

“It’s a marvelous piece of engineering.”



CENTER FOR DIGESTIVE HEALTH & NUTRITION
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Your Digestive System

Okay, so your digestive system is not a subject high on the list of topics for cocktail party chit-chat. But it’s surprising that the digestive system is largely ignored in today’s culture, where we’re bombarded with discussions around our most personal and intimate problems. It burrows through your body from mouth to anus, a remnant of the tubular blueprint that forms in the womb. You are not alone in taking your digestive system for granted. As long as it is functioning properly, you seldom think of it. But it is a marvelous piece of engineering and a formidable, dependable workhorse - the body's Clydesdale. Your digestive system is always ready, waiting to automatically process the next batch of food to come down the pipeline, requiring no conscious action by you. You can feast on fried chicken or three-alarm chili without understanding anything about the complex science of digestive chemistry.

Your Gut Feeds You

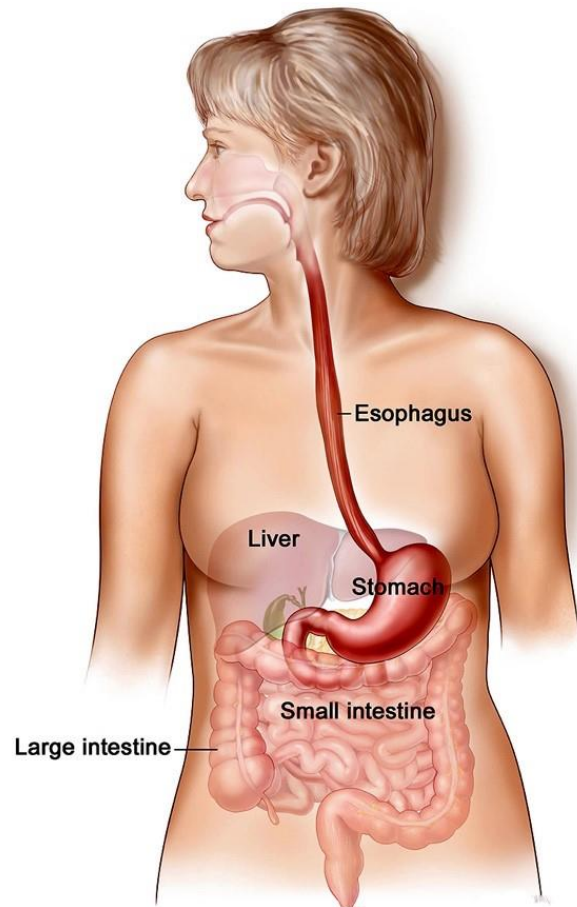
You may think that you feed your gut, but in reality, your gut feeds you. Without effective processing, most of your food would be as deadly as poison if it entered your bloodstream. Your gut can best be described as an elaborate food "disassembly" plant. Your gut disassembles virtually everything you eat into smaller components that your body can absorb and use as fuel. The crisp fat in your breakfast bacon is converted into smaller fatty acids, while the protein in your dinner lamb chop turns into smaller amino acids, and the large carbohydrates in your mashed potatoes are transformed into an essential energy source: simple sugar or glucose. Once processed, these much simpler nutrients are transferred to your blood system - for your body to use for energy, growth, and repair. The process of breaking down large molecules into their smallest parts is termed *digestion*.

The Upper Digestive System

From your mouth to your rectum, your entire digestive system is a single, long, hollow, muscular tube - about thirty feet long. Automatically, the muscles in this intestinal tube alternately contract and relax to move food and fluids through the digestive tract for processing.

Digestion begins when your food is mixed with saliva and mashed into smaller pieces by your jaws and teeth. After swallowing, your food is propelled down the ten inches of the *esophagus*, or "food pipe," and into your *stomach* "pouch." The reversal of the direction of stomach contents back into your esophagus is prevented by a one-way valve located at the bottom of the esophagus, known as the *lower esophageal sphincter*. When this valve malfunctions, it commonly causes heartburn.

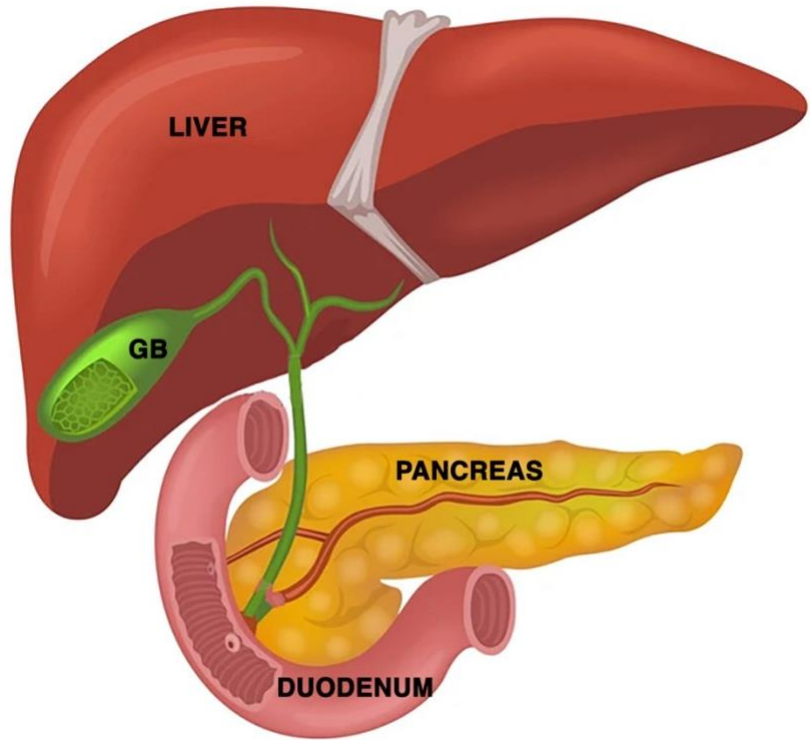
When empty, your stomach "pouch" has a volume of less than one-half cup. Its muscular wall contracts and expands as you eat, holding about three pints of sustenance. The contractions generate peristaltic waves every twenty seconds



or so that ripple through your stomach, first squeezing the upper part gently, then, more powerfully, the lower part. This churning motion mixes the food particles with powerful **hydrochloric acid** and the enzyme **pepsin**. These strong stomach chemicals liquefy the food into chyme, which has the consistency of cream of potato soup. Eventually, the chyme is injected by degrees through the one-way *pyloric valve* and into the small intestine.

Liver and Pancreas

Your digestive system also has two solid organs: the *liver* and the *pancreas*. They produce digestive juices that accelerate the disassembly process. These juices enter the small intestine through narrow tubes called ducts. Your gallbladder is a pear-shaped organ in the upper right abdomen beneath your liver. The liver manufactures bile, which is stored in the *gallbladder* before being carried down the bile duct to mix with the food. The pancreas produces enzymes that are transported down the pancreatic duct to further aid digestion. The pancreas also produces insulin, which regulates sugar in your blood.



The organs of your digestive tract work very efficiently. Your liver makes bile continuously, but since you only need bile when eating, precious excess bile is moved to the gallbladder for storage between meals. While the stored bile waits for your next meal, the gallbladder distills it, increasing its effectiveness. During a meal, the gallbladder contracts to inject the concentrated bile into the small intestine, which is used to break down that greasy cheeseburger.

The "Mid-Gut"

Located in the middle of your abdomen is the twenty-foot-long *small intestine*. This is where the two gallons of food, liquid, and digestive secretions you process each day enter the final digestion and nutrient absorption process. The small intestine is divided into three sections: the first and shortest is the *duodenum*; the second portion is referred to as the *jejunum*; and the last section is called the *ileum*. The entire small intestine is lined with intricate groups of muscles that are never entirely at rest. While one group produces a swaying motion that churns food and digestive juices together, another set of muscles produces a wavelike action, pushing the contents along. Somewhat like a conveyor belt, these muscular contractions cause a motion that carries the contents down the twenty-foot small intestine. Along the way, your body harvests whatever it needs, leaving the rest to pass downstream.

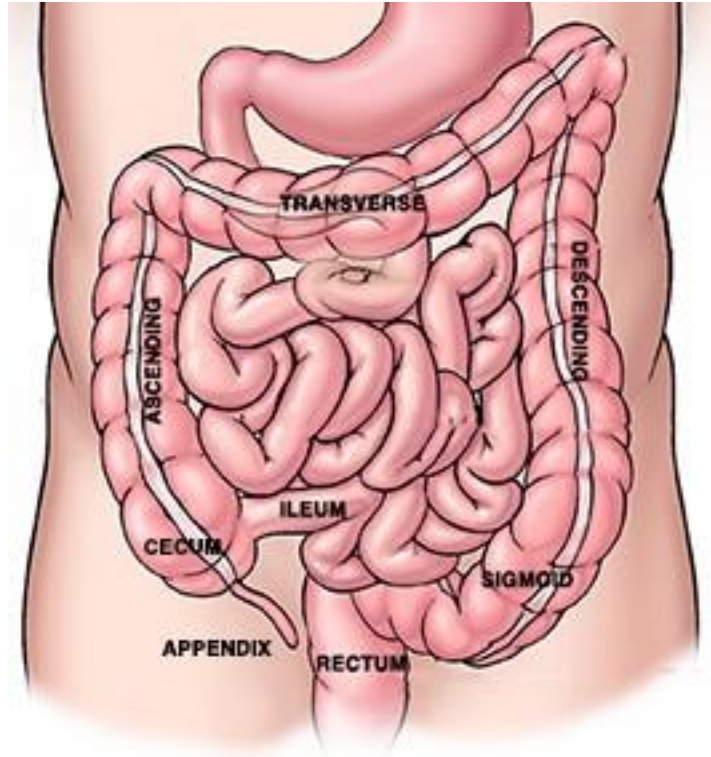
To maximize absorption, the food molecules must contact many specialized intestinal cells. To accomplish this, the walls of your intestines are covered with microscopic hairlike projections called *microvilli*. Microvilli are made up of special cells which enable the transfer of nutrients into your bloodstream. Each square inch of the intestine contains about 10 billion microvilli. This increases the surface area for food absorption dramatically. If your intestinal interior were smooth, it would present only about 6 square feet of absorptive surface. Instead, because of these microvilli, it offers almost 2700 square feet—about the same surface as a tennis court! It takes the small intestine about four hours to process a meal. Once all the "good stuff" is removed, your gut passes the remaining indigestible watery gruel to the last five feet of your digestive tract, the colon.

The Lower Digestive System

Sometimes called the **large intestine** because of its wider diameter, the *colon* is much shorter than the small intestine and is only about 6 feet long. The colon's main job is to reclaim excess water from the intestinal waste and recycle it into your bloodstream for reuse, like a "water treatment plant." As liquid waste moves through the digestive system, it gradually dries and forms a solid sludge which is eliminated as a bowel movement, also known as stool or feces. The typical brown color is a byproduct of red blood cell breakdown and liver bile. What begins in your mouth as an edible nourishment with pleasing tastes and aromas metamorphoses into smelly fecal waste exiting the body from its hidden posterior side.

The colon begins in the *cecum* located in the lower right portion of your abdominal cavity. Your appendix is connected to the cecum, which is why pain associated with appendicitis is felt in the right lower side of the abdomen. At the junction of the small intestine and the cecum, the ileocecal valve prevents material from the cecum from reversing course into the ileum. Your cecum continues upward along your right side as the *ascending* colon. Just under the liver, it makes a sharp turn continuing across the width of the upper abdomen as the *transverse* colon, before making another sharp turn straight down the left side of your abdomen as the *descending* colon. Another turn leads the colon into an S-shaped segment.

called the *sigmoid* colon. This is the area where most "pockets" of diverticulosis form. The sigmoid colon connects to the last six inches of your large intestine called the *rectum*. The rectum connects directly into the short anal canal, terminating at the anal sphincter. The anal sphincter is a valve that must remain closed to prevent involuntary stool elimination but opens properly to permit a bowel movement. Referred to in some circles, the anal sphincter muscle has been called the social muscle because it can distinguish between passing gas, liquids, and solids, thus preventing accidental bowel movements.



How can I reduce my risk of colorectal cancer?

The answer is colonoscopy, colonoscopy, colonoscopy! Colorectal cancer is the second most deadly cancer in this country, second only to lung cancer. In non-smokers, colorectal cancer is the number one cancer killer in Americans. This is sad as we have had an effective means of prevention for the past 50 years. Timed properly, periodic screening colonoscopy is *not* colon cancer screening. It is colon cancer prevention due to colon polyp screening. Find and remove a colon polyp and another potential cancer is prevented. It's no coincidence that the American Cancer Society strongly recommends that all adults undergo a program of colorectal screening at the age of 45 and repeated about every ten years if the initial test result is normal. Individuals with a family history of colon cancer or polyps should begin at age 40. Periodic colonoscopy exams maximize the chances that any polyps will be detected and removed before cancer cells develop. A program of periodic colonoscopy will significantly reduce your risk of colon cancer.

Wait. Wait. There's More...

All the preceding information is the same digestive anatomy and physiology taught in college over 50 years ago. That hasn't changed. However, advances over the past few decades have resulted in scientific discoveries that the digestive tract is even more complicated and powerful than realized.

The Intestinal Microbiome

Whereas the small intestine has very few bacteria, the colon is home to trillions of microorganisms, including thousands of different species of bacteria called the *microbiome*. These “bugs” coexist in a healthy person and provide various valuable functions. No matter how efficient our digestive system is, we can't digest everything we eat. Whatever gets moved into our colon is fair game for the gut bacteria to work on. Bacterial activity adds beneficial nutrients to our body that are unavailable from normal digestion. These tiny organisms also support intestinal health, help regulate our immune system, break down potentially toxic food compounds, and react quickly to protect us against harmful bacteria. The microbiome is essential enough to be considered a separate body system because of its critical role in promoting the smooth daily operations of the human body. Research on the intestinal microbiome continues.

Your "Second Brain"

Did you know you have a second brain? Your second brain, the enteric nervous system (ENS), is in your gut! The ENS comprises over 100 million nerve cells lining your digestive tract from mouth to anus. The enteric nervous system doesn't seem capable of thought as we know it, but it communicates back and forth with our big brain—with profound results. The ENS communicates directly with your central nervous system along a pathway called the gut-brain axis. Much of the information the gut sends to the brain affects well-being and doesn't even come to consciousness. Our two brains—the one in our head and the one in our bowels—must cooperate. If they do not, there is chaos in the gut and misery in the head—everything from "butterflies" to cramps, diarrhea, to constipation. Your gut's primary connection to the brain is the vagus nerve. This nerve also regulates messages sent to the heart, lungs, and other organs. The term “second brain” was first coined in 1996 by Dr. Michael Gershon, a Pathology and Cell Biology Professor at Columbia University. Experts and researchers continue to study the gut-brain axis and its effects on certain neurological conditions.

Autopilot

Your digestive system is a marvelous piece of engineering. When it functions normally, it does so in the background, on “autopilot,” leaving you blissfully unaware of its complicated functions. But sometimes, it malfunctions, leading to distressing, embarrassing symptoms, and occasionally, it can be the precursor of a serious ailment. If you are suddenly and unexpectedly aware of your digestive system, don't be embarrassed, and if you have persistent intestinal problems, consult your doctor.



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