

The Digestive System

The digestive system is a group of organs working together to convert food into basic nutrients to feed the entire body. Food passes through a long tube inside the body known as the alimentary canal or the gastrointestinal tract (GI tract). The alimentary canal is made up of the oral cavity, pharynx, esophagus, stomach, small intestines, and large intestines. In addition to the alimentary canal, there are several important accessory organs that help your body to digest food, but do not have food pass through them.

Accessory organs of the digestive system include the teeth, tongue, salivary glands, liver, gallbladder, and pancreas.

Food begins its journey through the digestive system in the mouth, also known as the oral cavity. Inside the mouth are many accessory organs that aid in the digestion of food—the tongue, teeth, and salivary glands. Teeth chop food into small pieces, which are moistened by saliva before the tongue and other muscles push the food into the pharynx.

TEETH The teeth are 32 small, hard organs found along the anterior and lateral edges of the mouth. Each tooth is made of a bone-like substance called dentin and covered in a layer of enamel—the hardest substance in the body. Teeth are living organs and contain blood vessels and nerves under the dentin in a soft region known as the pulp. The teeth are designed for cutting and grinding food into smaller pieces.

TONGUE The tongue is a small organ made up of several pairs of muscles covered in a thin, bumpy, skin-like layer. The outside of the tongue contains many rough papillae for gripping food as it is moved by the tongue's muscles. The taste buds on the surface of the tongue detect taste molecules in food and connect to nerves in the tongue to send taste information to the brain. The tongue also helps to push food toward the posterior part of the mouth for swallowing.

SALIVARY GLANDS Surrounding the mouth are 3 sets of salivary glands. The salivary glands are accessory organs that produce a watery secretion known as saliva. Saliva helps to moisten food and begins the digestion of carbohydrates. The body also uses saliva to lubricate food as it passes through the mouth, pharynx, and esophagus. The salivary glands produce an enzyme called amylase, which converts starch to sugar.

The **PHARYNX**, or throat, is a funnel-shaped tube connected to the posterior end of the mouth. The pharynx is responsible for the passing of masses of chewed food from the mouth to the esophagus. The pharynx also plays an important role in the respiratory system, as air from the nasal cavity passes through the pharynx on its way to the larynx and eventually the lungs. Because the pharynx serves two different functions, it contains a flap of tissue known as the epiglottis that

acts as a switch to route food to the esophagus and air to the larynx.

The **ESOPHAGUS** is a muscular tube connecting the pharynx to the stomach that is part of the upper gastrointestinal tract. It carries swallowed masses of chewed food along its length. At the lower end of the esophagus is a muscular ring called the cardiac sphincter. The function of this sphincter is to close off the end of the esophagus and trap food in the stomach.

The **STOMACH** is a muscular sac that is located on the left side of the abdominal cavity, just below the diaphragm. In an average person, the stomach is about the size of their two fists placed next to each other. This major organ acts as a storage tank for food so that the body has time to digest large meals properly. The stomach contains hydrochloric acid and digestive enzymes, such as pepsin, that continue the digestion of food that began in the mouth.

The **SMALL INTESTINE** is a long, thin tube about 1 inch in diameter and about 10 feet long that is part of the lower gastrointestinal tract. It is located just inferior to the stomach and takes up most of the space in the abdominal cavity. The entire small intestine is coiled like a hose and the inside surface is full of many ridges and folds lined with tiny microvilli. These microvilli have a huge surface area to maximize the digestion of food and absorption of nutrients. By the time food leaves the small intestine, around 90% of all nutrients have been extracted from the food that entered it.

The **LIVER** is a roughly triangular accessory organ of the digestive system located to the right of the stomach, just below the diaphragm and above the small intestine. The liver weighs about 3 pounds and is the second largest organ in the body.

The liver has many different functions in the body, but the main function of the liver in digestion is the production of bile and its secretion into the small intestine.

The **GALLBLADDER** is a small, pear-shaped organ located just behind the liver. The gallbladder stores and recycles excess bile from the small intestine so that it can be reused for the digestion of subsequent meals.

The **PANCREAS** is a large gland located just below and behind the stomach. It is about 6 inches long. The pancreas secretes digestive enzymes into the small intestine to complete the chemical digestion of foods.

The **LARGE INTESTINE** is a long, thick tube about 2 ½ inches in diameter and about 5 feet long. It is located just inferior to the stomach and wraps around the superior and lateral border of the small intestine. The large intestine absorbs water. It contains many symbiotic bacteria that aid in the breaking down of

wastes to extract some small amounts of nutrients. Feces in the large intestine exit the body through the anal canal.

FUNCTIONS OF THE DIGESTIVE SYSTEM

- 1. Ingestion of food**
- 2. Secretion of fluids and digestive enzymes**
- 3. Mixing and movement of food and wastes through the body**
- 4. Breakdown of proteins, carbohydrates and fats into smaller particles**
- 5. Absorption of nutrients into the bloodstream**
- 6. Excretion of wastes**

Secretion

In the course of a day, the digestive system secretes around 7 liters of fluids. These fluids include saliva, mucus, hydrochloric acid, enzymes, and bile. Saliva moistens dry food and contains salivary amylase, a digestive enzyme that begins the digestion of carbohydrates.

Mucus serves as a protective barrier and lubricant inside of the Gastrointestinal tract. Hydrochloric acid helps to digest food chemically and protects the body by killing bacteria present in our food. Enzymes are like tiny biochemical machines that disassemble large macromolecules like proteins, carbohydrates, and lipids into their smaller components. Finally, bile is used to emulsify large masses of lipids into tiny globules for easy digestion.

Mixing and Movement

The digestive system uses 3 main processes to move and mix food:

SWALLOWING Swallowing is the process of using smooth and skeletal muscles in the mouth, tongue, and pharynx to push food out of the mouth, through the pharynx, and into the esophagus.

PERISTALSIS is a muscular wave that travels the length of the GI tract, moving partially digested food a short distance down the tract. It takes many waves of peristalsis for food to travel from the esophagus, through the stomach and intestines, and reach the end of the GI tract.

SEGMENTATION Segmentation occurs only in the small intestine as short segments of intestine contract like hands squeezing a toothpaste tube. Segmentation helps to increase the absorption of nutrients by mixing food and increasing its contact with the walls of the intestine.

DIGESTION is the process of turning large pieces of food into its component chemicals. Mechanical digestion is the physical breakdown of large pieces of food into smaller pieces. This mode of digestion begins with the

chewing of food by the teeth and is continued through the muscular mixing of food by the stomach and intestines.

Bile produced by the liver is also used to mechanically break fats into smaller globules. While food is being mechanically digested it is also being chemically digested as larger and more complex molecules are being broken down into smaller molecules that are easier to absorb.

Chemical digestion begins in the mouth with salivary amylase in saliva splitting complex carbohydrates into simple carbohydrates. The enzymes and acid in the stomach continue chemical digestion, but the bulk of chemical digestion takes place in the small intestine thanks to the action of the pancreas. The pancreas secretes an incredibly strong digestive cocktail known as pancreatic juice, which is capable of digesting lipids, carbohydrates, proteins and nucleic acids. By the time food has left the duodenum, it has been reduced to its chemical building blocks—fatty acids, amino acids, monosaccharides, and nucleotides.

ABSORPTION

Once food has been reduced to its building blocks, it is ready for the body to absorb. Absorption begins in the stomach with simple molecules like water and alcohol being absorbed directly into the bloodstream. Most absorption takes place in the walls of the small intestine, which are densely folded and contain microvilli to maximize the surface area in contact with digested food.

Small blood and lymphatic vessels in the intestinal wall pick up the molecules and carry them to the rest of the body. The large intestine is also involved in the absorption of water and vitamins B and K before feces leave the body.

EXCRETION

The final function of the digestive system is the excretion of waste in a process known as defecation. Defecation removes indigestible substances from the body so that they do not accumulate inside the gut. The timing of defecation is controlled voluntarily by the conscious part of the brain, but must be accomplished on a regular basis to prevent a backup of indigestible materials.

NUTRITION

It's time to end the low-fat myth. That's because the percentage of calories from fat that you eat, whether high or low, isn't really linked with disease. What really matters is the type of fat you eat.

Choose foods with healthy fats, limit foods high in saturated fat, and do not eat foods with trans fat.

Foods high in good fats include coconut oil, avocados, olive oil, sunflower, nuts, seeds, and fish.

“Bad” fats—saturated and, especially, trans fats—increase disease risk! Foods high in bad fats include red meat, butter, cheese, and ice cream, as well as processed foods made with trans fat from partially hydrogenated oil.

The key to a healthy diet is to choose foods that have more good fats high in omega-3 than bad fats—coconut oil or butter instead of vegetable oils, salmon instead of steak—and that don’t contain any trans fat. Omega-3 fats are better than omega-6 fats.

“Low-fat,” “reduced fat,” or “fat-free” processed foods are not necessarily healthy. And low-fat diets are often higher in refined carbohydrates and starches from foods like white rice, white bread, potatoes, and sugary drinks.

When food manufacturers take out fat, they often replace it with carbohydrates from sugar, refined grains, or starch. Our bodies digest these refined carbohydrates and starches very quickly, causing blood sugar and insulin levels to spike and then dip, which in turn leads to hunger, overeating, and weight gain.

Over time, eating lots of “fast carbs” can raise the risk of heart disease and diabetes as much as—or more than—eating too much saturated fat.

So when you cut back on foods like red meat and butter, replace them with fish, beans, nuts, and healthy oils—not with refined carbohydrates.

CHOLESTEROL

For most people dietary cholesterol isn’t nearly the villain it’s been portrayed to be. Cholesterol in the bloodstream, specifically the bad LDL cholesterol, is what’s most important. And the biggest influence on blood cholesterol level is the mix of fats and carbohydrates in your diet—not the amount of cholesterol you eat from food.

12 Quick Tips

1. Use olive or coconut oil for cooking and baking. Olive, and other plant-based oils are rich in heart-healthy unsaturated fats. Try dressing up a salad or roasted vegetables with an olive oil-based vinaigrette, or savory almond-based pesto.

2. Ditch the trans fat. In the supermarket, read the label to find foods that are trans free. The label should say “0” (zero) on the line for trans fat; you should also scan the ingredient list to make sure it does not contain partially hydrogenated oils, MSG, sodium benzoate, high fructose corn syrup, aspartame, or GMO foods . In restaurants that don’t have nutrition information readily

available, steer clear of fried foods, biscuits, and other baked goods, unless you know that the restaurant has eliminated trans fat—many already have.

3. Butter is better than margarine, which is a trans fat.

4. Scan ingredient lists to make sure it does not contain partially hydrogenated oils. Even better, use a liquid plant oil whenever possible; refrigerated extra virgin olive oil makes a great spread for toast.

5. Eat at least one good source of omega-3 fats each day. Fatty fish (such as salmon and tuna), walnuts, and foods with flax seed all provide omega-3 fatty acids, essential fats that our bodies cannot make. Omega-3 fats, especially those from fish, are very beneficial for the heart. Read more about omega-3 fatty acids and why they are so important to good health.

6. Cut back on red meat, cheese, milk, ice cream, and processed meat, such as bacon, and choose fish, chicken, nuts, or beans instead. If you do eat red meat, choose lean cuts and keep the amounts low.

7. Processed meat such as hot dogs, sausage and lunch meats are very bad for you.

8. Eat the cheese you like and savor it in small amounts.

9. To be sure you are getting the nutrients you need, eat nutrient dense foods, like vegetables and fruits, instead of fast foods or “junk foods”.

10. It's ironic that we provide balanced nutrition for our farm animals and pets. Yet most Americans are deficient in many vitamins, including vitamin B, vitamin D, vitamin E and vitamin K, as well as in many minerals. It's cheap life insurance to take vitamin and mineral supplements. There is a total of 90 nutrients needed by humans.

11. We need at least eight glasses of water per day.

12. The American Dietetic Association describes fiber as complex carbohydrates your body can't digest or absorb and names two types: soluble and insoluble fiber.

Soluble fiber -- found in beans, fruits, and more -- aids in satiety (helping you feel full). Insoluble fiber -- found in wheat bran, whole grains, nuts, vegetables, and other foods -- helps keep your digestive system regular.

According to the National Academy of Sciences Institute of Medicine, the daily needs of men and women for fiber differ, and change as they age:

**Age 50 and younger
Women: 25 grams
Men: 38 grams**

ONE SENTENCE HAS KILLED MORE PEOPLE THAN ALL THE WARS IN AMERICAN HISTORY-

“YOU GET ALL THE NUTRITION YOU NEED FROM THE FOUR FOOD GROUPS”

This is because most of our soil is minerally deficient, and plants and animals get their minerals from the soil. They cannot make them.