

# Digestion and pH

## Reading Preview

### Key Concepts

- Why must your body digest food?
- How does pH affect digestion?

### Key Terms

- digestion
- mechanical digestion
- chemical digestion

## Target Reading Skill

**Sequencing** A sequence is the order in which a series of events occurs. As you read, make a flowchart that shows the sequence of changes in pH as food moves through the digestive system.

### pH During Digestion

At a pH near 7, enzymes in the mouth start to break down carbohydrates.



At a pH near 2, stomach enzymes break down proteins.

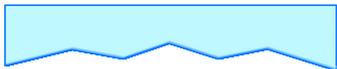


FIGURE 23

### Digestion

This sandwich is about to begin a journey that includes changes in pH.



Lab  
ZONE

## Discover Activity

### Where Does Digestion Begin?

1. Obtain a bite-sized piece of crusty bread.
2. Chew the bread for about one minute. Do not swallow until after you notice a change in taste.

### Think It Over

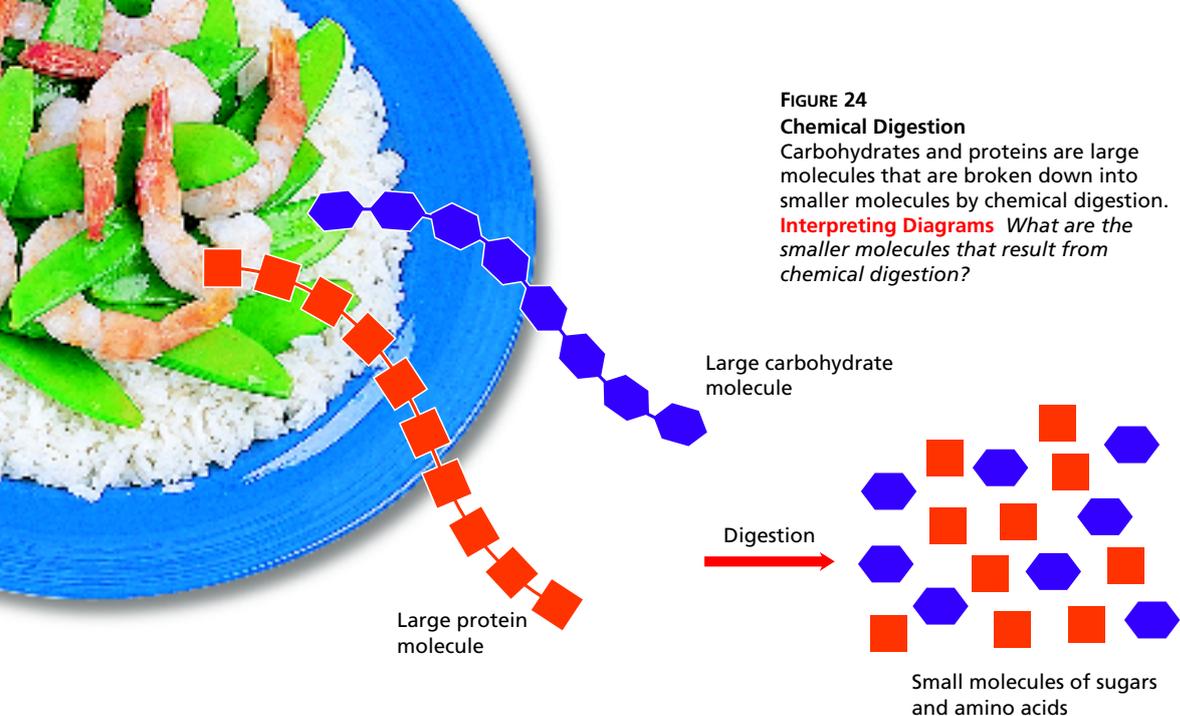
**Inferring** How did the bread taste before and after you chewed it? How can you explain the change in taste?

You may have seen commercials like the following: A man has a stomachache after eating spicy food. A voice announces that the problem is excess stomach acid. The remedy is an antacid tablet.

Ads like this one highlight the role of chemistry in digestion. You need to have acid in your stomach. But too much acid is a problem. Other parts of your digestive system need to be basic. What roles do acids and bases play in the digestion of food?

## What Is Digestion?

Foods are made mostly of water and three groups of compounds: carbohydrates, proteins, and fats. Except for water, your body can't use foods in the form they are in when you eat them. **Foods must be broken down into simpler substances that your body can use for raw materials and energy.**



**FIGURE 24**

**Chemical Digestion**

Carbohydrates and proteins are large molecules that are broken down into smaller molecules by chemical digestion.

**Interpreting Diagrams** *What are the smaller molecules that result from chemical digestion?*

The process of **digestion** breaks down the complex molecules of foods into smaller molecules. Digestion has two parts—mechanical and chemical.

**Mechanical Digestion** **Mechanical digestion** is a physical process in which large pieces of food are torn and ground into smaller pieces. The result is similar to what happens when a sugar cube is hit with a hammer. The size of the food is reduced, but the food isn't changed into other compounds.

**Chemical Digestion** **Chemical digestion** breaks large molecules into smaller ones. Look at Figure 24 to see what happens to large carbohydrate and protein molecules during chemical digestion. They are broken down into much smaller molecules. Some molecules are used by the body to get energy. Others become building blocks for muscle, bone, skin, and other organs.

Chemical digestion takes place with the help of enzymes. Recall from Chapter 15 that enzymes are catalysts that speed up reactions in living things. Enzymes require just the right conditions to work, including temperature and pH. **Some digestive enzymes work at a low pH. For others, the pH must be high or neutral.**



**What happens to foods during chemical digestion?**

## pH in the Digestive System

A bite of sandwich is about to take a journey through your digestive system. Figure 25 shows the main parts of the human digestive system. As you read, trace the food's pathway through the body. Keep track of the pH changes that affect the food molecules along the way.

**Your Mouth** The first stop in the journey is your mouth. Your teeth chew and mash the food. The food also is mixed with a watery fluid called saliva. Have you ever felt your mouth water at the smell of something delicious? The odor of food can trigger production of saliva.

What would you expect the usual pH of saliva to be? Remember that saliva tastes neither sour nor bitter. So you're correct if you think your mouth has a pH near 7, the neutral point.

Saliva contains amylase (AM uh lays), an enzyme that helps break down the carbohydrate starch into smaller sugar molecules. Amylase works best when the pH is near 7. You can sense the action of this enzyme if you chew a piece of bread. After about two minutes in your mouth, the starch is broken down into sugars. The sugars make the bread taste sweet.

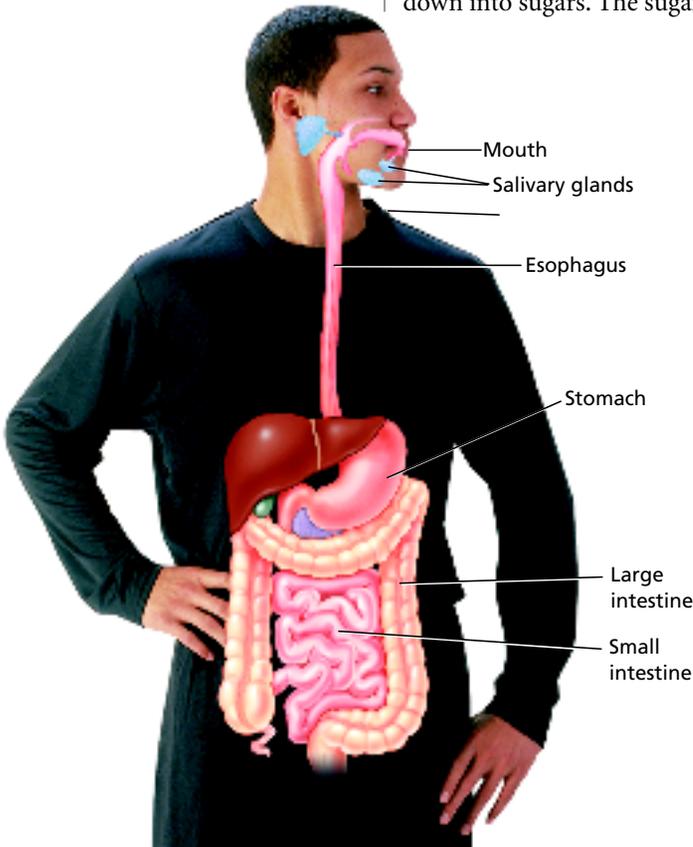


FIGURE 25

Foods are exposed to several changes in pH as they move through the digestive system.

**Relating Cause and Effect** *Why do certain digestive enzymes work only in certain parts of the digestive system?*

### pH Changes During Digestion

Organ	pH
Mouth	7
Stomach	2
Small intestine	8

**Your Stomach** Next, the food is swallowed and arrives in your stomach, where mechanical digestion continues. Also, chemical digestion begins for foods that contain protein, such as meat, fish, and beans. Cells in the lining of your stomach release enzymes and hydrochloric acid. In contrast to the near-neutral pH of your mouth, the pH here drops to a very acidic level of about 2.

The low pH in your stomach helps digestion take place. Pepsin is one enzyme that works in your stomach. Pepsin helps break down proteins into small molecules called amino acids. Most enzymes work best in a solution that is nearly neutral. But pepsin is different. It works most effectively in acids.

**Your Small Intestine** Your stomach empties its contents into the small intestine. Here, digestive fluid containing bicarbonate ions ( $\text{HCO}_3^-$ ) surrounds the food. This ion creates a slightly basic solution, with a pH of about 8. At this slightly basic pH, enzymes of the small intestine work best. These enzymes complete the breakdown of carbohydrates, fats, and proteins.

By now, the large food molecules from the sandwich have been split up into smaller ones. These smaller molecules pass through the walls of the small intestine into your bloodstream and are carried to the cells that will use them.



**What acid do the cells in the lining of your stomach release?**



For: Links on digestion and pH  
Visit: [www.SciLinks.org](http://www.SciLinks.org)  
Web Code: scn-1235

## Section 5 Assessment

**Target Reading Skill Sequencing** Refer to your flowchart about the digestive system as you answer Question 2.

### Reviewing Key Concepts

1. a. **Reviewing** What are the two parts of digestion?  
b. **Comparing and Contrasting** How do these two processes differ?  
c. **Inferring** People who have lost most of their teeth may have trouble chewing their food. How does this affect their digestive process?
2. a. **Listing** What is the pH in your mouth? Stomach? Small intestine?  
b. **Sequencing** Arrange the three body locations in part (a) from least acidic to most acidic.  
c. **Applying Concepts** Why are pH variations in different parts of the digestive system important to the process of digestion?

### Writing in Science

**News Report** Suppose you are a news reporter who can shrink from changes in size and be protected from changes in the environment with a special suit. You are assigned to accompany a bite of food as it travels through the digestive system. Report your findings in a dramatic but accurate way. Include a catchy headline.