Biology 30S

THE HUMAN DIGESTIVE SYSTEM

This unit has been adapted from bblearn.merlin.mb.ca

Name:
Introduction to Digestion and Nutrition

Eating is something you likely spend a lot of time thinking about—what you will eat, when you will eat, who you will eat with. Have you ever considered why you need to eat? Do you know the meaning of the term “junk foods”?

Go the Discussion area and find the Topic called "Junk Foods". Share your definition of the term "junk foods" with the class.

This unit will help you understand how your body acquires vital nutrients.

When we eat such things as bread, meat, and vegetables, they are not in a form that the body can use as nourishment. Our food must be changed into smaller molecules before they can be absorbed into the blood and carried to cells throughout the body. Digestion is the process by which food is broken down into smaller parts so that the body can use them to provide energy and build and nourish cells.

In this unit, you will study the structure and function of the human digestive system as well as some of the disorders and diseases that affect this system. You will identify essential nutrients, their sources and the effects of not enough or too much intake of these nutrients to normal body function. You will also have the opportunity to analyze your own eating habits.

Lesson 1 Introduction

Single-celled organisms can directly take in nutrients from their outside environment. Multicellular animals, with most of their cells removed from contact directly with the outside environment, have developed specialized structures for obtaining and breaking down their food. Animals such as humans depend on two processes: feeding and digestion.

Did you know that your digestive system is really a specialized tube that acts like a "disassembly line"?

The human digestive system has evolved into a very complex series of organs and structures, each with its own specialized function.
Lesson 1 Learning Outcomes

By the end of this lesson, you should be able to:

- Explain the need for digestion in humans
- Identify from a diagram, model, or specimen, and describe the function of the following structures of the human digestive system:
  - tongue
  - teeth
  - salivary glands
  - esophagus
  - epiglottis
  - stomach
  - liver
  - pancreas
  - gall bladder
  - small intestine
  - large intestine
  - rectum
  - appendix
  - anus
- Compare and contrast mechanical and chemical digestion
- Describe the role of sphincters and peristalsis in the digestive process.

Lesson 1 Overview

Following is a list of topics covered in this lesson.

- Human Digestive System Function
- The Mouth
- The Pharynx and Esophagus
- The Stomach
- The Small Intestine
- The Large Intestine
Human Digestive System

Function

The main function of the digestive system is to break down large macromolecules (proteins, fats and starch) into smaller molecules (amino acids, fatty acids and glucose) that can be absorbed into the circulatory system for distribution around your body. The breakdown of food is accomplished through a combination of mechanical and chemical processes. In this lesson, you will study the structure of the human digestive system and the mechanical processes of digestion. In the next lesson, you will study chemical digestion and control mechanisms.

The human digestive system is a coiled, muscular tube (6-9 meters long when fully extended) called the alimentary tract extending from the mouth to the anus. This tube is like a disassembly line, a well-run factory in which a large number of complex tasks are performed.

Several specialized compartments occur along this length: mouth, pharynx, esophagus, stomach, small intestine, large intestine, and anus. Accessory digestive organs are connected to the main system by a series of ducts: salivary glands, parts of the pancreas, and the liver and gall bladder.
There are five stages associated with the digestive process in humans.

1. motility – movement of food through the digestive system
2. secretion - release of digestive juices in response to a specific stimulus
3. digestion - the physical and chemical breakdown of food into small particles/molecules.
4. absorption - passage of the molecules into the bloodstream
5. elimination - removal of undigested food and wastes
Let’s now study the structures of the digestive system and how they play a role in the digestive process.

The Mouth

The mouth contains the following digestive structures: teeth, tongue, salivary glands, hard and soft palates.

Teeth

The teeth function to break apart and grind food to increase the surface area so that chemical digestion may be more effective. There are different types of teeth that perform different roles. At the front of the mouth are the incisors, four on top and four on the bottom. These are chisel-shaped teeth which are excellent for biting or cutting food. On each side of the incisors are the canines. Being pointed in shape, they are used to tear or shred food. Behind the canines are the premolars, followed by the molars; both are flattened on the upper surfaces and are used for grinding and chewing food, especially fibrous foods, such as meat.

Tongue

The tongue is a very important part of the chewing and swallowing processes. It not only positions the food on the molars for chewing, but also aids in mixing saliva with the food and tasting food. The tongue manipulates the food within the mouth. When food is soft, the tongue rolls it into a ball (bolus) and initiates swallowing by pressing against the hard palate and forcing the food backward in the mouth and into the pharynx.

Salivary Glands

There are three pairs of salivary glands that secrete their fluids into the mouth: parotid, submaxillary, and sublingual. These accessory organs of the digestive tract manufacture saliva.

The parotid gland is located just in front of and slightly below the level of the opening of the ear. This is the largest of the glands and the one that usually becomes enlarged during an attack of mumps. The parotid gland secretes salts, an enzyme (salivary amylase), and a watery serous fluid (serous fluid is the secretion of the epithelial cells that line body cavities and acts as a watery lubricant) into the mouth through the parotid duct.
The **submaxillary gland** is located below the parotid gland near the angle of the lower jaw. It produces serous fluid and some mucous (complex protein-carbohydrate compound that lubricates internal body surfaces) and delivers them to the mouth through the submaxillary duct.

The **sublingual gland** is located under the tongue and secretes mostly thick, stringy mucus, salts, and salivary amylase. These substances are emptied into the mouth through the submaxillary duct.

Since the salivary glands deliver their secretions through ducts into the mouth and not into the blood stream for transportation to the mouth, they are called **exocrine** glands.

Saliva flows from the salivary glands at all times, keeping your mouth moist. However, the sight or smell of good food may cause your mouth to "water." Of the approximately one liter of saliva produced every day, 99% is water, and the remainder is mucus and enzymes. The water in saliva moistens and dissolves particles of food, thereby aiding chemical digestion, the ability to taste, and the chewing process. Mucous helps make chewed food smooth and easy to swallow.

**Hard Palate**

The hard palate is the front part of the roof of your mouth. It has a bony foundation so that coarse food can be pressed against this region during chewing without any damage occurring. Also, the tongue pushes against the hard palate during swallowing, in order to squeeze the soft food backwards toward the pharynx. Your teeth are held securely, rooted in the bony structure of the hard palate.

**Soft Palate**

Feel the roof of your mouth with the tip of your tongue. The front part is hard, but farther back is a soft part, known as the soft palate. By using a mirror, you can see that the soft palate is formed into a piece of tissue that hangs down. This flap of tissue is the **uvula**.

The hard and soft palates together separate two spaces, the nasal chamber above, and the mouth cavity below. When a bolus of food is moved to the back of the tongue, and swallowing begins, the uvula is moved back and the soft palate rises to partially seal off the nasopharynx, the passageway leading from the nose to the throat. This action prevents food getting into the nasal chamber.
Pharynx and Esophagus

If you look into your mouth, using a mirror, you will see the upper portion of your **pharynx**. Better known as the throat, the pharynx is that part of your digestive tract that lies behind your mouth, below the soft palate.

The lower part of the pharynx connects to two tubes: the **trachea**, which carries air to the lungs; and the **esophagus**, which delivers food into the stomach. The pharynx is actually part of both the digestive and respiratory systems. As part of the digestive system, it connects the mouth and the esophagus; as part of the respiratory system, it connects the nasal passages with the larynx (upper portion of the trachea, containing the vocal cords) and the trachea.

During swallowing, at the same time that the soft palate closes off the nasal chamber, the flap of cartilaginous tissue, known as the **epiglottis**, bends over the rising larynx and closes off the glottis, the opening to the larynx. This temporarily stops breathing, but it also prevents the entrance of food into the trachea and possible choking and suffocation. Because the tongue, pushing against the hard palate, prevents food from moving forward in the mouth, food can move only to the pharynx, and then into the esophagus.

Moving the bolus of food toward the pharynx in preparation for swallowing is a voluntary act. You can start to swallow any time you want. Once you start, however, the process becomes involuntary and you can not stop.

Once food has passed through the pharynx into the esophagus, the larynx, epiglottis, and soft palate return to their former positions and breathing resumes. Refer to the diagram below.
Figure 3.1.2 Structure of the Throat and the Mechanics of Swallowing.


**Esophagus**

The esophagus is a 25 cm, flexible, muscular tube which leads from the pharynx to the stomach. It passes through the neck, the thoracic (chest) cavity, and the diaphragm on its way to the stomach.

On the inside of the tube is a thick lining covered with a film of slippery mucous, which helps food to pass easily. Then, there is a layer containing glands which produce this mucous. Outside of this are two layers of muscles: circular muscles, which encircle the esophagus; and longitudinal muscles, which run the length of the esophagus. Finally, there is a sheet of connective tissue around the outside, which helps to secure the esophagus to the surrounding tissue.

Swallowed food moves down the esophagus by being pushed by contractions of the muscles of the tube. This action is called **peristalsis**. Peristalsis is the forward movement of a ring of contraction along an organ such as the esophagus, stomach or intestine, followed by a wave of expansion that restores the original diameter. When circular muscles contract above a bolus of food, a downward force is applied to the bolus. At the same time the longitudinal muscles near the bolus contract, squeezing the bolus, and it is pushed downward. Both sets of muscles work together, simultaneously, to move the bolus closer to the stomach. These muscles now relax, and the above process repeats itself.
The stomach, located on your left side just below the diaphragm, and partially covered by the lower ribs, resembles the shape "J". It has a capacity of about one to two litres of food.

The stomach is a muscular bag that stretches as it fills with food. The inner layer of the stomach is folded into many ridges or wrinkles called **rugae**. At the bottom of these rugae, there are approximately 35 million gastric glands. From these glands, gastric juices are secreted into the stomach (up to 2 litres per day).

The muscle layer of the stomach contains three layers. In addition to muscles that encircle and run the length of the stomach, a third set lies at an angle to the other two, and stretches diagonally around it.
At the junction of the esophagus and the stomach there is a ring of muscle called the **cardiac sphincter**. A sphincter is a ring of muscle which acts like a valve to control the flow of materials. It relaxes to let food into the stomach and contracts to keep food from leaving the esophagus. **Heartburn** results from irritation of the esophagus by gastric juices that leak through this sphincter.

When food is moved by peristalsis through the cardiac sphincter, the three layers of muscles in the stomach wall contract and relax in a sequence that produces a churning action. The food is mixed by this churning motion with gastric juice produced by glands in the stomach wall and chemical digestion is promoted.

Gastric glands secrete fluids which contain hydrochloric acid, mucous, and digestive enzymes. Secretions of these glands are controlled by nervous signals such smells and thoughts and hormone (endocrine) signals. The hydrochloric acid increases the acidity of the stomach contents to a pH of 2 or lower. The low pH of the stomach contents kills many of the bacteria that enter on the food.

After about three to four hours in the stomach, food has become an acidic paste like mixture known as **chyme**. It is now ready to enter the small intestine, where most of the chemical digestion of it occurs. Peristalsis pushes the chyme, in spurts, through the **pyloric sphincter** at the lower end of the stomach and into the small intestine.

**Belching** is when swallowed gas moves up the esophagus and is released from the mouth and/or nose. Some people, whose larynx had to be removed, have learned to purposely swallow air and control its release to enable them to talk.
**Vomiting** is an important reflex to protect from harmful substances. Illnesses like flu, extreme pain (anywhere in the body: migraine, kidney stones...), and other stressful conditions can trigger the emptying of the stomach contents. It is actually referred to as anti-peristalsis because it is peristalsis in the opposite direction.

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**Small Intestine**

The small intestine is an extremely important part of your digestive system. It is here that digestion is completed and the products of digestion are absorbed into the blood stream.

This organ resembles a long, hollow tube, 3 m in length and 3 cm in diameter. It fits within the lower part of the abdomen because it coils back and forth in an orderly fashion and is carefully attached to the rear wall of the abdomen by a thin membrane called the **mesentery**. The mesentery not only supports the small intestine and keeps its coils from getting tangled, but it also supplies an abundance of blood vessels bringing food and oxygen to nourish the cells of the small intestine and taking away the recently absorbed products of digestion.

The sections of the small intestine include:

- the duodenum
- the jejunum
- the ileum

The first 25 cm of the small intestine is the **duodenum**. Digestion is essentially completed in this section. Most absorption occurs in the jejunum and ileum, the middle and final sections of the small intestine.

Three types of digestive secretions enter the small intestine: bile, pancreatic juice, and intestinal juice. Bile and pancreatic juice enter into the duodenum at a point near the pyloric sphincter; intestinal juice is secreted along the entire length of the small intestine.

**Bile**, a greenish-yellow liquid, is produced by the liver. It is stored in the **gallbladder** and secreted directly into the duodenum when food is there. Bile is a basic (pH greater than 7) mixture of substances, among which is bile salts. Bile salts emulsify fats – breaking them down into progressively smaller fat globules until they can be acted upon by fat digesting enzymes.
The pancreas secretes a mixture of carbohydrate, lipid, and protein digesting enzymes into the duodenum. This pancreatic juice is alkaline (basic), and along with bile, neutralizes the acidic chyme coming from the stomach. This produces a pH of 7 to 8 in the small intestine. The enzymes that act there function best at this pH.

The wall of the small intestine also secretes carbohydrate, lipid, and protein digesting enzymes. The enzymes produced in this fluid are different from those secreted in pancreatic juice. Their function is to accomplish the last step in breaking down food into its end products -- simple sugars, amino acids, fatty acids, and glycerol.

About nine liters of liquid chyme enter your small intestine each day. Most of this nutrient rich chyme is further digested and passes through the intestinal walls into the bloodstream and lymph system. The process by which nutrients pass from the digestive tract into body fluids is called absorption.

Large Intestine

The large intestine or colon is about 1.5 m long and 8 cm in diameter. Its shape resembles an inverted "U". The small intestine joins the large intestine on the right side of your body below the level of the top of your hip bone. Another sphincter, the ileocecal valve, occurs at this junction. Its function is to control the rate at which the contents of the small intestine pass into the colon.

The small pouch formed by the lower 6 cm of the colon, called the cecum has a small 6 cm tube attached to it. This is your appendix. It has no known digestive function in humans. Sometimes however, food gets lodged in the appendix. If disease-causing bacteria also lodge there and moisture, food, and warmth provide excellent conditions for growth, the appendix may become infected. This disorder is known as appendicitis. If the infected appendix is not treated (possibly by surgery) before it bursts, the contents of the appendix will spill out into the abdominal cavity. The bacteria may cause the peritoneum, the lining of the abdominal and pelvic cavities, to become infected. This very serious condition is known as peritonitis.

The material entering the colon consists of water, substances our own enzymes can not digest (mostly cellulose), and a great multitude of bacteria. The bacterial flora of the large intestine includes such things as Escherichia coli, Acidophilus spp., and other bacteria, as well as Candida yeast.
Lesson 1 Assignment

Answer the questions below. Copy the question text and paste it into a Word document.

1. Briefly describe the five stages associated with the digestive process in humans.

2. List the organs of the human alimentary tract in the sequence that food passes through them.

3. Describe the role of the tongue, teeth, and stomach in mechanical digestion.

4. Describe the mechanisms responsible for moving food along your digestive tract.

5. How is the flow of food controlled along the digestive tract?

6. What is the function of saliva in the digestive process?
Lesson 1 Summary

In this lesson, you studied the anatomy of the human digestive system. The human digestive system has evolved into a very complex series of organs and structures, each with its own specialized function.

In the next lesson, you will explore the microscopic world of digestion, relating what you learned in Module 2 – The Chemistry of Life to the actions of the digestive system. You will also learn how the digestive system is controlled in maintaining homeostasis in the body.

Lesson 2 Introduction

In the last lesson, we studied the structure of the human digestive system and the many different organs and secretions involved in the digestive process.

You will learn how the digestive system is controlled in maintaining homeostasis in the body.

Lesson 2 Learning Outcomes

By the end of this lesson, you should be able to:

- Describe the source and function(s) of the following digestive secretions:
  - amylase
  - mucous
  - pepsin
  - HCl
  - bile
  - pepsinogen
  - lipase
  - peptidase
  - maltase
  - sodium bicarbonate

- Explain how the nervous system and the hormones secretin and gastrin contribute to homeostasis by controlling the digestive process.
- Describe the role of insulin and glucagon in controlling blood sugar levels.
- Identify and describe the structure and function of villi in the small intestine.
Lesson 2 Overview

Following is a list of topics covered in this lesson.

- Chemical Digestion
- The Mouth and Stomach
- The Small Intestine
- Absorption
- Homeostasis and Blood Sugar Levels
- Control of Digestive Secretions

Chemical Digestion

As you studied in Lesson 1, the many organs of the digestive system secrete different substances. These secretions all play different roles in the chemical digestion of food. During the chemical digestion of food, enzymes break down large food molecules by the process of hydrolysis. During hydrolysis, a water molecule is added at the site where a bond is broken.

Let's review the structures of the digestive system and study the chemical digestion that occurs in each structure.

The Mouth and Stomach

The mouth begins the process of carbohydrate digestion through the action of saliva.

The enzyme found in saliva, salivary amylase, starts the chemical digestion of starch, converting it from a polysaccharide to the disaccharide maltose.

You can test the ability of saliva (amylase) to change starch to sugar by placing a portion of an unsalted cracker in your mouth. After chewing for a short while and allowing the saliva to work on it, the taste will be sweet.
The Stomach

The wall of the stomach is lined with millions of **gastric glands**, which together secrete 400-800 mL of gastric juice at each meal. Three kinds of cells are found in the gastric glands:

- parietal cells – secrete hydrochloric acid and intrinsic factor (aids in absorption of Vitamin B12 by small intestine)
- "chief" cells – secrete pepsinogen
- mucous-secreting cells – secrete mucous

A very important constituent of gastric juices is the substance **pepsinogen**. Pepsinogen is not an enzyme but a forerunner of the enzyme **pepsin**. The hydrochloric acid secreted increases the acidity of the stomach contents to a pH of 2 or lower. At this pH, pepsinogen is converted to pepsin, an active enzyme which begins the chemical digestion of proteins into peptides.

Salivary amylase functions best at pH 6 or 7 (very slightly acidic or neutral). Therefore, it becomes inactive when it reaches the stomach, and consequently, digestion of starch does not take place there.

Due to the fact that pepsin digests meat and other protein-containing foods, a good question may come to your mind. How does the stomach keep from digesting itself once pepsin forms? After all, the stomach is a piece of meat, too!

The answer in part lies in the mucous the stomach lining produces. The mucous coats the cells lining the stomach and protects them from the digestive action of the enzyme pepsin. Tight junctions link the epithelial stomach-lining cells together, further reducing or preventing stomach acids from passing through.

Unfortunately, the protective mechanisms do not always work. Sometimes, the mucous lining breaks down and the stomach starts to digest itself—a small portion of the lining may be eaten away by pepsin and HCl. The result is a **peptic ulcer**. The same situation can occur in the upper part of the small intestine (duodenum) resulting in a **duodenal ulcer**. If the ulcer is small in size and properly treated, it will heal. Bleeding ulcers result when tissue damage is so severe that bleeding occurs. Perforated ulcers are life-threatening situations where a hole has formed in the stomach or duodenal wall. At least 90% of all ulcers are caused by **Helicobacter pylori**, a bacterium. Other factors, including stress and aspirin, can also produce ulcers.
Small Intestine

The small intestine is where final digestion and absorption occur. The small intestine is a coiled tube over 3 meters long. Coils and folding plus villi (small, finger-like projections) give this 3m tube the surface area of a 500-600m long tube. Final digestion of proteins and carbohydrates must occur, and fats have not yet been digested. Villi have cells that produce intestinal enzymes which complete the digestion of peptides and sugars.

The upper part, the duodenum, is the most active in digestion. Secretions from the liver and pancreas are used for digestion in the duodenum. Epithelial cells of the duodenum secrete a watery mucous which acts to protect its lining from pepsin and HCl. The pancreas secretes digestive enzymes and stomach acid-neutralizing sodium bicarbonate. The sodium bicarbonate neutralizes the acidic chyme, allowing the enzymes in the small intestine to function and protecting the intestinal wall.

The liver produces bile, which is stored in the gall bladder before entering the bile duct into the duodenum. Bile contains cholesterol, phospholipids, bilirubin, and a mix of salts. Bile salts emulsify fats – breaking them down into progressively smaller fat globules until they can be acted upon by fat digesting enzymes. They also aid in neutralizing the chyme from the stomach.

The chemical digestion that begins in the small intestine is a result of pancreatic secretions. Starch and glycogen are broken down into maltose through the action of pancreatic amylase. Proteases continue the breakdown of protein that began in the stomach and form small peptide fragments and some amino acids. Lipases break down fats into fatty acids and glycerol.

Finally, the villi in the small intestine itself release enzymes which complete the digestive process. Maltase, lactase, and sucrase are three carbohydrate digesting enzymes which break down the maltose, sucrose and lactose into monosaccharides. Lactose intolerance results from a lack of the enzyme lactose. Peptidase breaks down peptides into amino acids and nuclease breaks down nucleic acids into sugars and nitrogen bases.
Chemical digestion is a very complex series of processes that involves many secretions. The following table summarizes the digestive secretions and their functions.

**Table 3.2.1 Digestive Secretions and Their Functions**

<table>
<thead>
<tr>
<th>Salivary Glands</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serous fluid/Mucous</td>
<td>Lubricates food during chewing</td>
</tr>
<tr>
<td>Salivary Amylase</td>
<td>Digests starch into maltose</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stomach</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric Acid</td>
<td>Initiates digestion of protein and kills bacteria</td>
</tr>
<tr>
<td>Pepsin</td>
<td>Starts protein digestion into peptides</td>
</tr>
<tr>
<td>Mucous</td>
<td>Lubricates food and protects lining of stomach</td>
</tr>
<tr>
<td>Intrinsic Factor</td>
<td>Aids in absorption of Vitamin B₁₂ by large intestine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pancreas</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Bicarbonate</td>
<td>Neutralizes acid and activates digestive enzymes</td>
</tr>
<tr>
<td>Pancreatic Amylase</td>
<td>DIGESTS starch and glycogen into disaccharides</td>
</tr>
<tr>
<td>Lipases</td>
<td>Digest fat into fatty acids and glycerol</td>
</tr>
<tr>
<td>Proteases</td>
<td>Digest protein into peptides</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liver/Gall Bladder</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bile</td>
<td>Emulsify fats and neutralizes acid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Small Intestine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maltase</td>
<td>DIGESTS maltose into glucose</td>
</tr>
<tr>
<td>Sucrase</td>
<td>DIGESTS sucrose into glucose and fructose</td>
</tr>
<tr>
<td>Lactase</td>
<td>DIGESTS lactose into glucose and galactose</td>
</tr>
<tr>
<td>Peptidase</td>
<td>DIGESTS peptides into amino acids</td>
</tr>
<tr>
<td>Nuclease</td>
<td>DIGESTS nucleic acids into sugar and nitrogen bases</td>
</tr>
</tbody>
</table>
Absorption

Absorption is a very important part of the digestive process. It allows digested food to be transferred to the bloodstream and transported to the cells in the body. Most absorption occurs in the duodenum and jejunum of the small intestine. However, some water, certain ions, and such drugs as aspirin and ethanol are absorbed from the stomach into the blood (accounting for the quick relief of a headache after swallowing aspirin and the rapid appearance of ethanol in the blood after drinking alcohol).

The inner surface of the small intestine has long finger-like tubes called villi that greatly increase the surface area for absorption. Villi increase the surface area by a factor of 10. The epithelial cells that cover the villi are lined with microvilli that further increase the surface area.

Absorption through the intestinal wall takes place by diffusion and active transport. Many substances must move through the membranes from an area of low concentration to one of higher concentration. Amino acids, for example, are absorbed by active transport.

A thin-walled capillary (small blood vessel) network extends through the core of the villus (singular form of villi). Most dissolved nutrients, which have already been absorbed by passive transport through the epithelial cells, pass into the capillaries. However, the products of fat digestion do not pass into the capillaries, but instead enter a vessel called a lacteal, which is part of the lymphatic system of the body. The absorbed fat droplets are transported to adipose (fat) tissue where they are stored.
As discussed in lesson 1, the large intestine absorbs water, salts, and vitamins. Bacteria in the large intestine, such as *E. coli*, produce vitamins (including vitamin K) that are absorbed.
Homeostasis and Blood Sugar Levels

In your previous unit, we discussed homeostasis as an important theme in biology and a very important process of maintaining a constant internal environment in the body. The regulation of blood sugar levels is a good example of homeostasis in action.

The pancreas contains clusters of endocrine (hormone-producing) cells. These cells secrete the hormones insulin and glucagon, which regulate blood glucose levels.

After a meal, blood glucose levels rise and chemical receptors cause the release of insulin, which triggers cells to increase their permeability glucose. Excess glucose is converted to glycogen liver and skeletal muscle cells. As glucose levels in the blood fall, further insulin production is inhibited. A decrease in blood glucose levels causes the release of glucagon. Glucagon causes the breakdown of glycogen into glucose, which in turn is released into the blood to maintain glucose levels and homeostasis.

Control of Digestive Secretions

A fascinating feature of the digestive system is that it contains its own regulators, both hormonal and nervous. The major hormones that control the functions of the digestive system are produced and released by cells in the lining of the stomach and small intestine. These hormones are released into the blood of the digestive tract, travel back to the heart and through the arteries, and return to the digestive system, where they stimulate digestive juices and cause organ movement. The hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK).

Gastrin secretion is stimulated by the presence of protein in the stomach and causes the stomach to release gastric juices and increase stomach motility. Secretin secretion is triggered by food passing into the duodenum. This hormone promotes release of sodium bicarbonate secretions from the pancreas and stops further passage of food into the intestine until the acid is neutralized. It also stimulates the liver to produce bile. CCK is released from intestinal wall in response to the presence of fats and causes the pancreas to produce the pancreatic enzymes and causes the gallbladder to empty.
Two types of nerves help to control the action of the digestive system. **Extrinsic** (outside) nerves come to the digestive organs from the unconscious part of the brain or from the spinal cord. They release a chemical called acetylcholine and another called adrenaline. Acetylcholine causes the muscle of the digestive organs to squeeze with more force and increase the "push" of food and juice through the digestive tract. Acetylcholine also causes the stomach and pancreas to produce more digestive juice. Adrenaline relaxes the muscle of the stomach and intestine and decreases the flow of blood to these organs. Seeing, smelling or tasting food produces gastric secretions even before there is food in the stomach.

Even more important, though, are the **intrinsic** (inside) nerves, which make up a very dense network embedded in the walls of the esophagus, stomach, small intestine, and colon. The intrinsic nerves are triggered to act when the walls of the hollow organs are stretched by food. They release many different substances that speed up or delay the movement of food and the production of juices by the digestive organs.
Lesson 2
Exercise

1. What important role does saliva play in chemical digestion?

2. Explain how ulcers may occur in the human body.

3. How are the cells of the small intestine protected from stomach acids?

4. Why are carbohydrates not digested in the stomach?

5. Explain the role of hydrochloric acid in protein digestion.
6. Complete the letters in the following table.

<table>
<thead>
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<tbody>
<tr>
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</tr>
<tr>
<td>Proteases</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Liver/Gall Bladder</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Small Intestine</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Sucrase</td>
</tr>
<tr>
<td>Lactase</td>
</tr>
<tr>
<td>Peptidase</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
7. Describe the structure of the interior surface of the small intestine and explain how this structure relates to its function.

8. Explain how the regulation of blood sugar levels demonstrates homeostasis.

9. Explain how digestive secretions are controlled by the nervous system and endocrine system.

Lesson 2 Summary

In this lesson, you have explored the microscopic world of digestion, relating what you learned in Module 2 – The Chemistry of Life to the actions of the digestive system. You have also learned how the digestive system is controlled in maintaining homeostasis in the body.

In the next lesson, you will study the essential nutrients required by the body, learn about the various nutrients found in different foods and analyze your own diet.
Lesson 3 Introduction

Let us review the statement "you are what you eat". Is there a connection between what you eat and a healthy body?

In this lesson, you will explore the answers to these questions and study the essential nutrients required by the human body. You will also study the nutrients found in various food types and analyze your own diet to determine whether you should modify your food intake.

Lesson 3 Learning Outcomes

By the end of this lesson, you should be able to:

- Describe the functions of the six basic types of nutrients (carbohydrates, lipids, proteins, vitamins, minerals, water) necessary for the normal functioning of the human body.
- List one dietary source for each of the six main nutrients necessary for the human diet.
- Explain the need for a balanced diet both in terms of satisfying the body's energy requirements and in the prevention of dietary disorders.
- Collect, analyze, and evaluate data concerning personal nutrient intake.

Lesson 3 Overview

Following is a list of topics covered in this lesson.

- Nutrition
- Human Nutrition
- Carbohydrates
- Fats
- Proteins
- Vitamins
- Minerals and Water
- Food Labels
- Tips for Healthy Eating
Food not only supplies energy vital for life, but also provides important building materials that allow organisms to grow, develop, and rebuild injured and damaged cells. Nutrition is the study of the composition of food, its energy content, and slowly synthesized organic molecules. In general, a **nutrient** is any substance that has a useful function when taken up by body cells.

In your previous unit, you studied energy requirements and the different ways organisms obtain that energy. **Autotrophs** convert sunlight energy into sugar or other organic molecules. **Heterotrophs** eat to obtain energy from the breakdown of organic molecules in their food.

Animals are classified as heterotrophs and most animals can be further categorized according to their diet –**carnivores** (meat eaters), **herbivores** (plant eaters), or **omnivores** (meat and plant eaters). Most humans are omnivores. However, some humans are strictly herbivorous and are usually called vegetarians. Strict vegetarians who consume no animal products, whatsoever, are called **vegans**. Some people are **lacto-ovo-vegetarians**, meaning that they also eat dairy products and eggs.

Recently, more Canadians have decided that a vegetarian diet is healthier. Some worry that such a diet doesn’t provide enough essential nutrients such as protein and iron. How much of each type of nutrient do you actually need? Let’s find out.

**Human Nutrition**

In addition to providing energy, food must also provide certain essential nutrients that cannot be manufactured by the body. The human diet must provide the following:

- **joules (calories)** - enough to meet daily energy needs.
- **amino acids** - nine "essential" amino acids needed for protein synthesis and cannot be synthesized from other substances.
- **fats** - three "essential" fatty acids that cannot be synthesized from other substances.
- **minerals** - a few like calcium in relatively large amounts; most, like potassium, in "trace" amounts.
- **vitamins** - small organic molecules that we cannot synthesize from other substances in our diet.
- **water** - the most abundant substance in the human body. The body requires about 2.5 L per day.
How dietary needs are established

Determining what substances must be incorporated in the human diet, and how much of each, is - even after years of research - still under active study. All food substances can be divided into two general groups: organic foods – produced by living organisms (carbohydrates, fats, proteins, vitamins) and inorganic foods – come from soil, rocks and the sea (minerals and water). Let’s look at the different categories of nutrients.

Carbohydrates

Carbohydrates provide the majority of the energy in most diets. In Canada, energy is measured in joules (J) or kilojoules (kJ). In the United States, food energy is measured in calories. One calorie is equal to 4.18 joules. The calorie is still used on many food labels. Age, sex, size, health, and the intensity of physical activity strongly affect the daily need for energy.

The table below outlines daily energy requirements for different age groups and levels of activity.

<table>
<thead>
<tr>
<th>Description of Person</th>
<th>Energy Requirements (kJ per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>newborn</td>
<td>2 000</td>
</tr>
<tr>
<td>child (2-3)</td>
<td>6 000</td>
</tr>
<tr>
<td>teenage girl</td>
<td>9 500</td>
</tr>
<tr>
<td>teenage boy</td>
<td>12 000</td>
</tr>
<tr>
<td>office worker</td>
<td>11 000</td>
</tr>
<tr>
<td>heavy manual worker</td>
<td>15 000</td>
</tr>
</tbody>
</table>

Good sources of carbohydrates include breads, cereals, pasta, potatoes and rice. Cellulose, another complex carbohydrate, is found in all plant walls and is not digestible by humans. However, cellulose (also known as fiber) is still an important item to include in the diet as it helps in the elimination of wastes. Some sources of fiber include bran and spinach.
Fats

The fats in our diet provide the basic building blocks from which we synthesize our own fat, as well as other lipids such as cholesterol and various phospholipids. Fat provides our most concentrated form of energy. Its energy content is over twice as great as carbohydrates and proteins.

There are three essential fatty acids that cannot be synthesized by our bodies and must be incorporated in the diet. These are:

- linoleic acid
- linolenic acid
- arachidonic acid

All three of the above are unsaturated; that is, have double bonds between carbon atoms.

Types of fats

- **Saturated** - no double bonds between the carbon atoms in the fatty acid chains. Most animal fats (e.g. butter) are highly saturated
- **Monounsaturated** - have a single double bond in the fatty acid chains. Examples: olive, peanut, and rapeseed (canola) oil
- **Polyunsaturated** - have two or more double bonds in their fatty acid chains. Examples: corn, soy bean, cottonseed, sunflower, and safflower oils
- **Trans Fats** - have been partially hydrogenated producing fewer double bonds. Example: margarine
- **Omega-3 fats** - have at least one double bond three carbon atoms in from the end of the fatty acid molecule. Linolenic acid is an example. Fish oils are a rich source of omega-3 fatty acids

Many studies have examined the relationship between fat in the diet and cardiovascular disease. There is still no consensus, but the evidence seems to indicate that:

- a diet high in fat is harmful
- mono and polyunsaturated fats are less harmful than saturated ones
- trans unsaturated fats may be worse than saturated fats
- ingestion of omega-3 unsaturated fats may be protective
Whether you are a vegetarian or a “meat eater”, you must have protein in your diet in order to survive. The protein in the food you eat is the main source of the chemical building blocks you need to build your own protein molecules.

Protein molecules are essential to us in a variety of different ways. Much of our body structure is constructed from protein molecules, making up about 15% of the mass of the average person. Muscle, cartilage, ligaments, skin and hair are all mainly protein materials.

Humans must include adequate amounts of 9 amino acids in their diet. These "essential" amino acids cannot be synthesized from other substances. Two of the essential amino acids, lysine and tryptophan, are not found in most plant proteins. Therefore, strict vegetarians should take special measures to ensure that their diet contains sufficient amounts of these two amino acids. The list below summarizes the "essential" amino acids.

**HISTIDINE** (Essential Amino Acid) is found abundantly in hemoglobin; has been used in the treatment of rheumatoid arthritis, allergic diseases, ulcers & anemia. A deficiency can cause poor hearing.

**TRYPTOPHAN** (Essential Amino Acid) A natural relaxant, helps alleviate insomnia by inducing normal sleep; reduces anxiety & depression; helps in the treatment of migraine headaches; helps the immune system; helps reduce the risk of artery & heart spasms; works with Lysine in reducing cholesterol levels.

**LYSINE** (Essential Amino Acid) Insures the adequate absorption of calcium; helps form collagen (which makes up bone cartilage & connective tissues); aids in the production of antibodies, hormones & enzymes. Recent studies have shown that Lysine may be effective against herpes by improving the balance of nutrients that reduce viral growth. A deficiency may result in tiredness, inability to concentrate, irritability, bloodshot eyes, retarded growth, hair loss, anemia & reproductive problems.

**METHIONINE** (Essential Amino Acid) Is a principle supplier of sulfur which prevents disorders of the hair, skin and nails; helps lower cholesterol levels by increasing the liver's production of lecithin; reduces liver fat and protects the kidneys; a natural chelating agent for heavy metals; regulates the formation of ammonia and creates ammonia-free urine which reduces bladder irritation; influences hair follicles and promotes hair growth.

**PHENYLALANINE** (Essential Amino Acid) Used by the brain to produce Norepinephrine, a chemical that transmits signals between nerve cells and the brain; keeps you awake & alert; reduces hunger pains; functions as an antidepressant and helps improve memory.
THREONINE (Essential Amino Acid) Is an important constituent of collagen, Elastin, and enamel protein; helps prevents fat build-up in the liver; helps the digestive and intestinal tracts function more smoothly; assists metabolism and assimilation.

VALINE (Essential Amino Acid) Promotes mental vigor, muscle coordination and calm emotions.

LEUCINE & ISOLEUCINE (Essential Amino Acid) they provide ingredients for the manufacturing of other essential biochemical components in the body, some of which are utilized for the production of energy, stimulants to the upper brain and helping you to be more alert.

Food sources of protein include fish, meat, eggs, milk, cheese, beans, nuts and lentils.

Vitamins

Vitamins are organic nutrients that are required in small amounts to maintain growth and metabolism. Vitamins can be categorized into two main groups: fat soluble and water soluble. Fat soluble vitamins can be stored in the liver. However, accumulation of excess amounts can be toxic (poisonous). Water soluble vitamins cannot be stored by the body and must be included regularly in the diet.

A great deal of attention is being generated by a group of vitamins called antioxidants. These vitamins include C, E, and beta carotene (the chemical parent of vitamin A). Early research has indicted that antioxidants lessen the danger of a harmful group of molecules known as oxygen-free radicals. Free radicals are formed in your body by exposure to sunlight, X rays, ozone, tobacco smoke, car exhaust, and other environmental pollutants. Oxygen-free radicals have been known to cause mutations (changes in the genetic information) in body cells. Many scientists believe that free radicals play a major role in the development of cancer, heart disease and lung disease. Eating foods rich in antioxidants could aid in the prevention of these diseases.
The following table summarizes the important vitamins required by the body.

### Table 3.3.2 Vitamins

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Function in the Body</th>
<th>Food Sources</th>
<th>Deficiency Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Soluble</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3 or Niacin</td>
<td>proper circulation, healthy functioning of the nervous system, proper protein and carbohydrate metabolism.</td>
<td>yeast, whole wheat, green leafy vegetables, tomatoes, nuts, sunflower seeds and peanuts.</td>
<td>pellagra, diarrhea, insomnia, anemia and mental disorders.</td>
</tr>
<tr>
<td>B12 or Cyanocobalim</td>
<td>production of red blood cells and for several metabolic and enzymatic processes.</td>
<td>milk, bananas, peanuts and sunflower seeds.</td>
<td>certain types of anemia, poor appetite and chronic fatigue.</td>
</tr>
<tr>
<td>B9 or Folic Acid or Folacin</td>
<td>growth of all body cells, healing processes and protein metabolism.</td>
<td>whole grains, nuts and fresh leafy vegetables such as asparagus, green beans and peas.</td>
<td>certain types of anemia, skin disorders and impaired circulation.</td>
</tr>
<tr>
<td>B5 or Panthothinic Acid</td>
<td>normal growth of hair and prevents dermatitis</td>
<td>wheat germ, whole grains, green vegetables, and peanuts.</td>
<td>mental depression, irritability, muscular weakness, insomnia and skin disorders.</td>
</tr>
<tr>
<td>C or Ascorbic Acid</td>
<td>growth and maintenance of body tissues - joints, bones, teeth and gums, protects against infection and helps in quick healing of wounds.</td>
<td>citrus fruits, green leafy vegetables, amla, sprouted Bengal and green grams.</td>
<td>scurvy, anemia, tooth decay, bleeding gums, painful and swollen parts, slow healing of wounds and premature aging.</td>
</tr>
<tr>
<td>Fat Soluble</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>maintain health of epithelial cells; formation of light-absorbing pigment; growth of bones and teeth</td>
<td>liver, broccoli, green and yellow vegetables, tomatoes, butter, egg yolk</td>
<td>poor vision, night blindness, kidney problems</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>proper bone and teeth formation and metabolism of calcium and phosphorus.</td>
<td>rays of the sun, milk, butter, and sprouted seeds.</td>
<td>rickets, tooth decay, pyorrhea, muscular weakness and gross deficiencies of bones.</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>normal reproductive function, fertility and physical vigor. It dilates blood vessels and improves circulation.</td>
<td>wheat or cereal germ, whole grain products, green leafy vegetables, milk and all whole, raw or sprouted seeds.</td>
<td>degeneration of reproductive tissues, liver disorders and sluggish circulation.</td>
</tr>
<tr>
<td><strong>K</strong></td>
<td>clotting of blood and for prevention of bleeding.</td>
<td>green leafy vegetables, spinach, cabbage and tomatoes.</td>
<td>certain types of anemia, skin disorders and impaired circulation</td>
</tr>
</tbody>
</table>
Minerals and Water

Minerals

A mineral is an inorganic substance that functions as a building material or takes part in a chemical reaction. Minerals make up about 4% of your total body weight, most of that being in your skeleton. Some important minerals and their functions are listed in the table below.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Function in the Body</th>
<th>Food Sources</th>
<th>Deficiency Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>teeth and bone formation, muscle and nerve activity, blood clotting</td>
<td>milk, cheese, grains, beans, hard water</td>
<td>soft bones and teeth, osteoporosis</td>
</tr>
<tr>
<td>Sodium</td>
<td>nerve activity, body pH regulation</td>
<td>table salt, vegetables, canned meat</td>
<td>dehydration</td>
</tr>
<tr>
<td>Iron</td>
<td>formation of hemoglobin (transports oxygen throughout the body)</td>
<td>green vegetables, liver, whole wheat bread, grains, nuts</td>
<td>lack of energy, anemia</td>
</tr>
<tr>
<td>Iodine</td>
<td>formation of thyroid hormone</td>
<td>seafood, eggs, iodized salt</td>
<td>swollen thyroid gland, goiter</td>
</tr>
<tr>
<td>Potassium</td>
<td>nerve and muscle activity</td>
<td>meats, grains, milk, fruits, green vegetables</td>
<td>weak muscles</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>teeth and bone formation, blood pH, part of enzymes and nucleic acids</td>
<td>meats, fish, dairy products, grains</td>
<td>poor development of bones and teeth</td>
</tr>
</tbody>
</table>

Water

The importance of water was discussed in detail in Module 2. All living things require water to survive. Approximately 70-90% of your body is water. Water facilitates the chemical reactions in your body and is necessary for the breakdown of foods during digestion (hydrolysis). Water is also an excellent solvent and helps to maintain body temperature. Your body loses approximately 2.5 L of water per day through exhalation, sweat, and urine. You must replenish this lost water or dehydration can result.
Food Labels

Have you ever looked at the information provided to you on food labels? The information currently provided varies depending on the type of food and the manufacturer. Health Canada is working to improve nutrition information on pre-packaged food labels. The following "Nutrition Facts" box will be present on all foods and provide the consumer with important nutritional information.

![Nutrition Facts](http://www.hc-sc.gc.ca/fn-an/label-etiquet/nutrition/cons/index-eng.php)

**Figure 3.3.1 Nutrition Facts**

*notice the values given are for a specific amount -- compare to how much you eat

**daily amount tells you if a good has a little or a lot of a nutrient per serving.*
Tips for Healthy Eating

Canada's Food Guide

The **Canada Food Guide** is a guide to help you make wise food choices. You can find it online by using the Web Links section or you can order it by phone at 1 800 O-Canada (1 800 622-6232) or download a PDF from the web site.

![Canada's Food Guide](healthcanada.gc.ca/foodguide)

---

**Figure 3.3.2 Canada's Food Guide 1**

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More Tips to Healthy Eating

**How many servings from each food group do you need?**

It may seem like a lot, so check to see how many you really need. And, you may be eating more servings than you realize. For example, a plate of pasta can count as 3-4 servings of Grain Products and a juice box as 2 servings of Vegetables and Fruit.

The number of servings you need every day from the 4 food groups and other foods depends on your age, body size, activity level, whether you are male or female and if you are pregnant or breast-feeding. Most people will need to have more than the lower number of servings, especially pregnant and breast-feeding women, male teenagers and highly active people.

**Different People Need Different Amounts of Food**

Here are some examples of how people would choose their servings in one day.

<table>
<thead>
<tr>
<th>Table 3.3.5 Examples of Food Servings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Products</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
</tbody>
</table>

---
Lesson 3 Exercise

1. List and briefly describe the six essential nutrients that you must provide in your diet.

2. How can vegetarians provide all the essential nutrients?

3. How do you obtain most of the energy that your body requires? What is the approximate amount of energy that you require?

4. Even though a diet high in fat is considered to be potentially dangerous, why must we consume some fat in our diet?

5. What is the result of consuming more energy than the body requires?

6. a) Explain why vitamins and mineral must be included in your diet.

   b) Name one vitamin and one mineral and describe the function in the body, a food source for each, and a possible deficiency symptom.

7. Why are antioxidants an important group of vitamins?
8. Why can a person survive for weeks without food but only days without water?

9. Study the following food label.

- **a)** What food group does this food item belong to?
- **b)** List the essential nutrients provided by this food item.
- **c)** Could you survive by eating this food alone? Why?
- **d)** List two "healthy" characteristics of this food.
Lesson 3 Assignment:
You Are What You Eat

In this assignment, you will track your diet over a period of one week and rate your diet in comparison to the recommendations in Canada’s Food Guide. This work will be suitable for inclusion in your wellness portfolio.

**Step 1: Answer the following questions.**

1. What are your favorite foods?

2. What similarities do you see among these foods? (e.g., saltiness or sweetness, similar ingredients, etc.)

3. Do you feel that these foods are healthy or unhealthy, and why?

4. Do you feel that you have healthy eating habits, and why or why not?

**Step 2**

1. Starting tomorrow, write down everything you eat (including snacks) and estimated quantities. Categorize the foods you consume in one of the four food groups. For those foods that don’t fit into one of the four food groups, categorize them as “other”. Determine the number of servings each item provides.
2. Record your observations in the table below. Use the same headings and recreate the table in Word.

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Supper</th>
<th>Snacks</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables and Fruit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat &amp; Alternatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Repeat the above procedure for two more days, including one weekend day. You may create your own chart or duplicate the one provided.

**Step 3: Answer the following questions.**

1. Based on the data you collected
   
   a) How does the number of servings you consumed compare to the recommendations in the Canada Food Guide?
   
   b) Would you categorize your diet as "healthy," "unhealthy," or both, and why?

2. a) How many of the foods substances that you consumed could be categorized as "high fat"?
b) Do you think you could have substituted these selections with others? Give examples.

3. How can you make your diet healthier?

Lesson 4 Introduction

In the last three lessons, you have studied the structure and function of the human digestive system. You have also learned about the many nutrients required by your body to stay healthy.

In this lesson, you will research some of the disorders and diseases that affect the digestive system. Some of these disorders have been discussed briefly in the last three lessons. You will have the opportunity to choose which disorder or disease you would like to research and report on your findings.
Lesson 4 Learning Outcomes

By the end of this lesson, you should be able to describe five of the following disorders/diseases of the digestive system:

- anorexia nervosa
- bulimia
- hyper-vitaminosis
- malnutrition
- ulcers
- gallstones
- lactose intolerance
- appendicitis
- Crohn's disease
- colitis
- colon/stomach cancer
- diabetes
- diarrhea
- cholera
- amoebic dysentery
- constipation
- hemorrhoids
- heartburn
- typhoid fever
- bacillary dysentery
- jaundice
- hepatitis
- cirrhosis
- food poisoning
Disorders and Diseases of the Digestive System

Disorders related to the digestive tract are some of the most common reasons we take over-the-counter medications, prescription medication, or seek the advice of health care providers. Each month 44 percent of adults take antacids or other medicines to treat heartburn.

In this lesson, you will choose a disorder or disease of the digestive system that interests you, research the topic and prepare a report that will be shared with other students in the class and submitted for evaluation. The research assignment is described on the next page.

Unit Research Assignment

Chose a human disease or disorder to investigate from the list below.

- anorexia nervosa
- bulimia
- hyper-vitaminosis
- malnutrition
- ulcers
- gallstones
- lactose intolerance
- appendicitis
- Crohn’s disease
- colitis
- colon/stomach cancer
- diabetes
- diarrhea
- cholera
- amoebic dysentery
- constipation
- hemorrhoids
- heartburn
- typhoid fever
- bacillary dysentery
- jaundice
- hepatitis
- cirrhosis
- food poisoning
Research Assignment Description

1. Use a minimum of four sources of information on your topic. Two of the four sources may be a textbook or reference book for general background material. At least two additional sources must be from a search on the Internet.

2. Prepare a research report (minimum 2 double spaced word processed pages) of your findings. The report should include the following components:
   
   o Description of the disease or disorder
   o Percentage of Canadian population affected
   o Signs/Symptoms
   o Causes/Risk factors
   o Effects of the disease on the body
   o Current treatments
   o Prognosis/Possible Complications
   o Prevention
   o Any research presently being conducted related to the disease or disorder and any prospects for future treatments.
   o Bibliography