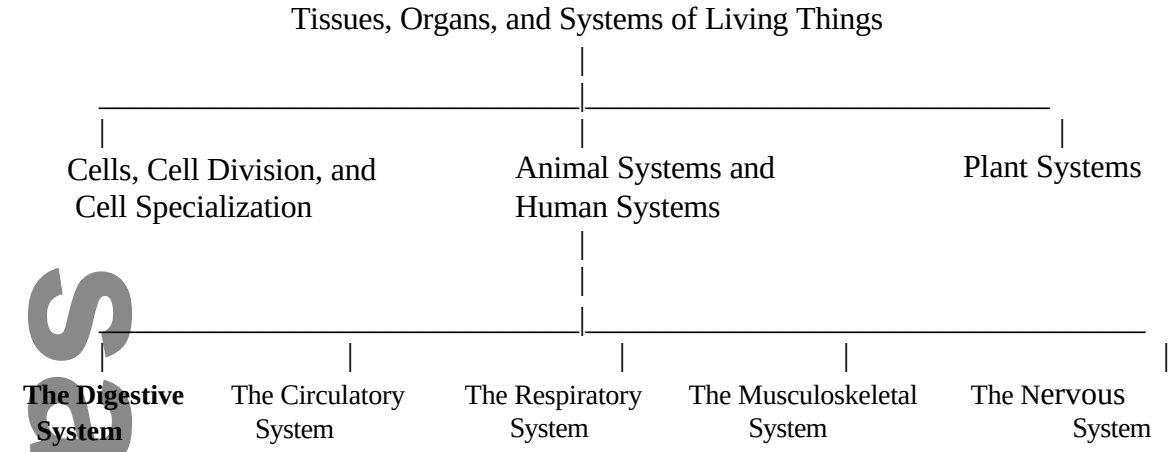
Animal Systems: The Digestive System



The Digestive System

Complex animals are made up of cells, tissues, organs, and organ systems.
Tissue: a collection of cells that perform a particular function.
An **organ** is a structure composed of different tissues specialized to carry out a specific function.
Organ Systems: a group of organs that perform one or more functions in the human body.

Each organ system has a specific function and corresponding specific structures.
Organ systems work together to accomplish digestion, transport, gas exchange, waste removal, movement, support, protection, communication, and reproduction, i.e. organ systems work together to keep the organism functioning.

Before energy can be obtained from food, it must be broken down by the process of digestion.

The digestive system is the organ system that is made up of the mouth, esophagus, stomach, intestines, liver, pancreas, and gall bladder, the system that takes in, breaks up, and digests food and then excretes the waste.

The purpose of the digestive system is to break food into smaller pieces, both mechanically(in the mouth) and chemically (in the mouth, stomach and small intestine). This process results in molecules of carbohydrates, proteins, fat, minerals and vitamins that can be absorbed in the digestive tract and are then carried by the circulatory system to all the cells in the body.

The digestive tract can be thought of as one long tube running through the body with two openings: one at the mouth and the second at the anus.
For humans, in between these two are the esophagus, the stomach, small intestine, large intestine, and rectum.
Other accessory organs in the digestive tract are the liver, pancreas and the gall bladder.

The entire digestive system in an adult human is ~ 9 m in length. The digestion process varies in total time from 9 to 72 hours.

The digestive tract is lined with epithelial tissue— tissue made up of many types of cells, e.g. goblet cells: their purpose is to secrete mucus—this mucus serves to (1) protect the digestive tube from digestive enzymes and (2) to allow the smooth passage of material along the tube.
The digestive tract is also made up of smooth muscle tissues, connective tissue and nerves.
The smooth muscle tissue can contract and relax without conscious thought.

The Digestive Tract

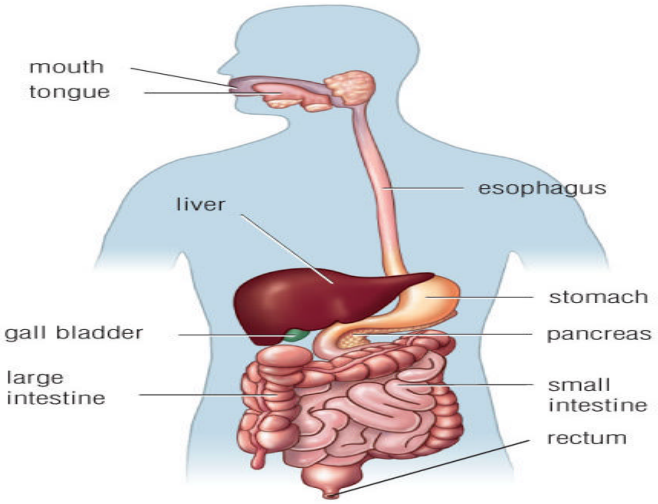


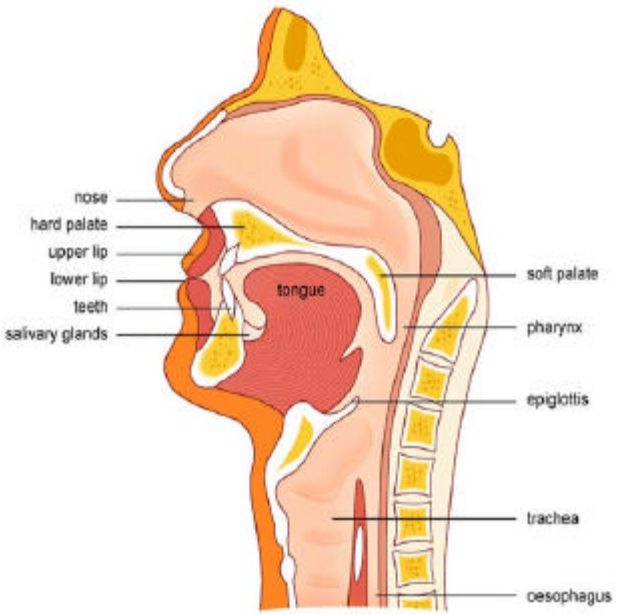
Figure 2.7 Organs of digestion

The Mouth

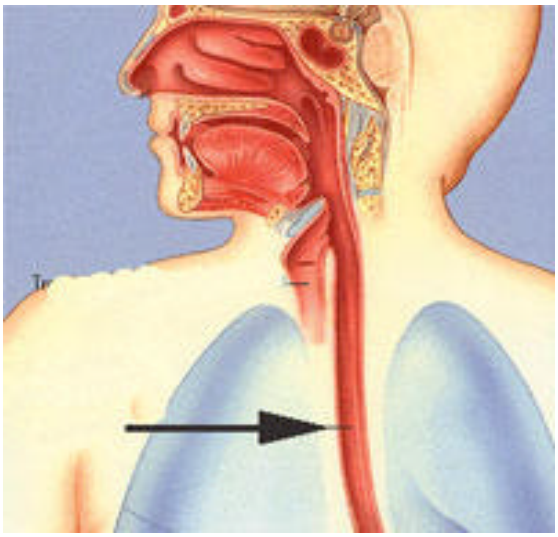
The chemical processes involved in the breaking down of food, i.e. digestion begins in the mouth.
Two processes are involved in the mouth:

1. Mechanically in the mouth by means of teeth and tongue.
2. The mouth adds saliva—a mixture of water and enzymes, to the food. Saliva is produced by cells in the epithelial tissue that lines the mouth. (Saliva contains the enzyme amylase which breaks some starches down into sugars)

The softened smaller pieces of food now pass on to the esophagus.



The Esophagus



The esophagus is a long muscular tube connecting your mouth to your stomach.

The esophagus consists of smooth muscle tissue which is able to contract and relax without our conscious thought— allowing the smooth passage of food.

This allows digestion to proceed naturally and prevents choking on food that might get stuck. (The movement of food by rhythmic waves is known as ‘peristalsis’.)

When digestive acids back up into the esophagus, the result is known as heartburn.

The esophagus does not have thick mucus layer, this causes a person to experience heartburn.

The Stomach

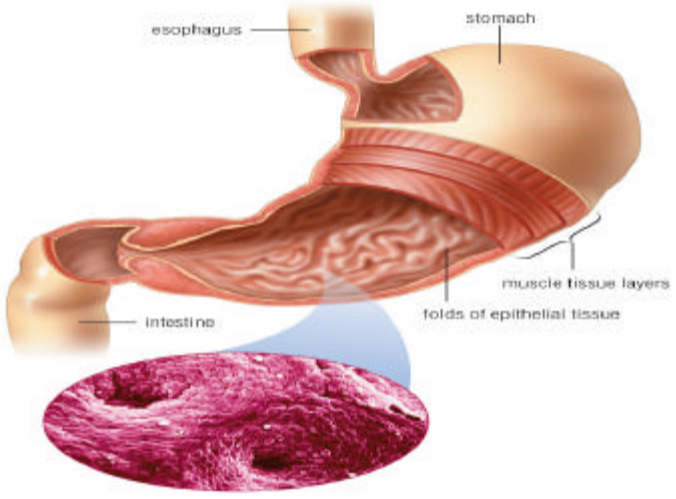


Figure 2.8 The stomach is made of smooth muscle and epithelial tissue as well as connective tissue and nervous tissue (not shown).

The stomach holds the food and churns it, (squish and mix), and blends it with digestive juices and enzymes to continue the process of digestion.

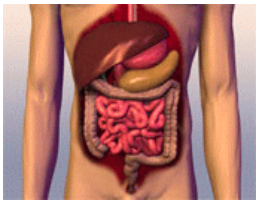
The stomach lining contains cells that produce a number of digestive enzymes and hydrochloric acid. (*See diagram above*)

(The purpose of the stomach acid is not to participate in breaking down food, but to kill bacteria and other microorganisms and to provide the right pH for stomach enzymes to function.
Stomach mucus prevents the stomach acid from damaging tissue—from formation of stomach ulcers.)

The nerves in the stomach signal when a person is full.

Food is only partially digested when it leaves the stomach. The digestion process is completed in the small intestine.

The Intestine



The intestine is made up of two parts:
1. The small intestine, and
2. The large intestine.

The small intestine is ~ 6 m long, it is named small because it is narrow in diameter; this is the place where the digestion process is completed. Additional enzymes from the liver, gall bladder, and pancreas are added.

Food is further broken down to the molecular level, so that it can pass through the walls of the small intestine into the bloodstream to be

At this stage, the molecules can be absorbed through the walls of the small intestine into the blood stream and carried to the body's cells.

The circulatory system delivers the nutrients processed in the digestive system throughout the organism, essentially making sure the entire organism is fed.

The large intestine is ~ 1.5 m long, and larger in diameter, any food that is indigestible passes out of the small intestine and into the large intestine.

The lining of the large intestine absorbs water from the indigestible food back into the body and the waste is subsequently eliminated from the body.

When too much water is absorbed from the large intestine, the result is constipation.

When not enough water is absorbed from the large intestine, the result is diarrhea.

Note: Colitis is a disease of the colon, this results from the epithelial tissue lining of the colon becoming inflamed, and hence do not work properly.
Colitis can result from viruses, bacteria, narrowed blood vessels and from immune disorders.

Accessory Organs

The accessory organs in the digestive tract are the *liver*, *pancreas* and the *gall bladder*— all these aid in the digestion process.

The liver secretes a fluid called bile—this helps to break down fats in the food.

The pancreas secretes pancreatic juice, enzymes and produces the enzyme insulin—this regulates the concentration of glucose (a sugar) in the blood.
If the pancreas does not produce sufficient insulin or if it produces too much insulin, then the disease diabetes is the result.

The gall bladder stores bile, which is used to help break down fats.

Anus and rectum— storage of waste material until elimination occurs.

When things are ingested that contains toxins, the digestive tract responds by quickly trying to remove them by vomiting or diarrhea.
Example: alcohol is a poison to the body. When too much is consumed, the digestive tract works to protect the body by removing the poison through vomiting.

Examples of Digestive Disorders

Assignment:
Research one of the following common digestive disorders and write a short account on it:
Appendicitis, celiac disease, dysentery, gallstones, gastroesophageal reflux disorder, (GERD), gingivitis, hiatus hernia, ulcerative colitis.

Summary of the process of digestion:

Food is taken in through the mouth, where chewing and saliva begin the digestive process.

The food is swallowed and passed into the esophagus, where it is moved slowly along by smooth muscle.

It is moved into the stomach, where it is saturated with digestive enzymes and acid.

Then the food is moved into the intestines, where the digestible food is absorbed and carried to other parts of the body.

The undigested food is moved into the colon, where the water is absorbed out of it and the rest is excreted as waste through the anus.

<u>There are four stage of food processing:</u>

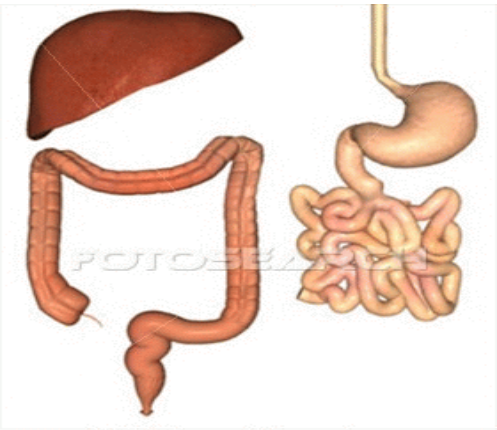
1. Ingestion: the taking of nutrients

2. Digestion: the breakdown of complex organic molecules into smaller components by physical and chemical means.

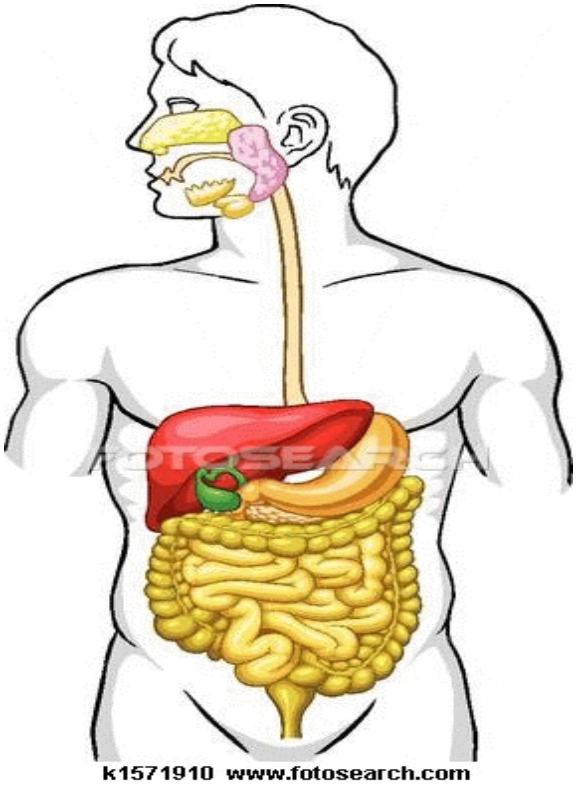
3. Absorption: the taking up of digested molecules into the cells of the digestive tract.

4. Egestion: the removal of waste food materials from the body.

Anterior view of the liver, colon and rectum, and stomach, esophagus and small intestine separated out



The Digestive System



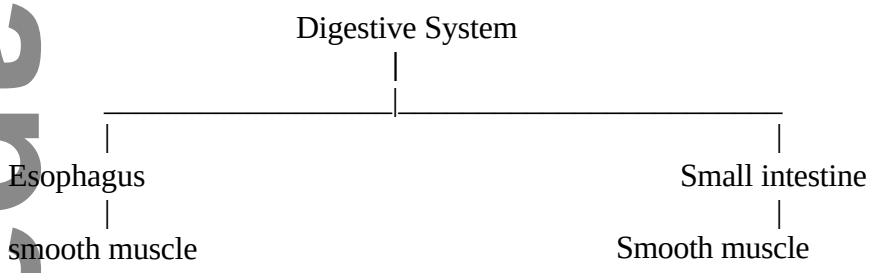
Summary of the Digestive System

cells →	tissues →	organ →	organ system
smallest unit of life	cells of similar shape, size work together to perform a specialized task	structure made of different type of tissue, e.g. kidney	a group of organs that has related structure or function.

There are four kinds of tissue:

5. Epithelial tissue: covering that protects organs, lines body cavities and covers the surface of body and forms glands.
6. Connective tissue: provides support and holds various parts of body together, e.g. bone, cartilage, fat, blood, ligaments, tendons.
7. Muscle tissue: contains sheets or bundles of muscle cells that contract to produce movement.
8. Nerve tissue: provides communication between all body structures

Muscles in the Digestive System



Products of Digestion

Carbohydrates, proteins and fats are macromolecules that provide the main nutrients in the human diet.

Through the digestive process, these three macromolecules (?....) are broken down into molecules that are small enough to be absorbed from the intestine and transported to body cells.

Carbohydrates → glucose

Proteins → amino acids

fats (triglycerides) → fatty acids and glycerol

Assignment: The Digestive System

1. Explain the term cell specialization as it applies to the development of tissues, organs, and systems. Why is this an important process?

2. Why is it necessary for food to be digested?

3. List the main parts of the digestive tract and their functions.

4. What kind of tissue contracts to push food through the digestive system?

5. Name four substances that are added to the food in the digestive tract to aid in digestion.

6. In patients with cystic fibrosis, the duct joining the pancreas to the small intestine is often blocked. What effect might this have on digestion?

7. What do people mean when they talk about "food that went down the wrong way"?

8. Explain what is meant by "heartburn".

9. Why does gastric juice need to be acidic?

10. Where does chemical digestion occur?

11. Briefly describe one disease or an illness that can result from a problem in the digestive system.

12. On an outline of the human body, locate the site of each of the following digestive disorder and label the organs involved in each disorder:
Appendicitis, celiac disease, dysentery, gallstones, gastroesophageal reflux disorder, (GERD), gingivitis, hiatus hernia, ulcerative colitis.