9-1. NUTRITION AND THE DIGESTIVE SYSTEM

Instructions: (1.) Read the text. (2.) Use the text to help you to answer the questions.

Your body requires certain substances for producing new cells, repairing worn and damaged tissues, and for maintaining your health. These substances are called "nutrients"; they are proteins, carbohydrates, fats, minerals, and vitamins. To obtain these nutrients, you must eat the right kinds of foods and your digestive system must be healthy.

Malnutrition is a general term used to describe what happens when your body does not get enough nutrients. You can become malnourished if you do not eat the right things or if your digestive system is not working properly. Malnutrition may cause problems in growth and development; it may cause general poor health, or "failure to thrive"; it is now known to be the cause of many diseases.

Pellagra is an example of a disease caused by an improper diet. Someone suffering from pellagra develops sores on his or her skin; in severe cases, the skin on the hands and feet may turn black. The mucous linings of the throat and intestines become inflamed, causing diarrhea and loss of appetite. The neurons in the brain may also be affected, so that the person loses the ability to think clearly. Until a cure was discovered, some mental hospitals were filled with patients suffering from pellagra.

In 1937 a scientist found that patients suffering from pellagra would improve in just a few days with the addition to their diets of a substance called "nicotinic acid"; it seemed to be a miracle cure. At that time it was made in the laboratory, but researchers later discovered that nicotinic acid can be found in many foods such as beans, fresh vegetables, eggs, and lean meat. After this discovery, nicotinic acid was classified as vitamin B. So that it would not be confused with nicotine (a drug found in tobacco), it was renamed "niacin."

By studying pellagra, scientists learned just how important it is for us to eat a healthful diet. While completing this unit you will learn more about the foods you eat. You will also learn about the structure of the digestive system and how this system breaks the foods you eat into the nutrients your body needs.

Level One Questions:

1. Your body requires certain ____________________________________.

2. These substances are called ____________________________________.

3. List the five kinds of nutrients.
   a. ___________________  b. ___________________  c. ___________________
   d. ___________________  e. ___________________

4. What causes pellagra?
   ____________________________________
5. Describe what happens to the body of a person suffering from pellagra.

6. What substance was found to be a cure for pellagra?

7. Why was this substance renamed?

8. What important fact did scientists learn while studying pellagra?

Level Two Question:

9. Why was nicotinic acid considered a miracle cure?

Level Three Question:

10. Look up the word *irony* in a dictionary. Why was it ironic when nicotinic acid was found in a variety of foods?
The job of your digestive system is to take nutrients from the foods you eat so that the cells of your body can use them. If for some reason your digestive system could not do this, you would become malnourished and your health would deteriorate.

While completing this project, you will learn to name the different parts of the digestive system and learn how these parts work together to utilize the nutrients in the foods you eat.
9-2. THE ANATOMY OF THE HUMAN DIGESTIVE SYSTEM, continued

Descriptions

1. The mouth is the beginning of the digestive system. Its job is to tear and grind food into pieces small enough to swallow. This tearing, grinding, and chewing process is called “mechanical digestion”; the mouth has thirty-two teeth and strong jaws to accomplish it. Find the arrow that points to the mouth. Label that arrow “mouth.”

2. Chemical digestion also begins in the mouth. In the tissues within the mouth are three pairs of glands called “salivary glands”; they release a liquid called “saliva.” Saliva moistens the food and helps you to swallow, and it has another important job to do: It contains a digestive enzyme called “amylase,” which breaks starch molecules into sugar. (You may have noticed that a cracker—composed mostly of starch—tastes sweet after you have chewed it for a few seconds.) Arrow A points to the salivary glands. Label arrow A “salivary glands.”

3. After food has been mechanically digested and moistened by saliva and after chemical digestion has begun, the tongue pushes the pulpy mass to the back of the throat and you swallow. Swallowing pushes the food into the esophagus, a tubular passageway to the stomach. Find the arrow that points to the esophagus. Label that arrow “esophagus.”

4. At its lower end, the esophagus widens into a pouch called the “stomach.” The stomach squeezes, sloshes, and mixes the food, and adds two important chemicals: hydrochloric acid and pepsin. These chemicals change food into a thick liquid called “chyme.” On the diagram, arrow B points to the stomach. Label arrow B “stomach.”

5. The chyme leaves the stomach and passes into the small intestine where chemical digestion continues. Specific chemical substances break complex sugars into simple sugars, break proteins into amino acids, and emulsify fats. Arrow G points to the small intestine. Label arrow G “small intestine.”

6. The term *emulsify* means “to change into small drops.” During emulsification, fats are broken into tiny drops that can pass through the wall of the small intestine. The small intestine uses a substance called “bile” to do this job. Bile is produced by the liver and is stored in the gallbladder. The gallbladder is a sac connected to the small intestine by a small tube. Arrow E points to the liver, and arrow F points to the gallbladder. Locate these arrows and label them.

7. The pancreas is a gland that adds more digestive chemicals to the chyme as the chyme travels through the small intestine. One such chemical is trypsin, which breaks proteins into amino acids. These amino acids enter the circulatory system where they are transported to the liver for storage. (A few of these amino acids are sent directly to the cells, where they are used to make new protein.) Arrow C points to the pancreas. Label arrow C “pancreas.”

8. The last step of digestion is called “absorption”; it occurs when nutrients pass through the wall of the small intestine and enter the circulatory system. Only wastes remain in the small intestine after absorption has occurred. They enter the large intestine, where water is removed from the wastes and returned to the body; this process is called “reabsorption.” Arrow D points to the large intestine. Label arrow D “large intestine.”

9. After reabsorption, wastes collect in the last four to six inches of the large intestine. This part of the large intestine is called the “rectum”; it has nerve endings that, when stretched, are responsible for the urge to defecate. Defecation occurs when wastes are removed from the rectum through an opening called the “anus.” Arrow I points to the rectum, and arrow J points to the anus. Locate and label these arrows.
Level One Questions:

1. The mouth is the __________________________ of the digestive system.

2. What is mechanical digestion?

3. Where does mechanical digestion take place?

4. Where does chemical digestion begin?

5. How many pairs of salivary glands are within the tissues of the mouth?

6. Name the digestive enzyme in saliva.

7. Amylase breaks starch molecules into __________________________.

8. What is the job of the esophagus?

9. What is the job of the stomach?

10. Where does chyme go after it leaves the stomach?

11. What happens to chyme in the small intestine?

12. What does the term *emulsify* mean?

13. Where are fats emulsified?

14. What is bile?

15. What does the gallbladder look like?

16. How is the gallbladder connected to the small intestine?

17. What is the job of the pancreas?

18. How does trypsin digest protein?

19. After proteins have been broken down into amino acids, where do the amino acids go?
20. What does the liver do with amino acids?

21. How do the cells use amino acids?

22. What remains in the small intestine after all the nutrients have passed through its walls?

23. What is the job of the large intestine?

24. What is the job of the rectum?

Level Two Questions:

25. Write a short report on the back of this sheet that describes how food passes through the digestive system.

26. From what you have learned, name two functions of the liver.

Level Three Questions:

27. The following statement is true, although it may not appear to be. Can you explain why scientists consider it to be accurate?

   Nutrients are not really inside the body until they have passed through the wall of the small intestine.

   As you consider your answer, you might think about a spool of thread. If you pass a length of thread through the center hole, is the thread inside the spool?

28. Persons suffering from severe diarrhea may become dehydrated. Look up "dehydration" in a dictionary, consider the eighth step in the digestive process, and explain what the term means and why it happens.
The Abdominal Thrust

Would you know what to do if someone around you started choking on a piece of food? With choking consistently ranked as one of the leading causes of accidental death in the United States, knowing what to do in such a respiratory emergency is an important skill. When food or some other object gets stuck in the throat, permanent brain damage or death from asphyxiation may occur. One important first-aid technique for choking is the abdominal thrust, developed in 1973 by Dr. Henry Heimlich. In this activity, you will take an inside look at the abdominal thrust to see how and why it works.

Part A: The Abdominal Thrust
Swift, decisive action is needed when someone begins to choke on an object blocking the air passage. The abdominal thrust is an emergency technique designed to quickly and effectively dislodge food or another object from the respiratory passage. Follow the steps of the abdominal thrust and then answer the questions below.

1. If the choking victim cannot breathe and is standing, quickly stand behind him or her and place your fist with the thumb side against the victim’s stomach. The correct placement of the fist is slightly above the navel but below the ribcage, as shown in Figure 1.

2. Grab your fist with the other hand and give four quick and forceful upward thrusts. Do not squeeze on the ribs with your arms. Just use your fist in the abdomen. It may be necessary to repeat this procedure several times until the airway is clear.

3. When the obstructing object comes free and moves into the victim’s mouth, remove it quickly.

4. The victim should be seen by a doctor or sent to a hospital as soon as possible for observation.

Thinking Critically
1. Why is quick action important in choking emergencies?
2. In most cases of choking, the air passage isn’t completely blocked. What signs might indicate a total blockage of the air passage?

3. When performing the abdominal thrust on a choking victim, the correct placement of your arms and hands is very important. What problems may result if the abdominal thrust isn’t performed properly?

Part B: Analyzing the Abdominal Thrust
A detailed look at the anatomy involved in the abdominal thrust can give a better appreciation of this important technique. Study Figure 2 and answer the questions below.

Thinking Critically
1. Use anatomical terms to describe what is meant when someone says that food or drink “has gone down the wrong pipe.”

2. Use your knowledge of the respiratory system to explain how a force applied in the abdominal area can dislodge an object caught in the throat.
Complete each statement.

1. The entire process of digestion involves first ___________________________ food, then ___________________________ it into simpler compounds, then ___________________________ nutrients for use by body cells, and, finally, ___________________________ wastes.

2. By chewing your food, you ___________________________ its surface area.

3. Various enzymes play a role in ___________________________ digestion, while the action of teeth, tongue, and muscles are involved in ___________________________ digestion.

4. In your mouth, the enzyme __________________ is released from __________________ glands to begin the chemical breakdown of ___________________________.

5. Your ___________________________ are adapted for cutting food, while your ___________________________ are best suited for grinding food.

If the statement is true, write true. If it is not, rewrite the italicized part to make it true.

6. During swallowing, the epiglottis covers the esophagus to prevent choking.

7. Food is moved through the digestive tract by rhythmic waves of voluntary muscle contractions called peristalsis.

8. The churning actions of the stomach help mix the food with pancreatic juices.

9. Pepsin is a protein-digesting enzyme that only works in an acidic environment.

10. The stomach releases its contents into the small intestine suddenly, all at once.
In your textbook, read about the small intestine and the large intestine.

Answer the following questions.

11. What role do the enzymes secreted by the pancreas play in the digestive process?

________________________________________________________________________
________________________________________________________________________

12. Explain the relationship between the liver, the gallbladder, and bile.

________________________________________________________________________
________________________________________________________________________

13. Once in the small intestine, what happens to
   a. digested food?
      ______________________________________________________________________
   b. indigestible materials?
      ______________________________________________________________________

Complete the table by checking the correct column(s) for each function.

<table>
<thead>
<tr>
<th>Function</th>
<th>Small Intestine</th>
<th>Large Intestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. Water is absorbed through walls.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Digestion is essentially completed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Vitamin K is produced.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Nutrients are absorbed by villi.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Contents are moved by peristalsis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Indigestible material is collected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Bile and pancreatic juices are added.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In your textbook, read about carbohydrates, fats, and proteins.

Complete the table by checking the correct column(s) for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Carbohydrates</th>
<th>Fats</th>
<th>Proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. the most energy-rich nutrients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. sugars, starches, and cellulose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. broken down into amino acids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. part of a nutritious, balanced diet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. normally used for building muscle, but can be used for energy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. broken down into glucose, fructose, and other simple sugars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. used to insulate the body from cold</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In your textbook, read about minerals and vitamins, water, and metabolism and calories.

Complete each statement.

8. ___________________________ are inorganic substances that help to build tissue or take part in chemical reactions in the body.
9. Unlike minerals, ___________________________ are organic nutrients that help to regulate body processes.
10. The two major vitamin groups are the ___________________________ and the ___________________________ vitamins.
11. The energy content of food is measured in ___________________________ , each of which is equal to ___________________________ calories.
12. Despite the claims of many fad diets, the only way to lose weight is to __________________________ more calories than you __________________________. 
In your textbook, read about control of the body and negative feedback control.

Complete each statement.

1. Internal control of the body is handled by the ___________________________ system and the ___________________________ system.

2. Most endocrine glands are controlled by the action of the ___________________________ , or master gland.

3. A(n) ___________________________ is a chemical released in one part of the body that affects another part.

4. The amount of hormone released by an endocrine gland is determined by the body’s ___________________________ for that hormone at a given time.

5. A ___________________________ system is one in which hormones are fed back to inhibit the original signal.

6. When your body is dehydrated, the pituitary releases ADH hormone, which reduces the amount of ___________________________ in your urine.

7. When you have just eaten and your blood glucose levels are high, your pancreas releases the hormone ___________________________ , which signals the liver to take in glucose, thereby lowering blood glucose levels.

In your textbook, read about hormone action, adrenal hormones and stress, and other hormones.

For each item in column A, write the letter of the matching item from Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____</td>
<td>a. steroid hormones</td>
</tr>
<tr>
<td>8.</td>
<td>b. glucocorticoids and aldosterone</td>
</tr>
<tr>
<td>_____</td>
<td>c. calcitonin and parathyroid hormone</td>
</tr>
<tr>
<td>9.</td>
<td>d. epinephrine and norepinephrine</td>
</tr>
<tr>
<td>_____</td>
<td>e. amino acid hormones</td>
</tr>
<tr>
<td>10.</td>
<td>f. thyroxine</td>
</tr>
<tr>
<td>_____</td>
<td>11. Produce a feeling called “adrenaline rush”</td>
</tr>
<tr>
<td>12.</td>
<td>12. Help the body prepare for stressful situations</td>
</tr>
<tr>
<td>_____</td>
<td>13. Regulate calcium levels in blood</td>
</tr>
</tbody>
</table>
Much of the work of the digestive system is actually a preparation for the absorption that takes place in the small intestine. In the space provided, explain the mechanical and chemical function of each structure involved in “digestion preparation.” (Some items may have only mechanical or only chemical function.)

1. **Mouth**

2. **Esophagus**

3. **Stomach**

4. **Duodenum of the small intestine**

5. **Pancreas**

6. **Liver**

7. **Gallbladder**

8. **Large intestine**

9. **Describe a villus in the small intestine.**

10. **Explain the function of a villus.**
The Digestive and Endocrine Systems

Chapter 35

Reviewing Vocabulary

Match the definition in Column A with the term in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Digestive enzyme that breaks down starch into smaller molecules</td>
<td>a. epiglottis</td>
</tr>
<tr>
<td>2. Muscular tube that connects the mouth to the stomach</td>
<td>b. pepsin</td>
</tr>
<tr>
<td>3. Series of involuntary muscle contractions along the walls of the</td>
<td>c. rectum</td>
</tr>
<tr>
<td>digestive tract</td>
<td>d. amylase</td>
</tr>
<tr>
<td>4. Flap of cartilage that covers the opening to the respiratory tract</td>
<td>e. stomach</td>
</tr>
<tr>
<td>during swallowing</td>
<td>f. target cells</td>
</tr>
<tr>
<td>5. Muscular, pouchlike enlargement of the digestive tract</td>
<td>g. esophagus</td>
</tr>
<tr>
<td>6. Digestive enzyme that begins the chemical digestion of proteins</td>
<td>h. endocrine gland</td>
</tr>
<tr>
<td>7. Chemical that breaks down fats into small droplets</td>
<td>i. small intestine</td>
</tr>
<tr>
<td>8. Last section of the digestive system from which feces are</td>
<td>j. liver</td>
</tr>
<tr>
<td>eliminated</td>
<td>k. thyroid gland</td>
</tr>
<tr>
<td>9. Regulates metabolism, growth, and development</td>
<td>l. bile</td>
</tr>
<tr>
<td>10. Specific cells in the body to which hormones convey information</td>
<td>m. peristalsis</td>
</tr>
<tr>
<td>11. Unit of heat used to measure the energy content of food</td>
<td>n. Calorie</td>
</tr>
<tr>
<td>12. Narrow, muscular tube in which digestion is completed</td>
<td></td>
</tr>
<tr>
<td>13. Organ that releases hormones directly into the bloodstream</td>
<td></td>
</tr>
<tr>
<td>14. Organ that produces bile</td>
<td></td>
</tr>
</tbody>
</table>
Understanding Main Ideas (Part A)

In the space at the left, write the letter of the word or phrase that best completes the statement or answers the question.

1. Starches are large
   a. fats.  b. proteins.  c. polysaccharides.  d. monosaccharides.

2. Which of the following is not mechanical digestion?
   a. chewing food  b. breakdown of fats by bile  c. churning of the stomach  d. action of pepsin on proteins

3. The surface area of the small intestine is greatly increased by
   a. a large number of villi.  b. chemical digestion.  c. peristalsis.  d. mechanical digestion.

4. Which of the following is part of the digestive tract?
   a. liver  b. small intestine  c. gallbladder  d. pancreas

5. Which of the following occurs in the large intestine as the work of anaerobic bacteria?
   a. absorption of water  b. synthesis of vitamin K and some B vitamins  c. change of glucose to glycogen  d. elimination of indigestible matter

6. Vitamins are used by the body to
   a. provide energy.  b. maintain growth and metabolism.  c. supply building materials.  d. digest proteins.

7. Which is the most abundant substance in the body?
   a. fat  b. water  c. sugar  d. protein

8. The body’s preferred energy source is
   a. carbohydrates.  b. vitamins.  c. proteins.  d. minerals.

9. As a result of digestion, proteins are broken down into
   a. monosaccharides.  b. amino acids.  c. triglycerides.  d. glycerol.

10. Cellulose is important in the diet as a source of
    a. energy.  b. protein.  c. fat.  d. fiber.

11. Pepsin works best in the presence of
    a. amylase.  b. protein.  c. saliva.  d. hydrochloric acid.