small intestine, bile flows from the gall bladder along the **bile duct** into the intestine. It helps to digest **fatty foods** and contains wastes for removal. Food does not actually move through the gall bladder.

Small Intestine
This part of the digestive tract is narrow, but very long - about 20 feet. In the small intestine more enzymes continue the chemical reactions, breaking down macromolecules into smaller ones. When the nutrients are small enough, they *pass through the lining of the small intestine, and into the blood*. They are carried away to the liver and other body parts to be processed, stored and distributed.
The small intestine is divided into the duodenum, jejunum, and ileum.

Most of the nutrients / molecules in the food you eat pass through the lining of your small intestine into your blood. The lining of the small intestine is covered in tiny villi.

These are microscopic, finger-like projections which give the lining of the small intestine a huge surface area for absorption of nutrients / molecules to occur across.

The villi are surrounded by a blood capillary. When nutrients are absorbed into a villus, they enter its blood capillary by diffusion. This is how nutrients from your food enter your blood.

Liver
Blood from the intestines flows to the liver, carrying nutrients, vitamins and minerals, and other products from digestion. The liver is like a food-processing factory with more than 200 different jobs. It stores some nutrients, changes them from one form to another, and releases them into the blood according to the activities and needs of the body. Food does not actually move through the liver.

Large Intestine
Any useful substances in the leftovers, such as spare water and body minerals, are absorbed through the walls of the large intestine, back into the blood. The left-overs are formed into brown, semi-solid feces, ready to be removed from the body.

Rectum and Anus
Not all that we eat can be digested, so the waste must be disposed of in an efficient way. The waste products of this process include undigested parts of the food, known as fiber, and older cells that have been shed from the mucus. The end of the large intestine and the next part of the tract, the rectum, store the feces. These are finally squeezed through a ring of muscle, the anus, and out of the body.

Production of Digestive Juices
The glands that act first are in the mouth, they are the salivary glands. **Saliva** produced by these glands contains an enzyme that begins to break down (digest) the starch from food into smaller molecules.

The next set of digestive glands is in the **stomach lining**. They produce stomach acid and an enzyme that digests protein.

After the stomach empties the food and its juice into the small intestine, the juices of the **pancreas** and **liver** mix with the food to continue the process of digestion.

The pancreas produces a juice that contains enzymes to break down the carbohydrates, fat, and protein in food. Other enzymes that are active in the process come from glands in the wall of the intestine or even a part of that wall.

The liver produces another digestive juice; bile. The bile is stored between meals in the gall bladder. After eating, it is squeezed out of the gallbladder into the bile ducts to reach the intestine and mix with the fat in our food. The bile acids dissolve the fat into the watery contents of the intestine, much like detergents that dissolve grease from a

frying pan. After the fat is dissolved, enzymes from the pancreas and the lining of the intestine digest it.

Absorption and Transport of Nutrients
Digested molecules of food, as well as water and minerals from the diet, are absorbed from the upper small intestine. The absorbed materials cross by **diffusion** into the blood, and are carried off in the bloodstream to other parts of the body for storage or further chemical change.

Carbohydrates. It is recommended that about 55 to 60 percent of total daily calories be from carbohydrates. Some of our most common foods contain mostly carbohydrates. Examples are bread, potatoes, legumes, rice, spaghetti, fruits, and vegetables. Many of these foods contain both starch and fiber.

The digestible carbohydrates are broken into simpler molecules by enzymes in the saliva, in juice produced by the pancreas, and in the lining of the small intestine. Starch is digested in two steps: First, an enzyme in the saliva and pancreatic juice breaks the starch into molecules called maltose; then an enzyme in the lining of the small intestine (maltase) splits the maltose into glucose molecules that can be absorbed into the blood. Glucose is carried through the bloodstream to the liver, where it is stored or used to provide energy for the work of the body.

Table sugar is another carbohydrate that must be digested to be useful. An enzyme in the lining of the small intestine digests table sugar into glucose and fructose, each of which can be absorbed from the intestinal cavity into the blood. Milk contains yet another type of sugar, lactose, which is changed into absorbable molecules by an enzyme called lactase, also found in the intestinal lining.

Protein. Foods such as meat, eggs, and beans consist of macromolecules of protein that must be digested by enzymes before they can be used to build and repair body tissues. An enzyme in the juice of the stomach starts the digestion of swallowed protein. Further digestion of the protein is completed in the small intestine. Here, several enzymes from the pancreatic juice and the lining of the intestine carry out the breakdown of huge protein molecules into small molecules called amino acids. These small molecules can be absorbed from the hollow of the small intestine into the blood and then be carried to all parts of the body to build the walls and other parts of cells.

Fats. Fat molecules are a rich source of energy for the body. The first step in digestion of a fat such as butter is to dissolve it into the watery content of the small intestine. The bile acids produced by the **liver** act as natural detergents to dissolve fat in water and allow the enzymes to break the large fat molecules into smaller molecules, some of which are fatty acids and cholesterol. The bile acids combine with the fatty acids and cholesterol and help these molecules to move into the cells of the **mucosa**. In these cells the small molecules are formed back into large molecules, most of which pass into the lymph vessels near the intestine. These vessels carry the reformed fat to the veins

of the chest, and the blood carries the fat to storage depots in different parts of the body.

Vitamins. Another important part of our food that is absorbed from the small intestine are the chemicals we call vitamins. The two different types of vitamins are classified by the fluid in which they can be **dissolved**: water-soluble vitamins (all the B vitamins and vitamin C) and fat-soluble vitamins (vitamins A, D, and K).

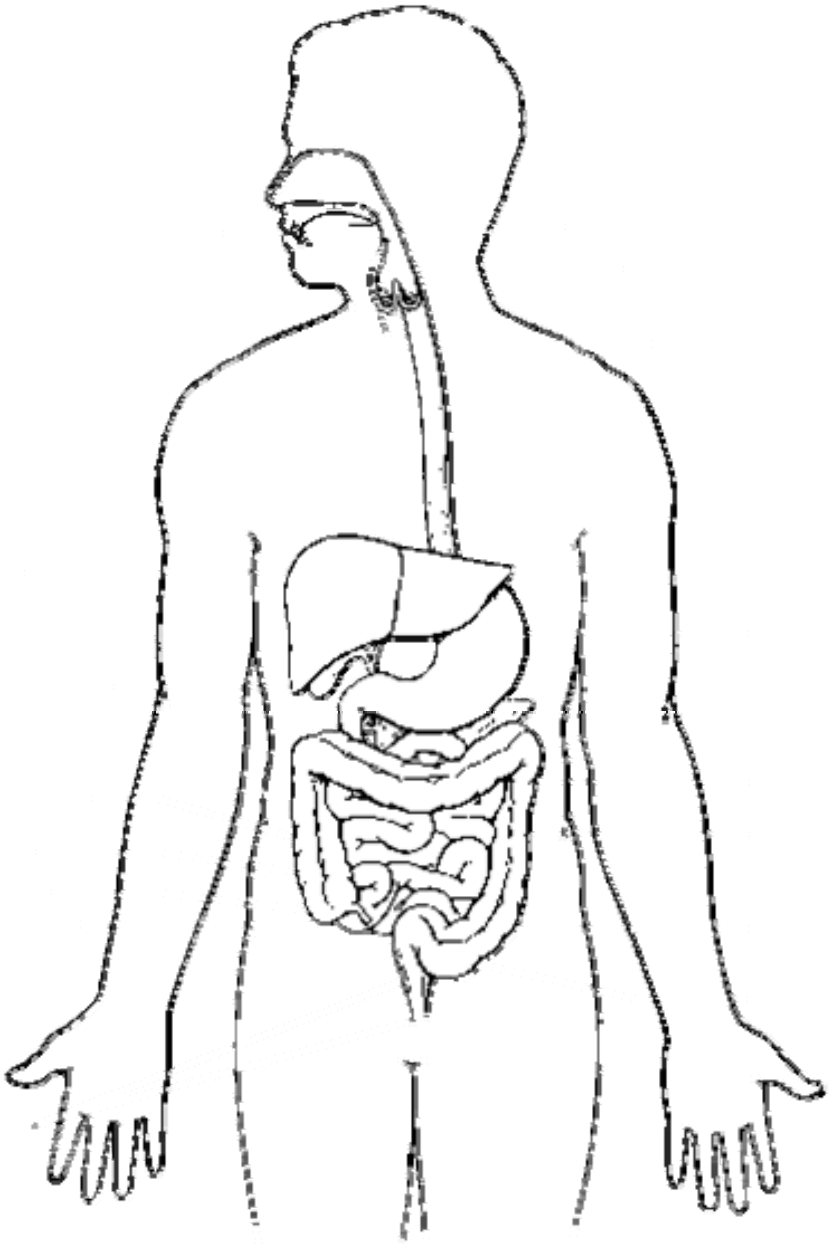
Water and salt. Most of the material absorbed from the cavity of the small intestine is water in which salt is dissolved. The salt and water come from the food and liquid we swallow and the juices secreted by the many digestive glands.

Procedure:

1. Use map pencils to label & color each of the following parts of the digestive system. Use the information on this page and your textbook (chapter 16) as resources.

Mouth	Teeth	Salivary Glands	Esophagus
Pancreas	Gallbladder	Liver	Small intestine
Large intestine	Rectum	Anus	Stomach

2. Briefly describe what happens to food in each part of the system.



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