

SECTION

3

READING WARM-UP

Objectives

- Explain why the endocrine system is important to the body.
- Identify five glands of the endocrine system, and describe what their hormones do.
- Describe how feedback mechanisms stop and start hormone release.
- Name two hormone imbalances.

Terms to Learn

endocrine system
gland
hormone

READING STRATEGY

Discussion Read this section silently. Write down questions that you have about this section. Discuss your questions in a small group.

endocrine system a collection of glands and groups of cells that secrete hormones that regulate growth, development, and homeostasis

gland a group of cells that make special chemicals for the body

Figure 1 When you have to move quickly to avoid danger, your adrenal glands make more blood-glucose available for energy.

The Endocrine System

Have you ever heard of an epinephrine (EP uh NEPH rin) rush? You might have had one without realizing it. Exciting situations, such as riding a roller coaster or watching a scary movie, can cause your body to release epinephrine.

Epinephrine is a chemical messenger produced by the adrenal glands. Adrenal glands are part of a second body-control system, the endocrine system.

Glands and Hormones

The **endocrine system** is a collection of glands and groups of cells that secrete hormones. A **gland** is a group of cells that make special chemical messengers for your body. These chemical messengers are called hormones. A **hormone** is a chemical messenger made in one cell or tissue that causes a change in another cell or tissue in another part of the body. Endocrine system hormones regulate growth, development, and homeostasis. Hormones flow through the bloodstream to all parts of the body. Thus, an endocrine gland near your brain can control an organ—or many organs—somewhere else in your body.

In the situation shown in **Figure 1**, the adrenal glands release the hormone *epinephrine*. Epinephrine increases your heartbeat and breathing rate. This response is called the “fight-or-flight” response. When you are frightened, angry, or excited, the “fight-or-flight” response prepares you to fight the danger or to run from it.



More Endocrine Glands

Your body has several other endocrine glands. Some of these glands have many functions. For example, your pituitary gland stimulates skeletal growth and helps the thyroid gland work properly. It also regulates the amount of water in the blood. And the pituitary gland stimulates the birth process in women.

Your thyroid gland is very important during infancy and childhood. Thyroid hormones control the secretion of growth hormones for normal body growth. Thyroid hormones also control the development of the central nervous system. And they control your metabolism. *Metabolism* is the sum of all the chemical processes that take place in an organism.

Your thymus gland is important to your immune system. Cells called *killer T cells* grow and mature in the thymus gland. These T cells help destroy or neutralize cells or substances that invade your body. The names and some of the functions of endocrine glands are shown in **Figure 2**.

Reading Check Name two endocrine glands, and explain why they are important to your body. (See the Appendix for answers to Reading Checks.)

hormone a substance that is made in one cell or tissue and that causes a change in another cell or tissue in a different part of the body

CONNECTION TO Language Arts

WRITING SKILL

Working Together

Write a report analyzing how your nervous system and your endocrine system work together to provide for your needs. Especially, evaluate how these two systems work together to help regulate your internal environment. Illustrate your report.

Figure 2 Endocrine Glands and Their Functions

The **pituitary gland** secretes hormones that affect other glands and organs.

The **parathyroid glands** (behind the thyroid) regulate calcium levels in the blood.

The **adrenal glands** help the body respond to danger.

The **pancreas** regulates blood-glucose levels.

The **ovaries** (in females) produce hormones needed for reproduction.

Your **thyroid gland** increases the rate at which you use energy.

The **thymus gland** regulates the immune system, which helps your body fight disease.

The **testes** (in males) produce hormones needed for reproduction.

Controlling the Endocrine Glands

Do you remember the feedback mechanisms at work in the nervous system? Endocrine glands control similar feedback mechanisms. For example, the pancreas has specialized cells that make two different hormones, *insulin* and *glucagon*. As shown in **Figure 3**, these two hormones control the level of glucose in the blood. Insulin lowers blood-glucose levels by telling the liver to convert glucose into glycogen and to store glycogen for future use. Glucagon has the opposite effect. It tells the liver to convert glycogen into glucose and to release the glucose into the blood.


 **Reading Check** What does insulin do?

Figure 3 Blood-Glucose Feedback Control

5b Sometimes, to raise your blood-glucose level, you must eat something.

5a If your blood-glucose falls too far, glucagon tells the liver to break down glycogen and release the glucose into your blood.



Pancreas

4 When the pancreas detects that your blood-glucose level has returned to normal, it stops releasing insulin.



Liver

1 Glucose is fuel for your body. Glucose is absorbed into the bloodstream from the small intestine.

2 When the glucose level in the blood is high, such as after a meal, the pancreas releases the hormone insulin into the blood.



Pancreas

3 Insulin signals the liver to take in glucose from the blood, convert the glucose into glycogen, and to store glycogen for future energy needs.



Hormone Imbalances

Occasionally, an endocrine gland makes too much or not enough of a hormone. For example, when a person's blood-glucose level rises, the pancreas secretes insulin. Insulin sends a message to the liver to convert glucose into glycogen. The liver stores glycogen for future use. But a person whose body does not use insulin properly or whose pancreas does not make enough insulin has a condition called *diabetes mellitus* (DIE uh BEET EEZ muh LIET uhs). A person who has diabetes may need daily injections of insulin to keep his or her blood-glucose levels within safe limits. Some patients, such as the woman in **Figure 4**, receive their insulin automatically from a small machine worn next to the body.

Another hormone imbalance is when a child's pituitary gland doesn't make enough growth hormone. As a result, the child's growth is stunted. Fortunately, if the problem is detected early, a doctor can prescribe growth hormone and monitor the child's growth. If the pituitary makes too much growth hormone, a child may grow taller than expected.

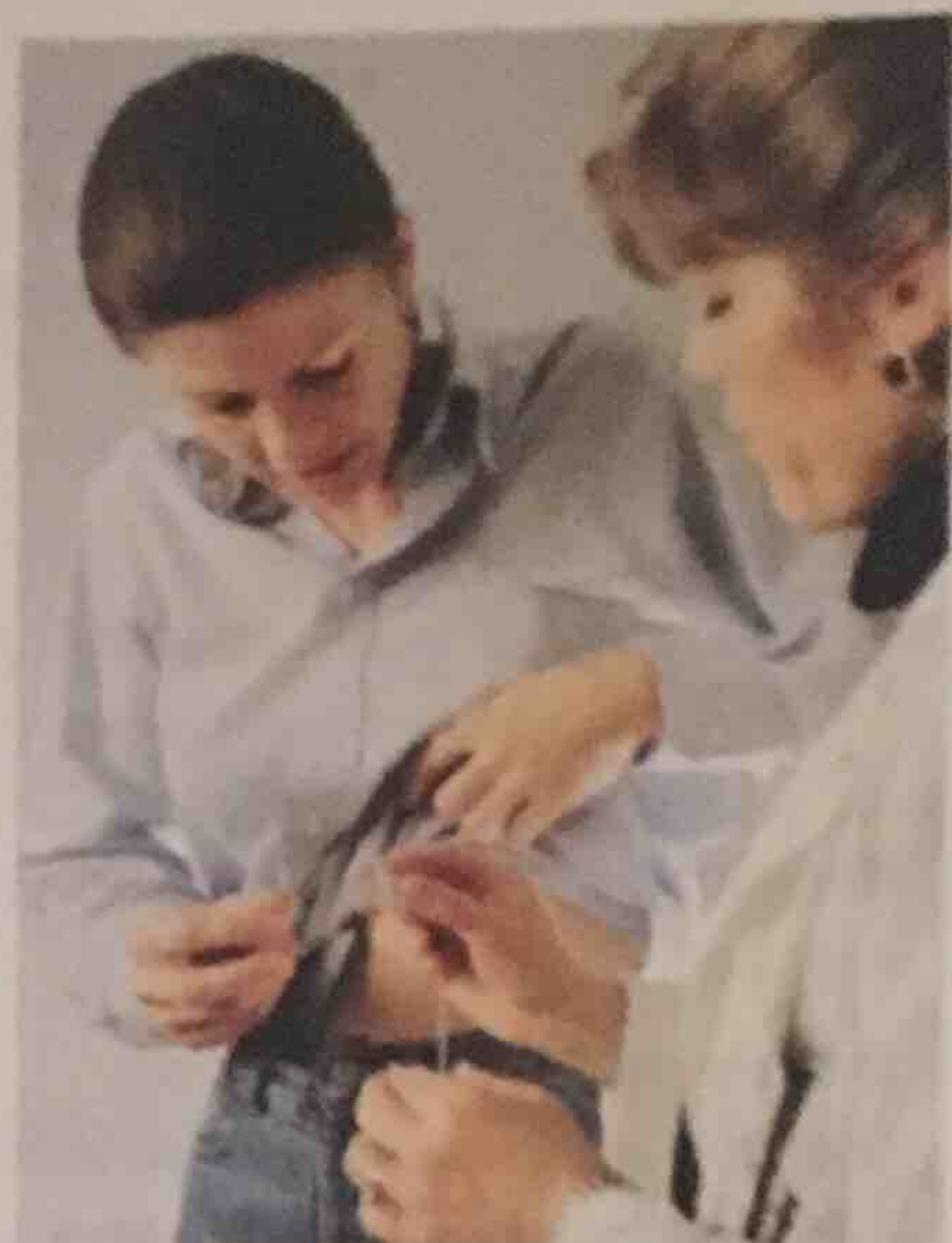


Figure 4 This woman has diabetes and receives insulin from a device that monitors her blood-glucose level.

SECTION Review

Summary

- Glands in the endocrine system use chemical messengers called *hormones*.
- Hormones regulate body functions by causing changes in cells or tissues.
- Feedback mechanisms tell endocrine glands when to turn hormones on and off.
- A hormone imbalance is when a gland releases too much or too little of a hormone.

Using Key Terms

1. Use the following terms in the same sentence: *endocrine system*, *glands*, and *hormone*.

Understanding Key Ideas

2. Identify five endocrine glands, and explain why their hormones are important to your body.
3. Hormone imbalances may cause
 - a. feedback and insulin.
 - b. diabetes and stunted growth.
 - c. thyroid and pituitary.
 - d. glucose and glycogen.
4. How do feedback mechanisms control hormone production?

Math Skills

5. One's bedtime blood-glucose level is normally 140 mg/dL. Ty's blood-glucose level is 189 mg/dL at bedtime. What percentage above 140 mg/dL is Ty's level?

Critical Thinking

6. **Making Inferences** Glucose is a source of energy. Epinephrine quickly increases the blood-glucose level. Why is epinephrine important in times of stress?
7. **Applying Concepts** The hormone glucagon is released when glucose levels fall below normal. Explain how the hormones glucagon and insulin work together to control blood-glucose levels.

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