18.2: Introduction to the Digestive System

We All Scream for Ice Cream

If you’re an ice cream lover, then just the sight of this yummy ice cream cone may make your mouth water. The “water” in your mouth is actually saliva, a fluid released by glands that are part of the digestive system. Saliva contains digestive enzymes among other substances important for digestion. When your mouth waters at the sight of a tasty treat, it’s a sign that your digestive system is preparing to digest food.

What Is the Digestive System?

The digestive system consists of organs that break down food, absorb its nutrients, and expel any remaining waste.
Organs of the digestive system are shown in Figure \(\PageIndex{2}\). Most of these organs make up the gastrointestinal (GI) tract. Food actually passes through these organs. The rest of the organs of the digestive system are called accessory organs. These organs secrete enzymes and other substances into the GI tract, but food does not actually pass through them.

**Functions of the Digestive System**

The digestive system has three main functions relating to food: digestion of food, absorption of nutrients from food, and elimination of solid food waste. Digestion is the process of breaking down food into components the body can absorb. It consists of two types of processes: mechanical digestion and chemical digestion. Mechanical digestion is the physical breakdown of chunks of food into smaller pieces. This type of digestion takes place mainly in the mouth and stomach. Chemical digestion is the chemical breakdown (bonds are broken) of large, complex food molecules into smaller, simpler nutrient molecules that can be absorbed by body fluids (blood or lymph). This type of digestion begins in the mouth and continues in the stomach but occurs mainly in the small intestine.

After food is digested, the resulting nutrients are absorbed. Absorption is the process in which substances pass into the bloodstream or lymph system to circulate throughout the body. Absorption of nutrients occurs mainly in the small intestine. Any remaining matter from food that is not digested and absorbed passes out of the body through the anus in the process of elimination.

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Gastrointestinal Tract

The gastrointestinal (GI) tract is basically a long, continuous tube that connects the mouth with the anus. If it were fully extended, it would be about 9 meters (30 feet) long in adults. It includes the mouth, pharynx, esophagus, stomach, and small and large intestines. Food enters the mouth and then passes through the other organs of the GI tract where it is digested and/or absorbed. Finally, any remaining food waste leaves the body through the anus at the end of the large intestine. It takes up to 50 hours for food or food waste to make the complete trip through the GI tract.

Tissues of the GI Tract

The walls of the organs of the GI tract consist of four different tissue layers, which are illustrated in the figure below: mucosa, submucosa, muscularis externa, and serosa.

1. The mucosa is the innermost layer surrounding the lumen, or open space within the organs of the GI tract. This layer consists mainly of the epithelium with the capacity to secrete and absorb substances. For example, the epithelium can secrete digestive enzymes and mucus, and it can absorb nutrients and water.

2. The submucosa layer consists of connective tissue that contains blood and lymph vessels and also nerves. The vessels are needed to absorb and carry away nutrients after food is digested, and nerves help control the muscles of the GI tract organs.

3. The muscularis externa layer contains two types of smooth muscle: longitudinal muscle and circular muscle. The longitudinal muscle runs the length of the GI tract organs and circular muscle encircles the organs. Both types of muscles contract to keep food moving through the track by the process of peristalsis, which is described below.

4. The serosa layer is the outermost layer of the walls of GI tract organs. This is a thin layer that consists of connective tissue and separates the organs from surrounding cavities and tissues.
Peristalsis in the GI Tract

The muscles in the walls of GI tract organs enable peristalsis, which is illustrated in the figure below. Peristalsis is a continuous sequence of involuntary muscle contraction and relaxation that moves rapidly along an organ like a wave, similar to the way a wave moves through a spring toy. Peristalsis in organs of the GI tract propels food through the tract.

Figure \(\PageIndex{4}\): Peristalsis pushes food through the GI tract. (Boumphreyfr [CC BY-SA 3.0]; via Wikimedia.org: Peristalsis.png)

Immune Function of the GI Tract

The GI tract plays an important role in protecting the body from pathogens. The surface area of the GI tract is estimated to be about 32 square meters or about half the area of a badminton court. This is more than three times the area of the exposed skin of the body, and it provides a lot of surface area for pathogens to invade the tissues of the body. The innermost mucosal layer of the walls of the GI tract provides a barrier to pathogens so they are less likely to be able to enter the blood or lymph circulations. For example, the mucus produced by the mucosal layer contains antibodies that mark many pathogenic microorganisms for destruction. Enzymes in some of the secretions of the GI tract also destroy pathogens. In addition, stomach acids have a very low pH that is fatal for many microorganisms that enter the stomach.

Divisions of the GI Tract

The GI tract is often divided into an upper GI tract and a lower GI tract. For medical purposes, the upper GI tract is typically considered to include all the organs from the mouth through the first part of the small intestine, called the duodenum. For instructional purposes, it makes more sense to include the mouth through the stomach in the upper GI tract and all of the small intestine as well as the large intestine in the lower GI tract. The latter approach is followed here.

Upper GI Tract

The mouth is the first digestive organ that food enters. The sight, smell, or taste of food stimulates the release of digestive enzymes and other secretions by salivary glands inside the mouth. The major salivary gland enzyme is amylase. It begins the chemical digestion of carbohydrates by breaking down starches into sugar. The mouth also begins the mechanical digestion of food. When you chew, your teeth break, crush, and grind food into increasingly smaller pieces. Your tongue helps to mix the food with saliva and also helps you swallow.

A lump of swallowed food is called a bolus. The bolus passes from the mouth into the pharynx and from the pharynx into the esophagus. The esophagus is a long, narrow tube that carries food from the pharynx to the stomach. It has no
other digestive functions. Peristalsis starts at the top of the esophagus when food is swallowed and continues down the esophagus in a single wave, pushing the bolus of food ahead of it.

From the esophagus, food passes into the stomach, where both mechanical and chemical digestion continue. The muscular walls of the stomach churn and mix the food, thus completing mechanical digestion as well as mixing the food with digestive fluids secreted by the stomach. One of these fluids is hydrochloric acid. As well as killing pathogens in food, it gives the stomach the low pH needed by digestive enzymes that work in the stomach. One of these enzymes is pepsin, which chemically digests proteins. The stomach stores the partially digested food until the small intestine is ready to receive it. Food that enters the small intestine from the stomach is in the form of a thick slurry (semi-liquid) called chyme.

Lower GI Tract

The small intestine is a narrow but very long tubular organ. It may be almost 7 meters (23 feet) long in adults. It is the site of most chemical digestion and virtually all absorption of nutrients. Many digestive enzymes are active in the small intestine, some of which are produced by the small intestine itself and some of which are produced by the pancreas, an accessory organ of the digestive system. Much of the inner lining of the small intestine is covered by tiny finger-like projections called **villi**, each of which in turn is covered by even tinier projections called **microvilli**. These projections, shown in the drawing below, greatly increase the surface area through which nutrients can be absorbed from the small intestine.

![Small Intestine Diagram](https://bio.libretexts.org/Bookshelves/Human_Biology/Book%3A_Human_Biology_(Wakim_and_Grewal)/18%3A_Digestive_System/18.06%3A_Digestive_System_(Wakim_and_Grewal)/18.06.06.01)

**Figure \(\PageIndex{5}\):** The figure above shows three hierarchical small intestine wall modifications that increase the absorptive surface area. The broadest and most gross modification is the projection of mucosa and submucosa called circular folds (b); then, there are projections of mucosa called villi (c); and, finally, the projections of the plasma membrane of absorptive cells called microvilli (d). Microvilli are also referred to as brush border where enzymes reside. (CC BY-NC 3.0; OpenStax College)

The small intestine is made up of three parts:

1. The duodenum is the first part of the small intestine. It is also the shortest part. This is where most chemical digestion takes place.
2. The jejunum is the second part of the small intestine. This is where most nutrients are absorbed into the blood.
3. The ileum is the last part of the small intestine. A few remaining nutrients are absorbed in the ileum. From the ileum,
any remaining food waste passes into the large intestine.

From the small intestine, any remaining nutrients and food waste pass into the large intestine. The large intestine is another tubular organ like the small intestine, but it is wider and shorter than the small intestine. It connects the small intestine and the anus. Waste that enters the large intestine is in a liquid state. As it passes through the large intestine, excess water is absorbed from it. The remaining solid waste, called feces, is eventually eliminated from the body through the anus.

Accessory Organs of the Digestive System

Accessory organs of the digestive system are not part of the GI tract, so they are not sites where digestion or absorption take place. Instead, these organs secrete or store substances that are needed for the chemical digestion of food. The accessory organs include the liver, gallbladder, and pancreas. They are shown in Figure \(\PageIndex{6}\) and described in the text that follows:

- The liver is an organ that has a multitude of functions. Its main digestive function is producing and secreting a fluid called bile, which reaches the small intestine through a duct. Bile breaks down large globules of lipids into smaller ones that are easier for enzymes to chemically digest. Bile is also needed to reduce the acidity of food entering the small intestine from the highly acidic stomach because enzymes in the small intestine require a less acidic environment in order to work.

- The gallbladder is a small sac below the liver that stores some of the bile from the liver. The gallbladder also concentrates the bile by removing some of the water from it. It then secretes the concentrated bile into the small intestine as needed for fat digestion following a meal.

- The pancreas secretes many digestive enzymes and releases them into the small intestine for the chemical digestion of carbohydrates, proteins, and lipids. The pancreas also helps to lessen the acidity of the small intestine by secreting bicarbonate, a basic substance that neutralizes the acid.
**Summary**

- The digestive system consists of organs that break down food, absorb its nutrients, and expel any remaining food waste.

- Digestion is the process of breaking down food into components that the body can absorb. It includes mechanical digestion and chemical digestion. Absorption is the process of taking up nutrients from food by body fluids for circulation to the rest of the body. Elimination is the process of excreting any remaining food waste after digestion and absorption are finished.

- Most digestive organs form a long, continuous tube called the gastrointestinal (GI) tract. It starts at the mouth, which is followed by the pharynx, esophagus, stomach, small intestine, and large intestine. The upper GI tract consists of the mouth through the stomach; the lower GI tract consists of the small and large intestines.

- Digestion and/or absorption take place in most of the organs of the GI tract. Organs of the GI tract have walls that consist of several tissue layers that enable them to carry out these functions. For example, the inner mucosa has cells that secrete digestive enzymes and other digestive substances and also cells that absorb nutrients. The muscle layer of the organs enables them to contract and relax in waves of peristalsis to move food through the GI tract.

- Three digestive organs — the liver, gallbladder, and pancreas — are accessory organs of digestion. They secrete substances needed for chemical digestion into the small intestine.
Review

1. What is the digestive system?
2. What are the three main functions of the digestive system? Define each function.
3. Describe the GI tract.
4. Distinguish between the upper and lower GI tracts.
5. Relate the tissues in the walls of GI tract organs to the functions the organs perform.
6. Identify accessory organs of digestion and their general function in digestion.
7. Identify the points in the GI tract where food becomes a bolus, chyme, and feces, respectively.
8. Does food pass through the pancreas? Why or why not?
9. True or False. Absorption mainly occurs in the stomach.
10. True or False. Some chemical digestion occurs in the mouth.
11. Most chemical digestion occurs in the _____________.
   A. Gall bladder
   B. Stomach
   C. Small intestine
   D. Large intestine
12. a. Describe one way in which proteins are at least partially chemically digested in the digestive system.
    b. Describe one way in which carbohydrates are at least partially chemically digested in the digestive system.
13. If the villi in your small intestine were damaged and could not function normally, what effect might this have on your body? Explain your reasoning.
14. The esophagus is considered:
   A. An accessory organ of the digestive system
   B. Part of the upper GI tract
   C. Part of the lower GI tract
   D. The longitudinal muscle

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