THE ENDOCRINE SYSTEM

From infancy through adulthood, the human body goes through many remarkable changes. When you were an infant you could not even sit up. As you grew and entered childhood, you became stronger and heavier. Some of the most profound physical changes occur during adolescence. This is the time when the reproductive system matures and you physically become an adult. Many of these changes are regulated by a network of organs that release specific chemicals into the bloodstream. This group of organs is collectively known as the **endocrine system** [*EN duh krun*].

MAIN IDEAS

CONCEPTS

- ✔ Hormones released by the endocrine system control many bodily functions.
- ✔ Hormones trigger many of the physical changes that occur during adolescence.
- ✔ Endocrine disorders can result in serious health problems.

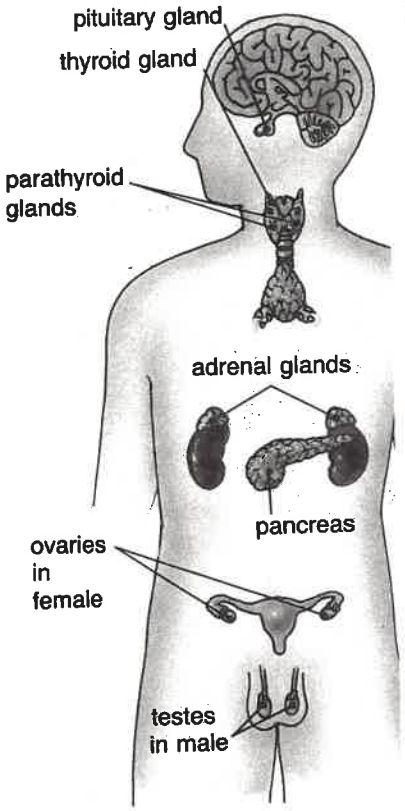
VOCABULARY

endocrine system
endocrine gland
hormone
hypothalamus
pituitary gland
pancreas
insulin
diabetes mellitus
thyroid gland
adrenal gland
adrenaline
puberty
estrogen
testosterone
ovary
testes

GLANDS AND HORMONES

The organs of the endocrine system are called **endocrine glands**. Each endocrine gland produces and releases hormones into the bloodstream. The major endocrine glands are shown in Figure 17-1. A **hormone** is a chemical substance that travels from an endocrine gland through the bloodstream to other organs and tissues to regulate growth or activity.

Figure 17-1 The endocrine glands are located throughout the body. Which gland is in the brain?



BODILY FUNCTIONS The endocrine system controls many important functions that keep your body in balance even under changing conditions. For example, the endocrine system is responsible for maintaining the body at a constant temperature whether you are exercising heavily or relaxing in the shade. The endocrine system also controls appetite and thirst, the rate at which food is digested, the elimination of waste through the kidneys, and a person's sleeping cycle. Even heart rate and blood pressure are partially controlled by the endocrine system. Finally, the endocrine system controls the rate at which you grow and develop, and it controls the changes that occur that make reproduction possible.

HYPOTHALAMUS AND PITUITARY GLANDS Because hormones can exert such powerful effects, even in small amounts, it is critical for the body to be able to regulate the amount of each hormone that is released by the glands. The key to controlling the release of hormones is by close coordination between the nervous system and the endocrine system. The nervous system senses whether hormones are needed and signals the endocrine system to release hormones. One of the most important connections between the nervous system and the endocrine system is the link between a part of the brain called the **hypothalamus** [*hy poh THAL uh mus*] and a pea-sized gland located just below the hypothalamus called the **pituitary gland** [*puh TYOO uh ter ee*].

The hypothalamus plays a key role in keeping track of many bodily functions. The hypothalamus monitors body temperature, blood pressure, and controls hunger and thirst. It also monitors the levels of many different hormones circulating in the blood. If the hypothalamus senses low levels of a particular hormone, it signals

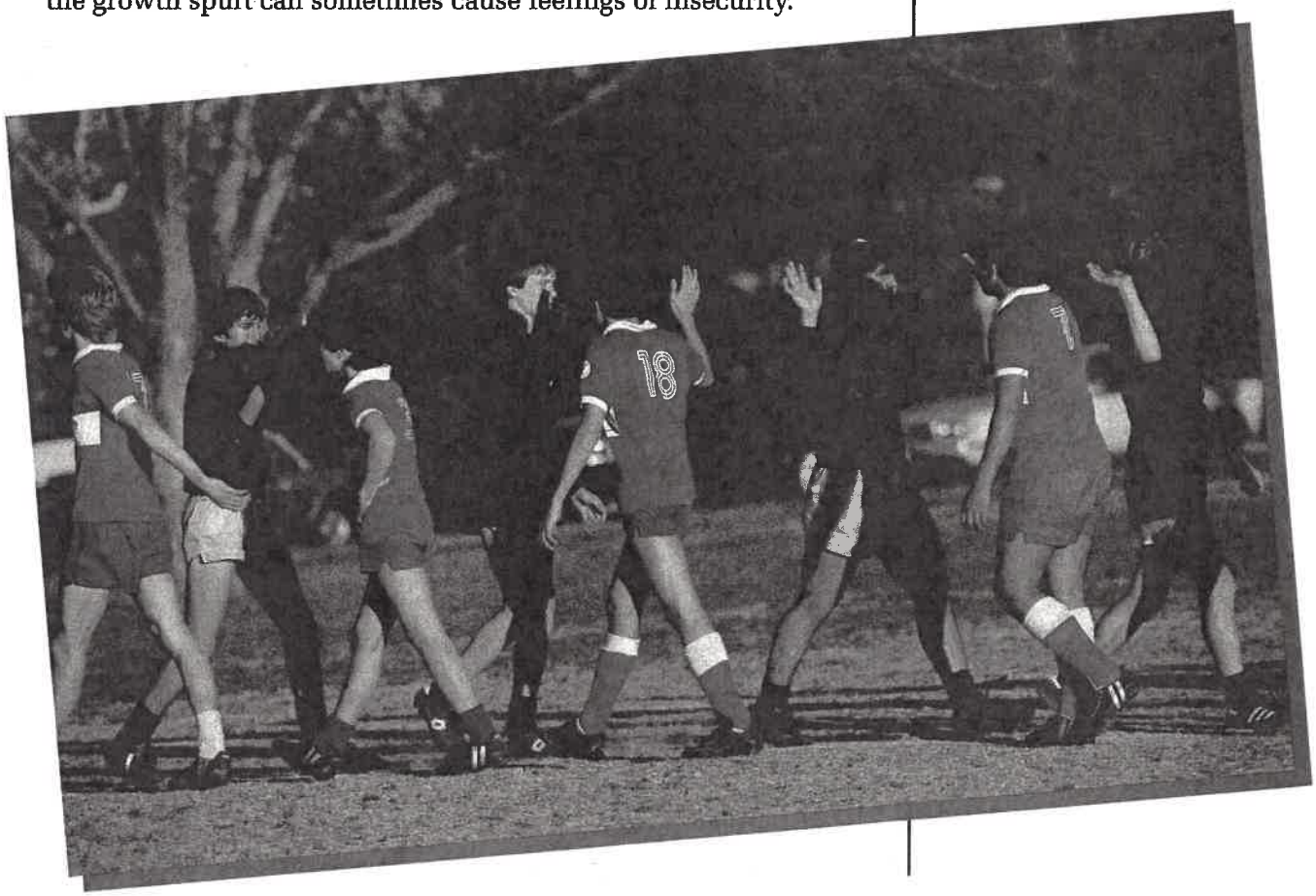
the pituitary gland to release specific hormones. These hormones released by the pituitary gland serve several purposes including the stimulation of other glands in the body for the release of other hormones.

REGULATING GROWTH

One of the many functions of hormones released by the pituitary gland is the regulation of growth of the human body. The rate of growth throughout a person's life is controlled by a hormone released by the pituitary gland called growth hormone. Growth hormone stimulates the growth of bones and muscles.

Some of the most dramatic periods of growth occur during adolescence. During this time, a teenager may grow an average of 3 or 4 inches a year, with boys usually growing faster than girls. During adolescence, teenagers also experience many other changes in their bodies, including weight gain, increased muscle development, and the redistribution of fat in the body. The pituitary gland also begins to release other hormones which stimulate the development of the reproductive glands. As you will learn, the reproductive glands produce hormones that cause other physical changes.

VARIATIONS IN GROWTH Although hormones play a major role in regulating growth, other factors are also important. A person's final height is largely determined by heredity. The timing of the growth spurt also varies between individuals. Differences in the timing of the growth spurt can sometimes cause feelings of insecurity.



The time at which teenagers physically mature varies from person to person. Is it possible to tell the age of these teenagers based on their appearance?

Marty was concerned that he was not physically developing as rapidly as other boys his age. He felt self-conscious about his lack of size and strength and therefore decided not to try out for any sports teams. Because he felt that girls only liked taller guys who play sports, he started to withdraw from social activities.

One day the coach of the baseball team approached Marty and asked him why he was not trying out. Marty explained that he didn't think he was big enough and that he was embarrassed to try out. The coach reassured Marty that his size would not be a problem as long as he had the interest. He also told Marty that it was common for some teenagers to develop later than others so there was no need to be embarrassed. Marty thought about what the coach had said. He decided that he could not control his growth and he was not going to let it prevent him from doing something he loved—playing baseball. He tried out and made the team. Although he was not on the first team, he began to build confidence in himself once again.

It is not uncommon for a person's growth spurt to occur two or three years before or after that of his or her peers. Females usually begin their growth spurt sooner than males. However, males eventually catch up and, on average, pass the females in height. A person's final height will be similar to that of other family members. The timing of the growth spurt has no effect on what the person will look like as an adult. It is therefore important that people who begin to develop later than their peers remain patient.

GROWTH DISORDERS In rare cases, the pituitary gland does not produce the proper amount of growth hormone. If too little growth hormone is produced, the person may be very short, although the body will still be normally proportioned. If detected early in childhood, this condition can often be corrected with injections of growth hormone. If too much growth hormone is released by the pituitary gland during childhood or adolescence, the person may be abnormally tall.

REGULATING ENERGY

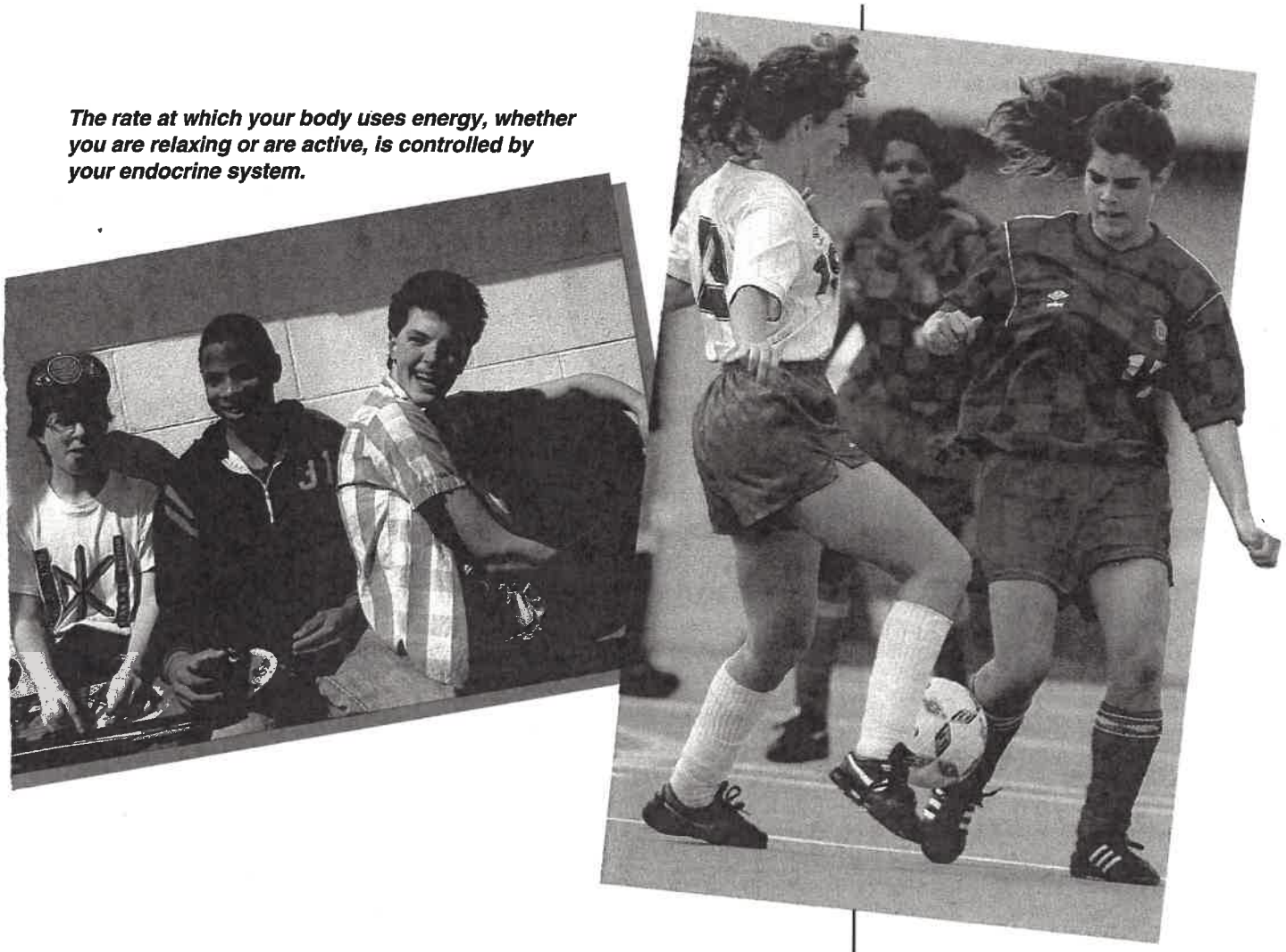
The availability of energy for your cells is critical for meeting the body's changing needs. Increased energy is needed for growth throughout childhood and adolescence, for periods of strenuous exercise, and for preparing the body to respond to stressful situations. The endocrine system plays a central role in regulating the amount of energy that the body uses.

CONTROL OF BLOOD SUGAR Most of the energy that cells use to carry out their functions comes from the sugar glucose. The rate at which glucose is moved from the bloodstream to the cells is controlled by hormones produced by the **pancreas** [*PANG kree us*]. The pancreas is a gland that is part of both the endocrine system and the digestive system. (See Chapter 12, "Digestion and Excretion.") One hormone produced by the pancreas is insulin. **Insulin** stimulates the cells to take up glucose from the bloodstream.

FOR YOUR INFORMATION

Hormonal disorders are sometimes caused by the growth of tumors on the pituitary gland.

The rate at which your body uses energy, whether you are relaxing or are active, is controlled by your endocrine system.



If the pancreas is unable to produce enough insulin, the amount of sugar in the bloodstream increases, causing a condition called **diabetes mellitus** [*dy uh BEET eez MEL ut us*]. If untreated, diabetes can lead to nerve damage, blindness, kidney failure, and death. Diabetes usually can be treated through a controlled diet, exercise, and if necessary, regular injections of insulin.

CONTROL OF METABOLISM Metabolism is the rate at which individual cells convert food to energy. The rate is controlled by the **thyroid gland** [*THY royd*]. As you can see in Figure 17-2, the thyroid gland is a butterfly-shaped gland that fits around your windpipe. It is stimulated by the pituitary gland to release hormones that control metabolism in each cell. One of the key chemicals that makes up these hormones is iodine. People who do not get enough iodine in their diet may develop an enlarged thyroid gland called a goiter. Good sources of iodine are seafood and enriched table salt.

Problems also can develop if the thyroid gland releases hormones at the wrong rate. If hormones are released too quickly, the heart rate increases and body temperature and blood pressure rise. An overactive thyroid can be treated with medicine or through surgical removal of part of the gland. If hormones are released too

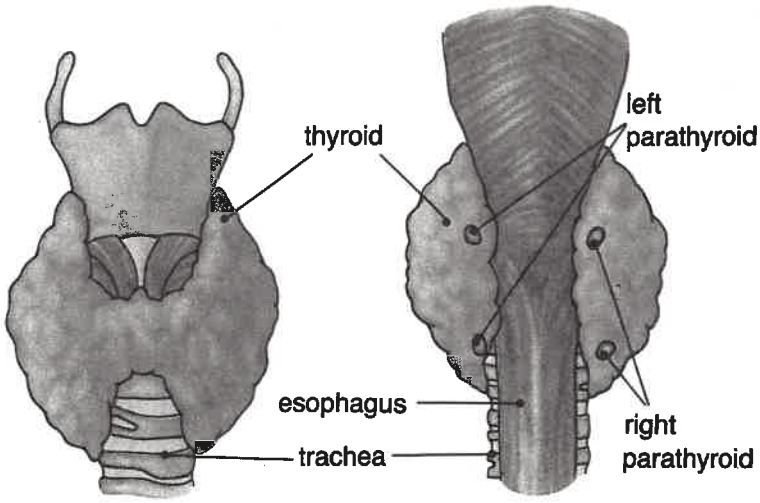


Figure 17-2 The thyroid gland is located around the windpipe at the front of your throat. Where are the parathyroid glands located?

slowly, metabolism slows down, heart rate decreases, and nervous system activity is reduced. Treatment for an underactive thyroid involves giving the person more of the hormone.

CONTROL OF CALCIUM

The healthy development of bones depends upon the availability of calcium. However, calcium is also necessary for muscle contractions, the proper functioning of nerves, and for blood clotting. Therefore, the healthy body requires a balance between the calcium used for bone development and the calcium that circulates in the bloodstream. The amount of calcium in the bloodstream is controlled by a hormone released by the thyroid gland and a hormone released by four glands located on the thyroid gland. These four glands are called the parathyroid glands. The hormone from the thyroid gland causes calcium to move from the bloodstream to the bones. The hormone from the parathyroid glands causes calcium to be released from the bones into the bloodstream.

STRESS

During an anxious situation, such as the moment just before a test or a frightening scene in a movie, you may become tense. Your heart starts to pound, and you become more alert. These reactions are caused by hormones released by the adrenal glands.

The **adrenal glands** sit on the top of the kidneys. When stimulated by the pituitary gland, the adrenal glands release several different hormones, including some hormones that help regulate metabolism and some hormones that regulate the amount of water in the bloodstream. The adrenal glands also produce **adrenaline** [*uh DREN ul un*]—the hormone that is released when you are angry, frightened, excited, or under stress. Adrenaline causes your heart to beat faster and increases blood flow to vital organs, giving your body a surge of power.

FOR YOUR INFORMATION

The hormone adrenaline is often used to treat people who have a severe reaction to bee stings.

ENDOCRINE GLANDS

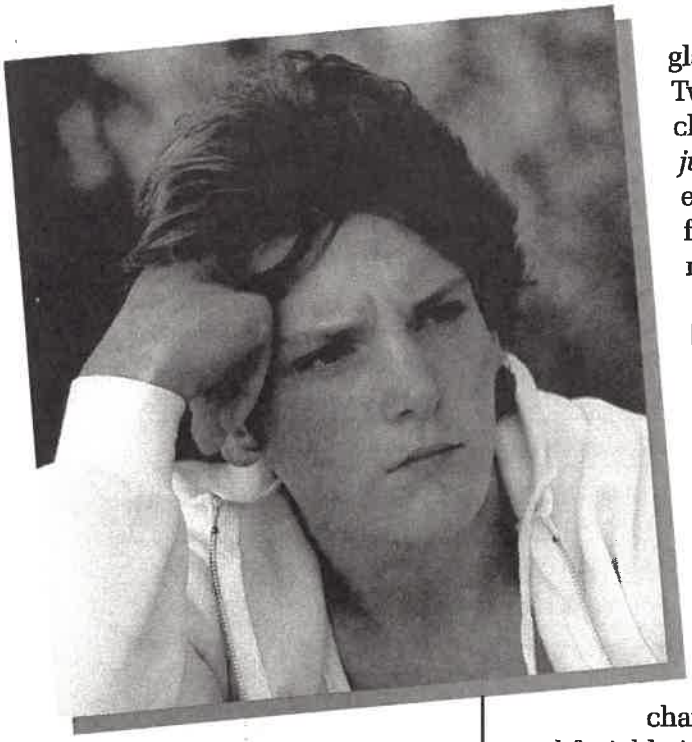
Gland	Hormone	Function
Pituitary anterior lobe	Growth hormone	Controls growth of bones and skeleton
	ACTH	Stimulates secretion of adrenal gland hormones
	Thyroid-stimulating hormone	Regulates body metabolism and the size of the thyroid gland
	Prolactin	Influences mammary glands to secrete milk
	Luteinizing hormone	Induces production and growth of corpus luteum
Pituitary posterior lobe	Follicle-stimulating hormone	Stimulates development of eggs in ovaries
	Oxytocin	Stimulates muscle contractions of uterus and milk production in mammary glands
	Vasopressin	Controls reabsorption of water in kidney
Thyroid	Thyroxin	Controls body's metabolic rate
	Calcitonin	Increases amount of calcium deposited in bones
Parathyroids	Parathyroid	Causes bones to release calcium into bloodstream
Adrenal Glands	Aldosterone	Prevents excess sodium and water loss into urine
	Cortisol	Controls protein metabolism and the production of glucose by the liver Regulates connective tissue structure and the amount of sodium and potassium in body tissues
	Adrenaline	Constricts blood vessels in liver, heart, and skeletal muscles Elevates blood pressure and respiratory rate Converts glycogen to glucose
Pancreas	Glucagon	Converts glycogen to glucose
	Insulin	Regulates glucose metabolism in liver and body tissues
Testes	Testosterone	Stimulates maturation of male reproductive system Produces male secondary sex characteristics
Ovaries	Estrogen	Stimulates maturation of female reproductive system Produces female secondary sex characteristics
	Progesterone	Maintains uterine lining

Figure 17-3 Some endocrine glands produce several different hormones. What hormones are produced by the adrenal glands?

During long periods of physical or emotional stress, the continuous release of adrenaline can have negative effects on your overall health. Symptoms of long periods of stress may include headaches, digestive problems, and greater susceptibility to illness. Prolonged stress also can lead to anxiety, irritability, and depression. Chapter 5, "Managing Stress," provides a more complete discussion on stress and related concerns.

HORMONES AND REPRODUCTION

The early teenage years is the time when the reproductive system in boys and girls begins to develop. This period of time is known as **puberty** [*PYOO burt ee*]. Many of the changes that teenagers experience are controlled by hormones produced by the pituitary



Adolescence can sometimes produce new emotions.

gland and by glands located in the reproductive organs. Two of the hormones that are responsible for many of the changes that occur during puberty are **estrogen** [*ES truh jun*] and **testosterone** [*te STAHS tuh rohn*]. Although estrogen and testosterone are present in males and females, females produce higher levels of estrogen and males produce higher levels of testosterone.

FEMALES During puberty, the production of estrogen in females increases dramatically. Estrogen is responsible for many of the physical characteristics of women. These characteristics include breast development and the widening of the hips. Estrogen is also essential for the regulation of the female reproductive cycle. Most of the estrogen in females is produced by the ovaries. The **ovaries**, the pair of organs that produce egg cells, are located in the pelvic region.

MALES The development of many of the physical characteristics in males, including the growth of chest and facial hair, the development of muscle tissue, and the enlargement of the penis, is triggered by testosterone. Testosterone is also involved in triggering the production of sperm cells. Most of the testosterone in males is produced by the **testes** [*TES teez*]. As you will learn, the testes are the organs where sperm cells are produced.

The changes that occur during puberty are some of the most dramatic examples of the endocrine system in action. Physical changes such as a sudden growth spurt or the development of the reproductive system are sometimes difficult to predict. Subtle changes experienced by some teenagers such as irritability, sudden mood swings, and emotional outbursts are even more difficult to anticipate. It is important to realize that these changes are experienced by all teenagers and that they are part of becoming an adult.

SUMMARY

The endocrine glands produce and release hormones directly into the bloodstream. Hormones help regulate the growth of bones and muscles, metabolism, responses to stress, and sexual development. During puberty, hormones trigger a growth spurt and the maturation of the reproductive system.

LESSON 17.1 USING WHAT YOU HAVE LEARNED

REVIEW

1. What is the function of insulin?
2. Describe the symptoms of an overactive thyroid gland.

THINK CRITICALLY

3. Many teenagers develop large appetites which then diminish as they reach adulthood. What changes occur during puberty that would cause the appetite to increase? Which hormones are involved in these changes?
4. Many disorders of the endocrine system are treated using hormones. Why might it be dangerous to use hormones when you are not under the strict supervision of a doctor?

APPLY IT TO YOURSELF

5. You are going to give a talk to a group of nine-year-olds about some of the physical changes they might experience as they grow older. What subjects would you be covering?

FEMALE DEVELOPMENT

For girls, puberty not only brings about changes in physical appearance, but it is also the time when the reproductive system matures and the reproductive cycle begins. Often these changes can seem unsettling. However, by understanding the changes that are taking place, a teenage girl can begin to come to terms with the changes that are occurring, and she also can take steps toward keeping her reproductive system healthy.

MAIN IDEAS

CONCEPTS

- ✔ The age at which puberty occurs varies from one girl to the next.
- ✔ Hormones control the stages of the female reproductive cycle.
- ✔ Most reproductive disorders in women can be prevented or treated.

VOCABULARY

secondary sex characteristic
pubic hair
Fallopian tube
uterus
endometrium
cervix
vagina
menstrual cycle
ovulation
menstruation
menopause
premenstrual syndrome
toxic shock syndrome
ovarian cyst
Pap test
infertile
endometriosis
pelvic inflammatory disease

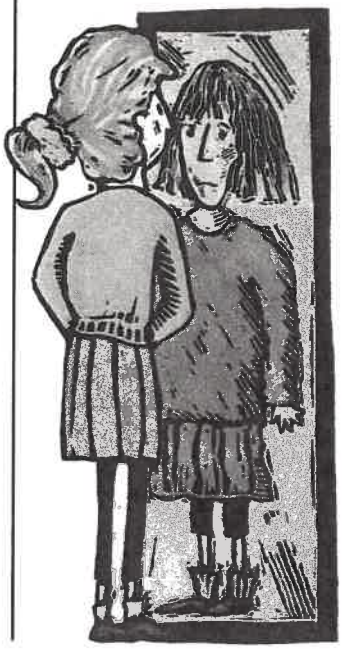
CHANGES DURING PUBERTY

As you learned in the previous lesson, hormones released by the pituitary gland and the ovaries trigger a growth spurt and the maturation of a girl's reproductive organs. The hormone estrogen is largely responsible for changes in the reproductive system; however it is also responsible for a number of other physical changes known as **secondary sex characteristics**.

SECONDARY SEX CHARACTERISTICS As puberty begins, a girl will start to notice changes in the shape of her body. One of the most notable changes is the development of breasts. The breasts start as a small concentration of fat and gradually develop to their full size over several years. A girl's hips will also begin to widen.

Other secondary sex characteristics begin to develop at various times during puberty. The girl's voice will become richer. Coarse hair called **pubic hair** begins to grow around the external sex organs, or genitals. Hair also begins to grow under the arms and on the legs. There also may be some growth of a small amount of facial hair. The pores in the skin become larger and glands in the skin produce more oil and sweat. Some effects of increased oil and sweat production include acne and increased body odor.

Rapid physical changes during adolescence often can make teenagers feel uncomfortable with their appearance.



STRESSES OF PUBERTY The rapid changes that occur during puberty can often be a source of tension, particularly for girls who develop earlier or later than others their age. A girl who matures early may sometimes feel isolated because none of her friends are at the same stage of development. On the other hand, a girl who develops later than her friends may feel anxious about her slower development and worry that something is wrong with her. In most cases, anxious feelings will disappear once everybody has reached a similar stage of development.

THE FEMALE REPRODUCTIVE SYSTEM

During puberty, the female reproductive system matures to the point where the teenager is physically able to have a child. A healthy female reproductive system is able to produce egg cells that are capable of being fertilized and also is physically able to support a developing fetus.

FOR YOUR INFORMATION

Hormones released by the ovaries, including estrogen and progesterone, trigger most of the physical changes that occur to women during pregnancy.

PRODUCTION OF EGG CELLS As you can see in Figure 17-4, egg cells are produced and stored in each ovary—the same organs that produce estrogen. Next to each ovary is a narrow tube called the **Fallopian tube** [*fuh LOH pee un*]. Egg cells that are released from the ovary travel through the Fallopian tube. If sperm cells are also present in the Fallopian tube, fertilization of the egg may occur.

THE UTERUS After traveling through the Fallopian tube, the egg cell reaches the uterus. The **uterus** [*YOOT uh rus*], or womb, is the muscular organ in which the fetus develops. The uterus is lined with a thick, spongy tissue called the **endometrium** [*en doh MEE tree um*], which provides the fertilized egg with nourishment during the early stages of development.

The lower portion of the uterus is called the **cervix**. Normally the opening to the cervix is quite small, but during childbirth the cervix stretches to allow the baby to pass through. The cervix opens into the **vagina**. The vagina, also called the birth canal, serves as a passageway for the baby during childbirth.

THE MENSTRUAL CYCLE

Once the reproductive organs have become mature, a woman's body begins a monthly reproductive cycle that is known as the **menstrual cycle** [*MEN strul*]. Girls usually experience their first menstrual cycle at about 12 years of age. However, the age at which the first menstrual cycle occurs varies from person to person and can start anytime between 9 and 16 years of age.

OVULATION During each menstrual cycle, an egg cell is released from one of the ovaries. The release of an egg cell from the ovary is called **ovulation**. The egg cell travels down the Fallopian tube to

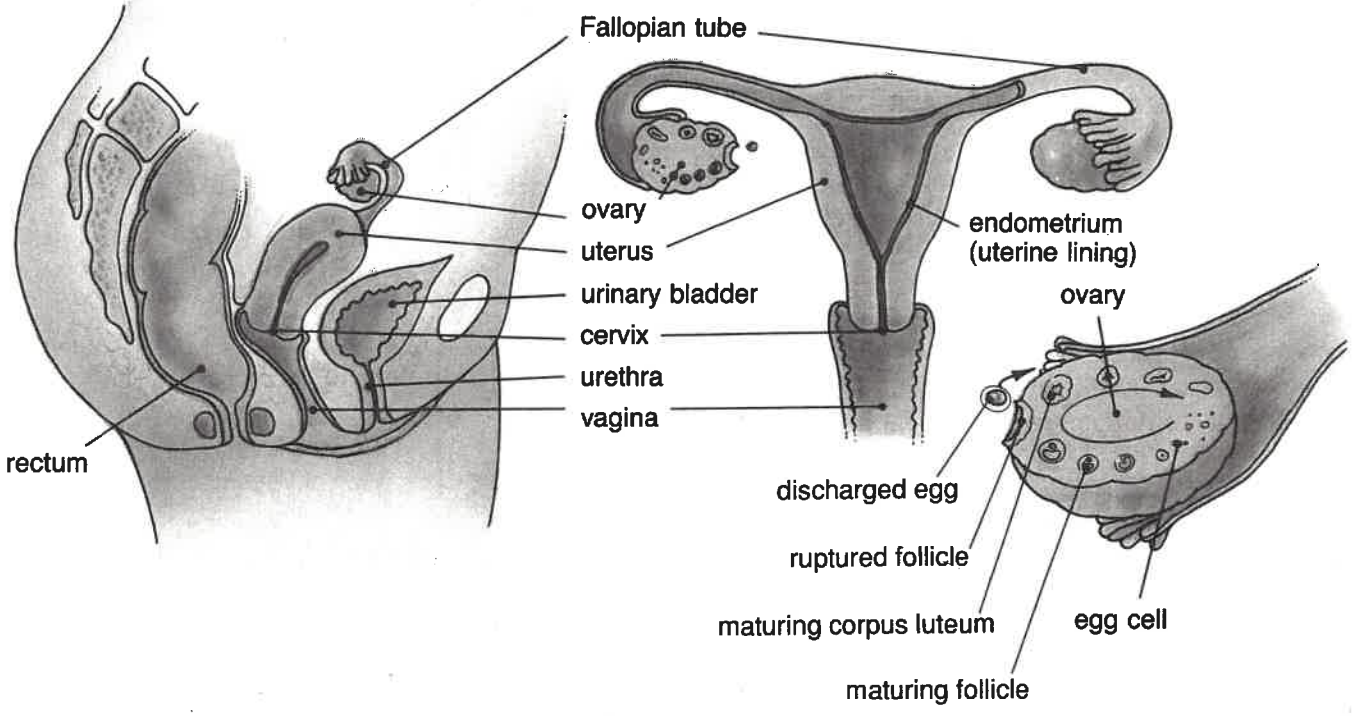


Figure 17-4 In which part of the female reproductive system are the egg cells produced?

The changes that girls experience during puberty indicate that they are becoming adult women.

the uterus. In the meantime, the endometrium begins to thicken, preparing the uterus in case fertilization occurs. If the egg cell becomes fertilized, it will become implanted in the wall of the uterus and begin to develop.

MENSTRUATION If the egg cell does not become fertilized, the endometrium breaks down into a fluid. This fluid, which also contains blood, flows out of the body through the vagina. The breakdown and loss of the endometrium is called **menstruation**. The menstrual period usually lasts from three to seven days. Women either wear sanitary pads and/or tampons to absorb the blood flow from menstruation.

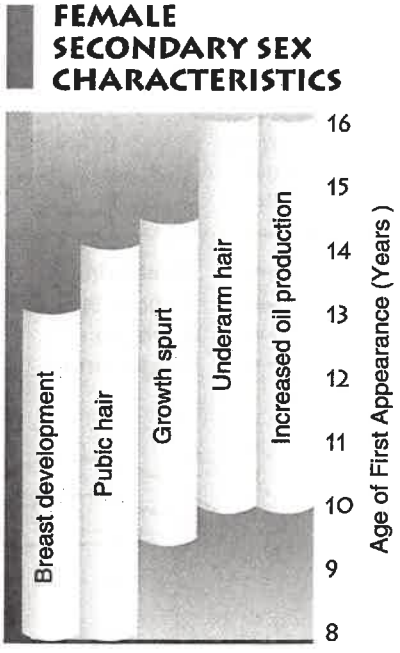
HORMONAL CONTROL Figure 17-6 shows how changing levels of different hormones released by the pituitary glands and by the ovaries affect each event of the menstrual cycle. The entire menstrual cycle typically lasts about 28 days. However, the length of the menstrual cycle will vary from one woman to the next, especially during the first few years of menstruation. Poor nutrition, low body fat, abnormally strenuous exercise, and mental stress can delay menstruation or stop the menstrual cycle altogether.

Menstruation usually occurs each month for as long as a woman has a healthy reproductive system or until she stops producing egg cells. At some point, often between 45 and 55 years of age, the ovaries stop producing estrogen, the hormone that controls menstruation, and menstruation ends. The time of life during which a woman stops menstruation is called **menopause**.

CONCERNS ABOUT MENSTRUATION

Although it is fairly uncommon for a woman to experience medical problems resulting from menstruation, it is common for some women to experience temporary discomfort during menstruation. Typical discomforts include mild soreness in the breasts, mood changes, and muscle cramps in the abdomen and back caused by the uterus contracting to get rid of the endometrial lining. Because

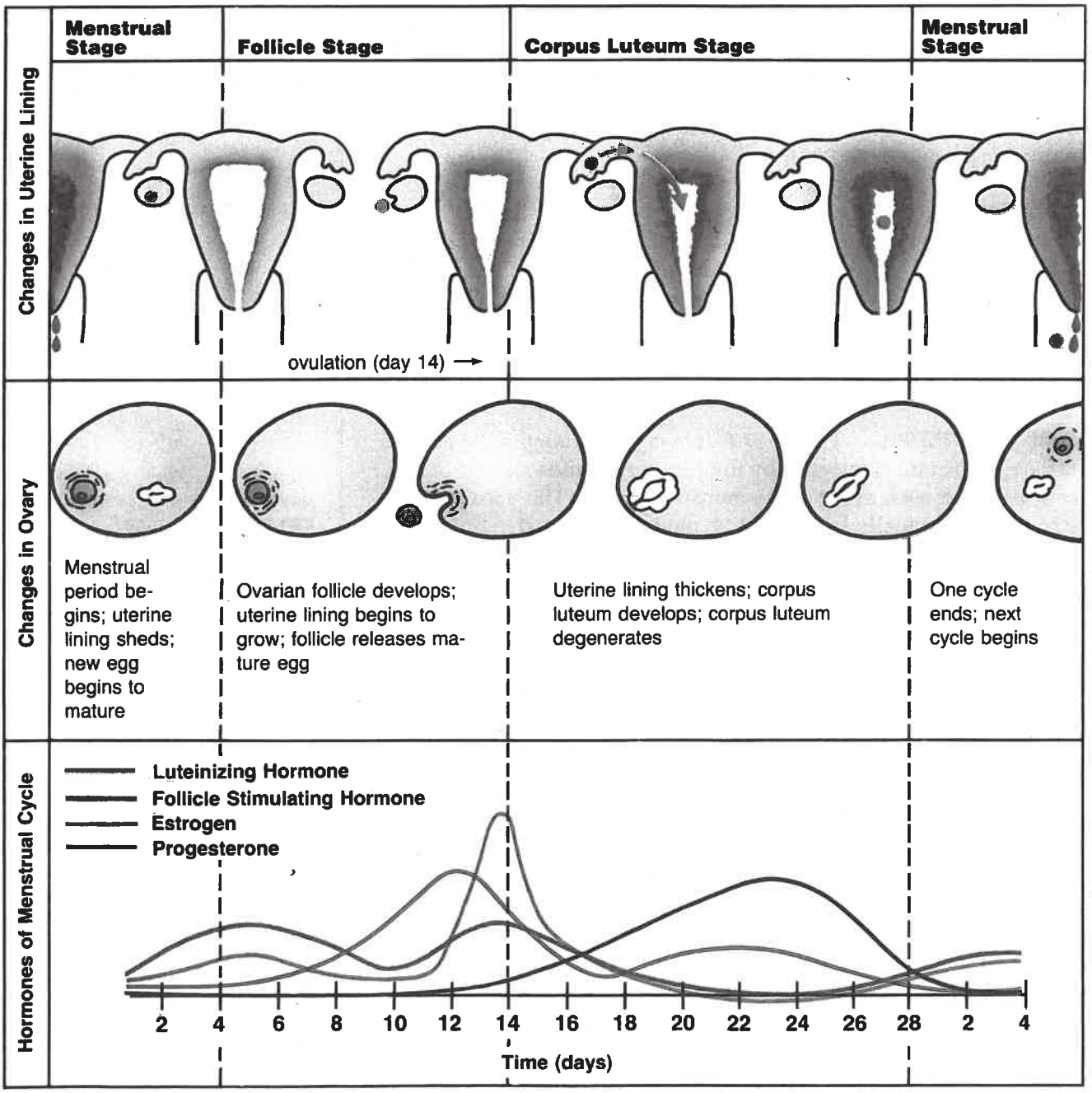
Figure 17-5 What are the first physical changes teenage girls can expect to notice?



the discomforts experienced during menstruation vary from one woman to the next, different remedies work for different women. Some find that getting more rest and using relaxation techniques help while others find that exercise helps.

PREMENSTRUAL SYNDROME Some women experience physical and emotional symptoms up to two weeks before menstruation begins. These symptoms are known as **premenstrual syndrome (PMS)**. Physical symptoms may include nausea, headaches, fatigue, a bloated feeling, and weight gain. Emotional symptoms may include mood swings, irritability, feelings of depression, and the inability to sleep or concentrate. Although these symptoms do not

Figure 17-6 In which stage of the menstrual cycle are estrogen levels the highest?



signify any underlying medical problems, for many women PMS can be disruptive.

It is not clear what causes PMS, although some studies suggest the symptoms may be connected with the rise and fall of hormone levels during the course of the menstrual cycle. The treatment for PMS varies by individual. Medications have been helpful for some women. A diet low in salt can reduce the bloated feeling. The avoidance of caffeine has been reported by some women to reduce some of the emotional symptoms associated with PMS. An exercise program may also reduce some of the symptoms associated with PMS. Also, in most cases, the severity of the symptoms will diminish as a woman becomes older.

Physical exercise, such as swimming, can help relieve some of the symptoms of PMS.

TOXIC SHOCK SYNDROME Many women choose to use tampons during menstruation. However, the misuse of tampons can result in a potentially fatal bacterial infection called **toxic shock syndrome**. If a tampon is kept in for too long, it can provide an ideal environment for the growth of bacteria. The toxin produced by these bacteria causes a sudden high fever, a rash on the hands and feet, a sudden drop in blood pressure, and kidney and liver damage. If detected early, toxic shock syndrome can be effectively treated with antibiotics. A woman should contact a doctor at once if she has any of these symptoms. Toxic shock syndrome can be avoided by limiting the use of tampons, especially the super absorbant tampons. If tampons are used, they should be changed every four to eight hours.

FEMALE REPRODUCTIVE DISORDERS

Women are susceptible to a number of disorders of the reproductive system. Many disorders, such as those that are caused by infections, can be prevented through good health practices. Other disorders, if discovered early, can be cured.

OVARIAN CYST A fairly common problem among women is the development of an ovarian cyst. An **ovarian cyst** is a fluid-filled sac on an ovary. Small cysts may develop as a result of regular changes in hormone levels and often disappear without treatment. Cysts that are large may cause severe pain in the abdomen and may need to be surgically removed.

CANCER Cancer is the uncontrolled growth of abnormal cells. In women, cancer sometimes occurs in the endometrium, cervix, or ovaries. Many times, cancer is curable if detected early. A routine pelvic exam in which a Pap test is given can often detect cancer of the cervix. A **Pap test** is an examination in which a doctor takes a smear of cells from the cervix. The cells are studied for any sign of cancer. A Pap test should be done every one or two years after a woman has reached 18 years of age or has become sexually active.

STRATEGIES FOR LIVING

Tips for lessening the effects of PMS:

- Eat a balanced diet, avoiding caffeine and salt.
- Have a regular exercise program.
- Get plenty of rest.
- Keep a diary of symptoms. A diary will allow a woman to predict the onset of symptoms and determine whether or not they are due to PMS.

HEALTHY PEOPLE 2000

Reduce deaths from cancer of the uterine cervix to no more than 1.3 per 100,000 women.

Objective 16.4
from *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*

INFERTILITY

A woman who is unable to become pregnant because of physical complications is said to be **infertile.** Infertility affects as many as eight percent of all women of childbearing age. The following are some of the most common causes of infertility.

FAILURE TO OVULATE In some women, the ovaries are unable to release an egg cell. The failure to ovulate regularly may be due to problems in the development of the ovaries or due to the underproduction of hormones which trigger ovulation. In some cases, women with this problem can be treated by giving them the hormone that stimulates ovulation.

BLOCKAGE OF THE FALLOPIAN TUBE The most common cause of infertility is a blockage of one or both of the Fallopian tubes, which prevents the egg cell from reaching the uterus. The blockage may be the result of an infection, a tumor in the Fallopian tube, or problems in the development of the Fallopian tube. In some cases, the blockage can be removed through surgery.

MAKING A DIFFERENCE

RESEARCH HEALTH

Hormone Replacement Therapy

All at once, when Theresa Gorman turned 50, she began to feel old. She began to have sweats at night and hot flashes during the day. Her skin grew flaky and wrinkled, and she was very depressed.

Gorman was experiencing menopause—a hormonal phenomenon that affects all women. Menopause occurs when a woman's body stops producing the hormones estrogen and progesterone, usually between the ages of 45 and 50. Some women experience severe changes. Other women hardly notice menopause.

If a woman decides that the changes she experiences during menopause are seriously affecting her life and happiness, she can talk with her doctor about the benefits and risks of Hormone Replacement Therapy (HRT). HRT is administered orally or through a skin patch. Today HRT includes a combination of estrogen and progestin—a synthetic progesterone.

Supporters of HRT swear by its ability to counteract some of the changes brought about by menopause. HRT, when begun within three years after the onset of menopause, can significantly reduce the incidence of osteoporosis. Recent studies also indicate that HRT may reduce heart disease. Other studies suggest that the risk of cancer associated with HRT may be reduced if the hormones are taken for short periods, such as six years.

Opponents of HRT suggest that hormone treatment is an example of society's lack of acceptance of aging as a natural process of life. Some scientists, concerned that HRT might increase the risk of cancer, find that many women who are experiencing an uncomfortable menopause can do just as well on a treatment plan that includes vitamins, good nutrition, and exercise.

Some women should not even consider HRT. These are women who have had breast cancer or now have migraine headaches,

diabetes, asthma, heart disease, or other illnesses. But the quality of life for women like Theresa Gorman, who have been helped by hormone replacement therapy, has vastly improved.

1. Explain what is meant by menopause.
2. What are the positive and negative aspects of hormone replacement therapy?

Many couples who have been unable to have children have turned to adoption.

OTHER CAUSES Sometimes infertility can be traced to problems in the uterus. **Endometriosis** [*en doh mee tree OH sus*] is a condition in which the endometrium grows outside of the uterus, sometimes blocking one or both of the Fallopian tubes. Endometriosis usually can be corrected by surgery. Infections, such as those caused by sexually transmitted diseases, can result in permanent damage to the reproductive system. One very serious condition resulting from bacterial infection is **pelvic inflammatory disease (PID)** which is an infection in the Fallopian tubes or other reproductive organs. PID can usually be treated with antibiotics.

Although there are many specific steps women can take to prevent reproductive disorders, maintaining one's general health is also important. Following a good nutrition plan, exercising regularly, and managing stress effectively can contribute to the health of the reproductive system.

LESSON 17.2 USING WHAT YOU HAVE LEARNED

REVIEW

1. Describe the events of the menstrual cycle. What is the average length of the menstrual cycle?
2. Describe two causes of infertility in women.

THINK CRITICALLY

3. During puberty, females undergo many physical changes. What do you think are the purpose of these changes?
4. As females reach puberty, the ovaries begin to produce fluctuating levels of the hormones estrogen and progesterone. Explain the function of these fluctuating hormone levels.

APPLY IT TO YOURSELF

5. You have been put in charge of writing a public service announcement about the health concerns of teenage girls. What do you think is the best way of presenting this information?

SUMMARY

During adolescence, girls reach sexual maturity and menstruation begins. Menstruation may cause discomfort for some women, but there are a variety of methods women can use to cope with the discomfort. Many disorders of the female reproductive system can be prevented with sensible health practices. Most disorders of the female reproductive system can be cured.

MALE DEVELOPMENT

During puberty, boys experience many of the same emotional changes as girls. Like girls, boys go through a phase of rapid growth as well as experiencing changes to the shape of their bodies. Often these changes cause a teenage boy to feel awkward. Although boys and girls may have many of the same types of anxieties as they go through puberty, there are important differences in their development.

MAIN IDEAS

CONCEPTS

- ✔ During puberty, hormones trigger the maturation of the male reproductive system.
- ✔ The age at which puberty occurs differs from one boy to the next.
- ✔ Many reproductive disorders can be prevented or cured if detected early.

VOCABULARY

scrotum
vas deferens
prostate gland
semen
urethra
ejaculation
penis
foreskin
circumcision
erection
nocturnal emission
inguinal hernia
testicular cancer

Boys undergo many physical changes during puberty.

CHANGES DURING PUBERTY

Puberty in males generally begins between 11 and 15 years of age. During puberty, growth hormone from a boy's pituitary gland triggers a very rapid growth spurt. At the same time, testosterone released from the testes causes the development of secondary sex characteristics. Finally, the reproductive system matures to the point that a boy is able to produce healthy sperm cells.

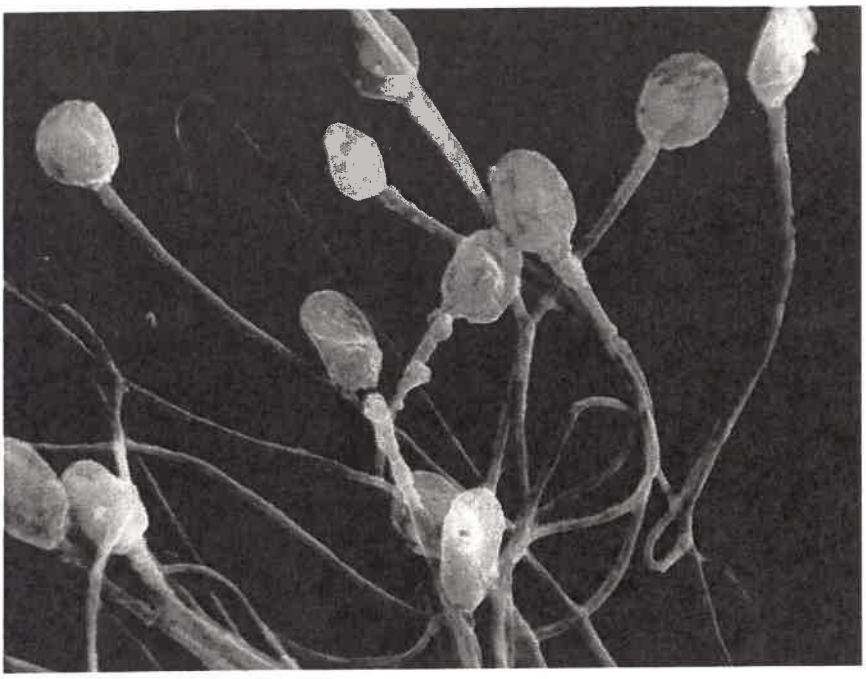
SECONDARY SEX CHARACTERISTICS Some of the secondary sex characteristics that occur in a girl also occur in a boy. The voice gradually becomes lower. Pubic hair begins to appear. Hair begins to grow under the arms and on the arms and legs. The skin starts to produce more oil which often results in acne. Other secondary sex characteristics are unique to boys. Secretion of the hormone testosterone triggers the growth of some facial hair and chest hair. In boys, muscles begin to develop rapidly and the amount of body fat decreases.

COPING WITH CHANGES Puberty can be an awkward time for many boys. The rapid growth of arms and legs may cause a boy to feel clumsy. While the voice is becoming deeper, it is common for the voice to crack, or to switch back to higher tones. However, these periods of transition will pass over time, and the boy will usually begin to feel more comfortable about his body as his coordination adjusts to his rapid changes in size.

A boy who develops later than other boys his same age may have negative feelings about himself. Sometimes these negative feelings can last into adulthood. In order to avoid feelings of self-doubt, it is important that the teenage boy remember that his development will eventually catch up with that of his friends. It is also important for him to remember that his delayed development does not mean that he is not normal, but rather that he is just developing at a different pace.

THE MALE REPRODUCTIVE SYSTEM

The male reproductive system is composed of both internal and external organs. Each structure is shown in Figure 17-8. During puberty, these organs mature to the point where the male can produce sperm cells.



These sperm cells shown in the photo have been magnified over 5,000 times.

SPERM-PRODUCING STRUCTURES Sperm cells are the cells that fertilize the egg cells of the female. They are composed of a head, a body, and a whip-like tail. The sperm cell uses the tail to swim toward the egg cell once the sperm cell enters the female.

Sperm cells are produced in the testes—the same glands that produce the hormone testosterone. Each male has two testes. After puberty, the testes can produce up to 300 million sperm cells a day. The testes are originally formed inside the body near the abdomen. However, just before birth, they descend into a pouch of loose skin called the **scrotum** [*SKROHT um*], which hangs outside the body. The testes hang outside the body where the temperature is a few degrees cooler than inside the body. The testes need this lower temperature to produce active, healthy sperm.

INTERNAL STRUCTURES Once sperm cells leave the testes, they travel to the penis through a series of tubes as shown in Figure 17-8. The first tube that the sperm cells enter is the **vas deferens** [*VAS DEF uh runz*], which connects the testes to the prostate gland. The **prostate gland** is a small, walnut-sized gland located below the bladder. As the sperm cells pass through the prostate gland, they combine with a thin, milky fluid produced by the prostate gland and fluids produced by another set of glands called the seminal vesicles. The combination of these fluids and the sperm cells is called **semen**. The final tube through which the semen travels is the **urethra** [*yu REE thruh*]. The opening of the urethra is at the tip of the penis. The process by which sperm leaves the penis is called ejaculation. **Ejaculation** [*ih jak yuh LAY shun*] is caused by muscle contractions that push the semen through the urethra and out of the penis. The urethra also carries urine from the bladder out of the body. Valves near the location where the urethra leaves the urinary bladder prevent urine from mixing with the semen.

FOR YOU
INFORMA

Testosteron
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MALE SECONDARY SEX CHARACTERISTICS

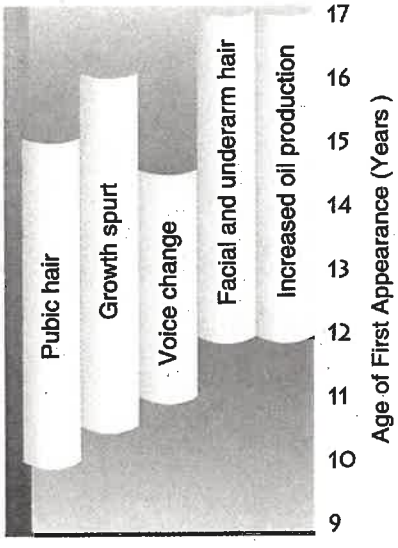

Figure 17-7 At which ages can you expect a boy's voice to change?

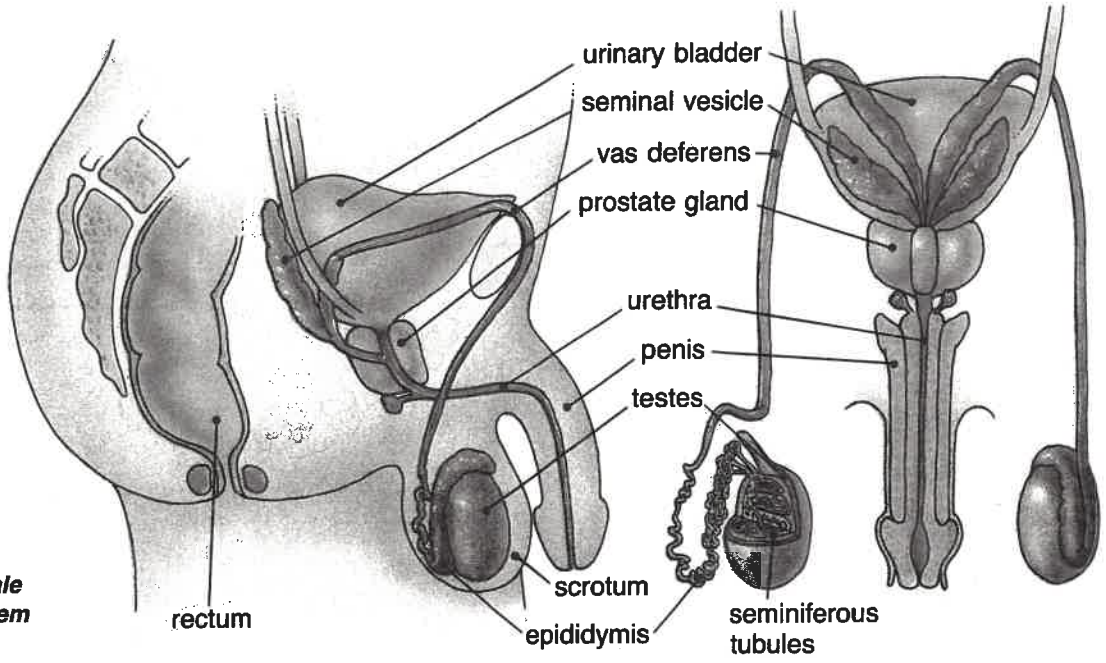

Figure 17-8 The diagram of the male reproductive system shows a circumcised penis.

PENIS The **penis** is the external, cylinder-shaped organ through which urine and sperm pass out of the body. At birth, the end of the penis is covered by a flap of skin called **foreskin**. For social and religious reasons, parents sometimes choose to have the foreskin removed from the infant shortly after birth. Surgical removal of the foreskin is called **circumcision**. If the penis is not circumcised, it is important to clean around the foreskin regularly while bathing. Otherwise a build-up of fluid from small glands in the foreskin will develop and may cause infection.

Normally the penis is limp. However, during certain states of arousal the spongy tissue and blood vessels of the penis will fill with blood, causing an erection. An **erection** is a stiffening of the penis that causes it to point up and away from the body.

One of the first signs that the reproductive system is maturing is the occurrence of **nocturnal emissions**, or wet dreams. A nocturnal emission is the normal ejaculation of semen during sleep, and does not mean that anything is wrong.

MALE REPRODUCTIVE DISORDERS

Although there are many types of disorders that can affect the male reproductive system, many can be prevented or effectively treated. Infections, including those that are a result of sexually transmitted diseases, usually can be prevented if proper precautions are taken. Other serious problems such as cancer often can be treated if detected early. However, many disorders can result in permanent damage if not treated early.

DEVELOPMENTAL DISORDERS Some male reproductive disorders result from developmental problems. Occasionally one or both testes may fail to descend from the abdomen into the scrotum before birth. This condition usually corrects itself within the boy's

first year. If it does not, hormone treatment or surgery can correct the problem. If untreated, undescended testes can lead to infertility and an increased risk of testicular cancer.

Sometimes the opening between the abdomen and the scrotum does not close properly after the testes have descended. Later in life, a part of the intestine may push through the opening into the scrotum or the groin area, causing an **inguinal hernia** [*ING gwuhn ul*]. An inguinal hernia can be corrected through surgery.

TESTICULAR CANCER One of the most serious reproductive disorders in men between 15 and 35 years of age is cancer in the testes which is called **testicular cancer**. Testicular cancer accounts for over 20 percent of all cancers of men in this age group. If detected during its early stages, it can be cured over 95 percent of the time. Testicular cancer can be detected by doing a simple monthly self-examination of the testes. A self-examination is performed by grasping the testicle and gently rolling it between the thumb and forefingers. Unusual lumps or other changes in the testes that are detected during a self-examination don't necessarily indicate cancer, but they should be examined by a physician.

DISORDERS OF THE PROSTATE GLAND As men get older, the prostate gland may become enlarged. In most cases, an enlarged prostate gland is not serious. However, if it gets too large, it can block urination. If the blockage is not treated, infection of the bladder and kidneys may occur. Medicine or a simple surgical procedure can be used to decrease the size of the prostate gland.

Cancer also can occur in the prostate gland. Unlike testicular cancer, prostate cancer is most common in men over 65 years of age. Like all cancers, prostate cancer is most easily treated if detected during its early stages. The American Cancer Society recommends that all men over 40 years of age receive a yearly examination for any signs of prostate cancer.

STRATEGIES FOR LIVING

Monthly self-examination for testicular cancer

- The best time to do a self-examination is after a warm bath or shower.
- Examine one testicle at a time.
- Roll testicle gently between thumb and forefinger.
- Feel for any unusual lumps on surface of testicle.
- Note any enlargement or hardening of testicles.
- Report any changes in testicles to your doctor.

CONSUMER HEALTH

Hair Loss

In much of the American culture, a thick, luxuriant head of hair is considered a sign of health, beauty, youth, and vitality. Advertisers have capitalized on these images—much to the dismay of those experiencing hair loss or baldness.

Baldness and thinning hair are due mainly to heredity. Hereditary hair loss is gradual and in most cases irreversible. Factors that can cause temporary hair loss are pregnancy and nursing, severe emotional stress, malnutrition, anorexia nervosa, anemia, and various medications, particularly chemotherapy for cancer patients.

Although many people find thinning hair or baldness attractive, many men and women feel uncomfortable with their thinning hair. For these people, there are many treatments for hereditary hair loss, most of them unreliable and all of them costly.

Hair implants cost about $10,000 and only work for some people. Cosmetic remedies, such as sprays and gels, hair dye, hair weaves, or a short haircut are less expensive than implants and mask the symptoms of thinning hair. Over-the-counter lotions, oils, or vitamin supplements do nothing to reverse hair loss. The best, least expensive remedy for hair loss is accepting yourself the way you are.

INJURIES TO THE TESTES

Because the testes are located outside of the body, they are prone to injuries. All blows to the testes can be very painful and can occasionally result in permanent damage. In extreme cases, damage to the testes can cause infertility. For these reasons, it is important that males wear protective gear when participating in contact sports. If a man receives a blow to the testes and the pain and swelling persist for more than a few hours, he should seek medical care.

INFERTILITY

Many reproductive disorders in men can affect their general health, and can also cause infertility, or the inability to fertilize an egg cell. The most common cause of infertility in men is the inability to produce enough sperm cells. Sperm production can be impaired by sexually transmitted diseases or other infections. Infections may also cause a blockage in the vas deferens, preventing sperm from passing through. Hormonal problems also might cause a decrease in sperm production. Hormonal disorders can sometimes be treated by using medication. Occasionally surgery can repair problems in the testes.

The health of the reproductive system often can be traced to health behaviors. The use of some drugs, both legal and illegal, has been linked to the decreased production of sperm. Exposure to toxic chemicals also may damage the male reproductive system. Because the health of the reproductive system is linked to one's overall well-being, maintaining a nutritious diet, avoiding alcohol and other drugs, and watching for any signs of problems are the best precautions one can take.

SUMMARY

During puberty, hormones secreted by the pituitary gland and the testes trigger the development of secondary sex characteristics in boys. The male reproductive structures mature during puberty, becoming capable of producing and releasing sperm cells. The health of the male reproductive system depends on one's overall well-being, the avoidance of sexually transmitted diseases, and the early detection of serious problems such as cancer.

LESSON 17.3 USING WHAT YOU HAVE LEARNED

REVIEW

1. Which changes during puberty does testosterone stimulate?
2. Why is the early detection of testicular cancer so important?

THINK CRITICALLY

3. The teenage years are sometimes marked by mood swings and periods of irritability. Why might these moods be a result of the physical changes teenagers are experiencing?
4. The rate of testicular cancer among young men is much higher than the rate of breast cancer among young women. Yet young women are more likely to receive regular examinations—by a doctor or self. Why do you think this difference in behavior exists?

APPLY IT TO YOURSELF

5. You are the teacher of a health class. Why do you think it is important for everybody to learn about the development of both males and females?