Chapter 35 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 35.1 Following Digestion of a Meal National Science Education Standards UCP.1-3, UCP.5; B.3; C.5; F.1; G.1 (1 session, ¹ / ₂ block)	 Recognize the different functions of the organs of the digestive system organs. Outline the pathway food follows through the digestive tract. Interpret the role of enzymes in chemical digestion. 	Inside Story: Your Mouth, p. 949 Problem-Solving Lab 35-1, p. 952
Section 35.2 Nutrition National Science Education Standards UCP.2, UCP.3; A.1, A.2; B.2, B.3, B.6; C.5, C.6; F.1 (¹ / ₂ session)	 Summarize the contribution of the six classes of nutrients to body nutrition. Identify the role of the liver in food storage. Relate caloric intake to weight loss or gain. 	MiniLab 35-1: Evaluate a Bowl of Soup, p. 957 Problem-Solving Lab 35-2, p. 958 Biology & Society: The Promise of Weight Loss, p. 968
Section 35.3 The Endocrine System National Science Education Standards UCP.1-3, UCP.5; A.1, A.2; B.2, B.3, B.6; C.1, C.5, C.6; F.1; G.1 (2 ¹ / ₂ ses- sions, 1 block)	 Identify the functions of some of the hormones secreted by endocrine glands. Summarize the negative feedback mechanism controlling hormone levels in the body. Contrast the actions of steroid and amino acid hormones. 	Problem-Solving Lab 35-3, p. 962 MiniLab 35-2: Compare Thyroid and Parathyroid Tissue, p. 964 Investigate BioLab: Average Growth Rate in Humans, p. 966

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at http://www.carolina.com

MATERIALS LIST

BioLab

p. 966 blue pencil, red pencil, graph paper, ruler

MiniLabs

946A

p. 957 paper, pencil **p. 964** microscope, prepared slide of thyroid and parathyroid tissue, paper, pencil

Alternative Lab

p. 950 Lactaid solution, glucose test paper, glucose solution, milk, graduated cylinder (2), test tubes (4), dropper

Ouick Demos

- p. 948 barium X ray of digestive tract p. 950 dialysis bag (2), starch solution, pancreatic enzyme solution, beaker,
- distilled water, Benedict's solution **p. 955** paper grocery bags, assorted
- food samples, water p. 960 human skull
- **p. 961** microprojector, prepared slide
- of pancreas
- **p. 963** preserved whole kidney

Key to Teaching Strategies

- Level 1 activities should be appropriate L1 for students with learning difficulties.
- Level 2 activities should be within the L2 ability range of all students.
- L3 Level 3 activities are designed for aboveaverage students.
- **ELL** ELL activities should be within the ability range of English Language Learners.
- **COOP LEARN** Cooperative Learning activities are designed for small group work.
- These strategies represent student products that can be placed into a best-work portfolio.
- These strategies are useful in a block scheduling format.

Teacher Classroom Resources						
Section	Reproducible Masters		Transparencies			
Section 35.1 Following Digestion of a Meal	Reinforcement and Study Guide, pp. 1 Content Mastery, pp. 173-174, 176	55-156 12	Section Focus Transparency 84 1 ELL Reteaching Skills Transparency 50 1 ELL			
Section 35.2 Nutrition	Reinforcement and Study Guide, p. 157 2 Concept Mapping, p. 35 3 ELL BioLab and MiniLab Worksheets, p. 155 2 Laboratory Manual, pp. 255-260 2 Content Mastery, pp. 173, 175-176 1		Section Focus Transparency 85 1 ELL Reteaching Skills Transparency 51 1 ELL			
Section 35.3 The Endocrine System	ction 35.3Reinforcement and Study Guide, p. 152ction 35.3Critical Thinking/Problem Solving, p. 3e EndocrineBioLab and MiniLab Worksheets, pp. 1stemContent Mastery, pp. 173, 175-176		Section Focus Transparency 86 [1] ELL Basic Concepts Transparency 65 [2] ELL			
Assessment Reso	urces	Additional	Resources			
Chapter Assessment, pp. 20 MindJogger Videoquizzes Performance Assessment in Alternate Assessment in th Computer Test Bank	05-210 n the Biology Classroom e Science Classroom Chapter 35 quiz	Spanish Resourc English/Spanish Cooperative Lea Lesson Plans/Blo	es ELL Audiocassettes ELL arning in the Science Classroom COOP LEARN ock Scheduling			

NATIONAL GEOGRAPHIC

Products Available From Glencoe

To order the following products, call Glencoe at 1-800-334-7344: **CD-ROMs**

NGS PictureShow: Human Body 1 NGS PictureShow: Human Body 2 **Curriculum Kit**

GeoKit: Human Body 1

Transparency Set

NGS PicturePack: Human Body 1 NGS PicturePack: Human Body 2 Videodisc

STV: Human Body

Videos Series)

The Digestive and Endocrine Systems

Teacher's Corner

Products Available From National Geographic Society To order the following products, call National Geographic Society at 1-800-368-2728:

Digestive System (Human Body

Our Immune System

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life

CD-ROM ELL



Video: X-Ray of Swallowing BioQuest: Body Systems Exploration: Nutrition

Videodisc Program



The Infinite Voyage A Taste of Health

X-Ray of Swallowing



Chapter 35

GETTING STARTED DEMO

Visual-Spatial Test a cracker for starch by

adding a few drops of iodine

to the ground crumbs. A dark

presence of starch. To demon-

starch, add about 1 g of ground

Add a small amount of amylase

(available from biological sup-

few minutes. You can test for

the breakdown of starch by

periodically using the iodine

The theme of systems and

interactions is developed by

looking at the role of the diges-

tive and endocrine systems in

Theme Development

regulating body functions.

test. 🖙

ply companies) and let sit for a

strate the effects of saliva on

crackers to 1-2 ml of water.

brown/purple indicates the

The Digestive and Endocrine Systems 35

What You'll Learn

Chapter

- You will trace the journey of a meal through the digestive system
- You will recognize different nutrients and their uses in the body.
- You will outline how endocrine hormones control internal body processes.

Why It's Important

By examining the functions of your digestive and endocrine systems, you will understand how your body obtains energy from food and how it controls your behavior and development.

GETTING STARTED

pening to the cracker in your mouth as you chew? Can you describe the movement of the cracker through your digestive system?

OUT OF TIME?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Initiating Digestion Bite into a cracker. What is hap-*Inter***NET** CONNECTION To find out more about digestion and the endocrine

system, visit the Glencoe Science Web Site. www.glencoe.com/sec/science

These projections, called villi, line the walls of your small intestine, absorbing food particles as they pass by.

946

Multiple Learning Styles

Kinesthetic Meeting Individual Needs, p. 948; Quick Demo, pp. 950, 955 Visual-Spatial Getting Started Demo, p. 946; Quick Demo,

pp. 948, 960, 961; Portfolio, p. 949; Meeting Individual Needs, pp. 954, 960; Reteach, p. 957

Interpersonal Check for Understanding, p. 953;

Look for the following logos for strategies that emphasize different learning modalities. Enrichment, p. 955; Biology Journal, p. 956

Intrapersonal Project, p. 952; Cultural Diversity, p. 955; Tech Prep, p. 962; Portfolio, p. 964 **Linguistic** Biology Journal, pp. 955, 961, 963; Tech Prep, p. 956; Extension, p. 957 **Logical-Mathematical** Project, **ур**. 957

Section **35.1 Following Digestion** of a Meal

ating is something you probably spend a lot of time thinking about—what you will eat, when you will eat, and who you will eat with. Your digestive system helps turn food into energy for your body. As in many animals you have studied, the human digestive system is essentially a specialized tube that has evolved over millions of years to form digestive organs, each of which performs a unique function.

Magnification: 55×

Functions of the Digestive System

The main function of the digestive system is to disassemble the food you eat into its component molecules so that it can be used as energy for your body. In this sense, your digestive system can be thought of as a sort of

Digestion is accomplished through a number of steps. First, the system takes ingested food and begins moving it through the digestive tract. As it does so, it digests-or breaks down mechanically and chemically-the complex food molecules. Then, the system absorbs the digested food and distributes it to your cells. Finally, it eliminates undigested materials from your body. As you read about each digestive organ, use Figure 35.1 to locate its position within the system.





Large

Portfolio Assessment

Portfolio, TWE, pp. 949, 964 Alternative Lab, TWE, pp. 950-951 Problem-Solving Lab, TWE, p. 958 Assessment, TWE, p. 957 BioLab, TWE, pp. 966-967 **Performance Assessment**

MiniLab, SE, p. 964 Alternative Lab, TWE, pp. 950-951

disassembly line.



These gastric pits in the stomach secrete acid needed for digestion.

alivarı glands Pharyn> Esophagus Diaphragm intestine

35.1 FOLLOWING DIGESTION OF A MEAL 947

Assessment Planner

Problem-Solving Lab, TWE, p. 952 MiniLab, TWE, pp. 956, 964 **Knowledge Assessment** Section Assessment, SE, pp. 953, 958, 965 Chapter Assessment, SE, pp. 969-971 Assessment, TWE, pp. 956, 965 Problem-Solving Lab, TWE, p. 962 **Skill Assessment** Assessment, TWE, pp. 951, 953, 961

SECTION PREVIEW

Objectives Recognize the different functions of the digestive system organs **Outline** the pathway food follows through the digestive tract.

Interpret the role of enzymes in chemical digestion.

Vocabularv

amylase esophagus peristalsis epiglottis stomach pepsin small intestine pancreas liver bile gallbladder villus large intestine rectum

Figure 35.1

All the digestive organs

work together to break

down food into simpler

compounds that can be

absorbed by the body.

Section 35.1

Prepare

Key Concepts

The structures and functions of the organs of the digestive system are presented as students follow a meal through the digestive tract.

Planning

- Acquire old barium X rays for the first Quick Demo.
- Prepare materials for the second Quick Demo.
- Purchase milk and Lactaid for the Alternative Lab.

1 Focus

Bellringer 🌢

Before presenting the lesson, display Section Focus Transparency 84 on the overhead projector and have students answer the accompanying questions. L1 ELL



2 Teach

Quick Demo

Visual-Spatial Show stu-dents old barium X rays of the digestive tract (often available at hospitals). Use the X rays to discuss and identify parts of the digestive tract. X rays of jawbones may also be obtained and used for discussions about teeth.

Visual Learning

Explain that the pancreas is 15 cm long and produces 1 L of pancreatic juice each day. Have students use Table 35.1 to list the chemicals that compose pancreatic juice. pancreatic amylase, trypsin, pancreatic lipase, nucleases 11

Reinforcement

Have two students hold a 9-m long piece of string. Explain that the string represents the length of the human digestive tract. Briefly discuss how food moves along the length of the digestive tract and the changes that occur within the tract.



The Mouth

Word Origin

From the Greek

"around." and

direction.

Figure 35.2

saliva, a watery sub-

word peri, meaning

stellein, meaning "to

draw in." Peristalsis

propels food in one

peristalsis

The first stop along the digestive disassembly line is your mouth. Suppose it's lunchtime and you have just prepared a bacon, lettuce, and tomato sandwich. The first thing you do is bite off a piece and chew it.

What happens as you chew?

In your mouth, your tongue moves the food around and helps position it between your teeth so that it can be chewed. Chewing is a form of mechanical digestion, the physical process of breaking food into smaller pieces. Mechanical digestion prepares food particles for chemical digestion. Chemical digestion is the process of changing food on a

Salivary glands secrete stance that contains the enzyme amylase.

molecular level through the action of enzymes. What purpose do the different structures inside your mouth serve? Find out by reading the Inside Story.

Chemical digestion begins in the mouth

Some of the nutrients in your sandwich are starches, large molecules known as polysaccharides. As you chew your bite of sandwich, salivary glands in your mouth secrete saliva, as shown in Figure 35.2. Saliva contains a digestive enzyme, called amylase, which breaks down starch into smaller molecules such as di- or monosaccharides. In the stomach, amylase continues to digest starch in the swallowed food for about 30 minutes. Table 35.1 lists some digestive enzymes that act to break food molecules apart.

Swallowing your food

Once you've thoroughly chewed your bite of sandwich, your tongue shapes it into a ball and moves it to the back of your mouth to be swallowed. Swallowing forces food from your mouth into your esophagus, a muscular tube that connects your mouth to your stomach. Food moves down the esophagus by way of

Table 35.1 Digestive enzymes				
Organ	Enzyme	Molecules digested	Product	
Salivary glands	Salivary amylase	Starch	Disaccharide	
Stomach	Pepsin	Proteins	Peptides	
Pancreas	Pancreatic amylase Trypsin Pancreatic lipase Nucleases	Starch Proteins Fats Nucleic acids	Disaccharide Peptides Fatty acids and glycerol Sugar and nitrogen bases	
Small intestine	Maltase Sucrase Lactase Peptidase Nuclease	Disaccharide Disaccharide Disaccharide Peptides Nucleic acids	Monosaccharide Monosaccharide Monosaccharide Amino acids Sugar and nitrogen bases	

948 THE DIGESTIVE AND ENDOCRINE SYSTEMS

MEETING INDIVIDUAL NEEDS

Learning Disabled

Kinesthetic Cut a 15-cm length of string and lay it fully stretched out on a desk. Use a second 15-cm piece of string to form a zigzag pattern. Have students observe the total horizontal distance between the two ends of each piece of string. Compare this to the increased surface area created by villi. **[1] ELL**

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VIDEODISC 0 STV: The Human Body, Vol. 1 Digestive System Unit 2, Side 2, 2 min. 10 sec. Stomach



Your Mouth

• our mouth houses many structures involved in other functions besides digestion. Some of these structures protect against foreign materials invading your body; others help you taste the food you eat.

Critical Thinking Why do your teeth come in various shapes?

Teeth The incisors are adapted for cutting food. The cuspids, or canines, tear or shred food. The three sets of molars can crush and grind food. Often, there is not enough room for Hard palate the third set of molars, called wisdom teeth. Uvula which then must be removed

3 Tongue The tongue is attached to the floor of the mouth. It is made Molars of numerous skeletal muscles covered with a mucous membrane.

> or premolars Cuspids or canines

Bicuspids

Cheek

4 Structure of a tooth Teeth are made mainly of dentin, a bonelike substance that gives a tooth its shape and strength. The dentin encloses a space filled with pulp, a tissue that contains blood vessels and nerves. The dentin of the crown is covered with an enamel that consists mostly of calcium salts. Tooth enamel is the hardest substance in the body.





0 STV: The Human Body, Vol. 1 Digestive System Unit 2, Side 2, 2 min. 30 sec. Mouth



Magnification: 725×

Gum

Incisors



The tongue is covered by projections that contain numerous taste receptor cells like the one shown here.

Soft palate

2 Tonsils A pair of tonsils is located at the back of the mouth. They play a role in preventing infections in the nose and mouth by helping to eliminate foreign bacteria.

Opening of salivary gland duct



Portfolio



Visual-Spatial Have students investigate how the number and location of primary teeth in humans differ from the secondary teeth. Ask students to diagram a mouth that shows only primary teeth. Have students identify the types of teeth shown in the diagram.





Purpose 🍘

Students examine teeth and other structures of the mouth.

Teaching Strategies

Bring in models of animal skulls, including a human skull, to compare teeth. Ask students whether other mammals have baby or milk teeth. Yes. Some students may recall their puppies or kittens losing baby teeth.

Misconception

Students may believe that cavities are the greatest threat to teeth. Explain that while cavities do destroy teeth, periodontal disease of the gums is much more serious and far more prevalent today.

Visual Learning

- Point out the structures of the mouth shown in the diagram. As each structure is mentioned, have a volunteer read the description of the structure.
- Ask students to name the three types of teeth shown. *incisors*, cuspids, and molars
- Elicit from students the function of the tonsils and their location. The tonsils are located in the back of the mouth and function to remove bacteria that enter the mouth or nose.

Critical Thinking

Different teeth perform different functions-incisors are shaped for cutting, while molars are shaped for crushing and grinding.

Quick Demo

Kinesthetic To demon-strate both digestion and diffusion, fill a dialysis bag with 1-5% starch solution. In a second dialysis bag, add 2 mL of pancreatic enzymes and fill the remainder of the bag with starch solution. Allow each bag to sit in a beaker of distilled water for one day. Then, run a Benedict's test on the fluid in each beaker. Explain that the enzymes will digest the starch and change it to glucose, which diffuses out of the dialysis bag. The glucose will produce a positive Benedict's test.

Visual Learning

Have students look at Figure 35.3. Ask: What type of muscle makes up the walls of the stomach? smooth muscle



Video: X Ray of Swallowing Disc 5 VIDEODISC **Biology: The Dynamics** 0 of Life X Ray of Swallowing (Ch. 31) Disc 2, Side 1, 35 sec.



Figure 35.3

D

Smooth muscle contractions are responsible for moving food through the digestive system.





Contraction in circular muscle layer forces food mass forward



peristalsis (per uh STAHL sus), a series of involuntary smooth muscle contractions along the walls of the digestive tract. Figure 35.3 shows how the food is moved along from the mouth to the stomach. The contractions occur in waves: first, circular muscles relax and longitudinal muscles contract; then circular muscles contract and longitudinal muscles relax.

Have you ever had food go down the wrong way? When you swallow, the food enters the esophagus. Usually, a flap of cartilage called the epiglottis (ep uh GLAHT us) closes over the opening to the respiratory tract as you swallow, preventing food from entering. After the food passes into your esophagus, the epiglottis opens again. But if you talk or laugh as you swallow, the epiglottis may open, allowing food to enter the upper portion of the respiratory tract. Your response, a reflex, is to choke and cough, forcing the food out of the respiratory tube.

The Stomach

When the chewed food reaches the end of your esophagus, it enters the stomach. The stomach is a muscular, pouchlike enlargement of the digestive tract. Both physical and chemical digestion take place in the stomach.

Muscular churning

Three layers of involuntary muscles, lying across one another, are located within the wall of the stomach. When these muscles contract, as shown in *Figure 35.4*, they work to physically break down the swallowed food, creating smaller pieces. As the muscles continue to work the food pieces, they mix them with digestive juices produced by the stomach.

with care and to dispose of any broken glass in the designated container.

- mL of milk in test tube 2, 2 mL of milk in test tube 3, and 2 mL of Lactaid in test tube 4.

- **5.** Using the glucose test paper, test each tube for glucose.

Chemical digestion in the stomach

The inner lining of the stomach contains millions of glands that secrete a mixture of chemicals called gastric juice. Gastric juice contains pepsin and hydrochloric acid. Pepsin is an enzyme that begins the chemical digestion of proteins in food. Pepsin works best in the acidic environment provided by hydrochloric acid, which increases the acidity of the stomach contents to pH 2.

Knowing that the stomach secretes acids and enzymes, you may be wondering why the stomach doesn't digest itself. The stomach lining is protected by mucus that forms a layer between it and the acidic environment of the stomach. The mucus is secreted by the stomach lining itself.

Food remains in your stomach for approximately two to four hours. By the time the food is ready to leave the stomach, it is about the consistency of tomato soup. At that time, the peristaltic waves gradually become more vigorous and begin to force small amounts of liquid out of the lower end of the stomach and into the small intestine.

The Small Intestine

From your stomach, the liquid food moves into your small intestine, a muscular tube about 6 m long. This section of the intestine is called *small* not because of its length, but because of its narrow diameter-only 2.5 cm. Digestion of your meal is completed within the small intestine. Muscle contractions contribute to further mechanical breakdown of the food: at the same time, carbohydrates and proteins undergo further chemical digestion with the help of enzymes produced and secreted by the pancreas and liver.

tests positive for glucose. If you use another liquid lactose digestive aid, test it

tubes

Procedure

for glucose first.

Materials 💁 🐨 📷

Digesting Lactose

Alternative Lab

Purpose C

Students test whether Lactaid or another lactose digestive aid will digest lactose.

Preparation

Do not use the tablet form of Lactaid; it

Give students the following directions. 1. Label four test tubes 1, 2, 3, and 4.

Lactaid or another liquid lactose digestive

aid, glucose test paper, glucose solution,

milk, graduated cylinders, droppers, test

Remind students to handle test tubes

- 2. Place 2 mL of glucose in test tube 1, 2
- 3. Place 5 drops of Lactaid in test tube 3.
- 4. Allow all tubes to sit for 5 minutes.

Analysis

- 1. What did Lactaid do to the lactose in milk? It broke down the lactose.
- 2. What is the function of test tubes 1, 2, and 4? They are controls.
- 3. How will Lactaid help people who cannot digest lactose. Lactaid will help break down the lactose present in dairy products.



Figure 35.5

intestine.

Both the pancreas

and the liver produce

chemicals needed for

digestion in the small

Chemical action

The first 25 cm of the small intestine is called the duodenum (doo AHD un um). Most of the enzymes and chemicals that function in the duodenum enter it through ducts that collect juices from the pancreas, liver, and gallbladder. These organs, shown in Figure 35.5, play important roles in digestion, even though food does not pass directly through them.

Secretions of the pancreas

The pancreas is a soft, flattened gland that secretes both digestive enzymes and hormones, which you will learn more about in the last section of this chapter. The mixture of enzymes it secretes breaks down carbohydrates, proteins, and fats. Alkaline pancreatic juices also help to neutralize the acidity of the liquid food, stopping any further action of pepsin.

Secretions of the liver

The **liver** is a large, complex organ that, among its many functions, produces bile. Bile is a chemical

35.1 FOLLOWING DIGESTION OF A MEAL 951

Assessment

Portfolio Have students write a summary of the lab, including the answers to the Analysis questions, and add them to their portfolios. Use the Performance Task Assessment List for Lab Report in PASC, p. 47. **L2 P**

Assessment

Skill Have students make a flow chart of the digestive system, listing the secretions at each stage. L2



CD-ROM Biology: The Dynamics of Life BioQuest: Body Systems Discs 1-5

NATIONAL **GEOGRAPHIC**



VIDEODISC STV: Human Body, Vol. 1 **Digestive System**

Unit 2, Side 2 Small Intestine 1, 3 min. 41 sec.



Small Intestine 2, 1 min. 47 sec.

Large Intestine, 1 min. 31 sec.

Resource Manager

Reinforcement and Study Guide, pp. 155-156 Content Mastery, p. 174 **Reteaching Skills Trans**parency 50 and Master L1 ELL

Problem-Solving Lab 35-1

Purpose C

Students compare the path of bile from the liver to the duodenum with and without the gallbladder.

Process Skills

analyze information, compare and contrast, draw a conclusion, interpret scientific illustrations, sequence, think critically

Teaching Strategies

Demonstrate the role of bile by adding a small amount of oil to a test tube of water. Shake it and have students note what happens to the oil after waiting a few minutes. (Oil reforms on top of the water.) Repeat the demonstration using liquid detergent to simulate bile. (Oil will remain as small droplets.)

Point out to students that the gallbladder is under involuntary control-it releases bile when stimulated by a hormone.

Thinking Critically

- **1.** liver; gallbladder
- 2. Bile physically changes fat into smaller droplets.
- 3. liver, hepatic duct, gallbladder, bile duct, duodenum
- 4. liver, hepatic duct, bile duct, duodenum
- **5.** Only a small, but continuous, amount of bile reaches the duodenum. Large amounts needed to break up fats efficiently are not available.



Performance Have students make a poster illustrating why gallstones cause discomfort. Advise them that (a) gallstones can block the bile duct and (b) the gallbladder contracts automatically when fats are in the duodenum. Have them explain what could cause the considerable discomfort associated with gallstones. the gallbladder squeezing and not being able to empty Use the Performance Task Assessment List for Poster in **PASC**, p. 73. **12**

Problem-Solving Lab 35-1 Sequencing

Is it possible to live without a gallbladder? Apparently yes, as many people have had this organ surgically removed and are still alive.

Analysis

The following diagrams show the appearance of a normal liver and gallbladder (diagram A) and the appearance when the gallbladder has been removed (diagram B).



- 2. Does bile bring about a chemical or physical change to fat? Explain.
- 3. Sequence the pathway for bile from the liver to the duo-
- denum in the person with a gallbladder.
- 4. Sequence the pathway for bile from the liver to the duodenum in the person with no gallbladder.
- 5. The gallbladder is a muscular sac. It squeezes and dis-
- charges a large quantity of bile when fats are present in the duodenum. Explain why a person without a gallbladder is unable to digest fats as efficiently as someone who
- has a gallbladder.

Figure 35.6 Gallstones can form in the gallbladder or bile duct. They consist mainly of precipitated bile salts.

substance that helps break down fats. Once made in the liver, bile is stored in a small organ called the gallbladder, from which it passes into the duodenum. Bile causes further mechanical digestion by breaking apart large drops of fat into smaller droplets. If bile becomes too concentrated due to high levels of cholesterol in the diet, or if the gallbladder becomes inflamed, gallstones can form, as seen in Figure 35.6. Can a person live without a gallbladder? Find out in the Problem-Solving Lab on this page.

Absorption of food

Liquid food stays in your small intestine for three to five hours and is slowly moved along its length by peristalsis. As digested food moves through the intestine, it passes over thousands of tiny fingerlike structures called villi. A villus is a single projection on the lining of the small intestine that functions in the absorption of digested food. The villi greatly increase the surface area of the small intestine, allowing for a greater absorption rate. Because the digested food is now in the form of small molecules, it can be absorbed



952 THE DIGESTIVE AND ENDOCRINE SYSTEMS

PROJECT

Meat Tenderizers

Intrapersonal Have students conduct Ibrary research to find out how meat tenderizer works. Have them use the information they gather to design a demonstration that can be used to explain the process to others. Encourage students to write out

the procedural steps for their demonstration and explain the purpose for each step. Finally, have students complete their demonstration with information that relates the function of meat tenderizer to its complementary organ of the digestive system. COOP LEARN

directly into the cells of the villi, as shown in Figure 35.7. The food molecules then diffuse into the blood vessels of the villus and enter the bloodstream. As you can see, the villi are the link between the digestive system and the circulatory system.

As your lunch comes to the end of its passage through the small intestine, only the indigestible materials remain in the digestive tract.

The Large Intestine

The indigestible material from your meal now passes into your large intestine, a muscular tube that is also called the colon. Even though the large intestine is only about 1.5 m long, it is much wider than the small intestine—about 6.5 cm in diameter. The appendix, a small, tubelike extension off the large intestine, is thought to be an evolutionary remnant from our herbivorous ancestors as it seems to serve no function in human digestion.

Water absorption

As the indigestible mixture passes through the large intestine, water is absorbed by the intestine walls, leaving behind a more solid material. In this way, the water is not wasted. A secondary function of the large

After 18 to 24 hours in the large intestine, the remaining indigestible material, now called feces, reaches the rectum. The **rectum** is the last part of the digestive system. Feces are eliminated from the rectum through the anus. Your meal's entire journey from the beginning of the digestive tract to the end has taken between 24 and 33 hours.

- Understanding Main Ideas
- **1.** Sequence the organs of your digestive system according to the order in which food passes through them.
- 2. In which sections of the digestive system are starches digested? Which enzymes break down starches?
- 3. How do villi of the small intestine increase the rate of nutrient absorption?
- 4. What role does the pancreas play in digestion?

- 1. mouth, esophagus, stomach, small integ tine, large intestine, rectum
- 2. mouth, small intestine; salivary amylase pancreatic amylase
- 3. By increasing the total surface area, vil allow for increased absorption rates.
- 4. The pancreas secretes digestive enzymes, mately these percentages: large intestine, which break down carbohydrates, pro-75%; small intestine, 13%; stomach, 11%; teins, and fats. mouth and esophagus, 1%





intestine is vitamin synthesis. Anaerobic bacteria in the large intestine synthesize some B vitamins and vitamin K, which are absorbed as needed by the body.

Figure 35.7

Once food has been fully digested in the small intestine, it is in the form of molecules small enough to enter the body's bloodstream.

Elimination of wastes

Section Assessment

Thinking Critically

5. How would chronic diarrhea affect the balance of fluids in your body?

SKILL REVIEW

6. Making and Using Graphs Prepare a circle graph representing the time food remains in each part of the digestive tract. For more help, refer to Organizing Information in the Skill Handbook.

35.1 FOLLOWING DIGESTION OF A MEAL 953

Section Assessment

S-	5. Loose stool has an unusually high water
	content. Patients suffering from diarrhea
e,	lose tremendous amounts of fluids every
	day. These fluids must be restored by
lli	drinking water regularly.
	6. Students' graphs should show approxi-

3 Assess

Check for Understanding

Interpersonal Play the "Digestive System Game." Have a student name an organ of the digestive system. The next student must name a type of digestion that occurs in the organ (chemical or mechanical). The next student must further define this action by listing the enzymes or juices involved or defining the mechanical action (chewing or stomach churning). A fourth student should tell how the digestive action is controlled. Repeat the process until all organs have been discussed.

Reteach

Visual-Spatial Have students prepare a chart of the digestive organs and the role of each in digestion. **L2**

Extension

Linguistic Have interested students research and report on cancers of the digestive tract and their possible causes and treatments. L3

Assessment

Skill Have students label a diagram of the digestive system and identify the functions of each part. 📘

4 Close

Discussion

Ask students how the digestive system is like the plumbing system of a house. Have them explain where the faucets of the digestive system are located.

Section 35.2

Prepare

Key Concepts

Students become familiar with the six classes of nutrients. They also relate these nutrients to Calories and metabolism.

Planning

- Purchase a school lunch for Meeting Individual Needs.
- Acquire foods and brown paper for the Quick Demo.
- Gather Calorie charts for the Project.

1 Focus

Bellringer 🌢

Before presenting the lesson, display Section Focus Transparency 85 on the overhead projector and have students answer the accompanying questions. L1 ELL



SECTION PREVIEW **Objectives** Summarize the contri-

bution of the six classes of nutrients to body nutrition Identify the role of the liver in food storage. Relate caloric intake to weight loss or gain.

Vocabularv mineral vitamin Calorie

Figure 35.8

Select foods from the

five food groups and

you'll have a healthful

diet that supplies the

six essential nutrients

your body needs.

often do you eat it? Of what nutritional value is it? The food pyramid is a diagram that indicates the number of servings a person should have daily from each of the food groups. How do your meals fit into this pyramid?

The

food

pyramio

35.2 Nutrition

Section



The Vital Nutrients

Six basic kinds of nutrients can be found in foods: carbohydrates, fats, proteins, minerals, vitamins, and water. These substances are essential to proper body function. You supply your body with these nutrients when you eat foods from the five main food groups shown in *Figure 35.8*.



954 THE DIGESTIVE AND ENDOCRINE SYSTEMS

MEETING INDIVIDUAL NEEDS

Hearing Impaired/English Language Learners

Visual-Spatial Bring in a sample school lunch. Ask students to list, on a sheet of paper, the nutrients found in each of the foods provided. Next, have them point out on a diagram of the digestive system where each type of nutrient is digested. 🚺 ELL 🖙

Carbohydrates

Perhaps your favorite food is pasta, fresh-baked bread, or corn on the cob. If so, your favorite food contains carbohydrates, important sources of energy for your body cells. Recall that carbohydrates are starches and sugars. Starches are complex carbohydrates found in bread, cereal, pota-

> toes, rice, corn, beans, and pasta. Sugars are simple carbohydrates found mainly in fruits, such as plums, strawberries, and oranges.

During digestion, complex carbohydrates are broken down into simple sugars such as glucose, fructose, and galactose. Absorbed into the bloodstream through the villi of the small intestine, these sugar molecules circulate to

Resource Manager

Section Focus Transparency 85 and

Concept Mapping, p. 35

Master 📘 ELL

fuel body functions. Some sugar is carried to the liver where it is stored as glycogen.

Cellulose, another complex carbohydrate, is found in all plant cell 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. Sources of fiber include bran and spinach.

Fats

Many people think that eating fat means getting fat, yet fats are an essential nutrient. They provide energy for your body and are also used as building materials. Recall that fats are essential building blocks of the cell membrane. They are also needed to synthesize hormones, protect body organs against injury, and insulate the body from cold.

Sources of fat in the diet include meats, nuts, and dairy products, as well as cooking oils. In the digestive system, fats are broken down into fatty acids and glycerol and absorbed by the villi of the small intestine. Eventually, some of these fatty acids end up in the liver. The liver converts them to glycogen or stores them as fat throughout your body.

Your body has many uses for proteins. Enzymes, antibodies, many hormones, and substances that help the blood to clot, are all proteins. Proteins form part of muscles and many cell structures, including the

amino acids have been absorbed by the small intestine, they enter the bloodstream and are carried to the liver. The liver can convert amino acids to fats or glucose, both of which can be used

for energy. However, your body uses amino acids for energy only if other energy sources are depleted. Most amino acids are absorbed by cells and used for protein synthesis. The human body needs 20 different amino acids to carry out protein synthesis, but it can make only 12 of them. The rest must be consumed in the diet and so are called essential amino acids. Sources of essential amino acids include meats, dried beans, whole grains, eggs and dairy products.

Proteins

cell membrane. During digestion, proteins are broken down into amino acids. After the

Cultural Diversity

Food Preferences

Intrapersonal Populations develop food preferences as they try to meet their nutritional needs using foods that are locally available. Have students find out how different cultures choose combinations of foods and flavors. Have them bring in samples of foods from various cultures. **[2**



Fluorine (F)

Dental cavity reduction Fluoridated water

line (I)

Formation of thyroid hormone Seafood, eggs, iodized salt milk group

lron (Fe)

Formation of hemoglobin (carries oxygen to body cells) and cytochromes (ATP formation) Liver, egg yolk, grain and meat group, leafy vegetables

lium (Na)

Nerve activity, body pH regulation Bacon, butter, table salt. vegetable group

Magnesium <u>(M</u>

Muscle and nerve activity, bone formation. enzyme function Fruit, vegetable and grain groups

alcium (Ca) Teeth and bone formation, muscle and nerve activity, blood clotting Milk and grain group

osphorus (P) Teeth and bone

formation, blood pH, muscle and nerve activity, part of enzymes and nucleic acids Milk. grain and vegetable group

Copper (Cu)

Development of red blood cells, formation of some respiratory enzymes Grain group, liver

Potassium (K)

Nerve and muscle activity Vegetable group, bananas

Sulfur (S)

Builds hair, nails and skin, component of insulin Grain and fruit group, eggs, cheese

Figure 35.9 Minerals serve many vital functions.

35.2 NUTRITION 955

BIOLOGY JOURNAL

Cancer and Nutrients

Linguistic Have students research how antioxidants destrov free radicals that can damage cells and lead to cancer. Ask them to find out how vitamins C and E and beta-carotene destroy these substances. 13

2 Teach

Quick Demo

Kinesthetic Test various foods for the presence of fat using brown paper (from grocery sacks). Smear the food on the brown paper and allow to dry. If the food is dry, grind a small portion with some water. After the paper has had sufficient time to dry, hold it up to the light. If the paper is translucent, the food tested contains fat.

Visual Learning

Refer to the periodic table on page A9 of Appendix D as you discuss Figure 35.9. Challenge students to locate the minerals on the periodic table.

Enrichment

Interpersonal Have students work in groups to investigate and prepare a report on one vitamin deficiency, such as scurvy, beriberi, rickets, night blindness, polyneuritis, or pellagra. L2 COOP LEARN



CD-ROM Biology: The Dynamics of Life Exploration: Nutrition Disc 5



Knowledge Have students list three good sources of each mineral (or vitamin) discussed in the text.

MiniLab 35-1

Purpose 🍘

Students evaluate the nutritional value of a food based on its label.

Process Skills

observe and infer, analyze, interpret data

Teaching Strategies

Explain the concept of daily value (DV) to students. ■ You may wish to have students work in pairs.

Expected Results

Students should discover that the soup represented is basically a healthy meal.

Analysis

1. Yes, sodium.

- **2.** A serving of soup contains about 39% of its Calories from saturated fat. (6 g/serving x 9 Cal/g = 54 Calories of saturated fat per serving. $54 \div 140 = 39\%$)
- **3.** Basically yes, although the sodium content is high.

Assessment

Performance Have students repeat the MiniLab for three foods found in their homes. Use the Performance Task Assessment List for Carrying Out a Strategy and Collecting Data in **PASC**, p. 25. **12**



Minerals and vitamins

Word Origin

From the Latin

word vita, meaning

"life." Vitamins are

necessary for life.

vitamin

When you think of minerals, you may picture substances that people mine, or extract from Earth. As shown in Figure 35.9 on the previous page, the same minerals can also be extracted from foods and put to use by your body.

A mineral is an inorganic substance that serves as a building material or takes part in a chemical reaction in the body. Minerals make up about four percent of your total body weight, most of it in your skeleton. Although they serve many different functions within the body, minerals are not used as an energy source.

Unlike minerals, vitamins are organic nutrients that are required in

small amounts to maintain growth and metabolism. The two main groups of vitamins are fat-soluble and water-soluble, as shown in Table 35.2. Although fat-soluble vitamins can be stored in the liver, the accumulation of excess amounts can prove toxic. Water-soluble vitamins cannot be stored in the body and so must be included regularly in the diet. Table 35.2 lists foods that contain fat-soluble and water-soluble vitamins.

Vitamin D, a fat-soluble vitamin, is synthesized in your skin. Vitamin K and some B vitamins are made by bacteria in your large intestine. The rest of the vitamins must be consumed in vour diet.

Table 35.2 Vitamins						
Vitamin	Function	Source				
Fat-soluble						
A	maintain health of epithelial cells; formation of light-absorbing pigment; growth of bones and teeth	liver, broccoli, green and yellow vegetables, tomatoes, butter, egg yolk				
D	absorption of calcium and phosphorus in digestive tract	egg yolk, shrimp, yeast, liver, fortified milk; produced in the skin upon exposure to ultraviolet rays in sunlight				
E	formation of DNA, RNA, and red blood cells	leafy vegetables, milk, butter				
К	blood clotting	green vegetables, tomatoes; produced by intestinal bacteria				
Water-soluble						
B ₁	sugar metabolism; synthesis of neurotransmitters	ham, eggs, green vegetables, chicken, raisins, seafood, soybeans, milk				
B ₂ (riboflavin)	sugar and protein metabolism in cells of eyes, skin, intestines, blood	green vegetables, meats, yeast, eggs				
Niacin	energy-releasing reactions; fat metabolism	yeast, meats, liver, fish, whole-grain cereals, nuts				
B ₆	fat metabolism	salmon, yeast, tomatoes, corn, spinach, liver, yogurt, wheat bran, whole-grain cereals and breads				
B ₁₂	red blood cell formation; metabolism of amino acids	liver, milk, cheese, eggs, meats				
Pantothenic acid	aerobic respiration; synthesis of hormones	milk, liver, yeast, green vegetables, whole- grain cereals and breads				
Folic acid	synthesis of DNA and RNA; production of red and white blood cells	liver, leafy green vegetables, nuts, orange juice				
Biotin	aerobic respiration; fat metabolism	yeast, liver, egg yolk				
с	protein metabolism; wound healing	citrus fruits, tomatoes, leafy green vegetables, broccoli, potatoes, peppers				

Water

Water is the most abundant substance in your body, making up 60 percent of red blood cells and 75 percent of muscle cells. Water facilitates the chemical reactions in your body and is necessary for the breakdown of foods during digestion. Water is also an excellent solvent; oxygen and nutrients from food could not enter your cells if they did not first dissolve in water.

Recall that water absorbs and releases heat slowly. It is this characteristic that helps water maintain your body's internal temperature. A large amount of heat is needed to raise the temperature of water. Because the body contains so much water, it takes a lot of added energy to raise its internal temperature. Your body loses about 2.5 L of water per day through exhalation, sweat, and urine. As a result, water must be replaced constantly.

Calories and Metabolism

The energy content of food is measured in units of heat called **Calories**, each of which represents a kilocalorie, or 1000 calories (written with a small c). A calorie is the amount of heat required to raise the temperature of 1 mL of water by 1°C. Some foods, especially those with fats, contain more Calories than others. In general, 1 g of fat contains nine Calories, while 1 g of carbohydrate or protein contains four Calories. To learn more about Calories in meals, complete the MiniLab on this page.

The number of Calories needed each day varies from person to person, depending on the person's metabolism, or the rate at which they burn energy. Metabolic rate, in turn, is determined by a person's body

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TECHPREP

Professional Nutritionist

Linguistic Students interested in nutrition can interview a nutritionist working for a food company. They may ask what tests are carried out to determine the nutritional content of food produced by the company. **12**

BIOLOGY JOURNAL

Nutritional Issues

Interpersonal Divide the class into groups. Have each group prepare a presentation on a nutrition issue such as cholesterol, HDLs versus LDLs, anorexia, bulimia, weight gain, junk foods, vegetarian diets, or food additives. Have students record their notes for the group report in their journals. **[2 COOP LEARN**

PROJECT

Calories

Logical-Mathematical Ask students to list all the foods they eat during a 24-hour period. Distribute Calorie charts. Have students use the charts to figure out how many Calories they ate, as well as calculate the grams of carbohydrates, fats, and proteins they consumed. **[2**



MiniLab 35-1

Interpreting the Data

Evaluate a Bowl of Soup As a consumer, you are bombarded by advertising that promotes the nutritional benefits of specific food products. Choosing a food to eat on the basis of such ads may not make nutritional sense. By examining the ingredients of processed foods, you can learn about their actual nutritional content.

Table 35.3	
Percentage of Daily Value (DV	1)
Carbohydrates	60%
Fat Saturated Fats	30% 10%
Cholesterol	1.5%
Protein	10%
Total Calories	2000

NUTRITION FACTS Serving Size: 2 cups (452g) Servings Per Container: 1										
Amount P	er Serving	3								۰.
Calories	140		Cal	ori	es	fro	m	Fat	54	ī
						%	Dail	y Va	lue	•
Total Fat	8q							1	2%	5
Satura	ted Fat 6	a						3	0%	5
Choleste	rol 20m	<u> </u>						-	7%	5
Sodium	1640 mg	5						6	8%	
Total Car	bohvdra	te 2	2a						7%	5
Dietary	/ Fiber 5	q						2	0%	5
Sugars	s 5a	0								-
Protein 6	a									-
Vitamin A	50%			Vi	tan	nin	С		4%	5
Calcium	2%			Irc	on				2%	5
* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs: Calories 2,000 - 2,500										
Total Fat Sat Fat Cholesterol Sodium Total Carboh Fiber	Less than Less than Less than Less than ydrate	65g 20g 300m 2,400 300g 25g	ng)mg	0 0 0 0 0 0	30g 25g 300n 2,40 375g 30g	ng Dmç I	ļ			_
Calories per gram: Fat 9 * Carbohydrates 4* Protein 4										

Procedure

1 Examine the information in the table listing the daily value (DV) of various

nutrients. DV expresses what percent of Calories should come from certain nutrients. For instance, in the proposed diet of 2000 Calories, 60 percent of the Calories should come from carbohydrates.

Examine the nutritional information on the soup can label and compare it with the DV table.

Analvsis

1. Does your bowl of soup provide more than 30 percent of any of the daily nutrients? Which ones? 2. Evaluate the percentage of calories in soup that are pro-

vided by saturated fat.

3. Is soup a nutritious meal? Explain your answer.

mass, age, sex, and level of physical activity. In general, males need more Calories per day than females, teenagers need more than adults, and active people need more than inactive people. Physicians have determined that many Americans are overweight. Calculate your Body Mass Index by doing the Problem-Solving Lab on the next page.

35.2 NUTRITION 957



3 Assess

Check for Understanding

Give the students a sample lunch that has nutritional deficiencies. Ask them to evaluate the lunch. Ask what nutrients are in excess and what nutrients should be added. Elicit what foods could provide these nutrients.

Reteach

Visual-Spatial Have students prepare a chart of the six nutrients. Have them identify the functions of these nutrients and identify foods that contain each.

Extension

Linguistic Have students interview a TECH PREP nutritionist to find out what criteria the nutritionist uses when planning meals that meet nutritional needs.



Portfolio Ask students to write a summary of which substances need to be included in a daily balanced diet and what each nutrient does. **[2]**



VIDEODISC

The Infinite Voyage A Taste of Health, Consequences of a Fatty Diet



Ancel Keys: Pioneer in Nutrition (Ch. 5) 6 min.



Assessing Dietary Intake Through Analysis of Garbage (Ch. 8)



Understanding How to Eat and Live (Ch. 9) 6 min.



Problem-Solving Lab 35-2

Purpose 🍘

Students learn how to calculate their Body Mass Index and determine whether or not their weight is within accepted values.

Process Skills

think critically, apply concepts, collect data, interpret data, recognize cause and effect, use numbers

Teaching Strategies

Allow students to use calculators.

Review the technique for squaring a number.

Vou may wish to illustrate the process of calculating BMI by working an example on the board or overhead projector.

Thinking Critically

- **1.** Student answers will vary.
- **2.** The person could reduce his or her Calorie intake, and/or increase activity level.
- 3. His Calorie intake is in balance with his expenditure.
- **4.** Student answers may include the idea that fatty food intake has increased even as daily exercise has decreased.

Assessment

Portfolio Have student groups plan a general long-range program that will either maintain their BMI if below 25 or reduce their BMI if over 25. Use the Performance Task Assessment List for Group Work in PASC, p. 97. L3

4 Close

Discussion

Ask students to evaluate an average American's diet compared with that of someone living in a developing nation. Have students consider differences in protein, mineral, and vitamin content.

What is your BMI? Fifty-five percent of adults in the United
States are considered overweight. How can you tell if you fall into this category? Use the following equation to find out
where you rank in relation to the rest of the population.
Analysis
Compute your BMI, or Body Mass Index, using the follow- ing formula:
weight (in pounds) height (in inches) ² × 704.5 = BMI
The federal guidelines are as follows:
A BMI
 25 or below = normal weight
 from 25 to 29.9 = overweight
• 30 or over = obese
Thinking Critically

Problem-Solving Lab 35-2 Using Numbers

- 1. According to federal guidelines, are you normal weight, overweight, or obese? 2. How might a person with a BMI of 27 reduce his or her
- BMI? Consider both nutritional intake and physical activity.
- 3. Fred has a BMI of 22. How do you suppose his Calorie
- intake compares to his Calorie expenditure?
- 4. Since 1960, the population of obese individuals in the
- United States has risen from 13 to 22 percent. Formulate a hypothesis that may explain this rise.

What happens if you eat more Calories than your body can metabolize? As Figure 35.10 shows, you store the extra energy as body fat and gain weight. On the other hand, if

Understanding Main Ideas

- 1. In what ways are proteins used in the body?
- 3. What happens when a person takes in more
- food energy than his or her body needs? 4. Why are fats needed in the diet?

Thinking Critically

Figure 35.10

When the energy taken in is greater than the energy expended, a person gains weight.

you eat fewer Calories than your body can metabolize, you use some of the energy stored in your body as fat and lose weight.

Millions of people put themselves on diets every year in hopes of losing weight. While many diets are nutritionally sound, others prescribe eating habits that are not sensible and usually fail to produce the desired result. Read more about fad diets in the Biology & Society section at the end of this chapter.

Section Assessment

- 2. Why is it important to eat cellulose even
- though it has no nutritional value?

5. A person can live several weeks without

food, but can live only days without water.

Why is the constant intake of water necessary for the body?

SKILL REVIEW

6. Classifying Prepare a chart of food groups, each group showing foods rich in one of the six nutrients discussed in this section. For more help, refer to Organizing Information in the Skill Handbook.

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Section Assessment

- **1.** to form enzymes, antibodies, hormones, clotting chemicals, and cell structures
- 2. Cellulose provides bulk in the diet, helping with the elimination of wastes.
- 3. That person gains weight.
- 4. Fats provide energy for the body, act as building materials, protect body organs against injury, and insulate the body from cold.

5. Water is needed for oxygen and nutrients to enter cells and to maintain body

temperature. 6. carbohydrates: bread, pasta, cereal, fruits and vegetables; fats: dairy, meat, oil, butter; protein: meat, dairy, beans; minerals: fruits and vegetables, meat, dairy; vitamins: fruits and vegetables, grains, dairy,

meat; and so on



magine yourself as a quarterback behind these linemen. Could you see over everyone's head? Do you wonder how tall you will end up being? Because you continue growing until about age 25, you may still be a few inches shy of your adult height. What controls your growth? In part, chemical messages within your body. They can affect how long and at what rate you grow.

gland

Pituitary

Control of the Body

Internal control of the body is directed by two systems: the nervous system, which you will learn more about later, and the endocrine system. The endocrine system is made up of a series of glands, called endocrine glands, that release chemicals directly into the bloodstream. These chemicals act as messengers, relaying information to other parts of the body. Whereas the nervous system produces an immediate response, the endocrine system induces gradual change. Let's take one of the football players as an

Although endocrine glands are found throughout the body, most of them are controlled by the action of the pituitary gland (puh TEW uh ter ee), the master endocrine gland. Because there are two control systems within the body-nervous and endocrine-coordination is needed.

Internet Address Book INTERNET Note Internet addresses that you find useful in the space **CONNECTION** below for quick reference.

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The pituitary gland releases chemicals important in controlling the growth of these linemen

example: While his nervous system is directing his legs to run in order to catch a forward pass, his endocrine system is controlling the rate at which he grows. The first response is instant; the second takes years.

Interaction of the nervous system and endocrine system

SECTION PREVIEW

Obiectives **Identify** the functions of some of the hormones secreted by endocrine glands.

Summarize the negative feedback mechanism controlling hormone levels in the body

Contrast the actions of steroid and amino acid hormones.

Vocabularv

endocrine glands pituitary gland hypothalamus target tissues receptor negative feedback system adrenal glands thyroid gland parathyroid glands

Word Origin

endocrine

From the Greek words endo, meaning "within," and krinein, meaning "to separate." The endocrine glands secrete hormones into the blood.

35.3 THE ENDOCRINE SYSTEM 959

Section 35.3

Prepare

Key Concepts

Students study how the nervous system and hormones control metabolic processes in the body.

Planning

- Borrow a human skull or a large animal skull for the first Quick Demo.
- Order slides of the pancreas for the second Quick Demo.
- Purchase a whole kidney that still has the adrenal gland attached for use in the third Ouick Demo.
- Order slides of thyroid/parathyroid tissue for the MiniLab.

1 Focus

Bellringer 🌢

Before presenting the lesson, display Section Focus Transparency 86 on the overhead projector and have students answer the accompanying questions. L1 ELL



2 Teach

Using Science Terms

Explain the meaning of the following terms: Endo is Greek for "within" and crine (krinein) is Greek for "to separate." Insulin gets its name from the Latin insula, meaning "island." Insulin is made in the small islands or islets of beta cells in the pancreas. Hypo is Greek for "under" and thalamus is Greek for "the inner room." The thalamus was an inner room in a Greek ship.

Quick Demo

Visual-Space. human skull or large Visual-Spatial Use a animal skull to demonstrate where the pituitary gland sits inside the cranium.





Pituitary Amino acid hormones Controls adrenal **Controls pituitary** gland, thyroid and synthesizes gland, ovaries, antidiuretic testis. mammarv hormone and glands, stores oxvtocin for uterus hypothalamus contraction during hormones, and birth secretes growth hormone Parathyroid Gland Secretes thyroxin to stimulate A*mino acid* growth and hormones metabolism and Secretes parasecretes calcitonin thyroid hormone Adrenal Medulla Ovary Steroid hormones Amino acid Secretes female hormones sex hormones Secretes epinephrine and norepinephrine Steroid hormones Secretes male Adrenal Cortex sex hormones Steroid hormones Secretes glucocorticoid and aldosterone Figure 35.11

This diagram shows the principal human endocrine glands. The top label indicates the name of the gland, the middle label indicates the type of hormone(s) secreted, and the bottom label tells the action of the gland/hormone.

> The **hypothalamus** is the portion of the brain that controls the pituitary gland. The pituitary gland is located in the skull just beneath the hypothalamus, and the two are connected

by nerves and blood vessels. The hypothalamus sends messages to the pituitary, which then releases its own chemicals, or stimulates other glands to release theirs. Other endocrine glands under control of the pituitary include the thyroid gland, the adrenal glands, and glands associated with reproduction.

Endocrine control of the body

ypothalamus mino acid

Thyroid gland Amino acid

mones

The chemicals secreted by endocrine glands into the bloodstream are called hormones. Recall that a hormone is a chemical released in one part of an organism that affects another part. Hormones convey information to other cells in your body, giving them instructions regarding your growth, development, and behavior. Once released by the glands, the hormones travel in the bloodstream and then attach to specific binding sites found on the plasma membranes, or in the nuclei, of target tissue cells. These binding sites on cells are called receptors. Figure 35.11 summarizes the action of endocrine hormones.

Example of endocrine control

Human growth hormone (hGH) is a good example of an endocrine system hormone. When your body is actively growing, blood glucose levels are slightly lowered as the growing cells use up the sugar. This low blood glucose level is detected by the hypothalamus, which stimulates the production and release of hGH from the pituitary into the bloodstream. hGH binds to receptors on the plasma membranes of liver cells. stimulating the liver cells to release glucose into your blood. Your cells need the glucose in order to continue growing. Figure 35.12 summarizes the control of hGH by the pituitary gland. You can further

investigate growth rate in humans by doing the *BioLab* at the end of this chapter.

Negative **Feedback Control**

The amount of hormone released by an endocrine gland is determined by your body's demand for that hormone at a given time. In this way, the endocrine system ensures that the appropriate amounts of hormone are present in the system at all times.

How do your endocrine glands know when you need a certain hormone? The endocrine system is controlled by a self-regulating system called the negative feedback system. The negative feedback system is a system in which the hormones, or their effects, are fed back to inhibit the original signal. The thermostat in your home is controlled by a similar negative feedback system. It maintains the room at a set temperature. When the temperature drops, the thermostat senses the lack of thermal energy and signals the heater to increase its output. When the thermal energy of the room rises again to a certain point, the thermostat no longer stimulates the heater, which shuts off. When the temperature drops again, the process repeats itself. In this negative feedback system, the increase in temperature "feeds back" to signal the thermostat to stop stimulating thermal energy production.

Feedback control of hormones

The majority of endocrine glands operate under negative feedback systems. A gland synthesizes and secretes its hormone, which travels in the blood to the target tissue where the appropriate response occurs. Information regarding the hormone

BIOLOGY JOURNAL

Hormone Actions

Linguistic Have students write a paragraph describing what happens to insulin and glucagon levels in their bodies while they sleep.

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MEETING INDIVIDUAL NEEDS

English Language Learners

Visual-Spatial Have students who are having difficulty keeping track of hormones and glands prepare a table with the columns Gland, Hormone, Action, and Target tissue. Beneath the Gland head, have students list the names of the glands presented in this section and then complete the table for each gland. [1] ELL 🎲





level or its effect on the target tissue is fed back, usually to the hypothalamus or pituitary gland, to regulate the gland's production of the hormone.

Control of blood water levels

Let's take a look at an example of a hormone that is controlled by a negative feedback system. After working out in the gym and building up a sweat, you are thirsty. This is because the water content of your blood has been reduced. The hypothalamus, which is able to sense the concentration of water in your blood. determines that your body is dehydrated. In response, it stimulates the pituitary gland to release antidiuretic (ANT ih di uh reht ihk) hormone (ADH). ADH reduces the amount of

Figure 35.12 The hypothalamus and pituitary gland control the amount of human growth hormone (hGH) in your blood.

35.3 THE ENDOCRINE SYSTEM 961

Concept Development

Insulin-dependent diabetes is also called Type I, or juvenile, diabetes. One major complication of Type I diabetes is loss of vision due to cataracts. The excessive blood glucose chemically attaches to the lens proteins, clouding the lens. Type I diabetes often causes kidney damage, also. Noninsulindependent diabetes is called Type II diabetes. Because this type of diabetes is most common in elderly people, it is sometimes called late-onset diabetes.

Ouick Demo

🔜 Visual-Spatial Using a projection microscope viewer, show a section of the pancreas. Point out the islets (small islands) containing the hormone-producing cells. These cells are surrounded by other cells that produce digestive enzymes. 👘

Assessment

Skill Have students make a graph plotting blood glucose levels against production of hGH by the pituitary.



Problem-Solving Lab 35-3

Purpose C

Students relate changes in blood insulin and glucagon levels during prolonged exercise to the body's need to get glucose to its cells.

Process Skills

recognize cause and effect, interpret data, analyze

Teaching Strategies

Ask students to list on the chalkboard the changes that occur in the body during exercise. Identify the changes that require increased glucose inside cells.

Thinking Critically

Glucagon causes blood glucose levels to rise by increasing the conversion of glycogen into glucose. The body needs more glucose during exercise. Insulin acts to lower blood glucose levels by converting glucose to glycogen. Consequently, its levels are reduced during exercise.

Assessment

Knowledge Ask students to summarize in their journals the effects of prolonged exercise on blood insulin and glucagon. Have them explain how the actions of exercise help get glucose to body cells. Use the Performance Task Assessment List for Writing in Science in PASC, p. 87. L2



VIDEODISC The Secret of Life Control of Blood Glucose



Problem-Solving Lab 35-3 Interpreting Data

What are the effects of glucagon and insulin during exercise? Exercise represents a special example of rapid fuel mobilization in the body. The body must dear up to supply great amounts of glucose and oxygen for muscle metabolism. The glucose use in a resting muscle is generally low but changes dramatically with exercise. Within ten minutes of beginning exercise, glucose uptake from the blood may increase by fifteenfold; within 60 minutes, it may increase by thirtyfold.

Analysis

Word Origin

From the Latin

words ad, meaning

"attached to," and

ren, meaning "the

adrenal glands are

located on top of

the kidneys.

kidneys." The

adrenal

The graph here shows the effects of prolonged exercise on blood insulin and glucagon levels in humans.



water in your urine. It does so by binding to receptors in kidney cells, promoting their absorption of water and reducing the amount of water excreted in urine. Information regarding blood water levels is constantly fed back to the hypothalamus so it can regulate the pituitary's release of ADH. If the body becomes overhydrated, the hypothalamus stops stimulating release of ADH.

Control of blood glucose levels

Another example of a negative feedback system involves the regulation of blood glucose levels. Unlike most other endocrine glands, the

pancreas is not controlled by the pituitary gland. When you have just eaten and your blood glucose levels are high, your pancreas releases the hormone insulin. Insulin signals liver and muscle cells to take in glucose, thus lowering blood glucose levels. When blood glucose levels become too low, another pancreatic hormone, glucagon, is released. Glucagon binds to liver cells, signaling them to release stored glycogen as glucose. Learn more about glucose storage and release by doing the Problem-Solving Lab on this page.

Hormone Action

Once hormones are released by an endocrine gland, they travel to the target tissue and cause a change. Hormones can be grouped into two basic types according to how they act on their target cells: steroid hormones and amino acid hormones.

Action of steroid hormones

Hormones that are made from lipids are called steroid hormones. Steroid hormones are lipid-soluble and therefore diffuse freely into cells through their plasma membranes, as shown in *Figure 35.13*. There they bind to a hormone receptor inside the cell. The hormone-receptor complex then travels to the nucleus where it activates the synthesis of specific messenger RNA molecules. The mRNA molecules move out to the cytoplasm where they activate the synthesis of the required proteins.

Action of amino acid hormones

The second group of hormones is made from amino acids. Recall that amino acids can be strung together in chains and that proteins are made from long chains of amino acids. Some hormones are short chains



of amino acids and others are large chains. These amino acid hormones, once secreted into the bloodstream, bind to receptors embedded in the plasma membrane of the target cell, as shown in Figure 35.14. From there, they open ion channels in the membrane, or route signals down from the surface of the membrane to activate enzymes inside the cell. The enzymes, in turn, alter the behavior of other molecules inside the cell. In both of these ways, the hormone is able to control what goes on inside the target cell.

Adrenal Hormones and Stress

You are sitting in math class and the teacher is about to hand out the semester test. Because this test is an important one, you have spent many hours studying for it. Like most of your classmates, you are a little nervous as the test is being passed down the row. Your heart is beating fast and your hands are a little sweaty. As you review the first problem, however, you begin to calm down because you know how to solve it.

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DECHPREP Juvenile Diabetes Juvenile Diabetes Juvenile Diabetes Superior State Superior State Superior	Resource Manager Basic Concepts Transparency 65 and Master 2 ELL	BIOLOGY JOURNAL Hormone Release <i>Linguistic</i> Have students write a story that describes how and whe stress hormones are released in their bo ies and the effects of these hormones. 12
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Figure 35.13 Steroid hormones

enter a cell (1), bind to a receptor (2), which in turn binds to DNA (3).

The adrenal glands play an important role in preparing your body for stressful situations. The adrenal glands, located on top of the kidneys, consist of two parts—an inner portion and an outer portion. The outer portion secretes steroid hormones, including glucocorticoids (glew ko KOR tuh koydz) and aldosterone (ahl duh STEER ohn). These steroid

Figure 35.14

When an amino acid hormone binds to the receptor on the cell membrane (1), it can open ion channels (2), or activate enzymes (3).



Enrichment

Have students identify causes of stress in their lives and bodily responses they notice as a result. increase in breathing rate, heart rate, alertness, a churning feeling in the stomach, or an increase in blood pressure List the stresses and responses on the chalkboard. Point out to students that such responses are under the control of the nervous system and hormones.

Ouick Demo

Using a whole kidney with adrenal gland attached, point out the gland and relate its position to the word origin of "adrenal" (attached to the kidneys). 👘

MiniLab 35-2

Purpose C

Students analyze a prepared slide of thyroid and parathyroid tissue.

Process Skills

compare and contrast, observe, apply concepts, hypothesize, interpret scientific illustrations

Teaching Strategies

Prepared slides of thyroid and parathyroid tissue are available from biological supply houses. It is cheaper to purchase the combined slide of both tissues rather than separate slides of each.

To further reduce costs, project one prepared slide onto a TV screen using a video camera.

Expected Results

Students will be able to differentiate between thyroid and parathyroid tissue.

Analysis

- **1.** Student may notice that thyroid tissue contains many large spaces surrounded by a thin band while parathyroid tissue contains no large spaces or follicles.
- **2. a.** thyroid
- **b.**stored hormones (thyroxine or calcitonin)
- **c.**No. No, cells, not storage areas, would be needed to produce the hormone. **d**.It makes the hormones.
- **3.** Both glands are located in the
- same general area of the neck. The parathyroids lie on the thyroid gland itself.

Assessment

Performance Ask students to research the cause and appearance of thyroid goiter. Provide students with prepared slides of normal thyroid tissue and thyroid tissue exhibiting a goiter. Have students compare and contrast the two tissues. Ask them to relate their microscopic observations to the macroscopic appearance of a goiter. Use the Performance Task Assessment List for Making Observations and Inferences in **PASC**, p. 17.

MiniLab 35-2 Observing

Compare Thyroid and Parathyroid Tissue Although their names seem somewhat similar, the thyroid and parathyroid glands perform rather different functions within the body.



a photograph of thyroid Parathvroid (A) and and parathyroid tissue. Use thyroid (B) tissue it as a guide in locating the two types of endocrine

slides.

gland tissue under low power and in answering certain analysis questions.

4 Now locate each type of gland tissue under high-power magnification. Draw what you see in the data table. Then use what you learned in the chapter to identify the names of the hormones produced by each gland.

Data Table		
Tissue	Drawing	Name of hormone(s) produced
Thyroid		
Parathyroid		
Analysis		
1. Compare th sue to that	e microscopic appeara of thyroid tissue.	nce of parathyroid tis-
2. a. Which tis storage a	ssue type contains folli areas)?	cles (large liquid
b. What ma	ay be present within th	e follicles?
c. Are follio hormone your ans	les composed of cells? associated with this g wer.	Could they produce the land tissue? Explain
d. Hypothe layer of t	size what the function tissue that surrounds e	may be for the thin ach follicle.
 How might parathyroid 	you explain the fact th I tissue can be seen on	hat both thyroid and the same slide?

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Resource Manager Reinforcement and Study Guide, p. 158 📘 2 Content Mastery, pp. 173, 175-176 BioLab and MiniLab Worksheets, p. 156 📘 2

hormones cause an increase in available glucose and raise blood pressure. In this way, they help the body combat stresses such as fright, temperature extremes, bleeding, infection, disease, and even test anxiety.

The inner portion of the adrenal gland secretes two amino acid hormones: epinephrine (ep uh NEF run)-often called adrenaline-and norepinephrine. Recall the fight-orflight response discussed in the animal behavior chapter. During such a response, the hypothalamus relays impulses to the nervous system, which in turn stimulates the adrenal glands to increase their output of epinephrine and norepinephrine. These hormones increase heart rate, blood pressure, and rate of respiration; increase efficiency of muscle contractions; and increase blood sugar levels. If you have ever had to perform in front of a large audience, you may have experienced these symptoms, often referred to collectively as an "adrenaline rush." This is how the body prepares itself to face or flee a stressful situation.

Thyroid and **Parathyroid Hormones**

The thyroid gland, located in the neck, regulates metabolism, growth, and development. The main metabolic and growth hormone of the thyroid is thyroxine. This hormone affects the rate at which the body uses energy and determines your food intake requirements.

The thyroid gland also secretes calcitonin (kal suh TONE un)-a hormone that regulates calcium levels in the blood. Calcium is a mineral the body needs for blood clotting, formation of bones and teeth, and normal nerve and muscle function. Calcitonin binds to the membranes

of kidney cells and causes an increase in calcium excretion. Calcitonin also binds to bone-forming cells, causing them to increase calcium absorption and synthesize new bone.

Another hormone involved in mineral regulation, the parathyroid hormone (PTH), is produced by the parathyroid glands, which are closely associated with the thyroid gland. It increases the rate of calcium, phosphate, and magnesium absorption in the intestines and causes the release of calcium and phosphate from bone tissue. It also increases the rate at which the kidneys remove calcium and magnesium from urine and return them to the blood.

The overall effect of parathyroid hormone and calcitonin hormone interaction in the body is shown in Figure 35.15. Take a closer look at thyroid and parathyroid tissue by completing the MiniLab on the previous page.

As you can see, hormones associated with the endocrine system are responsible for controlling many different functions in your body. Different hormones may play more important roles during some periods in your life than others. In any case, they remain the principal biological influence on your behavior and development.

Understanding Main Ideas

- 1. How does a steroid hormone affect its target cell? How does this action differ from how an
- amino acid hormone affects its target cell? 2. Explain how the nervous system helps to control
- the endocrine system.
- **3.** How does the negative feedback system work to 6. Comparing and Contrasting What effects do calcitonin and parathyroid hormone have on control hormone levels in the blood? blood calcium levels? For more information, refer 4. What glands and hormones are involved in stress reactions? to Thinking Critically in the Skill Handbook.

Portfolio

Parathyroid Hormone

Intrapersonal Have students sequence the pathway of parathyroid hormone from the parathyroid glands to its target tissues. Have students caption their flowcharts with a summary of the effects the hormone has on its target tissues. [2 P 🖙

1. A steroid hormone passes through the target cell membrane and activates protein synthesis. An amino acid hormone activates ion channels or enzyme pathways in the cell from its position on the membrane.

2. The hypothalamus, part of the brain (central nervous system), controls the

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Figure 35.15

Calcitonin and parathyroid hormone (PTH) have opposite effects on blood calcium levels.



Section Assessment

Thinking Critically

5. Hormones continually make adjustments in blood glucose levels. Why must blood glucose levels be kept fairly constant?

SKILL REVIEW

35.3 THE ENDOCRINE SYSTEM 965

3 Assess

Check for Understanding

Have students make a diagram that summarizes the control of calcium levels in the body. **ELL**

Reteach

Have students go around the room, with the first student naming a gland, the second naming a hormone, and the third naming the function of the hormone.

Extension

Have students look up information on scientists who have discovered or synthesized endocrine hormones. F. G. Banting and C. H. Best discovered insulin, while E. C. Kendall isolated thyroxine and cortisone, and P. S. Hench discovered that cortisone had a beneficial effect on inflamed tissues.



Knowledge Ask students to summarize hormonal control of blood sugar levels.

4 Close

Discussion

Discuss with students what might happen if their thyroid gland became over- or underactive.

Section Assessment

pituitary, or master, endocrine gland.

- **3.** In a negative feedback system, when a hormone reaches an appropriate level, it or its effects feed back to inhibit the release of more hormone.
- 4. The adrenal glands secrete glucocorticoids and epinephrine, hormones involved in stress reactions
- 5. Glucose is the fuel for body cells and a constant level needs to be maintained for normal body functions.
- 6. Parathyroid hormone raises blood calcium levels by increasing the rate of absorption in the intestines, while calcitonin lowers blood calcium levels by increasing its excretion rate.



Time Allotment C One class period

Process Skills

make and use graphs, interpret data, analyze

PREPARATION

Collect two sheets of graph paper and two different colored pencils for each student.





Average Growth Rate in Humans

uman growth results from more than one hormone. Human growth hormone, thyroid hormones, and the reproductive hormones that are produced during puberty are all important in human growth at various ages. Together, these hormones stimulate the growth of bone and cartilage, protein synthesis, and the addition of muscle mass. Because the reproductive hormones are involved in human growth, perhaps there is a difference in the growth rate between males and females.

PREPARATION

Problem

Is average growth rate the same in males and females?

Objectives

- In this BioLab, you will:
- **Graph** the average growth rates in males and females.
- Identify any differences in the average growth rates of males and females.

Materials blue pencils graph paper red pencils ruler

Skill Handbook

Use the **Skill Handbook** if you need additional help with this lab.

PROCEDURE

1. Construct a graph for the growth rate data that shows mass on the vertical axis and age on the horizontal axis.

2. On the graph, plot the data shown in the table for the average female growth in mass from ages 8 to 18. Use a ruler to connect the data points with a straight red line.

3. On the same graph, plot the data for the average male growth in mass from ages 8 to 18. Connect these data points with a straight blue line.

- **4.** Construct a second graph that shows height on the vertical axis and age on the horizontal axis.
- **5.** Plot the data for the average female growth in height from ages 8 to 18. Connect the data points with a straight red line.
- 6. Plot the data for the average male growth in height from ages 8 to 18. Connect these data points with a straight blue line.

Data Table: Averages for growth in humans

	Mass	s (kg)	Heigh	t (cm)		
Age	Female	Male	Female	Male		
8	25	25	123	124		
9	28	28	129	130		
10	31	31	135	135		
11	35	37	140	140		
12	40	38	147	145		
13	47	43	155	152		
14	50	50	159	161		
15	54	57	160	167		
16	57	62	163	172		
17	58	65	163	174		
18	58	68	163	178		

ANALYZE AND CONCLUDE

- **1. Analyzing Data** During what ages do females and males increase the most in mass? In height?
- **2. Analyzing Data** Interpret the data to find if the average growth rate is the same in males and females.
- 3. Thinking Critically How can you explain the differences in growth rates between males and females?
 4. Relating Concepts Why do you
- think male and female growth

PROCEDURE

Teaching Strategies

• Have students refer to the Making and Using Graphs section of the **Skill Hand-book** for help.

Troubleshooting

As students connect their data points, they should draw a line closest to the given

set of points. Remind them that not all of the points will be on the line.

Data and Observations

Students will observe that females have an earlier growth spurt than males, but on the average, males grow taller and heavier than females.



rates increase during the teen years?

Going Further

Application Determine the height of all the students in your biology class. Compare the range of heights in your class to the statistical average.

To find out more about human growth, visit the Glencoe Science Web Site. www.glencoe.com/sec/science

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Analyze and Conclude

- **1.** Mass: females, ages 11-13; males, ages 12-14. Height: females, ages 9-14; males, ages 12-15
- 2. Average growth is the same until puberty. At puberty, females have an earlier growth spurt than males, but on the average, males grow taller and have greater mass than females.
- **3.** Timing of puberty and the production of sex hormones differ between males and females. For example, males produce more of the hormone testosterone than females. Testosterone increases growth in muscle and bone mass in males.
- **4.** The reproductive hormones released during the teen years increase the growth rate.

Assessment

Portfolio Have students write summaries of the BioLab and include them, their graphs, and their answers to the questions posed in the Analyze and Conclude section in their portfolios. Use the Performance Task Assessment List for Lab Report in **PASC**, p. 47. **12**

Going Further

Ask students to research which factors are known to affect growth rate in humans, including hormones, genetics, and diet. [2]



Purpose C

Students evaluate diet programs in light of what they know about good nutrition.

Background

Several years ago, nutritionists belonging to the Food and Nutrition Science Alliance (FANSA) put together a list of "warning signs" to help consumers evaluate various diet programs. Claims to watch out for include the following:

- Recommendations that promise a quick fix
- Dire warnings of danger from a single product or regimen
- Claims that sound too good to be true
- Simplistic conclusions drawn from a complex study
- Recommendations based on a single study
- Dramatic statements that are refuted by reputable scientific organizations
- Lists of "good" and "bad" foods
- Recommendations made to
- help sell a product Recommendations based on studies published without peer review
- Recommendations from studies that ignore differences among individuals or groups

Teaching Strategies

Invite a nutritionist to your classroom to talk about the risks of fad diets and to suggest strategies for designing healthy eating plans.

Divide the class into three groups. Have each group research a popular fad diet and then present their findings regarding the likelihood that the diet will result in safe, long-term weight loss.



The Promise of **Weight Loss**

"Lose ten pounds in one week!" "Shed weight without going hungry! "Burn fat while you sleep!"

You've probably come across statements like these in magazine and television advertisements. Take a pill, sip a shake, or follow a certain eating plan and those extra pounds will just slip away—or so the headlines claim.

The appeal of fad diets Many people who are overweight (or who simply think they are) are often willing to do almost anything to lose unwanted pounds. Most fad diets look like a fast and easy solution to a weight-loss problem. But do fad diets work as advertisements claim they do? And are they safe?

Types of fad diets Some fad diets involve fasting—going without food for a period of time. Some require taking diet pills that depress the appetite, or that cause the body to lose water. Other fad diets revolve around eating only one food, or a certain kind of food. Then there are liquid diets, in which a special drink replaces breakfast and lunch, and a dieter eats only one meal of solid food each day.

A temporary solution Many people who start a fad diet shed weight quickly in the first week or two. After that, however, weight loss usually slows dramatically. This is because the initial weight loss is mostly due to loss of water, not fat. When people quit a fad diet, they usually return to their old eating habits and rapidly regain the lost weight.

What the advertisements don't say Nearly all fad diets are based on unhealthy nutritional principles. People on fad diets usually are not eating a balanced diet, and, therefore, not getting proper amounts of vitamins, minerals, and other important compounds their bodies need to grow and function properly.

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Lead the class in a discussion about societal pressures to be thin, and why Americans spend millions of dollars every year trying to lose weight.

Investigating the Issue

In most cases, students will be able to identify serious flaws in the nutritional soundness of fad diets, as well as potential health risks if the diet is followed for an extended period of time.



Some fad diets also can cause serious health problems. High-protein diets, for example, are very high in fat and cholesterol, substances that promote heart disease and circulatory problems.

Fad diets may help some people lose a few pounds temporarily. But for safe, long-term weight loss, nutritionists recommend a diet based on healthy eating habits: balanced, regular meals rich in fruits, vegetables, whole grains, sufficient protein, and small amounts of fat.

NVESTIGATING THE SSUE

Analyzing Information Collect advertisements for three different fad diets that promise "miracle" results. Based on what you know about good nutrition, would you recommend any of these diets to a friend who is trying to lose weight? Why or why not?

*inter***NET** To find out more about fad diets, visit the Glencoe Science Web Site.

www.glencoe.com/sec/science

Going Further

Have students check out Internet sites that look at the topic of weight loss or other health issues.

Digestion of a Meal

Section 35.1

Following









Main Ideas

Main Ideas

Main Ideas

stomach.

Section 35.3 The Endocrine System

Blood hormone levels are controlled by a negative feedback system. Steroid hormones bind to receptors inside the

plasma membrane receptors.

UNDERSTANDING MAIN DEAS

- **1.** Which of these is an example of mechanical digestion? a. peristalsis **c.** chewing
- **b.** coughing
- **d.** epiglottis
- **GLENCOE** TECHNOLOGY



Chapter 35: The Digestive and Endocrine Systems

Have students work in groups as they play the videoquiz game to review key chapter concepts.

Chapter 35 Assessment

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Chapter 35 Assessment

SUMMARY

Digestion begins in the mouth with both mechanical and chemical action. The esophagus transports food from the mouth to the

Chemical and mechanical digestion continue in the acidic environment of the stomach.

■ In the small intestine, digestion is completed and food is absorbed. The liver and pancreas play key roles in digestion.

The large intestine absorbs water before indigestible materials are eliminated.

Carbohydrates are the body's main source of energy. Fats are used to store energy. Proteins are used as building materials.

■ Minerals serve as structural materials or take part in chemical reactions. Vitamins are needed for growth and metabolism.

Metabolic rate determines how quickly energy

The endocrine glands work with the nervous system to regulate body functions.

target cells and amino acid hormones bind to

Vocabularv

amylase (p. 948) bile (p. 951) epiglottis (p. 950) esophagus (p. 948) gallbladder (p. 952) large intestine (p. 953) liver (p. 951) pancreas (p. 951) pepsin (p. 951) peristalsis (p. 950) rectum (p. 953) small intestine (p. 951) stomach (p. 950) villus (p. 952)

Vocabulary

Calorie (p. 957) mineral (p. 956) vitamin (p. 956)

Vocabulary

adrenal glands (p. 963) endocrine glands (p. 959) hypothalamus (p. 960) negative feedback system (p. 961) parathyroid glands (p. 965) pituitary gland (p. 959) receptor (p. 960) target tissues (p. 960) thyroid gland (p. 964)

- 2. Which of these is NOT a function of the digestive system?
- **a.** eliminating wastes
- **b.** absorbing nutrients
- **c.** digesting food
- **d.** regulating metabolism

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Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site. www.glencoe.com/sec/science



All Chapter Assessment

questions and answers have been validated for accuracy and suitability by The Princeton Review.

Understanding Main Ideas

1. c **2.** d

Chapter 35 Assessment

- **3.** a
- 4. (lemon juice)
- **5.** c
- 6. d
- **7.** a
- 8. d
- **9.** c
- **10.** c
- **11.** endocrine, target tissues
- **12.** amylase, starches
- **13.** epiglottis, respiratory tract
- **14.** glycogen, glucose **15.** insulin, glucose
- **16.** mineral
- **17.** Steroid, amino acids
- **18.** hypothalamus, pituitary gland
- **19.** pituitary, hypothalamus
- **20.** esophagus, stomach

process would still move food along your digestive tract. **a.** peristalsis **c.** secretion **b.** swallowing **d.** absorption

3. Even if you were standing on your head, this

- **4.** Which of the substances listed in *Table 35.4* have a pH near that of vour stomach during digestion?
- **5.** Which of these enzymes functions best in the acidic pH of the stomach?

baking soda

- **a.** lipase c. pepsin **b.** lactase **d.** amylase
- 6. What is the primary function of the large intestine?
- **c.** vitamin synthesis **a.** food absorption **b.** food digestion **d.** water absorption
- 7. Which of the following is under the control of the hypothalamus?
- **a.** pituitary gland **c.** pancreas
- **b.** taste buds **d**. liver
- 8. Which of these is NOT a function of the thyroid gland?
- **a.** controls growth and development
- **b.** regulates metabolism
- **c.** regulates blood calcium levels
- **d.** responds to stressful situations
- 9. What unit is used to measure the energy content of food? **a.** temperature **c.** Calorie
- **b.** grams **d.** mass
- THE PRINCETON REVIEW TEST-TAKING TIP

Where's the fire?

Slow down! Go back over reading passages and double-check your math. Remember that doing most of the questions and getting them right is always preferable to doing all the guestions and getting lots of them wrong.

10. What is the most abundant substance in the human body? **a.** carbohydrates **c.** water **b.** vitamins **d.** proteins

- **11.** Hormones released by _____ glands affect specific areas known as _____
- **12.** Salivary glands in your mouth produce , an enzyme that breaks down
- **13.** The _____ prevents swallowed food from entering the
- **14.** When your body needs energy, it breaks in the liver and releases down _ into the bloodstream.
- **15.** The pancreas releases the hormone which removes _____ from the blood.
- is an inorganic substance that **16.** A(n) serves as a building material or takes part in a chemical reaction in the body.
- hormones are made from lipids; the 17. other group of hormones is made from
- **18.** A negative feedback system controls the level of hormones by feeding back information to the _____ or the _
- **19.** The _____ gland is controlled by the ____, tying the endocrine and nervous systems together.



APPLYING MAIN DEAS

21. Achlorhydria is a condition in which the stomach fails to secrete hydrochloric acid. How would this condition affect digestion? 22. How could removal of the parathyroid gland affect muscle contraction?

THINKING CRITICALLY

- 23. Recognizing Cause and Effect How is the role of pancreatic hormones in glucose regulation important for homeostasis?
- **24.** Interpreting Data The relationship between parathyroid hormone secretion and blood calcium levels is shown in the graph below. To what level does the blood calcium level have to fall in order to get maximum parathyroid hormone secretion?



25. Concept Mapping Complete the concept map by using the following vocabulary terms: liver, bile, small intestine, stomach, esophagus, gallbladder.



CD-ROM

For additional review, use the assessment options for this chapter found on the Biology: The Dynamics of Life Interactive CD-ROM and on the Glencoe Science Web Site. www.glencoe.com/sec/science

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Table 35.4 рН 5 12

Substance black coffee bleach lemon juice 2

9

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í.				
ł	6	2		
L	ç	2		

Assessing Knowledge & Skills

The following table contains nutritional information for a meal of macaroni and cheese.

Table 35.5 Macaroni and cheese nutrition Serving size: 8 ounces Calories per serving: 280		
Nutrient	Grams per serving	Calories per gram
Protein	7	4
Carbohydrate	35	4
Fat	12	9
Sodium	1.540	0

Interpreting Data Use the data in *Table*

35.5 to answer the following questions.

- **1.** How many Calories are there in one serving of macaroni and cheese? **a.** 7 **c.** 280 **b.** 35 **d.** 1540
- 2. Being fond of macaroni and cheese, Juan eats five servings each day. Assuming this is all he eats, how many Calories does Juan eat each day? **c.** 300

d. 1400

- **a.** 8 **b.** 35
- **3.** What percent of Juan's Calories are derived from fat?
- **a.** less than 1 percent
- **b.** approximately 10 percent
- **c.** approximately 38 percent
- **d.** more than 50 percent
- 4. Juan should eat only 1800 Calories a day. What proportion of his daily diet is derived from his five servings of macaroni and cheese?
- **a.** 10 percent **b.** 38 percent
- **c.** 50 percent **d.** 78 percent
- 5. Interpreting Data The recommended daily allowance of sodium is approximately 2.4 g. Make a statement that describes Juan's sodium intake.

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APPLYING MAIN DEAS

- **21.** The enzyme pepsin would not have the proper environment in which to function. As a result, proteins would not be digested in the stomach.
- 22. The parathyroid glands secrete PTH, which increases the calcium level in the blood. Calcium is required for muscle contraction. Removal of the gland could greatly reduce blood calcium concentration and interfere with muscle contraction.

THINKING CRITICALLY

- 23. The glucose concentration in the blood is maintained in a very narrow range. The pancreas releases insulin to remove glucose from the blood and glucagon to cause the release of glucose into the blood.
- 24. Blood calcium levels must drop below 8 mg/dL to get maximum parathyroid hormone secretion.
- 25. 1. Esophagus; 2. Stomach; 3. Small intestine; 4. Liver; 5. Bile; 6. Gallbladder

Assessing Knowledge & SKILLS

- **1.** c
- **2.** d
- **3.** c
- **4.** d
- **5.** George's diet contains too much sodium.