An overview of the human digestive system

About the gastrointestinal (GI) tract

The gut, or the GI tract, is a long tube that runs from the mouth to the anus (see Figure 1.1). Its most important function is to break down (digest) food that we eat and to absorb nutrients, water, and vitamins. These are essential for cell repair, normal growth, and to produce energy that keeps our body going.

To transport food and water downstream, the GI tract relies on peristalsis. This is a propelling force caused by the coordinated contraction and relaxation of the muscles found in the wall of the GI tract.

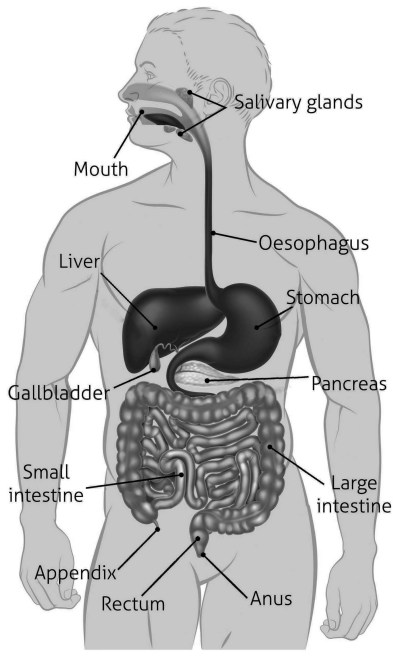


Figure 1.1 Human gastrointestinal tract (*Source*: Christos Georghiou/Shutterstock.com).

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The mouth, oesophagus and stomach

In the mouth, food that has been ingested is ground into small pieces by the chewing action of teeth (see Figure 1.2). At the same time, the food mixes with saliva, which contains enzymes that break down food. The tongue then rolls the food into a small ball (bolus) that can then be swallowed. The food bolus then travels down the oesophagus (esophagus or "food pipe") into the stomach, where it is mixed with gastric juices containing acid (see Figure 1.3). After around 1 to 2 hours of churning and mixing the food, the stomach slowly releases it into the small bowel.

The small bowel, liver and pancreas

The small bowel (small intestine) is the longest segment of the GI tract, measuring on average 6 metres in adults (see Figure 1.4). The pancreas, a leaf-shaped organ in the upper part of the abdomen, releases enzymes into the small bowel in order to complete the process of digestion (see Figure 1.5). At the same time, the gallbladder releases bile (produced by the liver) to help the digestion of fat. Once

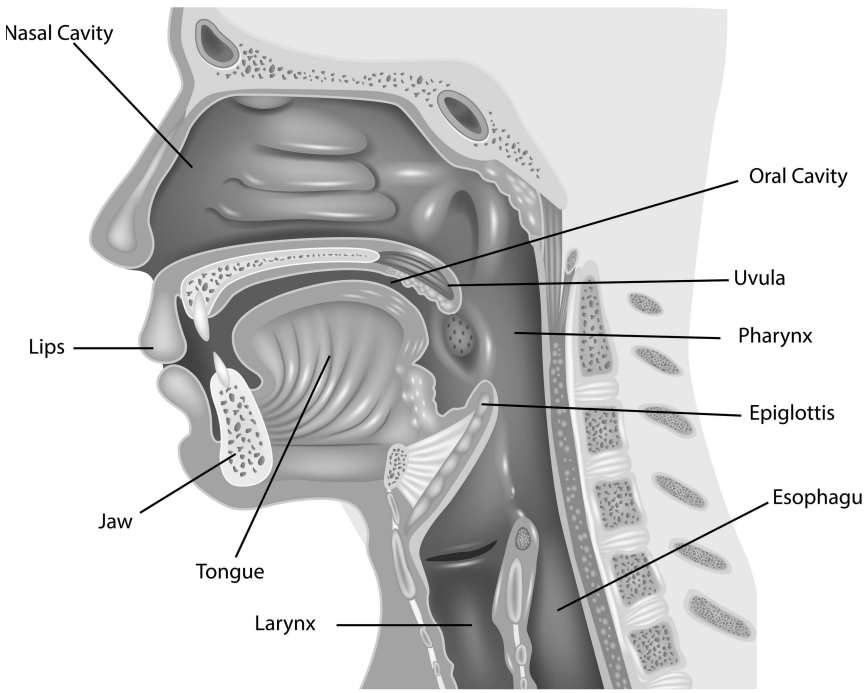


Figure 1.2 The oral cavity (*Source*: Teguh Mujiono/Shutterstock.com).

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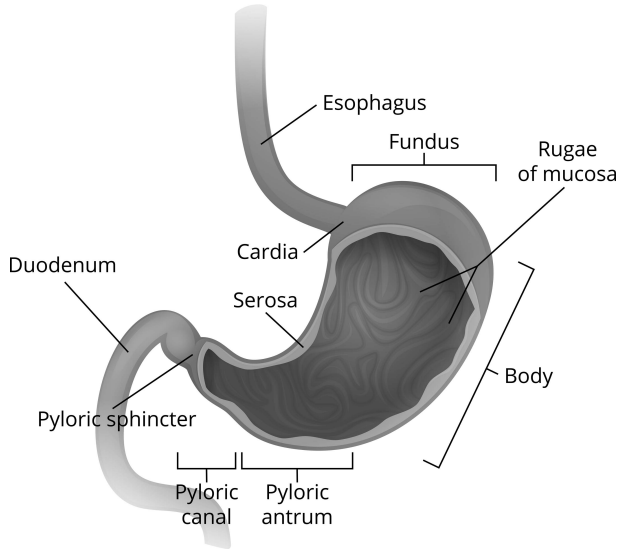


Figure 1.3 Anatomy of the stomach (*Source*: Marochkina Anastasiia/Shutterstock.com).

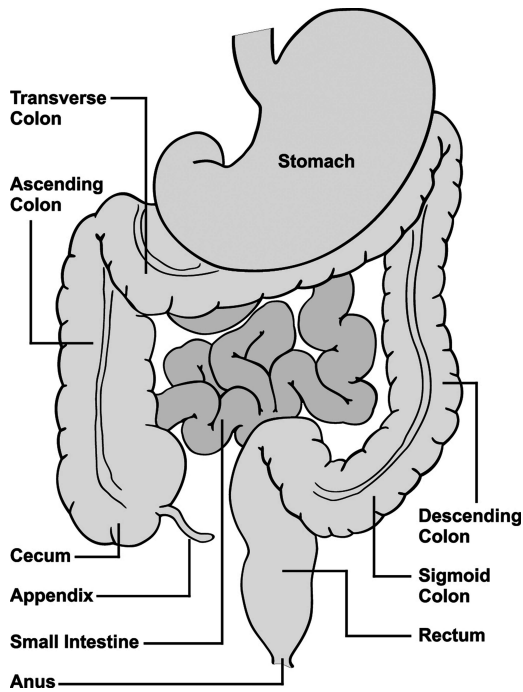


Figure 1.4 Stomach, small intestine, and large intestine (*Source*: Udaix/Shutterstock.com).

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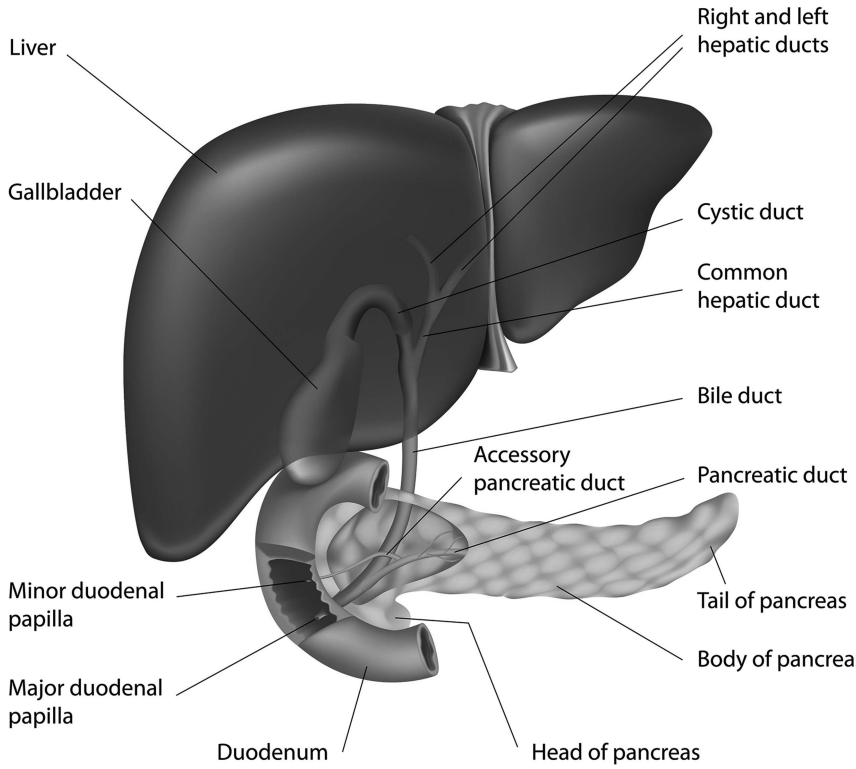


Figure 1.5 The liver, pancreas, and bile duct (*Source*: Alila Medical Media/Shutterstock.com).

the nutrients are broken down into small molecules, they can then be absorbed across the wall of the small bowel and delivered to the liver for further processing or redistribution to other organs. Water, salts and some vitamins are also absorbed in the small bowel. Overall, the transit time of food (or what is left of food) in the small bowel is between 3 and 4 hours.

The large bowel, rectum, and anus

By the time the bowel content leaves the small bowel, most of the nutrients have been absorbed. The main job of the large bowel (colon or large intestine) is therefore to absorb water and to carry faeces all the way to the rectum and anus (see Figure 1.6). The transit time in the large bowel ranges between 24 to 48 hours. The rectum stores stool while the anus is responsible for maintaining continence so that stool is only passed when desired. The anus has two layers of muscles that are normally contracted to prevent leakage of stool. When the individual wants

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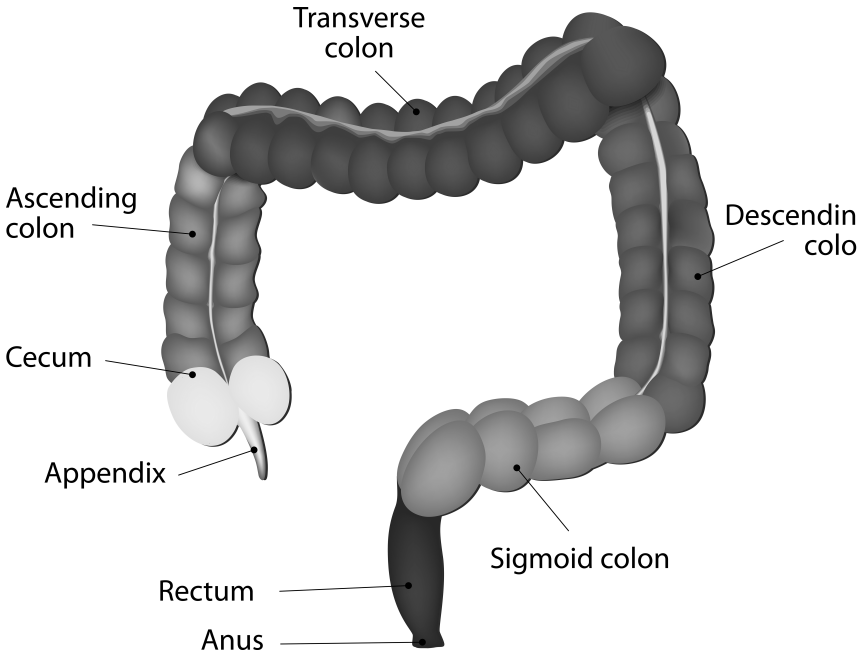


Figure 1.6 Anatomy of the large intestine (*Source*: Designua/Shutterstock.com).

to pass stool, the brain signals the outer muscle of the anus to relax. At the same time, by straining, pressure is generated in the abdomen, forcing stool out.

The immune system of the GI tract

As the GI tract is constantly exposed to the external environment, it has several mechanisms in place to protect it from potentially harmful organisms and invaders (e.g., bacteria and viruses) and prevent us from falling ill. The lining of the GI tract and some secretions produced are the first line of defence against invading bugs. Many cells of the immune system (such as white blood cells) also live in the GI tract, and their job is to kill potentially harmful organisms and invaders.

The enteric nervous system (or the "second brain" of the body)

The gut has a complex network of nerves, termed the enteric nervous system (ENS). Consisting of over 200 million neurons, it is considered the "second brain" of the body due to its similarities with the structure and function of the brain. The ENS serves many functions. It regulates contractions and blood flow in the gut, controls how much enzyme is produced by digestive organs like the pancreas, and

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even influences the response of our body's immune system in the bowel. While the ENS can work on its own, it also has connections to the brain, so that the "two brains" can communicate with each other.

The gut microbiota

The GI tract microbiota refers to the large number of living organisms (e.g., bacteria) that normally live and grow in our GI tract. The composition of the gut microbiota varies significantly from one person to another and is affected by several factors such as diet, environment and medications, including antibiotics. In people with some diseases, the composition of the GI microbiota is noted to be different from normal individuals. However, it is not clear yet whether these changes in bacteria are the cause of disease or occur just as a result of having the disease. In inflammatory bowel disease, for example, researchers have observed that the types of bacteria living in the GI tract are less diverse than in healthy people. Research is therefore underway to see if changing GI microbiota leads to an improvement in symptoms or disease. For more information about the GI microbiota, see Handout 5.2.

This handout was written by Dr's Christopher F.D. Li Wai Suen and Peter De Cruz based upon their chapter entitled "The gastrointestinal tract: A brief introduction to healthy digestion" (Chapter 1) from Knowles, S.R., Keefer, L., & Mikocka-Walus, A. (2019). Psychogastroenterology with Adults: A Handbook for Mental Health Professionals. Oxon, UK: Routledge Press.

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