Child Development, 9/e
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Chapter 5

“Untitled”  
Deanna Hodgson  
12 years, United Kingdom  
The dramatic gains in strength and coordination of adolescence are evident in this young dancer’s grace and expressiveness. Her exuberant leap radiates self-confidence and pleasure in her expanding physical capacities.  
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Physical Growth

On Sabrina’s eleventh birthday, her friend Joyce gave her a surprise party, but Sabrina seemed somber during the celebration. Although Sabrina and Joyce had been close friends since third grade, their relationship was faltering. Sabrina was a head taller and some 20 pounds heavier than most girls in her sixth-grade class. Her breasts were well-developed, her hips and thighs had broadened, and she had begun to menstruate. In contrast, Joyce still had the short, lean, flat-chested body of a school-age child.

Ducking into the bathroom while Joyce and the other girls put candles on the cake, Sabrina frowned at her image in the mirror. “I’m so big and heavy,” she whispered. At church youth group on Sunday evenings, Sabrina broke away from Joyce and joined the eighth-grade girls. Around them, she didn’t feel so large and awkward.

Once a month, parents gathered at Sabrina’s and Joyce’s school to discuss child-rearing concerns. Sabrina’s parents, Franca and Antonio, attended whenever they could. “How you know they are becoming teenagers is this,” volunteered Antonio. “The bedroom door is closed, and they want to be alone. Also, they contradict and disagree. Anything I say to Sabrina, she gives me an argument.”

“All our children were early developers,” Franca added. “But it was easier for the boys—being tall made them feel big and important. Sabrina is moody, she avoids her old friends, and she thinks about boys instead of her studies. As a little girl, she was skinny, but now she says she is too fat and needs to diet. I try to be patient with her,” reflected Franca sympathetically.

During the first two decades of life, the human body changes continuously and dramatically. The average individual’s height multiplies more than threefold, and weight increases as much as 15- to 20-fold. The top-heavy, chubby infant, whose head represents a quarter of the body’s total length, gradually becomes the better-proportioned child and eventually the taller, broader, more muscular teenager. This chapter traces the course of human growth, along with biological and environmental factors that regulate and influence it.

As Sabrina’s behavior indicates, physical and psychological development are closely linked. But just how the child’s transforming body is related to cognitive, emotional, and social changes has puzzled philosophers and scientists for centuries. In particular, they have pondered this question with respect to puberty. TAKE A MOMENT... Ask several parents of young children what they expect their sons and daughters to be like as teenagers. You will probably get answers like these: “Rebellious and reckless,” “Full of rages and tempers” (Buchanan & Holmbeck, 1998). This widespread view dates back to eighteenth-century philosopher Jean-Jacques Rousseau (see Chapter 1), who believed that the biological upheaval of puberty triggered heightened emotionality, conflict, and defiance of adults.

In the early twentieth century, major theorists picked up this storm-and-stress perspective. The most influential, G. Stanley Hall, described adolescence as a cascade of instinctual passions, a period so turbulent that it resembled the era in which humans evolved from savages into civilized beings.

Were Rousseau and Hall correct in seeing adolescence as a period of biologically engendered storm and stress? Or do social and cultural factors combine with biology to influence psychological development? In our discussion, we will see what contemporary research says about this issue.
Describe the course of physical growth, including changes in body size, proportions, muscle–fat makeup, and skeleton, and their relationship to gains in gross-motor skills.

Describe hormonal influences on physical growth.

Discuss factors that contribute to worldwide variations and secular trends in physical growth.

## The Course of Physical Growth

Compared with other animals, primates (including humans) experience a prolonged period of physical growth. Mice and rats develop from birth to puberty in just a few weeks—about 2 percent of the lifespan. By contrast, in chimpanzees, the species most similar to humans genetically, growth takes about seven years, or 16 percent of the lifespan. Physical immaturity is even more exaggerated in humans, who devote about 20 percent of their total years to growing. This prolonged physical immaturity is adaptive (Konner, 2010). By ensuring that children remain dependent on adults, it gives them added time to acquire the knowledge and skills essential for life in a complex social world.

### Changes in Body Size

The most obvious signs of physical growth are changes in overall body size. During infancy, these changes are rapid—faster than at any other time after birth. By the end of the first year, a typical infant’s height is 50 percent greater than at birth; by 2 years, it is 75 percent greater. Similarly, birth weight typically doubles by age 5 months, triples by 1 year, and quadruples by age 2. If children kept growing at this rate, by age 10 they would be 10 feet tall and weigh over 200 pounds! Fortunately, growth slows in early and middle childhood, when children add about 2 to 3 inches in height and 5 pounds in weight each year. Then, puberty brings a sharp acceleration. On average, adolescents gain 10 to 11 inches in height and about 50 to 75 pounds in weight.

Two types of growth curves are used to track overall changes in body size. The first, shown in Figure 5.1a, is a **distance curve**, which plots the average size of a sample of children at each age, indicating typical yearly progress toward maturity. The figure shows gains in height; weight gain follows a similar trend. Notice how during infancy and childhood the two sexes are similar, with the typical girl just slightly shorter (and lighter) than the typical boy. Around age 10 to 11, the typical North American and European girl becomes taller (and heavier) for a time because her pubertal growth spurt takes place two years earlier than the boy’s (Archibald, Graber, & Brooks-Gunn, 2006; Bogin, 2001). At age 14, however, she is surpassed by the typical boy, whose growth spurt has now started, whereas hers is almost finished. Growth in height is complete for most North American and European girls by age 16, for boys by age 17½.

Figure 5.1b shows a second type of growth curve, the **velocity curve**, which plots the average amount of growth at each yearly interval, revealing the exact timing of growth spurts. Note the rapid but decelerating growth in infancy; a slower, constant rate during early and middle childhood; and a sharp increase in early adolescence, followed by a swift decrease as the body approaches its adult size.

### Changes in Body Proportions

As the child’s overall size increases, parts of the body grow at different rates. Two growth patterns describe these changes. The first is the **cephalocaudal trend**—from the Latin for “head to tail.” Recall from Chapter 3 that during the prenatal period, the head develops first from the primitive embryonic disk, followed by the lower part of the body. After birth, the head and chest continue to have a growth advantage, but the trunk and legs gradually pick up speed. In the second pattern, the **proximodistal trend**, growth proceeds, literally, from “near to far”—from the center of the body...
outward. In the prenatal period, the head, chest, and trunk grow first, then the arms and legs, finally the hands and feet. During infancy and childhood, the arms and legs continue to grow somewhat ahead of the hands and feet.

During puberty, growth proceeds in the reverse direction. The hands, legs, and feet accelerate first, followed by the torso, which accounts for most of the adolescent height gain (Sheehy et al., 1999). This pattern helps explain why young adolescents often appear awkward and out of proportion—long-legged, with giant feet and hands.

In infancy and childhood, girls and boys have similar body proportions. During adolescence, however, large differences appear, caused by the action of sex hormones on the skeleton. Boys’ shoulders broaden relative to the hips, whereas girls’ hips broaden relative to the shoulders and waist. Of course, boys also end up considerably larger than girls, and their legs are longer in relation to the rest of the body. The major reason is that boys have two extra years of preadolescent growth, when the legs are growing the fastest.

Changes in Muscle–Fat Makeup

Body fat (most of which lies just beneath the skin) increases in the last few weeks of prenatal life and continues to do so after birth, reaching a peak at about 9 months of age. This early rise in “baby fat” helps the infant keep a constant body temperature. Starting in the second year and continuing into middle childhood, most toddlers slim down (Fomon & Nelson, 2002). At birth, girls have slightly more body fat than boys, a difference that persists into the early school years and then magnifies. Around age 8, girls start to add more fat on their arms, legs, and trunk; they continue to do so throughout puberty, while the arm and leg fat of adolescent boys decreases (Siervogel et al., 2000).

Muscle accumulates slowly throughout infancy and childhood, with a dramatic rise at adolescence. Both sexes gain muscle at puberty, but this increase is 150 percent greater in boys, who develop larger skeletal muscles, hearts, and lung capacity (Rogol, Roemmich, & Clark, 2002). Also, the number of red blood cells—and therefore the ability to carry oxygen from the lungs to the muscles—increases in boys but not in girls. Altogether, boys gain far more muscle strength than girls, contributing to their superior athletic performance during the teenage years (Ramos et al., 1998).
Skeletal Growth

Because children of the same age differ in rate of physical growth, researchers have devised methods for measuring progress toward physical maturity that are useful for studying the causes and consequences of these individual differences. The best estimate of a child’s physical maturity is skeletal age—a measure of development of the bones of the body. The embryonic skeleton is first formed out of soft, pliable tissue called cartilage. In the sixth week of pregnancy, cartilage cells begin to harden into bone, a gradual process that continues throughout childhood and adolescence (Moore & Persaud, 2008).

Just before birth, special growth centers, called epiphyses, appear at the two extreme ends of each of the long bones of the body (see Figure 5.2). Cartilage cells continue to be produced at the growth plates of these epiphyses, which increase in number throughout childhood and then, as growth continues, get thinner and disappear. After that, no further growth in bone length is possible. As Figure 5.3 shows, skeletal age can be estimated by X-raying the bones to determine the number of epiphyses and the extent to which they are fused.

African-American children tend to be slightly ahead of Caucasian-American children in skeletal age. And girls are considerably ahead of boys—a gap of about four to six weeks at birth, which widens over infancy and childhood (Tanner, Healy, & Cameron, 2001). Girls are advanced in development of other organs as well. This greater physical maturity may contribute to girls’ greater resistance to harmful environmental influences. As noted in Chapter 3, girls experience fewer developmental problems than boys and have lower infant and childhood mortality rates.

Gains in Gross-Motor Skills

Changes in size, proportions, and muscle strength support an explosion of new gross-motor skills. As the body becomes more streamlined and less top-heavy, the center of gravity shifts downward, toward the trunk. The resulting improvement in balance paves the way for new motor skills involving large muscles.

Advances in Early and Middle Childhood

By age 2, preschoolers’ gaits become smooth and rhythmic—secure enough that they soon leave the ground, first by running and jumping and then, between 3 and 6 years, by hopping, galloping, and skipping. Eventually, upper and lower body skills combine into more effective actions (Haywood & Getchell, 2005). Whereas 2- and 3-year-olds throw a ball rigidly, using only the arms, 4- and 5-year-olds use a smooth, flexible motion, involving the shoulders, torso, trunk, and legs, that makes the ball travel faster and farther.

During the school years, improved balance, strength, agility, and flexibility support refinements in running, jumping, hopping, and ball skills. Children sprint across the playground, play hopscotch in intricate patterns, kick and dribble soccer balls, and swing bats at pitched balls. The Milestones table on the following page summarizes gross-motor achievements in early and middle childhood. At adolescence, increased body size and muscle bring continued motor gains.

The same principle that governs motor development during the first two years continues to operate in childhood and adolescence. Children integrate previously acquired skills into more complex, dynamic systems of action. (Return to Chapter 4, page 148, to review this concept.) Then they revise each skill as their bodies grow larger and stronger, their central nervous systems become better developed, their interests and goals become clearer, and their
environments present new challenges. Sex differences in motor skills, already present in the preschool years, illustrate these multiple influences. Size and strength contribute to boys’ superior athletic performance in adolescence but cannot fully account for their childhood advantage. As the Social Issues: Education box on page 180 reveals, the social environment plays a prominent role.

**Organized Youth Sports** Partly because of parents’ concerns about safety and the availability and attractions of TV, computer and video games, and the Internet, today’s school-age children and adolescents devote less time to outdoor, informal physical play than children in

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**Milestones**

**Gross-Motor Development in Early and Middle Childhood**

<table>
<thead>
<tr>
<th>AGE</th>
<th>GROSS-MOTOR SKILLS</th>
</tr>
</thead>
</table>
| 2–3 years | ● Walks more rhythmically; hurried walk changes to run  
              ● Jumps, hops, throws, and catches with rigid upper body  
              ● Pushes riding toy with feet; little steering |
| 3–4 years | ● Walks up stairs, alternating feet, and down stairs, leading with one foot  
              ● Jumps and hops, flexing upper body  
              ● Throws and catches with slight involvement of upper body; still catches by trapping ball against chest  
              ● Pedals and steers tricycle |
| 4–5 years | ● Walks down stairs, alternating feet  
              ● Runs more smoothly  
              ● Gallops and skips with one foot  
              ● Throws ball with increased body rotation and transfer of weight on feet; catches ball with hands  
              ● Rides tricycle rapidly; steers smoothly |
| 5–6 years | ● Increases running speed to 12 feet per second  
              ● Gallops more smoothly; engages in true skipping and sideways stepping  
              ● Displays mature, whole-body throwing and catching pattern; increases throwing speed  
              ● Rides bicycle with training wheels |
| 7–12 years | ● Increases running speed to more than 18 feet per second  
              ● Displays continuous, fluid skipping and sideways stepping  
              ● Increases vertical jump from 4 to 12 inches and broad jump from 3 to over 5 feet; accurately jumps and hops from square to square  
              ● Increases throwing and kicking speed, distance, and accuracy  
              ● Increases ability to catch small balls thrown over greater distances  
              ● Involves the whole body in batting a ball; batting increases in speed and accuracy  
              ● Hand dribbling changes from awkward slapping of the ball to continuous, relaxed, even stroking |

*Note:* These milestones represent overall age trends. Individual differences exist in the precise age at which each milestone is attained.


*Photos:* (top) © Lawrence Migdale/Photo Researchers, Inc.; (upper middle) © Bob Daemmrich/PhotoEdit; (lower middle) © David Madison/Getty Images/Photographer’s Choice; (bottom) © Lynn Harty Photography/Alamy
Sex Differences in Gross-Motor Development

Sex differences in gross-motor development are present as early as the preschool years, increase during middle childhood, and are large at adolescence. What underlies this expanding gender gap, and how can we ensure that both boys and girls have opportunities that optimize skill and enjoyment of athletics?

Early and Middle Childhood

In early childhood, boys are advanced over girls in abilities that emphasize force and power. By age 5, they can broad-jump slightly farther, run slightly faster, and throw a ball about 5 feet farther. During middle childhood, these differences intensify. For example, on average, a 12-year-old boy can throw a ball 43 feet farther than a 12-year-old girl. Boys are also more adept at batting, kicking, dribbling, and catching. Their slightly greater muscle mass and, in the case of throwing, slightly longer forearms contribute to their skill advantages. And partly because of greater overall physical maturity, girls have an edge in fine-motor skills of handwriting and drawing and in gross-motor capacities that depend on balance and agility, such as hopping and skipping (Fischman, Moore, & Steele, 1992; Haywood & Getchell, 2005).

Sex differences in motor skills increase with age. However, differences in physical capacity remain small throughout childhood, suggesting that social pressures for boys, more than girls, to be active and physically skilled exaggerate small genetically based sex differences. In support of this view, boys can throw a ball much farther than girls only when using their dominant hand. Practice—such as fathers more often playing catch with sons than with daughters—seems to be largely responsible for this advantage. When boys use their nondominant hand, the sex difference is minimal (Williams, Haywood, & Painter, 1996).

Research confirms that parents hold higher expectations for boys’ athletic performance—a social message that children absorb at an early age. From first through twelfth grade, girls are less positive than boys about the value of sports and their own sports ability—differences explained in part by parental beliefs (Fredricks & Eccles, 2002). The stronger girls’ belief that females are incompetent at sports (such as hockey or soccer), the lower girls judge their own ability and the poorer their actual performance (Belcher et al., 2003; Chalabaev, Sarrazin, & Fontayne, 2009). Girls have few opportunities in school to reverse these gender-based appraisals. To devote more time to academic instruction, U.S. schools have cut back on physical education. Currently, only 15 percent of U.S. elementary and middle schools provide a physical education class at least three days a week, and just 6 percent provide a daily class (Lee et al., 2007).

Adolescence

Not until puberty do sharp sex differences in physical size and muscle strength account for large differences in athletic ability. During adolescence, girls’ gains in gross-motor performance are slow and gradual, leveling off by age 14. In contrast, boys show a dramatic spurt in strength, speed, and endurance that continues through the teenage years, widening the gender gap. By midadolescence, girls perform as well as the average boy in running speed, broad jump, or throwing distance. And practically no boys score as low as the average girl (Haywood & Getchell, 2005; Malina & Bouchard, 1991).

In 1972, the U.S. federal government required schools receiving public funds to provide equal opportunities for males and females in all educational programs, including athletics. Since then, girls’ high school extracurricular sports participation has increased, although it still falls far short of boys. In a recent survey of all 50 U.S. state high school athletic associations, 41 percent of sports participants were girls, 59 percent boys (National Federation of State High School Associations, 2009).

By high school, only 58 percent of U.S. boys and 55 percent of girls take any physical education, and daily physical education classes are offered in just 2 percent of U.S. high schools (Centers for Disease Control and Prevention, 2007; U.S. Department of Health and Human Services, 2010). For both sexes, physical activity declines during adolescence, a trend that parallels school cutbacks (typically to conserve costs) in required physical education. The drop is sharper for girls, two-thirds of whom (compared with just half of boys) take no physical education during their senior year.

Interventions

Besides improving motor performance, sports and exercise influence cognitive and social development. Interschool and intramural athletics provide important lessons in teamwork, problem solving, assertiveness, and competition. And regular, sustained physical activity is associated with healthier dietary habits, enhanced functioning of the immune and cardiovascular systems, better sleep quality, and favorable psychological well-being, as indicated by better academic performance and reduced alcohol and drug use in adolescence (Brand et al., 2010; Castelli et al., 2007; Fate et al., 2000).

Special steps must be taken to raise girls’ confidence that they can do well at athletics. Educating parents about the minimal differences between school-age boys’ and girls’ physical capacities and sensitizing them to unfair biases against promotion of athletic ability among girls may prove helpful. Greater emphasis on skill training for girls, along with increased attention to their athletic achievements, is also likely to improve their participation and performance.

Finally, daily physical education in school, emphasizing enjoyable games and individual exercise rather than competition, is particularly motivating for girls and is associated with lasting positive consequences (Weinberg et al., 2000). In a longitudinal study, participating in team or individual sports at age 14 predicted high rates of physical activity at age 31. Endurance sports such as running and cycling—activities that can easily be performed on one’s own time, without expensive equipment or special facilities—were especially likely to carry over into adulthood (Tammelin et al., 2003). The stamina these activities require fosters high physical self-efficacy—belief in one’s ability to sustain an exercise program (Motl et al., 2002; Telama et al., 2005).
Hormonal Influences on Physical Growth

The endocrine glands control the vast physical changes of childhood and adolescence. They manufacture hormones, chemical substances secreted by specialized cells in one part of the body that pass to and influence cells in another.

The most important hormones for human growth are released by the pituitary gland, located at the base of the brain near the hypothalamus, a structure that initiates and regulates pituitary secretions (see Figure 5.4). Once pituitary
hormones enter the bloodstream, they act directly on body tissues to induce growth, or they stimulate the release of other hormones from endocrine glands located elsewhere in the body. The hypothalamus contains special receptors that detect hormone levels in the bloodstream. Through a highly sensitive feedback loop, it instructs the pituitary gland to increase or decrease the amount of each hormone. In this way, growth is carefully controlled. You may find it useful to refer to Figure 5.5 as we review major hormonal influences.

**Growth hormone (GH),** the only pituitary secretion produced continuously throughout life, affects development of all tissues except the central nervous system and the genitals. GH production doubles during puberty, contributing to tremendous gains in body size, and then decreases after final adult height is reached. GH acts directly on the body and also stimulates the liver and epiphyses of the skeleton to release another hormone, *insulin-like growth factor 1 (IGF-1),* which triggers cell duplication throughout the body, especially the skeleton, muscles, nerves, bone marrow (origin of blood cells), liver, kidney, skin, and lungs.

Although GH does not seem to affect prenatal growth, it is necessary for physical development from birth on. About 2 percent of children suffer from inherited conditions that cause either GH deficiency or IGF-1 deficiency (in which GH fails to stimulate IGF-1). Without medical intervention, such children reach an average mature height of only 4 to 4½ feet. When treated early with injections of GH or IGF-1 (depending on the disorder), these children show catch-up growth and then grow at a normal rate, becoming much taller than they would have without treatment (Bright, Mendoza, & Rosenfeld, 2009; Saenger, 2003).
A second pituitary hormone, thyroid-stimulating hormone (TSH), prompts the thyroid gland in the neck to release thyroxine, which is necessary for brain development and for GH to have its full impact on body size. Infants born with a deficiency of thyroxine must receive it at once, or they will be mentally retarded. Once the most rapid period of brain development is complete, thyroxine deficiency no longer affects the central nervous system but still causes children to grow more slowly than average. With prompt treatment, however, they eventually reach normal size (Salerno et al., 2001).

Sexual maturation is controlled by pituitary secretions that stimulate the release of sex hormones. Although we think of estrogens as female hormones and androgens as male hormones, both types are present in each sex, but in different amounts. The boy’s testes release large quantities of the androgen testosterone, which leads to muscle growth, body and facial hair, and other male sex characteristics. Androgens (especially testosterone for boys) exert a GH-enhancing effect, contributing greatly to gains in body size. The testes also secrete small amounts of estrogen—the reason that 50 percent of boys experience temporary breast enlargement. In both sexes, estrogens also increase GH secretion, adding to the growth spurt and, in combination with androgens, stimulating gains in bone density, which continue into early adulthood (Cooper, Sayer, & Dennison, 2006; Styne, 2003).

Estrogens released by girls’ ovaries cause the breasts, uterus, and vagina to mature, the body to take on feminine proportions, and fat to accumulate. Estrogens also contribute to regulation of the menstrual cycle. Adrenal androgens, released from the adrenal glands located on top of each kidney, influence girls’ height spurt and stimulate growth of underarm and pubic hair. They have little impact on boys, whose physical characteristics are influenced mainly by androgen and estrogen secretions from the testes.

### Worldwide Variations in Body Size

**TAKE A MOMENT...** Glance into almost any school classroom, and notice the wide individual differences in body growth. Diversity in physical size is especially apparent when we travel to different nations. Worldwide, a 9-inch gap exists between the smallest and the largest 8-year-olds. The shortest children, found in South America, Asia, the Pacific Islands, and parts of Africa, include such ethnic groups as Colombian, Burmese, Thai, Vietnamese, Ethiopian, and Bantu. The tallest children—living in Australia, northern and central Europe, Canada, and the United States, come from Czech, Dutch, Latvian, Norwegian, Swiss, and African populations (Meredith, 1978; Ruff, 2002).

Ethnic variations in growth rate are also common: African-American and Asian children tend to mature faster than Caucasian-American children, who are slightly ahead of European children (Eveleth & Tanner, 1990; Komlos & Breitfelder, 2008). These findings remind us that growth norms (age-related averages for height and weight) must be applied cautiously, especially in countries with high immigration rates and many ethnic minorities.

Both heredity and environment contribute to these differences. Body size sometimes reflects evolutionary adaptations to a particular climate. Long, lean physiques are typical in hot, tropical regions and short, stocky ones in cold, Arctic areas (Katzmarzyk & Leonard, 1998). Also, children who grow tallest usually live in developed countries, where food is plentiful and infectious diseases are largely controlled. Physically small children tend to live in less-developed regions, where poverty, hunger, and disease are common (Bogin, 2001). When families move from poor to wealthy nations, their children not only grow taller but also change to a longer-legged body shape. (Recall that during childhood, the legs are growing fastest.) For example, U.S.-born school-age children of immigrant Guatemalan Mayan parents are, on average, 4½ inches taller, with legs nearly 3 inches longer, than their agemates in Guatemalan Mayan villages (Bogin et al., 2002; Varela-Silva et al., 2007).

Body size is often the result of evolutionary adaptations to a particular climate. These boys of Tanzania, who live on the hot African plains, have long, lean physiques that permit their bodies to cool easily.
PART II  Foundations of Development

Secular Trends

Over the past 150 years, secular trends in physical growth—changes in body size from one generation to the next—have occurred in industrialized nations. In Australia, Canada, Japan, New Zealand, the United States, and nearly all European countries, most children today are taller and heavier than their parents and grandparents were as children (Ong, Ahmed, & Dunger, 2006). The secular gain appears early in life, increases over childhood and early adolescence, and then declines as mature body size is reached. This pattern suggests that the larger size of today’s children is mostly due to a faster rate of physical development. Consistent with this view, age of first menstruation declined steadily from 1900 to 1970, by about 3 to 4 months per decade. Although evidence on boys is sparse, they, too, show signs of having reached puberty earlier in recent decades (Euling et al., 2008).

Improved health and nutrition are largely responsible. As developing nations make socioeconomic progress, they also show secular gains (Ji & Chen, 2008). Secular trends are smaller for low-income children, who have poorer diets and are more likely to suffer from growth-stunting illnesses. And in regions with widespread poverty, famine, and disease, either no secular change or a secular decrease in body size has occurred (Barnes-Josiah & Augustin, 1995; Cole, 2000).

In most industrialized nations, the secular gain in height has slowed, and—as Figure 5.6 illustrates—the trend toward earlier first menstruation has stopped or undergone a slight reversal. But in the United States and a few European countries, soaring rates of overweight and obesity are responsible for a modest, continuing trend toward earlier menarche (Kaplowitz, 2008; Parent et al., 2003).

![Secular trend in age at menarche in six industrialized nations.](image)


ASK YOURSELF

**Review**  ■ What aspects of physical growth account for the long-legged appearance of many 8- to 12-year-olds?

**Connect**  ■ Relate secular trends in physical growth to the concept of cohort effects, discussed on page 62 in Chapter 2.

**Apply**  ■ Nine-year-old Allison dislikes physical education and thinks she isn’t good at sports. What strategies can be used to improve her involvement and pleasure in physical activity?

**Reflect**  ■ How does your height compare with that of your parents and grandparents when they were your age? Do your observations illustrate secular trends?

Brain Development

The human brain is the most elaborate and effective living structure on earth today. Despite its complexity, it reaches its adult size earlier than any other organ. We can best understand brain growth by looking at it from two vantage points: (1) the microscopic level of individual brain cells and (2) the larger level of the cerebral cortex, the most complex brain structure and the one responsible for the highly developed intelligence of our species.

- Cite major milestones in brain development, at the level of individual brain cells and at the level of the cerebral cortex.
- Describe changes in other brain structures and in the adolescent brain, and discuss evidence on sensitive periods in brain development.
Development of Neurons

The human brain has 100 to 200 billion neurons, or nerve cells, that store and transmit information, many of which have thousands of direct connections with other neurons. Unlike other body cells, neurons are not tightly packed together. Between them are tiny gaps, or synapses, where fibers from different neurons come close together but do not touch (see Figure 5.7). Neurons send messages to one another by releasing chemicals called neurotransmitters, which cross synapses.

The basic story of brain growth concerns how neurons develop and form this elaborate communication system. Figure 5.8 summarizes major milestones of brain development. In the prenatal period, neurons are produced in the embryo's primitive neural tube. From there, they migrate to form the major parts of the brain (see Chapter 3, page 91). Once neurons are in place, they differentiate, establishing their unique functions by extending their fibers to form synaptic connections with neighboring cells. During infancy and early childhood, neural fibers increase at an astounding pace (Huttenlocher, 2002; Moore & Persaud, 2008). A surprising aspect of brain growth is programmed cell death, which makes space for these connective structures: As synapses form, many surrounding neurons die—20 to 80 percent, depending on the brain region (de Haan & Johnson, 2003b; Stiles, 2008). Fortunately, during the prenatal period, the neural tube produces far more neurons than the brain will ever need.

As neurons form connections, stimulation becomes vital to their survival. Neurons that are stimulated by input from the surrounding environment continue to establish synapses, forming increasingly elaborate systems of communication that support more complex abilities. At first, stimulation results in massive overabundance of synapses, many of which serve identical functions, thereby ensuring that the child will acquire the motor, cognitive, and social skills that our species needs to survive. Neurons that are seldom stimulated soon lose their synapses, in a process called synaptic pruning that returns neurons not needed at the moment to an uncommitted state so they can...
support future development. In all, about 40 percent of synapses are pruned during childhood and adolescence (Webb, Monk, & Nelson, 2001). For this process to go forward, appropriate stimulation of the child’s brain is vital during periods in which the formation of synapses is at its peak (Nelson, Thomas, & de Haan, 2006).

If few new neurons are produced after the prenatal period, what causes the dramatic increase in brain size during infancy and early childhood? About half the brain’s volume is made up of glial cells, which are responsible for myelination, the coating of neural fibers with an insulating fatty sheath (called myelin) that improves the efficiency of message transfer. Glial cells multiply rapidly from the fourth month of pregnancy through the second year of life—a process that continues at a slower pace through middle childhood and accelerates again in adolescence. Gains in neural fibers and myelination are responsible for the extraordinary increase in overall size of the brain—from nearly 30 percent of its adult weight at birth to 70 percent by age 2 and 90 percent at age 6 (Johnson, 2005; Knickmeyer et al., 2008).

Brain development can be compared to molding a “living sculpture.” First, neurons and synapses are overproduced; then, cell death and synaptic pruning sculpt away excess building material to form the mature brain—a process jointly influenced by genetically programmed events and the child’s experiences. The resulting “sculpture” is a set of interconnected regions, each with specific functions—much like countries on a globe that communicate with one another (Johnston et al., 2001). This “geography” of the brain permits researchers to study its organization using neurobiological methods, such as EEG, ERP, fMRI, and NIRS (see page 48 in Chapter 2 to review). We will encounter these measures as we turn now to the development of the cerebral cortex.

Development of the Cerebral Cortex

The cerebral cortex surrounds the rest of the brain, resembling half of a shelled walnut. It is the largest brain structure—accounting for 85 percent of the brain’s weight and containing the greatest number of neurons and synapses. Because the cerebral cortex is also the last brain structure to stop growing, it is sensitive to environmental influences for a much longer period than any other part of the brain.

Regions of the Cerebral Cortex  Figure 5.9 shows specific functions of regions of the cerebral cortex, such as receiving information from the senses, instructing the body to move, and thinking. The order in which cortical regions develop corresponds to the order in which various capacities emerge in the infant and growing child. For example, a burst of activity occurs in the auditory and visual cortices and in areas responsible for body movement over the first year—a period of dramatic gains in auditory and visual perception and mastery of motor skills (Johnson, 2005). Language areas are especially active from late infancy through the preschool years, when language development flourishes (Pujol et al., 2006; Thompson et al., 2000).

The cortical regions with the most extended period of development are the frontal lobes. The prefrontal cortex, lying in front of areas controlling body movement, is responsible for thought—in particular, consciousness, attention, inhibition of impulses, integration of information, and use of memory, reasoning, planning, and problem-solving strategies. From age 2 months on, the prefrontal cortex functions more effectively. But it undergoes especially rapid myelination and formation and pruning of synapses during the preschool and school years, followed by another period of accelerated growth in adolescence, when it reaches an adult level of synaptic connections (Nelson, 2002; Nelson, Thomas, & de Haan, 2006; Sowell et al., 2002).
Lateralization and Plasticity of the Cerebral Cortex. The cerebral cortex has two hemispheres, or sides, that differ in their functions. Some tasks are done mostly by the left hemisphere, others by the right. For example, each hemisphere receives sensory information from the side of the body opposite to it and controls only that side. For most of us, the left hemisphere is largely responsible for verbal abilities (such as spoken and written language) and positive emotion (such as joy). The right hemisphere handles spatial abilities (judging distances, reading maps, and recognizing geometric shapes) and negative emotion (such as distress) (Banish & Heller, 1998; Nelson & Bosquet, 2000). In left-handed people, this pattern may be reversed or, more commonly, the cortex may be less clearly specialized than in right-handers.

Why does this specialization of the two hemispheres, called lateralization, occur? Studies using fMRI reveal that the left hemisphere is better at processing information in a sequential, analytic (piece-by-piece) way, a good approach for dealing with communicative information—both verbal (language) and emotional (a joyful smile). In contrast, the right hemisphere is specialized for processing information in a holistic, integrative manner, ideal for making sense of spatial information and regulating negative emotion. A lateralized brain may have evolved because it enabled humans to cope more successfully with changing environmental demands (Falk, 2005). It permits a wider array of functions to be carried out effectively than if both sides processed information exactly the same way.

Brain Plasticity. Researchers study when brain lateralization occurs to learn more about brain plasticity. A highly plastic cerebral cortex, in which many areas are not yet committed to specific functions, has a high capacity for learning. And if a part of the cortex is damaged, other parts can take over the tasks it would have handled. But once the hemispheres lateralize, damage to a specific region means that the abilities it controls cannot be recovered to the same extent or as easily as earlier.

At birth, the hemispheres have already begun to specialize. Most newborns favor the right side of the body in their head position and reflexive reactions (Grattan et al., 1992; Rönnqvist & Hopkins, 1998). Most also show greater activation (detected with either ERP or NIRS) in the left hemisphere while listening to speech sounds or displaying a positive state of arousal. In contrast, the right hemisphere reacts more strongly to nonspeech sounds and to stimuli (such as a sour-tasting fluid) that evoke negative emotion (Davidson, 1994; Fox & Davidson, 1986; Hespos et al., 2010).

Nevertheless, research on brain-damaged children and adults offers dramatic evidence for substantial plasticity in the young brain, summarized in the Biology and Environment box on page 188. Furthermore, early experience greatly influences the organization of the cerebral cortex. For example, deaf adults who, as infants and children, learned sign language (a spatial skill) depend more than hearing individuals on the right hemisphere for language processing (Neville & Bavelier, 2002). And toddlers who are advanced in language development show greater left-hemispheric specialization for language than their more slowly developing age-mates (Mills et al., 2005). Similarly, while performing motor and cognitive tasks, children show diffuse fMRI activity in the cerebral cortex relative to adolescents and adults, for whom activity is concentrated in certain cortical areas (Casey et al., 2002; Luna et al., 2001). Apparently, the very process of acquiring motor, cognitive, and language skills promotes lateralization.

In sum, the brain is more plastic during the first few years than it will ever again. An overabundance of synaptic connections supports brain plasticity, ensuring that young children will acquire certain capacities even if some areas are damaged. And although the cortex is programmed from the start for hemispheric specialization, experience greatly influences the rate and success of its advancing organization.

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1 The eyes are an exception. Messages from the right half of each retina go to the right hemisphere; messages from the left half of each retina go to the left hemisphere. Thus, visual information from both eyes is received by both hemispheres.
Brain Plasticity: Insights from Research on Brain-Damaged Children and Adults

In the first few years of life, the brain is highly plastic. It can reorganize areas committed to specific functions in ways that the mature brain cannot. Consistently, adults who suffered brain injuries in infancy and early childhood show fewer cognitive impairments than adults with later-occurring injuries (Holland, 2004; Huttenlocher, 2002). Nevertheless, the young brain is not totally plastic. When it is injured, its functioning is compromised. The extent of plasticity depends on several factors, including age at time of injury, site of damage, and skill area.

Brain Plasticity in Infancy and Early Childhood

In a large study of children with injuries to the cerebral cortex that occurred before birth or in the first six months of life, language and spatial skills were assessed repeatedly into adolescence (Akshoomoff et al., 2002; Stiles, 2001a; Stiles et al., 2005, 2008). All the children had experienced early brain seizures or hemorrhages. Brain-imaging techniques (fMRI and PET) revealed the precise site of damage.

Regardless of whether injury occurred in the left or right cerebral hemisphere, the children showed delays in language development that persisted until about 3½ years of age. That damage to either hemisphere affected early language competence indicates that at first, language functioning is broadly distributed in the brain. But by age 5, the children caught up in vocabulary and grammatical skills. Undamaged areas—in either the left or the right hemisphere—had taken over these language functions.

Compared with language, spatial skills were more impaired after early brain injury. When preschool through adolescent-age youngsters were asked to copy designs, those with early-right-hemispheric damage had trouble with holistic processing—accurately representing the overall shape. In contrast, children with left-hemispheric damage captured the basic shape but omitted fine-grained details. Nevertheless, the children improved in drawing skills with age—gains that do not occur in brain-injured adults (Akshoomoff et al., 2002; Stiles et al., 2003, 2008).

Clearly, recovery after early brain injury is greater for language than for spatial skills. Why is this so? Researchers speculate that spatial processing is the older of the two capacities in our evolutionary history and, therefore, more lateralized at birth (Stiles, 2001b; Stiles et al., 2002, 2008). But early brain injury has far less impact than later injury on both language and spatial skills. In sum, the young brain is remarkably plastic.

The Price of High Plasticity in the Young Brain

Despite impressive recovery of language and (to a lesser extent) spatial skills, children with early brain injuries show deficits in a wide variety of complex mental abilities during the school years. For example, their reading and math progress is slow. And in telling stories, they produce simpler narratives than agemates without early brain injuries (although many catch up in narrative skills by early adolescence) (Reilly, Bates, & Marchman, 1998; Reilly et al., 2004). Furthermore, the more brain tissue destroyed in infancy or early childhood, the poorer children score on intelligence tests (Anderson et al., 2006).

High brain plasticity, researchers explain, comes at a price. When healthy brain regions take over the functions of damaged areas, a “crowding effect” occurs: Multiple tasks must be done by a smaller than usual volume of brain tissue. Consequently, the brain processes information less quickly and accurately than it would if it were intact. Complex mental abilities of all kinds suffer into middle childhood, and often longer, because performing them well requires considerable space in the cerebral cortex (Huttenlocher, 2002).

Later Plasticity

Brain plasticity is not restricted to early childhood. Though far more limited, reorganization in the brain can occur later, even in adulthood. For example, adult stroke victims often display considerable recovery, especially in response to stimulation of language and motor skills. Brain-imaging techniques reveal that structures adjacent to the permanently damaged area or in the opposite cerebral hemisphere reorganize to support the impaired ability (Kalra & Ratan, 2007; Murphy & Corbett, 2009).

In infancy and childhood, the goal of brain growth is to form neural connections that ensure mastery of essential skills. Animal research reveals that plasticity is greatest while the brain is forming many new synapses; it declines during synaptic pruning (Murphy & Corbett, 2009). At older ages, specialized brain structures are in place, but after injury they can still reorganize to some degree. The adult brain can produce a small number of new neurons. And when an individual practices relevant tasks, the brain strengthens existing synapses and generates new ones (Nelson, Thomas, & de Haan, 2006).

Plasticity seems to be a basic property of the nervous system. Researchers hope to discover how experience and brain plasticity work together throughout life so they can help people of all ages—with and without brain injuries—develop at their best.
**Lateralization and Handedness.** Research on handedness supports the joint contribution of nature and nurture to brain lateralization. As early as the tenth prenatal week, most fetuses show a right-hand preference during thumb-sucking (Hepper, McCartney, & Shannon, 1998). And by age 6 months, infants typically reach more smoothly and efficiently with their right than their left arm. These tendencies, believed to be biologically based, may contribute to the right-handed bias of most children by the end of the first year (Hinojosa, Sheu, & Michel, 2003; Rönnqvist & Domellöf, 2006). During toddlerhood and early childhood, handedness gradually extends to a wider range of skills.

Handedness reflects the greater capacity of one side of the brain—the individual’s dominant cerebral hemisphere—to carry out skilled motor action. Other important abilities are generally located on the dominant side as well. For right-handed people—in Western nations, 90 percent of the population—language is housed in the left hemisphere with hand control. For the left-handed 10 percent, language is occasionally located in the right hemisphere or, more often, shared between the hemispheres (Perelle & Ehrman, 2009). This indicates that the brains of left-handers tend to be less strongly lateralized than those of right-handers.

Left-handed parents show only a weak tendency to have left-handed children (Vuoksimaa et al., 2009). One genetic theory proposes that most children inherit a gene that biases them for right-handedness and a left-dominant cerebral hemisphere. But that bias is not strong enough to overcome experiences that might sway children toward a left-hand preference (Annett, 2002). Even prenatal events may profoundly affect handedness. Both identical and fraternal twins are more likely than ordinary siblings to differ in hand preference, probably because twins usually lie in opposite orientations in the uterus (Derom et al., 1996). The orientation of most singleton fetuses—facing toward the left—is believed to promote greater control over movements on the body’s right side (Previc, 1991).

Handedness also involves practice. It is strongest for complex skills requiring extensive training, such as eating with utensils, writing, and engaging in athletic activities. And wide cultural differences exist: In Tanzania, Africa, where children are physically restrained and punished for favoring the left hand, less than 1 percent of adults are left-handed (Provins, 1997).

Although rates of left-handedness are elevated among people with mental retardation and mental illness, atypical brain lateralization is probably not responsible for these individuals’ problems. Rather, early damage to the left hemisphere may have caused their disabilities while also leading to a shift in handedness. In support of this idea, left-handedness is associated with prenatal and birth difficulties that can result in brain damage, including prolonged labor, prematurity, and Rh incompatibility (Powls et al., 1996; Rodriguez & Waldenström, 2008).

Most left-handers, however, have no developmental problems—in fact, unusual lateralization may have certain advantages. Left- and mixed-handed young people are slightly advantaged in speed and flexibility of thinking, and they are more likely than their right-handed agemates to develop outstanding verbal and mathematical talents (Flannery & Liederman, 1995; Gunstad et al., 2007). More even distribution of cognitive functions across both hemispheres may be responsible.

**Advances in Other Brain Structures**

Besides the cerebral cortex, several other areas of the brain make strides during childhood and adolescence. All of these changes involve establishing links among parts of the brain, increasing the coordinated functioning of the central nervous system. (To see where the structures we are about to discuss are located, turn back to Figure 5.4 on page 181.)

At the rear and base of the brain is the **cerebellum**, a structure that aids in balance and control of body movement. Fibers linking the cerebellum to the cerebral cortex grow and myelinate from birth through the preschool years, contributing to dramatic gains in motor coordination: By the time they start school, children can play hopscotch, throw and catch a ball with well-coordinated movements, and print letters of the alphabet. Connections between the cerebellum and the cerebral cortex also support thinking (Diamond, 2000). Children with
damage to the cerebellum usually display both motor and cognitive deficits, including problems with memory, planning, and language (Noterdaeme et al., 2002; Riva & Giorgi, 2000).

The reticular formation, a structure in the brain stem that maintains alertness and consciousness, generates synapses and myelinates from early childhood into adolescence. Neurons in the reticular formation send out fibers to many other areas of the brain. Many go to the prefrontal lobes of the cerebral cortex, contributing to improvements in sustained, controlled attention.

An inner-brain structure called the hippocampus, which plays a vital role in memory and in images of space that help us find our way, undergoes rapid synapse formation and myelination in the second half of the first year, when recall memory and independent movement emerge. Over the preschool and elementary school years, the hippocampus and surrounding areas of the cerebral cortex continue to develop swiftly, establishing connections with one another and with the prefrontal cortex (Nelson, Thomas, & de Haan, 2006). These changes make possible dramatic gains in memory (ability to use strategies to store and retrieve information) and spatial understanding (drawing and reading of maps), which we will take up in Chapters 6 and 7.

Also located in the inner brain, adjacent to the hippocampus, is the amygdala, a structure that plays a central role in processing emotional information. The amygdala is sensitive to facial emotional expressions, especially fear (Whalen et al., 2009). It also enhances memory for emotionally salient events, thereby ensuring that information relevant for survival—stimuli that evoke fear or signify safety—will be retrieved on future occasions. This capacity for emotional learning seems to emerge in early childhood: Damage to the amygdala in the first few years leads to loss of ability to learn about fear and safety signals and typically results in wide-ranging socially inappropriate behaviors (Shaw, Brierley, & David, 2005). Throughout childhood and adolescence, connections between the amygdala and the prefrontal cortex, which governs regulation of emotion, form and myelinate (Tottenham, Hare, & Casey, 2009).

The corpus callosum is a large bundle of fibers connecting the two cerebral hemispheres. Production of synapses and myelination of the corpus callosum increase at 1 year, peak between 3 and 6 years, and then continue at a slower pace through middle childhood and adolescence (Thompson et al., 2000). The corpus callosum supports smooth coordination of movements on both sides of the body and integration of perception, attention, memory, language, and problem solving. The more complex the task, the more essential is communication between the hemispheres.

Brain Development in Adolescence

From middle childhood to adolescence, connectivity among distant regions of the cerebral cortex expands and attains rapid communication. As a result, the prefrontal cortex becomes a more effective “executive”—overseeing and managing the integrated functioning of various areas, yielding more complex, flexible, and adaptive thinking and behavior (Blakemore & Choudhury, 2006; Lenroot & Giedd, 2006). Consequently, adolescents gain in diverse cognitive skills, including speed of thinking, attention, memory, planning, capacity to integrate information, and regulation of cognition and emotion.

But these advances occur gradually over the teenage years. fMRI evidence reveals that adolescents recruit the prefrontal cortex’s connections with other brain areas less effectively than adults do. Because the prefrontal cognitive-control network still requires fine-tuning, teenagers’ performance on tasks requiring self-restraint, planning, and future orientation (rejecting a smaller immediate reward in favor of a larger delayed reward) is not yet fully mature (Luna et al., 2001; McClure et al., 2004; Steinberg et al., 2009).

Adding to these self-regulation difficulties are changes in the brain’s emotional/social network. As humans and other mammals become sexually mature, neurons become more responsive to excitatory neurotransmitters. As a result, adolescents react more strongly to stressful events and experience pleasurable
stimuli more intensely. But because the cognitive control network is not yet functioning optimally, most teenagers find it hard to manage these powerful influences (Casey, Getz, & Galvan, 2008; Spear, 2008; Steinberg et al., 2008). This imbalance contributes to adolescents’ unchecked drive for novel experiences, including drug taking, reckless driving, unprotected sex, and delinquent activity, especially among those who are highly stressed and engage in reward seeking to counteract chronic emotional pain.

In addition, the surge in sex hormones (both estrogens and androgens) at puberty heightens sensitivity of the prefrontal cortex and inner brain structures (such as the amygdala) to the hormone oxytocin, secreted by the pituitary gland. In new mothers, oxytocin promotes caregiving behavior. In teenagers, it increases responsiveness to emotional and social stimuli, including feedback from others (Steinberg, 2008). Enhanced oxytocin sensitivity helps explain why adolescents, as we will we will see in Chapter 15, are so self-conscious and sensitive to others’ opinions. It also contributes to teenagers’ receptiveness to peer influence—a strong predictor of adolescent risk taking of all kinds (Gardner & Steinberg, 2005; Ranking et al., 2004).

Of course, not all teenagers display this rise in risk taking in the form of careless, dangerous acts: Temperament, parenting, and school and neighborhood resources (which are linked to opportunities to take risks) make a difference. Nevertheless, transformations in the adolescent brain enhance our understanding of both the cognitive advances and worrisome behaviors of this period, along with teenagers’ need for adult patience, oversight, and guidance.

Sensitive Periods in Brain Development

We have seen that stimulation of the brain is vital when it is growing most rapidly. Both animal and human studies, as noted in Chapter 4, reveal that early, extreme sensory deprivation results in permanent brain damage and loss of functions—findings that verify the existence of sensitive periods in brain development. Recall, also, that research on children adopted from Romanian orphanages indicates that deprived institutional care extending beyond the first six months results in persistent intellectual impairments and mental health problems (see page 170).

Much evidence confirms that the brain is particularly spongelike during the first few years, enabling children to acquire new skills easily and quickly. How, then, can we characterize appropriate stimulation during this time? To answer this question, researchers distinguish between two types of brain development. The first, experience-expectant brain growth, refers to the young brain’s rapidly developing organization, which depends on ordinary experiences—opportunities to interact with people, hear language and other sounds, see and touch objects, and move about and explore the environment. As a result of millions of years of evolution, the brains of all infants, toddlers, and young children expect to encounter these experiences and, if they do, grow normally. The second type of brain development, experience-dependent brain growth, occurs throughout our lives. It consists of additional growth and refinement of established brain structures as a result of specific learning experiences that vary widely across individuals and cultures (Greenough & Black, 1992). Reading and writing, playing computer games, weaving an intricate rug, and practicing the violin are examples. The brain of a violinist differs in certain ways from that of a poet because each has exercised different brain regions for a long time.

Experience-expectant brain development occurs early and naturally, as caregivers offer babies and preschoolers age-appropriate play materials and engage them in enjoyable daily routines—a shared meal, a game of peekaboo, a bath before bed, a picture book to talk about, or a song to sing. The resulting growth provides the foundation for later-occurring, experience-dependent development (Huttenlocher, 2002; Shonkoff & Phillips, 2001). In Chapter 4, we indicated that not just
understimulation but also overstimulation—overwhelming children with tasks and expectations for which they are not yet ready—can threaten their development. No evidence exists for a sensitive period in the first five or six years for mastering skills that depend on extensive training, such as reading, musical performance, or gymnastics (Bruer, 1999). To the contrary, rushing early learning harms the brain by overwhelming its neural circuits, thereby reducing the brain’s sensitivity to the everyday experiences it needs for a healthy start in life.

**ASK YOURSELF**

| Review | How does stimulation affect brain development?  
Cite evidence at the level of neurons and at the level of the cerebral cortex. |
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<tr>
<td>Connect</td>
<td>What stance on the nature–nurture issue does evidence on development of handedness support? Document your answer with research findings.</td>
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<tr>
<td>Apply</td>
<td>Lucia experienced damage to the left hemisphere of her cerebral cortex shortly after birth. As a first grader, she shows impressive recovery of language and spatial skills, but she lags behind her peers in academic progress. What accounts for her recovery of skills? How about her cognitive deficits?</td>
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<tr>
<td>Reflect</td>
<td>Which infant enrichment program would you choose: one that emphasizes social games and gentle talking and touching, or one that includes reading and number drills and classical music lessons? Explain.</td>
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### Factors Affecting Physical Growth

Physical growth, like other aspects of development, results from a complex interplay between genetic and environmental factors. Although heredity remains important, environmental factors continue to affect genetic expression. Good nutrition, relative freedom from disease, and emotional well-being are essential to children’s healthy development, while environmental pollutants can be a threat. The Biology and Environment box on the following page considers the extent to which one of the most common pollutants, low-level lead, undermines children’s mental and emotional functioning.

#### Heredity

Because identical twins are much more alike in body size than fraternal twins, we know that heredity contributes considerably to physical growth (Estourgie-van Burk et al., 2006). When diet and health are adequate, height and rate of physical growth (as measured by skeletal age and timing of first menstruation) are largely determined by heredity. In fact, as long as negative environmental influences, such as poor nutrition or illness, are not severe, children and adolescents typically show *catch-up growth*—a return to a genetically influenced growth path once conditions improve. Still, the brain, the heart, the digestive system, and many other internal organs may be permanently compromised (Hales & Ozanne, 2003). (Recall the consequences of inadequate prenatal nutrition for long-term health, discussed on page 104 in Chapter 3.)

Genes influence growth by controlling the body’s production of and sensitivity to hormones. Mutations can disrupt this process, leading to deviations in physical size. Occasionally, a mutation becomes widespread in a population. Consider the Efe of the Republic of Congo, whose typical adult height is less than 5 feet. For genetic reasons, the impact of growth hormone (GH) is reduced in Efe children (Bailey, 1990). By age 5, the average Efe child is shorter than over 97 percent of North American agemates. The Efe’s small size probably evolved because it reduces their caloric requirements in the face of food scarcity in the rain forests of Central Africa and enables them to move easily through the dense forest underbrush (Perry & Dominy, 2009).
Low-Level Lead Exposure and Children’s Development

Lead is a highly toxic element that, at blood levels exceeding 60 μg/dL (micrograms per deciliter), causes brain swelling, hemorrhaging, disrupted functioning of neurons, and widespread cell death. Before 1980, exposure to lead resulted from use of lead-based paints for the interiors of residences (infants and young children often ate paint flakes) and from use of leaded gasoline (car exhaust resulted in a highly breathable form of lead). Laws limiting the lead content of paint and mandating lead-free gasoline led to a sharp decline in children’s lead levels, from an average of 15 μg/dL in 1980 to 1.8 μg/dL today (Jones et al., 2009; Meyer et al., 2003).

But in areas near airports with significant burning of jet fuel, near industries using lead production processes, or where lead-based paint remains in older homes, children’s blood levels are still markedly elevated. In some areas, water-pipe corrosion has caused lead to rise in drinking water. Contaminated soil and imported consumer products, such as toys made of leaded plastic, are additional sources of exposure (Cole & Winsler, 2010). About 15 percent of low-income children living in large central cities, and 19 percent of African-American children, have blood-level levels exceeding 10 μg/dL (the U.S. government official “level of concern”), warranting immediate efforts to reduce exposure (Jones et al., 2009). How much lead exposure is too much? Does lead contamination, even in small quantities, impair children’s mental functioning? Until recently, answers were unclear. Studies reporting a negative relationship between children’s current lead levels and cognitive performance had serious limitations. Researchers knew nothing about children’s history of lead exposure and often failed to control for factors associated with both blood-lead levels and mental test scores (such as family income, home environmental quality, and nutrition) that might account for the findings.

Over the past two decades, a host of longitudinal studies of the developmental consequences of lead have been conducted in multiple countries, including the United States, Australia, Mexico City, and Yugoslavia. Some focused on inner-city, economically disadvantaged minority children, others on middle- and upper-middle-class suburban children, and one on children living close to a lead smelter. Each tracked children’s lead exposure over an extended time and included relevant controls.

All but one site reported negative relationships between lead exposure and children’s IQs (Canfield et al., 2003; Hubbs-Tait et al., 2005; Lanphear et al., 2005). Higher blood levels were also associated with deficits in verbal and visual-motor skills and with distractibility, overactivity, poor organization, weak academic performance, and behavior problems. And an array of additional findings suggested that persistent childhood lead exposure contributes to antisocial behavior in adolescence (Needleman et al., 2002; Nevin, 2006; Stretesky & Lynch, 2004).

The investigations did not agree on an age period of greatest vulnerability. In some, relationships were strongest in toddlerhood and early childhood; in others, at the most recently studied age, suggesting cumulative effects over time. Still other studies reported similar lead-related cognitive deficits from infancy through adolescence. Overall, poorer mental test scores associated with lead exposure persisted over time and seemed to be permanent. Children given drugs to induce excretion of lead (chelation) did not improve (Dietrich et al., 2004; Rogan et al., 2001). And negative cognitive consequences were evident at all levels of lead exposure—even below 10 μg/dL (Canfield et al., 2003; Lanphear et al., 2005; Wright et al., 2008).

Furthermore, in several investigations, cognitive consequences were much greater for children from low-income than middle- and high-income families (see, for example, Figure 5.10) (Bellinger, Leviton, & Sloman, 1990; Ri et al., 2004; Tong, McMichael, & Baghurst, 2000). A stressed, disorganized home life seems to heighten lead-induced damage. Dietary factors can also magnify lead’s toxic effects. Iron and zinc deficiencies, especially common in economically disadvantaged children, increase lead concentration in the blood (Noonan et al., 2003; Wolf, Jimenez, & Lozoff, 2003; Wright et al., 2003).

In sum, lead impairs mental development and contributes to behavior problems. Children from low-income families are more likely both to live in lead-contaminated areas and to experience additional risks that magnify lead-induced damage. Because lead is a stable element, its release into the air and soil is difficult to reverse. Therefore, in addition to laws that control lead pollution, interventions that reduce the negative impact of lead—through involved parenting, dietary enrichment, better schools, and public education about lead hazards—are vital.

FIGURE 5.10 Relationship of lifetime average lead exposure to 11- to 13-year-olds’ IQ by family economic status. In this study, conducted in the lead-smelting city of Port Pirie, Australia, blood-lead levels of 375 children were measured repeatedly from birth to age 11 to 13. The lead-exposure-related drop in IQ was much greater for children from economically disadvantaged than advantaged families. (Adapted from Tong, McMichael, & Baghurst, 2000.)
Twin studies reveal that genetic makeup also affects body weight (Kinnunen, Pietilainen, & Rissanen, 2006). At the same time, environment—in particular, nutrition and eating habits—plays an especially important role.

**Nutrition**

Nutrition is important at any time of development, but it is especially crucial during the first two years because the baby's brain and body are growing so rapidly. Pound for pound, an infant's energy needs are twice those of an adult. Twenty-five percent of babies' total caloric intake is devoted to growth, and infants need extra calories to keep their rapidly developing organs functioning properly (Meyer, 2009).

**Breastfeeding versus Bottle-Feeding** Babies need not only enough food but also the right kind of food. In early infancy, breast milk is ideally suited to their needs, and bottled formulas try to imitate it. Applying What We Know on the following page summarizes major nutritional and health advantages of breast milk.

Because of these benefits, breastfed babies in poverty-stricken regions are much less likely to be malnourished and 6 to 14 times more likely to survive the first year of life. The World Health Organization recommends breastfeeding until age 2 years, with solid foods added at 6 months. These practices, if widely followed, would save the lives of more than a million infants annually (World Health Organization, 2011). Even breastfeeding for just a few weeks offers some protection against respiratory and intestinal infections, which are devastating to young children in developing countries. Also, because a nursing mother is less likely to get pregnant, breastfeeding helps increase spacing between siblings, a major factor in reducing infant and childhood deaths in nations with widespread poverty. (Note, however, that breastfeeding is not a reliable method of birth control.)

Yet many mothers in the developing world do not know about the benefits of breastfeeding. In Africa, the Middle East, and Latin America, most babies get some breastfeeding, but fewer than 40 percent are exclusively breastfed for the first 6 months, and one-fourth are fully weaned from the breast by 1 year (UNICEF, 2009). In place of breast milk, mothers give their babies commercial formula or low-grade nutrients, such as rice water or highly diluted cow or goat milk. Contamination of these foods as a result of poor sanitation is common and often leads to illness and infant death. The United Nations has encouraged all hospitals and maternity units in developing countries to promote breastfeeding as long as mothers do not have viral or bacterial infections (such as HIV or tuberculosis) that can be transmitted to the baby. Today, most developing countries have banned the practice of giving free or subsidized formula to new mothers.

Partly as a result of the natural childbirth movement, breastfeeding has become more common in industrialized nations, especially among well-educated women. Today, 75 percent of American mothers breastfeed, but more than half stop by 6 months (U.S. Centers for Disease Control and Prevention, 2010). And despite the health benefits of breast milk, only 50 percent of preterm infants are breastfed at hospital discharge. Breastfeeding a preterm baby presents special challenges, including maintaining a sufficient milk supply with artificial pumping until the baby is mature enough to suck at the breast and providing the infant with enough sucking experience to learn to feed successfully (Callen & Pinelli, 2005). Kangaroo care (see pages 115–116 in Chapter 3) and the support of health professionals are helpful.

Because breast milk is so easily digestible, a breastfed infant becomes hungry every 1½ to 2 hours, compared to every 3 or 4 hours for a bottle-fed baby. This makes breastfeeding inconvenient for many employed women. Not surprisingly, mothers who return to work sooner wean their babies from the breast earlier (Kimbro, 2006). But mothers who cannot be with their babies all the time can still combine breast- and bottle-feeding. The U.S.
Department of Health and Human Services (2009a) advises exclusive breastfeeding for the first 6 months and inclusion of breast milk in the baby’s diet until at least 1 year. Women who do not breastfeed sometimes worry that they are depriving their baby of an experience essential for healthy psychological development. Yet breastfeeding mothers are not more attached to their babies, and breastfed and bottle-fed children in industrialized nations do not differ in emotional adjustment (Fergusson & Woodward, 1999; Jansen, de Weerth, & Riksen-Walraven, 2008). Some studies report a small advantage in intelligence test performance for children and adolescents who were breastfed, after controlling for many factors. Most, however, find no cognitive benefits (Der, Batty, & Deary, 2006; Holme, MacArthur, & Lancashire, 2010).

Nutrition in Childhood and Adolescence Around 1 year, infants’ diets should include all the basic food groups. As children approach age 2, their appetites become unpredictable. Preschoolers eat well at one meal but barely touch their food at the next. And many become picky eaters. This decline in appetite occurs because growth has slowed. Furthermore, preschoolers’ wariness of new foods is adaptive. If they stick to familiar foods, they are less likely to swallow dangerous substances when adults are not around to protect them (Birch & Fisher, 1995). Parents need not worry about variations in amount eaten from meal to meal. Over the course of a day, preschoolers compensate for eating little at one meal by eating more at a later one (Hursti, 1999).

**APPLYING WHAT WE KNOW**

**Reasons to Breastfeed**

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<tr>
<th>NUTRITIONAL AND HEALTH ADVANTAGES</th>
<th>EXPLANATION</th>
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<tr>
<td>Provides the correct balance of fat and protein</td>
<td>Compared with the milk of other mammals, human milk is higher in fat and lower in protein. This balance, as well as the unique proteins and fats contained in human milk, is ideal for a rapidly myelinating nervous system.</td>
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<tr>
<td>Ensures nutritional completeness</td>
<td>A mother who breastfeeds need not add other foods to her infant’s diet until the baby is 6 months old. The milks of all mammals are low in iron, but the iron contained in breast milk is much more easily absorbed by the baby’s system. Consequently, bottle-fed infants need iron-fortified formula.</td>
</tr>
<tr>
<td>Helps ensure healthy physical growth</td>
<td>One-year-old breastfed babies are leaner (have a higher percentage of muscle to fat), a growth pattern that persists through the preschool years and that may help prevent later overweight and obesity.</td>
</tr>
<tr>
<td>Protects against many diseases</td>
<td>Breastfeeding transfers antibodies and other infection-fighting agents from mother to baby and enhances functioning of the immune system. Compared with bottle-fed infants, breastfed babies have far fewer allergic reactions and respiratory and intestinal illnesses. Breast milk also has anti-inflammatory effects, which reduce the severity of illness symptoms. Breastfeeding in the first four months (especially when exclusive) is linked to lower blood cholesterol levels in childhood and, thereby, may help prevent cardiovascular disease.</td>
</tr>
<tr>
<td>Protects against faulty jaw development and tooth decay</td>
<td>Sucking the mother’s nipple instead of an artificial nipple helps avoid malocclusion, a condition in which the upper and lower jaws do not meet properly. It also protects against tooth decay due to sweet liquid remaining in the mouths of infants who fall asleep while sucking on a bottle.</td>
</tr>
<tr>
<td>Ensures digestibility</td>
<td>Because breastfed babies have a different kind of bacteria growing in their intestines than do bottle-fed infants, they rarely suffer from constipation or other gastrointestinal problems.</td>
</tr>
<tr>
<td>Smooths the transition to solid foods</td>
<td>Breastfed infants accept new solid foods more easily than do bottle-fed infants, perhaps because of their greater experience with a variety of flavors, which pass from the maternal diet into the mother’s milk.</td>
</tr>
</tbody>
</table>

Sources: American Academy of Pediatrics, 2005a; Buescher, 2001; Michels et al., 2007; Owen et al., 2008; Rosetta & Baldi, 2008; Wayerman, Rothenbacher, & Brenner, 2006.
Children tend to imitate the food choices and eating practices of people they admire, both adults and peers. For example, mothers who drink milk or soft drinks tend to have 5-year-old daughters with a similar beverage preference (Fisher et al., 2001). In Mexico, where children see family members delighting in the taste of peppery foods, preschoolers enthusiastically eat chili peppers, whereas most U.S. children reject them (Birch, Zimmerman, & Hind, 1980).

Repeated, unpressured exposure to a new food also increases acceptance (Fuller et al., 2005). Serving broccoli or tofu increases children's liking for these healthy foods. In contrast, offering sweet fruit or soft drinks promotes “milk avoidance” (Black et al., 2002).

Although children's healthy eating depends on a wholesome food environment, too much parental control over eating limits children's opportunities to develop self-control. When parents offer bribes (“Finish your vegetables, and you can have an extra cookie”), children tend to like the healthy food less and the treat more (Birch, Fisher, & Davison, 2003). Similarly, restricting access to tasty foods focuses children's attention on those foods and increases their desire to eat them. After caregivers in a child-care center prevented 3- to 6-year-olds from selecting apple-bar cookies at snack time by enclosing them in a transparent jar but gave them free access to peach-bar cookies (which they liked just as well), the children more often talked about and asked for the apple-bar cookies and otherwise tried to obtain them (see Figure 5.11) (Fisher & Birch, 1999). And when given access, they ate more apple-bar cookies than they had during previous, unrestricted snack times.

During puberty, rapid body growth leads to a dramatic rise in food intake. This increase in nutritional requirements comes at a time when eating habits are the poorest. Of all age groups, adolescents are the most likely to skip breakfast (a practice linked to obesity), eat on the run, and consume empty calories rather than nutrient-rich fruits and vegetables (Ritchie et al., 2007; Striegel-Moore & Franko, 2006). Fast-food restaurants, where teenagers often gather, have begun to offer some healthy menu options, but adolescents need guidance in choosing these alternatives. Eating fast food and school purchases from snack bars and vending machines is strongly associated with consumption of high-fat foods and soft drinks (Bowman et al., 2004; Kubik et al., 2003).

Frequency of family meals is a powerful predictor of healthy eating—greater intake of fruits, vegetables, grains, and milk products and reduced soft drink and fast-food consumption (Burgess-Champoux et al., 2009; Fiese & Schwartz, 2008). But compared to families with children, those with adolescents eat fewer meals together. Finding ways to arrange family meals, despite busy schedules, can greatly improve teenagers’ diets.

Malnutrition

In developing countries and war-torn areas where food resources are limited, malnutrition is widespread. Recent evidence indicates that about 27 percent of the world's children suffer from malnutrition before age 5 (World Health Organization, 2010b). The 10 percent who are severely affected suffer from two dietary diseases.

Marasmus is a wasted condition of the body caused by a diet low in all essential nutrients. It usually appears in the first year of life when a baby’s mother is too malnourished to produce enough breast milk and bottle-feeding is also inadequate. Her starving baby becomes painfully thin and is in danger of dying.

Kwashiorkor is caused by an unbalanced diet very low in protein. The disease usually strikes after weaning, between 1 and 3 years of age. It is common in regions where children get just enough calories from starchy foods but little protein. The child’s body responds by breaking down its own protein reserves. Soon the belly enlarges, the feet swell, the hair falls out, and a skin rash appears. A once bright-eyed, curious youngster becomes irritable and listless.
Children who survive these extreme forms of malnutrition often grow to be smaller in all body dimensions and suffer from lasting damage to the brain, heart, liver, or other organs (Müller & Krawinkel, 2005). When their diets do improve, they tend to gain excessive weight (Uauy et al., 2008). A malnourished body protects itself by establishing a low basal metabolism rate, which may endure after nutrition improves. Also, malnutrition may disrupt appetite-control centers in the brain, causing the child to overeat when food becomes plentiful.

Learning and behavior are also seriously affected. In one long-term study of marasmic children, an improved diet led to some catch-up growth in height, but not in head size (Stoch et al., 1982). The malnutrition probably interfered with growth of neural fibers and myelination, causing a permanent loss in brain weight. And animal evidence reveals that a deficient diet alters the production of neurotransmitters in the brain—an effect that can disrupt all aspects of development (Haller, 2005). These children score low on intelligence tests, show poor fine-motor coordination, and have difficulty paying attention (Bryce et al., 2008; Liu et al., 2003). They also display a more intense stress response to fear-arousing situations, perhaps caused by the constant, gnawing pain of hunger (Fernald & Grantham-McGregor, 1998).

Recall from our discussion of prenatal malnutrition in Chapter 3 that the passivity and irritability of malnourished children worsen the impact of poor diet. These behaviors may appear even when protein-calorie deprivation is only mild to moderate. They also accompany iron-deficiency anemia, a condition affecting about 25 percent of infants and children worldwide that interferes with many central nervous system processes. Withdrawal, listlessness, and inability to be soothed when upset reduce the iron-deficient baby’s capacity to pay attention, explore, and evoke sensitive caregiving from parents (Lozoff, 2007; Lozoff et al., 2008). These infants score lower than their nonanemic counterparts in motor and mental development, with iron supplementation alone failing to correct the difference. In one follow-up, young adults who had been profoundly iron-deficient as babies but iron-sufficient thereafter nevertheless performed poorly on diverse cognitive tasks (Łukowski et al., 2010). Consequently, in addition to improving early iron status, interventions must foster development by supporting the parent-child relationship.

Inadequate nutrition is not confined to developing countries. Because government-sponsored supplementary food programs do not reach all families in need, an estimated 21 percent of U.S. children suffer from food insecurity—uncertain access to enough food for a healthy, active life. Food insecurity is especially high among single-parent families (35 percent) and low-income ethnic minority families—for example, African Americans and...
Hispanics (25 and 27 percent, respectively) (U.S. Department of Agriculture, 2011). Although few of these children have marasmus or kwashiorkor, their physical growth and ability to learn are still affected.

**Obesity** Today, 32 percent of U.S. children and adolescents are overweight, more than half of them extremely so: 17 percent suffer from obesity, a greater-than-20-percent increase over healthy weight, based on body mass index (BMI)—a ratio of weight to height associated with body fat. (A BMI above the 85th percentile for the child’s age and sex is considered overweight, a BMI above the 95th percentile obese.) During the past several decades, a rise in overweight and obesity has occurred in many Western nations, with large increases in Canada, Germany, Israel, Greece, Ireland, New Zealand, the United Kingdom, and the United States (Ogden et al., 2010; World Health Organization, 2009, 2010a). Smaller increases have occurred in other industrialized nations, including Australia, Finland, the Netherlands, Norway, and Sweden.

Obesity rates are also increasing rapidly in developing countries as urbanization shifts the population toward sedentary lifestyles and diets high in meats and energy-dense refined foods (World Health Organization, 2010a, 2010b). In China, for example, where obesity was nearly nonexistent a generation ago, today 20 percent of children are overweight, with 7 percent obese—a nearly fivefold increase over the past twenty-five years, with boys affected more than girls (Ding, 2008). Childhood obesity in China is especially high in cities, where it has reached 10 percent (Ji & Chen, 2008). In addition to lifestyle changes, a prevailing belief in Chinese culture that excess body fat represents prosperity and health—carried over from a half-century ago, when famine caused millions of deaths—has contributed to this alarming upsurge. High valuing of sons may induce Chinese parents to offer boys especially generous portions of meat, dairy products, and other energy-dense foods that were once scarce but now are widely available.

Overweight rises with age, from 21 percent among U.S. preschoolers to 35 percent among school-age children and adolescents (Ogden et al., 2010). In a longitudinal study of more than 1,000 U.S. children, overweight preschoolers were five times more likely than their normal-weight peers to be overweight at age 12 (Nader et al., 2006). And an estimated 70 percent of affected teenagers become overweight adults (U.S. Department of Health and Human Services, 2011).

Besides serious emotional and social difficulties, obese children are at risk for lifelong health problems. Symptoms that begin to appear in the early school years—high blood pressure, high cholesterol levels, respiratory abnormalities, and insulin resistance—are powerful predictors of heart disease and other circulatory difficulties, type 2 diabetes, gallbladder disease, sleep and digestive disorders, many forms of cancer, and early death (Krisnamoorthy, Hart, & Jelalian, 2006; World Cancer Research Fund, 2007). Indeed, type 2 diabetes—formerly also known as “adult-onset” diabetes because it was rarely seen in childhood—is rising rapidly among overweight children, sometimes leading to early, severe complications, including stroke, kidney failure, and circulatory problems that heighten the risk of eventual blindness and leg amputation (Hannon, Rao, & Arslanian, 2005).

**Causes of Obesity.** Not all children are equally at risk for excessive weight gain. Overweight children tend to have overweight parents, and identical twins are more likely to share the disorder than fraternal twins. But heredity accounts for only a tendency to gain weight (Kral & Faith, 2009).

The importance of environment is seen in the consistent relationship of low education and income to overweight and obesity in industrialized nations, especially among ethnic minorities—in the United States, African-American, Hispanic, and Native-American children and adults (Anand et al., 2001; Ogden et al., 2010). Factors responsible include lack of
knowledge about healthy diet; a tendency to buy high-fat, low-cost foods; neighborhoods that lack convenient access to affordable, healthy foods in grocery stores and restaurants; and family stress, which can prompt overeating.

Furthermore, as noted on page 197, children who were undernourished in their early years are at risk for later excessive weight gain. In industrialized nations, many studies confirm that infants whose mothers smoked during pregnancy and who therefore are often born underweight (see Chapter 3) are more likely to suffer from childhood overweight and obesity (Rogers, 2009). Nevertheless, in the developing world (unlike in industrialized countries), obesity risk is greatest for individuals living in economically well-off households, probably because of greater food availability and reduced activity levels (Subramanian et al., 2011).

Parental feeding practices also contribute to childhood obesity. Overweight children are more likely to eat larger quantities of high-calorie sugary and fatty foods, perhaps because these foods are prominent in the diets offered by their parents, who also tend to be overweight. Interviews with more than 3,000 U.S. parents revealed that many served their 4- to 24-month-olds French fries, pizza, candy, sugary fruit drinks, and soda on a daily basis. On average, infants consumed 20 percent and toddlers 30 percent more calories than they needed (Briefel et al., 2004). Recent research confirms a strengthening relationship between rapid weight gain in infancy and later obesity (Botton et al., 2008; Chomtho et al., 2008).

Some parents anxiously overfeed, interpreting almost all their child’s discomforts as a desire for food. Others pressure their children to eat, a practice common among immigrant parents and grandparents who, as children themselves, survived periods of food deprivation. Still other parents are overly controlling, restricting when, what, and how much their child eats and worrying that the child will gain too much weight (Moen, Braet, & Soetens, 2007). In each case, parents fail to help children learn to regulate their own food intake. Also, parents of overweight children often use high-fat, sugary foods to reinforce other behaviors, leading children to attach great value to treats (Sherry et al., 2004).

Because of these experiences, obese children soon develop maladaptive eating habits. They are more responsive than normal-weight individuals to external stimuli associated with food—taste, sight, smell, time of day, and food-related words—and less responsive to internal hunger cues (Jansen et al., 2003; Temple et al., 2007). They also eat faster and chew their food less thoroughly, a behavior pattern that appears as early as 18 months of age (Drabman et al., 1979).

Another factor consistently associated with weight gain is insufficient sleep (Nielsen, Danielsen, & Sørensen, 2011). Reduced sleep may increase time available for eating, leave children too fatigued for physical activity, or disrupt the brain’s regulation of hunger and metabolism.

Overweight children are less physically active than their normal-weight peers. Inactivity is both cause and consequence of excessive weight gain. Research reveals that the rise in childhood obesity is due in part to the many hours U.S. children spend watching television. In a study that tracked children’s TV viewing from ages 4 to 11, the more TV children watched, the more body fat they added. Children who devoted more than 3 hours per day to TV accumulated 40 percent more fat than those devoting less than 1½ hours (see Figure 5.12) (Proctor et al., 2003). Watching TV reduces time devoted to physical exercise, and TV ads encourage children to eat fattening, unhealthy snacks. Children permitted to have a TV in their bedroom—a practice linked to especially high TV viewing—are at even greater risk for overweight (Adachi-Mejia et al., 2007).

Finally, the broader food environment affects the incidence of obesity. The Pima Indians of Arizona, who two decades ago changed from a traditional diet of plant foods to a high-fat, typically American diet, have one of the world’s highest obesity rates. Compared with descendants of their...
ancestors living in the remote Sierra Madre region of Mexico, the Arizona Pima have body weights 50 percent greater. Half the population has diabetes (eight times the national average), with many in their twenties and thirties already disabled by the disease—blind, in wheelchairs, and on kidney dialysis. The Pima have a genetic susceptibility to overweight, but it emerges only under Western dietary conditions (Gladwell, 1998; Traurig et al., 2009). Other ethnic groups with a hereditary tendency to gain weight are the Pacific Islanders, including native Hawaiians and Samoans (Furusawa et al., 2010). Many now eat an Americanized diet of high-calorie processed and fast foods, and over 80 percent are overweight.

Consequences of Obesity. Unfortunately, physical attractiveness is a powerful predictor of social acceptance. In Western societies, both children and adults rate obese youngsters as unlikable, stereotyping them as lazy, sloppy, dirty, ugly, stupid, and deceitful (Kilpatrick & Sanders, 1978; Penny & Haddock, 2007; Tiggemann & Anesbury, 2000). In school, obese children and adolescents are often socially isolated. They report more emotional, social, and school difficulties, including peer teasing and consequent low self-esteem, depression, and (among obese teenagers) suicidal thoughts and suicide attempts. Because unhappiness and overeating contribute to each other, the child remains overweight (Puhl & Latner, 2007; Zeller & Modi, 2006). Persistent obesity from childhood to adolescence predicts serious disorders, including defiance, aggression, and severe depression (Schwimmer, Burwinkle, & Varni, 2003; Young-Hyman et al., 2006).

The psychological consequences of obesity combine with continuing discrimination to result in reduced life chances. Overweight individuals are less likely than their normal-weight age-mates to receive financial aid for college, be rented apartments, find mates, and be offered jobs. And they report frequent mistreatment by family members, peers, co-workers, and health-care professionals, which contributes further to physical and psychological health problems (Carr & Friedman, 2005; Puhl, Heuer, & Brownell, 2010).

Treating Obesity. Childhood obesity is difficult to treat because it is a family disorder. In one study, only one-fourth of overweight parents judged their overweight children to have a weight problem (Jeffrey, 2004). Consistent with these findings, most obese children do not get any treatment.

The most effective interventions are family-based and focus on changing behaviors (Oude et al., 2009). In one program, both parent and child revised their eating patterns, exercised daily, and reinforced each other with praise and points for progress, which they exchanged for special activities and times together. The more weight parents lost, the more their children lost (Wrotniak et al., 2004). Follow-ups after five and ten years showed that children maintained weight loss more effectively than adults—a finding that underscores the importance of intervening at an early age (Epstein, Roemmich, & Raynor, 2001). Treatment programs that focus on both diet and lifestyle can yield substantial, long-lasting weight reduction among children and adolescents. But these interventions work best when parents’ and children’s weight problems are not severe (Eliakim et al., 2004; Nemet et al., 2005).

Children consume one-third of their daily energy intake at school. Therefore, schools can help reduce obesity by serving healthier meals and ensuring regular physical activity. Because obesity is expected to rise further without broad prevention strategies, many U.S. states and cities have passed obesity-reduction legislation (Levi et al., 2009). Among measures taken are weight-related school screenings for all children, improved nutrition standards and limited vending machine access in schools, additional recess time in the elementary grades and increased physical education time in all grades, obesity awareness and weight-reduction programs as part of school curricula, and menu nutrition labeling (including calories counts) in chain and fast-food restaurants.
Infectious Disease

In well-nourished children, ordinary childhood illnesses have no effect on physical growth. But when children are poorly fed, disease interacts with malnutrition in a vicious spiral, with potentially severe consequences.

Infectious Disease and Malnutrition

In developing nations where a large proportion of the population lives in poverty, children do not receive routine immunizations. As a result, illnesses such as measles and chicken pox, which typically do not appear until after age 3 in industrialized nations, occur much earlier. Poor diet depresses the body’s immune system, making children far more susceptible to disease. Of the 9 million annual deaths of children under age 5 worldwide, 98 percent are in developing countries and 70 percent are due to infectious diseases (World Health Organization, 2010b).

Disease, in turn, is a major contributor to malnutrition, hindering both physical growth and cognitive development. Illness reduces appetite and limits the body’s ability to absorb foods, especially in children with intestinal infections. In developing countries, widespread diarrhea, resulting from unsafe water and contaminated foods, leads to growth stunting and nearly 3 million childhood deaths each year (World Health Organization, 2010b). Studies carried out in the slums and shantytowns of Brazil and Peru reveal that the more persistent diarrhea is in early childhood, the shorter children are in height and the lower they score on mental tests during the school years (Checkley et al., 2003; Niehaus et al., 2002).

Most developmental impairments and deaths due to diarrhea can be prevented with nearly cost-free oral rehydration therapy (ORT), in which sick children are given a glucose, salt, and water solution that quickly replaces fluids the body loses. Since 1990, public health workers have taught nearly half the families in the developing world how to administer ORT. Also, supplements of zinc (essential for immune system functioning), which cost only 30 cents for a month’s supply, substantially reduce the incidence of severe and prolonged diarrhea (Aggarwal, Sentz, & Miller, 2007). Through these interventions, the lives of millions of children are saved each year. Still, only a minority of children with diarrhea in the world’s poorest countries—such as Chad, Morocco, Somalia, and Togo—receive ORT (World Health Organization, 2010b).

Immunization

In industrialized nations, childhood diseases have declined dramatically during the past half-century, largely as a result of widespread immunization of infants and young children. Nevertheless, about 20 percent of U.S. infants and toddlers are not fully immunized. Of the 80 percent who receive a complete schedule of vaccinations in the first two years, some do not receive the immunizations they need later, in early childhood. Overall, 30 percent of U.S. preschoolers lack essential immunizations. The rate rises to 32 percent for poverty-stricken children, many of whom do not receive full protection until age 5 or 6, when it is required for school entry (U.S. Department of Health and Human Services, 2010b). In contrast, fewer than 10 percent of preschoolers lack immunizations in Denmark and Norway, and fewer than 7 percent in Canada, the Netherlands, Sweden, and the United Kingdom (World Health Organization, 2010b).

Why does the United States lag behind these other countries in immunization? As noted in earlier chapters, many U.S. children do not have access to the health care they need. In 1994, all medically uninsured children in the United States were guaranteed free immunizations, a program that has led to gains in immunization rates. Still, the cost of the doctor’s visit to obtain the immunization may not be covered.
Inability to pay for vaccines is only one cause of inadequate immunization. Parents with little education and with stressful daily lives often fail to schedule vaccination appointments, and those without a primary-care physician do not want to endure long waits in crowded U.S. public health clinics (Falagas & Zarkadoulia, 2008). Some parents have been influenced by media reports suggesting a link between a mercury-based preservative used for decades in vaccines and a rise in the number of children diagnosed with autism. But large-scale studies show no association with autism and no consistent effects on cognitive performance (Dales, Hammer, & Smith, 2001; Richler et al., 2006; Stehr-Green et al., 2003; Thompson et al., 2007). Still, as a precautionary measure, mercury-free versions of childhood vaccinations are now available.

In areas where many parents have refused to immunize their children, outbreaks of whooping cough and rubella have occurred, with life-threatening consequences (Kennedy & Gust, 2008; Tuyen & Bisgard, 2003). Public education programs directed at increasing parental knowledge about the importance and safety of timely immunizations are badly needed.

**Emotional Well-Being**

We may not think of affection as necessary for healthy physical growth, but it is as vital as food. **Growth faltering** is a term applied to infants whose weight, height, and head circumference are substantially below age-related growth norms and who are withdrawn and apathetic (Black, 2005). In as many as half such cases, a disturbed parent–child relationship contributes to the failure to grow normally. These infants often keep their eyes on nearby adults, anxiously watching their every move, and they rarely smile at their caregiver (Steward, 2001).

Family circumstances surrounding growth faltering help explain these reactions. During feeding, diaper changing, and play, mothers of these infants seem cold and distant, at other times impatient and hostile (Hagekull, Bohlin, & Rydell, 1997). In response, babies try to protect themselves by keeping track of the threatening adult’s whereabouts and, when she approaches, avoiding her gaze. Often an unhappy marriage or parental psychological disturbance contributes to these serious caregiving problems. And most of the time, the baby is irritable and displays abnormal feeding behaviors, such as poor sucking or vomiting, that both disrupt growth and lead parents to feel anxious and helpless, which stress the parent–infant relationship further (Batchelor, 2008; Linscheid, Budd, & Rasnake, 2005).

When treated early, by intervening in infant feeding problems, helping parents with their own life challenges, and encouraging sensitive caregiving, these babies show quick catch-up growth. But if the disorder is not corrected in infancy, most children remain small and show lasting cognitive and emotional difficulties (Black et al., 2007; Drewett, Corbett, & Wright, 2006).

Extreme emotional deprivation can interfere with the production of GH and lead to **psychosocial dwarfism**, a growth disorder that appears between 2 and 15 years of age. Typical characteristics include decreased GH secretion, very short stature, immature skeletal age, and serious adjustment problems, which help distinguish psychosocial dwarfism from normal shortness (Tarren-Sweeney, 2006). When such children are removed from their emotionally inadequate environments, their GH levels quickly return to normal, and they grow rapidly. But if treatment is delayed, the dwarfism can be permanent.

**ASK YOURSELF**

**Review** Explain why breastfeeding can have lifelong consequences for the development of babies born in poverty-stricken regions of the world.

**Connect** How are bidirectional influences between parent and child involved in the impact of malnutrition on psychological development?

**Apply** Ten-month-old Shaun is below average in height and painfully thin. He has a serious growth disorder. List possibilities, and indicate what clues you would look for to tell which one Shaun has.

**Reflect** In rearing a child, which feeding and other child-rearing practices would you use, and which would you avoid, to prevent overweight and obesity?
During puberty, young people attain an adult-sized body and become capable of producing offspring. Accompanying rapid body growth are changes in physical features related to sexual functioning. Some, called primary sexual characteristics, involve the reproductive organs directly (ovaries, uterus, and vagina in females; penis, scrotum, and testes in males). Others, called secondary sexual characteristics, are visible on the outside of the body and serve as additional signs of sexual maturity (for example, breast development in females and the appearance of underarm and pubic hair in both sexes). As the Milestones table on page 204 shows, these characteristics develop in a fairly standard sequence, although the ages at which each begins and is completed vary greatly. Typically, pubertal development takes about four years, but some adolescents complete it in two years, whereas others take five to six years.

**Sexual Maturation in Girls**

Female puberty usually begins with the budding of the breasts and the growth spurt. Menarche, or first menstruation (from the Greek word arche, meaning “beginning”), typically occurs relatively late in the sequence of pubertal events—around age 12½ for North American girls, 13 for Western Europeans. But the age range is wide, from 10½ to 15½ years. Following menarche, breast and pubic hair growth are completed, and underarm hair appears.

Notice in the Milestones table that nature delays sexual maturity until the girl's body is large enough for childbearing; menarche takes place after the peak of the height spurt. As an extra measure of security, for 12 to 18 months following menarche, the menstrual cycle often occurs without the release of an ovum from the ovaries (Archibald, Graber, & Brooks-Gunn, 2006; Bogin, 2001). But this temporary period of sterility does not occur in all girls, and it cannot be counted on for protection against pregnancy.

**Sexual Maturation in Boys**

The first sign of puberty in boys is the enlargement of the testes (glands that manufacture sperm), accompanied by changes in the texture and color of the scrotum. Pubic hair emerges soon after, about the same time the penis begins to enlarge (Rogol, Roemmich, & Clark, 2002).

Refer again to the Milestones table, and you will see that the growth spurt occurs much later in the sequence of pubertal events for boys than for girls. Also, boys' height gain is more intense and longer lasting. When it reaches its peak around age 14, enlargement of the testes and penis is nearly complete, and underarm hair appears. Facial and body hair also emerge just after the peak in body growth and increase gradually for several years. Another landmark of male physical maturity is the deepening of the voice as the larynx enlarges and the vocal cords lengthen. (Girls' voices also deepen slightly.) Voice change usually takes place at the peak of the male growth spurt and often is not complete until puberty is over (Archibald, Graber, & Brooks-Gunn, 2006).
While the penis is growing, the prostate gland and seminal vesicles (which together produce semen, the fluid containing sperm) enlarge. Then, around age 13½, spermarche, or first ejaculation, occurs (Rogol, Roemmich, & Clark, 2002). For a while, the semen contains few living sperm. So, like girls, boys have an initial period of reduced fertility.

### Individual and Group Differences in Pubertal Growth

Heredity contributes substantially to the timing of pubertal changes. Identical twins are more similar than fraternal twins in attainment of most pubertal milestones, including growth spurt, menarche, breast development, body hair, and voice change (Eaves et al., 2004; Mustanski et al., 2004). Nutrition and exercise also make a difference. In females, a sharp rise in body weight and fat may trigger sexual maturation. Fat cells release a protein called leptin, which is believed to signal the brain that girls’ energy stores are sufficient for puberty—a likely reason that breast and pubic hair growth and menarche occur earlier for heavier and, especially, obese girls. In contrast, girls who begin rigorous athletic training at an early age or who eat very little (both of which reduce the percentage of body fat) usually experience later puberty (Kaplowitz, 2008; Lee et al., 2007; Rubin et al., 2009). Few studies, however, report a link between body fat and puberty in boys.
Variations in pubertal growth also exist between regions of the world and between income and ethnic groups. Physical health plays a major role. In poverty-stricken regions where malnutrition and infectious disease are common, menarche is greatly delayed, occurring as late as age 14 to 16 in many parts of Africa. Within developing countries, girls from higher-income families consistently reach menarche 6 to 18 months earlier than those from economically disadvantaged homes (Parent et al., 2003).

But in industrialized nations where food is abundant, the joint roles of heredity and environment in pubertal growth are apparent. For example, breast and pubic hair growth begin, on average, around age 9 in African-American girls—a year earlier than in Caucasian-American girls. And African-American girls reach menarche about six months earlier, around age 12. Although widespread overweight and obesity in the black population contribute, a genetically influenced faster rate of physical maturation is also involved. Black girls usually reach menarche before white girls of the same age and body weight (Chumlea et al., 2003; Herman-Giddens, 2006; Hillard, 2008).

Early family experiences may also affect pubertal timing. One theory suggests that humans have evolved to be sensitive to the emotional quality of their childhood environments. When children's safety and security are at risk, it is adaptive for them to reproduce early. Research indicates that girls and (less consistently) boys with a history of family conflict, harsh parenting, or parental separation tend to reach puberty early. In contrast, those with warm, stable family ties reach puberty relatively late (Belsky et al., 2007; Bogaert, 2005; Ellis & Essex, 2007; Mustanski et al., 2004; Tremblay & Frigon, 2005). Critics offer an alternative explanation—that mothers who reached puberty early are more likely to bear children earlier, which increases the likelihood of marital conflict and separation (Mendle et al., 2006). But longitudinal evidence on a large, ethnically diverse sample of U.S. girls followed from birth through age 15 confirmed the former chain of influence: from harsh parenting in childhood to earlier menarche to increased sexual risk taking in adolescence (Belsky et al., 2010).

The Psychological Impact of Pubertal Events

TAKE A MOMENT... Think back to your late elementary school and junior high days. As you reached puberty, how did your feelings about yourself and your relationships with others change? Were your reactions similar to those predicted by Rousseau and Hall, described at the beginning of this chapter?

Is Puberty Inevitably a Period of Storm and Stress?

Contemporary research suggests that the notion of adolescence as a biologically determined period of storm and stress is greatly exaggerated. Certain problems, such as eating disorders, depression, suicide (see Chapter 11), and lawbreaking (see Chapter 12), occur more often than earlier (Farrington, 2004; Graber, 2004). But the overall rate of serious psychological disturbance rises only slightly (by about 3 percent) from childhood to adolescence, when it is nearly the same as in the adult population—about 15 percent (Roberts, Attkisson, & Rosenblatt, 1998). Although some teenagers encounter serious difficulties, emotional turbulence is not routine.

The first researcher to point out the wide variability in adolescent adjustment was anthropologist Margaret Mead (1928). She returned from the Pacific islands of Samoa with a startling conclusion: Because of the culture's relaxed social relationships and openness toward sexuality, adolescence “is perhaps the pleasantest time the Samoan girl (or boy) will ever know” (p. 308). In Mead's alternative view, the social environment is entirely responsible for the range of teenage experiences, from erratic and agitated to calm and stress-free.

Later researchers found that Samoan adolescence was not as untroubled as Mead had assumed (Freeman, 1983). Still, Mead's work had an enormous impact. Today we know that

- What factors influence adolescents' reactions to the physical changes of puberty?
- Describe the impact of pubertal timing on adolescent adjustment, noting sex differences.
biological, psychological, and social forces combine to influence adolescent development (Susman & Dorn, 2009). Most tribal and village societies have a briefer transition to adulthood, but adolescence is not absent (Weisfield, 1997). In industrialized nations, where successful participation in economic life requires many years of education, young people face prolonged dependence on parents and postponement of sexual gratification. As a result, adolescence is greatly extended, and teenagers confront a wider array of psychological challenges. In the following sections, we will see many examples of how multiple factors combine to affect teenagers’ adjustment.

Reactions to Pubertal Changes

Two generations ago, menarche was often traumatic. Today, girls commonly react with surprise, undoubtedly due to the sudden onset of the event. Otherwise, they typically report a mixture of positive and negative emotions (DeRose & Brooks-Gunn, 2006). Yet wide individual differences exist that depend on prior knowledge and support from family members, which in turn are influenced by cultural attitudes toward puberty and sexuality.

For girls who have no advance information, menarche can be shocking and disturbing. In the 1950s, up to 50 percent received no prior warning, and of those who did, many were given negative, “grin-and-bear-it” messages (Costos, Ackerman, & Paradis, 2002; Shainess, 1961). Today, few girls are uninformed, a shift that is probably due to parents’ greater willingness to discuss sexual matters and to the spread of health education classes (Omar, McElderry, & Zakharia, 2003). Almost all girls get some information from their mothers. And some evidence suggests that compared with Caucasian-American families, African-American families may better prepare girls for menarche, treat it as an important milestone, and express less conflict over girls reaching sexual maturity—factors that lead African-American girls to react more favorably (Martin, 1996).

Like girls’ reactions to menarche, boys’ reactions to spermarche reflect mixed feelings. Virtually all boys know about ejaculation ahead of time, but many say that no one spoke to them before or during puberty about physical changes (Omar, McElderry, & Zakharia, 2003). Usually they get their information from reading materials or websites. Even boys who had advance information often say that their first ejaculation occurred earlier than they expected and that they were unprepared for it. As with girls, boys who feel better prepared tend to react more positively (Stein & Reiser, 1994). But whereas almost all girls tell a friend that they are menstruating, far fewer boys tell anyone about spermarche (DeRose & Brooks-Gunn, 2006; Downs & Fuller, 1991). Overall, boys get much less social support than girls for the physical changes of puberty. They might benefit, especially, from opportunities to ask questions and discuss feelings with a sympathetic parent or health professional.

Many tribal and village societies celebrate physical maturity with an adolescent initiation ceremony, a ritualized announcement to the community that marks an important change in privilege and responsibility. Consequently, young people know that reaching puberty is valued in their culture. In contrast, Western societies grant little formal recognition to movement from childhood to adolescence or from adolescence to adulthood. Ceremonies such as the Jewish bar or bat mitzvah and the quinceañera in Hispanic communities (celebrating a 15-year-old girl’s sexual maturity and marriage availability) resemble initiation ceremonies, but only within the ethnic or religious subculture. They do not mark a significant change in social status in the larger society.

Instead, Western adolescents are granted partial adult status at many different ages—for example, an age for starting employment, for driving, for leaving high school, for voting, and for drinking. And in some contexts (at home and at school), they may still be regarded as children. The absence of a single widely accepted marker of physical and social maturity makes the process of becoming an adult more confusing.
CHAPTER 5 Physical Growth

Pubertal Change, Emotion, and Social Behavior

A common belief is that puberty has something to do with adolescent moodiness and the desire for greater physical and psychological separation from parents. Let’s see what research says about these relationships.

Adolescent Moodiness  Higher pubertal hormone levels are linked to greater moodiness, but only modestly so (Buchanan, Eccles, & Becker, 1992; Graber, Brooks-Gunn, & Warren, 2006). What other factors might contribute? In several studies, the moods of children, adolescents, and adults were monitored by having them carry electronic pagers. Over a one-week period, they were beeped at random intervals and asked to write down what they were doing, whom they were with, and how they felt.

As expected, adolescents reported less favorable moods than school-age children and adults (Larson et al., 2002; Larson & Lampman-Petraitis, 1989). But negative moods were linked to a greater number of negative life events, such as difficulties getting along with parents, disciplinary actions at school, and breaking up with a boyfriend or girlfriend. Negative events increased steadily from childhood to adolescence, and teenagers also seemed to react to them with greater emotion than children (Larson & Ham, 1993). (Recall that stress reactivity is heightened by changes in brain neurotransmitter activity during adolescence.)

Compared with the moods of older adolescents and adults, those of younger adolescents (ages 12 to 16) were less stable, often varying from cheerful to sad and back again. These mood swings were strongly related to situational changes. High points of adolescents’ days were times spent with friends and in self-chosen leisure activities. Low points tended to occur in adult-structured settings—class, job, and religious services. Furthermore, emotional highs coincided with Friday and Saturday evenings, especially in high school (see Figure 5.13). Going out with friends and romantic partners increases so dramatically during adolescence that it becomes a “cultural script” for what is supposed to happen. Teenagers who spend weekend evenings at home often feel profoundly lonely (Larson & Richards, 1998).

Yet another contributor to adolescent moodiness is change in sleep schedules. Although teenagers need almost as much sleep as they did in middle childhood (about nine hours), they go to bed much later than they did as children, perhaps because of increased neural sensitivity to evening light. This sleep “phase delay” strengthens with pubertal development. But today’s teenagers—with more evening social activities, part-time jobs, and bedrooms equipped with TVs, computers, and phones—get much less sleep than teenagers of previous generations (Carskadon, Acebo, & Jenni, 2004; Carskadon et al., 2002). Sleep-deprived adolescents are more likely to suffer from depressed mood, achieve poorly in school, and engage in high-risk behaviors, including drinking and reckless driving (Dahl & Lewin, 2002; Hansen et al., 2005). Later school start times ease but do not eliminate sleep loss.

Fortunately, frequent reports of negative mood level off in late adolescence, when teenagers’ emotions also become more stable (Holsen, Kraft, & Vitterso, 2000; Natsuaki, Biehl, & Ge, 2009). And overall, teenagers with supportive family and peer relationships more often report positive and less often negative moods than their agemates with few social supports (Weinstein et al., 2006). In contrast, poorly adjusted young people—with low self-esteem, conduct difficulties, or delinquency—tend to react with stronger negative emotion to unpleasant daily experiences, perhaps compounding their adjustment problems (Schneiders et al., 2006).

FIGURE 5.13 Younger and older adolescents’ emotional experiences across the week. Adolescents’ reports revealed that emotional high points are on Fridays and Saturdays. Mood drops on Sunday, before returning to school, and during the week, as students spend much time in adult-structured settings in school. (From R. Larson & M. Richards, 1998, “Waiting for the Weekend: Friday and Saturday Night as the Emotional Climax of the Week,” in A. C. Croeter & R. Larson [Eds.], Temporal Rhythms in Adolescence: Clocks, Calendars, and the Coordination of Daily Life, San Francisco: Jossey-Bass, p. 41. Reprinted by permission of John Wiley & Sons, Inc.)
Parent–Child Relationships  Recall the observations of Sabrina’s father in the introduction to this chapter—that as children enter adolescence, they resist spending time with the family and become more argumentative. Research in cultures as diverse as the United States and Turkey shows that puberty is related to a rise in parent–child conflict, which persists into the mid-teenage years (Gure, Ucanok, & Sayil, 2006; Laursen, Coy, & Collins, 1998; McGue et al., 2005).

Why should a youngster’s more adultlike appearance trigger these disputes? From an evolutionary perspective, the association may have adaptive value. Among nonhuman primates, the young typically leave the family group around the time of puberty. The same is true in many nonindustrialized cultures (Caine, 1986; Schlegel & Barry, 1991). Departure of young people discourages sexual relations between close blood relatives. But adolescents in industrialized nations, who are still economically dependent on parents, cannot leave the family. Consequently, a modern substitute seems to have emerged: psychological distancing.

As children become physically mature, they demand to be treated in adultlike ways. And as we will see in later chapters, adolescents’ new powers of reasoning may also contribute to a rise in family tensions. Parent–adolescent disagreements focus largely on everyday matters such as driving, dating partners, and curfews (Adams & Laursen, 2001). But beneath these disputes lie serious concerns: parental efforts to protect teenagers from substance use, auto accidents, and early sex. The larger the gap between parents’ and adolescents’ views of teenagers’ readiness for new responsibilities, the more they quarrel (Deković, Noom, & Meeus, 1997).

Parent–daughter conflict tends to be more intense than conflict with sons, perhaps because girls reach puberty earlier and parents place more restrictions on girls (Allison & Schultz, 2004). But most disputes are mild, and by late adolescence, only a small minority of families experience continuing friction. Parents and teenagers display both conflict and affection, and they usually agree on important values, such as honesty and the importance of education.

Although separation from parents is adaptive, both generations benefit from warm, protective family bonds throughout the lifespan. As the teenage years conclude, parent–adolescent interactions are less hierarchical, setting the stage for mutually supportive relationships in adulthood (Laursen & Collins, 2009).

Pubertal Timing  In addition to dramatic physical change, the timing of puberty has a major impact on psychological adjustment. Findings of several studies indicate that both adults and peers viewed early-maturing boys as relaxed, independent, self-confident, and physically attractive. Popular with agemates, they tended to hold leadership positions in school and to be athletic stars. In contrast, late-maturing boys expressed more anxiety and depressed mood than their on-time counterparts (Brooks-Gunn, 1988; Huddleson & Ge, 2003). But early-maturing boys, though viewed as well-adjusted, reported slightly more psychological stress, depressed mood, and problem behaviors (sexual activity, smoking, drinking, aggression, delinquency) than both their on-time and later-maturing agemates (Ge, Conger, & Elder, 2001b; Natsuaki, Biehl, & Ge, 2009; Susman & Dorn, 2009).

In contrast, early-maturing girls were unpopular, withdrawn, lacking in self-confidence, anxious, and prone to depression, and they held few leadership positions and achieved less well in school (Ge, Conger, & Elder, 1996; Graber et al., 1997; Graber, Brooks-Gunn, & Warren, 2006; Jones & Mussen, 1958). And like early-maturing boys, they were more involved in deviant behavior (smoking, drinking, early sexual activity) (Caspi et al., 1993; Dick et al., 2000; Ge et al., 2006). In contrast, their later-maturing counterparts were regarded as physically attractive, lively, sociable, and leaders at school. In one study of several hundred eighth graders, however, negative effects were not evident among early-maturing African-American
girls, whose families—and perhaps friends as well—tend to be more unconditionally welcoming of menarche (see page 206) (Michael & Eccles, 2003).

Two factors largely account for these trends: (1) how closely the adolescent’s body matches cultural ideals of physical attractiveness and (2) how well young people fit in physically with their agemates.

The Role of Physical Attractiveness  **TAKE A MOMENT...** Flip through the pages of your favorite popular magazine. You will see evidence of our society’s view of an attractive female as thin and long-legged and of a good-looking male as tall, broad-shouldered, and muscular. The female image is a girlish shape that favors the late developer. The male image fits the early-maturing boy.

Consistent with these preferences, early maturing Caucasian girls tend to report a less positive **body image**—conception of and attitude toward their physical appearance—than their on-time and late-maturing agemates. Compared with African-American and Hispanic girls, Caucasian girls are more likely to have internalized the cultural ideal of female attractiveness. Most want to be thinner (Rosen, 2003; Stice, Presnell, & Bearman, 2001; Williams & Currie, 2000). Although boys are less consistent, early, rapid matures are more likely to be satisfied with their physical characteristics (Alsaker, 1995; Sinkkonen, Anttila, & Siimes, 1998).

Body image is a strong predictor of young people’s self-esteem (Harter, 2006). But the negative effects of pubertal timing on body image and—as we will see next—emotional adjustment are greatly amplified when accompanied by other stressors (Stice, 2003).

The Importance of Fitting in with Peers  Physical status in relation to peers also explains differences in adjustment between early and late matures. From this perspective, early-maturing girls and late-maturing boys have difficulty because they fall at the extremes in physical development. Recall that Sabrina felt “out of place” when with her agemates. Not surprisingly, adolescents feel most comfortable with peers who match their own level of biological maturity (Stattin & Magnusson, 1990).

Because few agemates of the same pubertal status are available, early-maturing adolescents of both sexes seek out older companions, who often encourage them into activities they are not yet ready to handle. And hormonal influences on the brain’s emotional/social network (see pages 190–191) are stronger for early matures, further magnifying their receptiveness to sexual activity, drug and alcohol use, and minor delinquent acts (Ge et al., 2002; Steinberg, 2008). Perhaps because of such involvements, early matures of both sexes report feeling emotionally stressed and show declines in academic performance (Mendle, Turkheimer, & Emery, 2007; Natsuaki, Biehl, & Ge, 2009).

At the same time, the young person’s context greatly increases the likelihood that early pubertal timing will lead to negative outcomes. Early matures in economically disadvantaged neighborhoods are especially vulnerable to establishing ties with deviant peers, which heightens their defiant, hostile behavior (Obeidallah et al., 2004). And because families in such neighborhoods tend to be exposed to chronic, severe stressors and to have few social supports, these early matures are also more likely to experience harsh, inconsistent parenting, which, in turn, predicts both deviant peer associations and antisocial activity (Ge et al., 2002, 2011).

Long-Term Consequences  Do the effects of pubertal timing persist? Follow-ups reveal that early-maturing girls, especially, are prone to lasting difficulties. In one study, early-maturing boys’ depression subsided by age 13, but depressed early-maturing girls tended to remain depressed (Ge at al., 2003). In another study, which followed young people from ages 14 to 24, early-maturing boys again showed good adjustment. Early-maturing girls, however, reported poorer-quality relationships with family and friends, smaller social networks, and lower life satisfaction into early adulthood than their on-time counterparts (Graber et al., 2004). Similarly, in a Swedish investigation, achievement and substance use difficulties of
Puberty and Adolescent Health

The arrival of puberty brings new health concerns related to the young person's efforts to meet physical and psychological needs. As adolescents attain greater autonomy, their personal decision making becomes important, in health as well as other areas. Yet none of the health concerns we are about to discuss can be traced to a single cause. Rather, biological, psychological, family, peer, and cultural factors jointly contribute.

Eating Disorders

Girls who reach puberty early, who are very dissatisfied with their body image, and who grow up in homes where concern with weight and thinness is high are at risk for eating problems. Severe dieting is the strongest predictor of an eating disorder in adolescence (Lock & Kirz, 2008). The two most serious are anorexia nervosa and bulimia nervosa.

Anorexia Nervosa  Anorexia nervosa is a tragic eating disorder in which young people starve themselves because of a compulsive fear of getting fat. Typically appearing between ages 14 and 16, it affects about 1 percent of North American and Western European teenage girls. During the past half-century, cases have increased sharply, fueled by cultural admiration of female thinness. Anorexia nervosa is equally common in all social-class groups, but Asian-American, Caucasian-American, and Hispanic girls are at greater risk than African-American girls, who tend to be more satisfied with their size and shape (Granillo, Jones-Rodriguez, & Carvajal, 2005; Ozer & Irwin, 2009; Steinhausen, 2006). Boys account for 10 to 15 percent of anorexia cases; about half of these are gay or bisexual young people who are uncomfortable with a strong, muscular appearance (Raevuori et al., 2009; Robb & Dadson, 2002).

Individuals with anorexia have an extremely distorted body image. Even after they have become severely underweight, they see themselves as too heavy. Most go on self-imposed diets so strict that they struggle to avoid eating in response to hunger. To enhance weight loss, they exercise strenuously.

In their attempt to reach "perfect" slimness, individuals with anorexia lose between 25 and 50 percent of their body weight. Because a normal menstrual cycle requires about 15 percent body fat, either menarche does not occur or menstrual periods stop. Malnutrition causes pale skin, brittle discolored nails, fine dark hairs all over the body, and extreme sensitivity to

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**Ask Yourself**

- What factors contribute to eating disorders in adolescence?
- Discuss cultural, social, and personal influences on adolescent sexual attitudes and behavior.
- Cite factors involved in the development of homosexuality.
- Discuss factors related to sexually transmitted disease and teenage pregnancy and parenthood, noting prevention and intervention strategies.
cold. If it continues, the heart muscle can shrink, the kidneys can fail, and irreversible brain damage and loss of bone mass can occur. About 6 percent of individuals with anorexia die of the disorder, as a result of either physical complications or suicide (Katzman, 2005).

Forces within the person, the family, and the larger culture give rise to anorexia nervosa. Identical twins share the disorder more often than fraternal twins, indicating a genetic influence. Abnormalities in neurotransmitters in the brain, linked to anxiety and impulse control, may make some individuals more susceptible (Kaye, 2008; Lock & Kirz, 2008). And problem eating behavior in early childhood—persistently refusing to eat or eating very little—is linked to anorexia in adolescence (Nicholls & Viner, 2009). Many young people with anorexia have unrealistically high standards for their own behavior and performance, are emotionally inhibited, and avoid intimate ties outside the family. Consequently, they are often excellent students who are responsible and well-behaved. But as we have seen, the societal image of “thin is beautiful” contributes to the poor body image of many girls—especially early-maturing girls, who are at greatest risk for anorexia nervosa (Hogan & Strasburger, 2008).

In addition, parent–adolescent interactions reveal problems related to adolescent autonomy. Often the mothers of these girls have high expectations for physical appearance, achievement, and social acceptance and are overprotective and controlling. Fathers tend to be emotionally distant. These parental attitudes and behavior may contribute to affected girls’ persistent anxiety and fierce pursuit of perfection in achievement, respectable behavior, and thinness (Kaye, 2008). Nevertheless, it remains unclear whether maladaptive parent–child relationships precede the disorder, emerge as a response to it, or both. In a longitudinal study in which 12- to 16-year-old girls were followed for four years, unhealthy eating behaviors led to conflict-ridden interactions with parents, not the reverse (Archibald et al., 2002).

Because individuals with anorexia typically deny or minimize the seriousness of their disorder, treating it is difficult (Couturier & Lock, 2006). Hospitalization is often necessary to prevent life-threatening malnutrition. The most successful treatment is family therapy plus medication to reduce anxiety and neurotransmitter imbalances (Robin & Le Grange, 2010; Treasure & Schmidt, 2005). As a supplementary approach, behavior modification— in which individuals hospitalized with anorexia are rewarded with praise, social contact, and opportunities for exercise when they eat and gain weight—is helpful.

Still, less than 50 percent of young people with anorexia recover fully. For many, eating problems continue in less extreme form. About 10 percent show signs of a less severe, but nevertheless debilitating, disorder: bulimia nervosa. And the chronic anxiety associated with both eating disorders increases girls’ risk for major depression in both adolescence and adulthood (Godart et al., 2006).

Bulimia Nervosa In bulimia nervosa, young people (again, mainly girls, but gay and bisexual boys are also vulnerable) engage in strict dieting and excessive exercise accompanied by binge eating, often followed by deliberate vomiting and purging with laxatives (Herzog, Eddy, & Beresin, 2006; Wichström, 2006). Bulimia typically appears in late adolescence and is more common than anorexia nervosa, affecting about 2 to 4 percent of teenage girls, only 5 percent of whom previously suffered from anorexia.

Twin studies show that bulimia, like anorexia, is influenced by heredity (Klump, Kaye, & Strober, 2001). Overweight and early menarche increase the risk. Some adolescents with bulimia, like those with anorexia, are perfectionists. But most are impulsive, sensation-seeking young people who lack self-control in many areas, engaging in petty shoplifting, alcohol abuse, and other risky behaviors. And although girls with bulimia, like those with anorexia, are pathologically anxious about gaining weight, they may have experienced their parents as disengaged and emotionally unavailable rather than overcontrolling (Fairburn & Harrison, 2003).
In contrast to young people with anorexia, those with bulimia usually feel depressed and guilty about their abnormal eating habits and desperately want help. As a result, bulimia is usually easier to treat than anorexia, through support groups, nutrition education, training in changing eating habits, and anti-anxiety, antidepressant, and appetite-control medication (Hay & Bacaltchuk, 2004).

**Sexuality**

With the arrival of puberty, hormonal changes—in particular, the production of androgens in young people of both sexes—lead to an increase in sex drive (Halpern, Udry, & Suchindran, 1997). In response, adolescents become very concerned about managing sexuality in social relationships. New cognitive capacities involving perspective taking and self-reflection affect their efforts to do so. Yet like the eating behaviors we have just discussed, adolescent sexuality is heavily influenced by the young person’s social context.

**The Impact of Culture**

When did you first learn “the facts of life”—and how? Was sex discussed openly in your family, or was it treated with secrecy? Exposure to sex, education about it, and efforts to limit the sexual curiosity of children and adolescents vary widely around the world. At one extreme are a number of Middle Eastern peoples, who murder girls if they lose their virginity before marriage. At the other extreme are several Asian and Pacific Island groups with highly permissive sexual attitudes and practices. For example, among the Trobriand Islanders of Papua New Guinea, older companions provide children with instruction in sexual practices, and adolescents are expected to engage in sexual experimentation with a variety of partners (Weiner, 1988).

Despite the prevailing image of sexually free adolescents, sexual attitudes in North America are relatively restrictive. Typically, parents provide little or no information about sex, discourage sex play, and rarely talk about sex in children’s presence. When young people become interested in sex, only about half report getting information from parents about intercourse, pregnancy prevention, and sexually transmitted disease. Many parents avoid meaningful discussions about sex out of fear of embarrassment or concern that the adolescent will not take them seriously (Wilson et al., 2010). Yet warm, open give-and-take, as described in Applying What We Know on the following page, is associated with teenagers’ adoption of parents’ views and with reduced sexual risk taking (Jaccard, Dodge, & Dittus, 2003; Usher-Seriki, Bynum, & Callands, 2008).

Adolescents who do not get information about sex from their parents are likely to learn from friends, books, magazines, movies, TV, and the Internet (Jaccard, Dodge, & Dittus, 2002; Sutton et al., 2002). On prime-time TV shows, which adolescents watch more than other TV offerings, 80 percent of programs contain sexual content. Most depict partners as spontaneous and passionate, taking no steps to avoid pregnancy or sexually transmitted disease, and experiencing no negative consequences (Roberts, Henriksen, & Foehr, 2004). In several studies, teenagers’ media exposure to sexual content positively predicted current sexual activity, intentions to be sexually active in the future, and subsequent sexual activity, pregnancies, and sexual harassment behaviors (offensive name-calling or touching, pressuring a peer for a date), even after many other relevant factors were controlled (Brown & L’Engle, 2009; Chandra et al., 2008; Roberts, Henriksen, & Foehr, 2009).

Not surprisingly, adolescents who are prone to early sexual activity choose to consume more sexualized media (Steinberg & Monahan, 2011). Still, the Internet is a hazardous “sex educator.” In a survey of a large sample of U.S. 10- to 17-year-old Web users, 42 percent said they had viewed online pornographic websites (images of naked people or people having sex) while surfing the Internet in the past 12 months. Of these, 66 percent indicated they had encountered the images accidentally and did not want to view them. Youths who felt depressed, had been bullied by peers, or were involved in delinquent activities had more encounters with Internet pornography, which may have intensified their adjustment problems (Wolak, Mitchell, & Finkelhor, 2007).

Consider the contradictory messages young people receive. On one hand, adults emphasize that sex at a young age and outside marriage is wrong. On the other hand, the social
environment extols sexual excitement, experimentation, and promiscuity. American teenagers are left bewildered, poorly informed about sexual facts, and with little sound advice on how to conduct their sex lives responsibly.

**Adolescent Sexual Attitudes and Behavior** Although differences between subcultural groups exist, the sexual attitudes of U.S. adolescents and adults have become more liberal over the past 40 years. Compared with a generation ago, more people approve of sexual intercourse before marriage, as long as two people are emotionally committed to each other (ABC News, 2004; Hoff, Greene, & Davis, 2003). During the past decade, adolescents have swung slightly back toward more conservative sexual beliefs, largely in response to the risk of sexually transmitted disease, especially AIDS, and to teenage sexual abstinence programs sponsored by schools and religious organizations (Akers et al., 2011; Ali & Scelfo, 2002).

Trends in adolescents’ sexual behavior are consistent with their attitudes. Rates of extramarital sex among U.S. young people rose for several decades but have recently declined (U.S. Department of Health and Human Services, 2010d). Nevertheless, as Figure 5.14 reveals, a substantial percentage of young people are sexually active by ninth grade (age 14 to 15).

Overall, teenage sexual activity rates are similar in the United States and other Western countries: Nearly half of adolescents have had intercourse. But quality of sexual experiences differs. U.S. youths become sexually active earlier than their Canadian and European counterparts (Boyce et al., 2006; U.S. Department of Health and Human Services, 2010d). And about 14 percent of adolescent boys in the United States—more than in other Western nations—have had sexual relations

**FIGURE 5.14** U.S. adolescents who report ever having had sexual intercourse. Many young U.S. adolescents are sexually active—more than in other Western nations. Boys tend to have their first intercourse earlier than girls. In tenth and eleventh grades, rates of boys and girls having had sexual intercourse are similar. In twelfth grade, girls’ rate exceeds boys’. (From U.S. Department of Health and Human Services, 2010d.)
Adolescence is an especially important time for the development of sexuality. But American teenagers receive contradictory and confusing messages about the appropriateness of sex. Because many of these factors are associated with growing up in a low-income family, it is not surprising that early sexual activity is more common among young people from economically disadvantaged homes. Living in a neighborhood high in physical deterioration, crime, and violence also increases the likelihood that teenagers will be sexually active (Ge et al., 2002). In such neighborhoods, social ties are weak, adults exert little oversight or control over adolescents’ activities, and negative peer influences are widespread. In fact, the high rate of sexual activity among African-American teenagers—65 percent report having had sexual intercourse, compared with 46 percent of all U.S. young people—is largely accounted for by widespread poverty in the black population (Darroch, Frost, & Singh, 2001; U.S. Department of Health and Human Services, 2010d).

Early and prolonged father absence predicts higher rates of intercourse and pregnancy among adolescent girls, after many family background and personal characteristics are controlled (Ellis et al., 2003). Perhaps father absence exposes young people to the dating and sexual behaviors of their mothers, who serve as models for their physically maturing children. An alternative, evolutionary account proposes that fathers’ investment in parenting encourages daughters to delay sexual activity in favor of seeking a similarly committed male partner to ensure their offspring’s well-being. Because father-absent girls view male commitment as uncertain, they may readily enter into casual sexual relationships.

Contraceptive Use Although adolescent contraceptive use has increased in recent years, about 20 percent of sexually active teenagers in the United States are at risk for unintended pregnancy because they do not use contraception consistently (see Figure 5.15) (Alan Guttmacher Institute, 2002, 2005; Fortenberry et al., 2010). Why do so many fail to take precautions? Typically, teenagers respond, “I was waiting until I had a steady boyfriend,” or “I wasn’t planning to have sex.” As we will see in Chapter 6, although adolescents can consider multiple possibilities when faced with a theoretical problem, they often fail to apply this advanced reasoning to everyday situations.

One reason is that advances in perspective taking—the capacity to imagine what others may be thinking and feeling—lead teenagers, for a time, to be extremely concerned about what others think of them. Also, in the midst of everyday social pressures, adolescents often overlook the potential consequences of risky behaviors. And many teenagers—especially
as those from troubled, low-income families—do not have realistic expectations about the impact of early parenthood on their current and future lives (Stevens-Simon, Sheeder, & Harter, 2005).

As these findings suggest, the social environment also contributes to adolescents’ reluctance to use contraception. Those without the rewards of meaningful education and work are especially likely to engage in irresponsible sex, sometimes within relationships characterized by exploitation. About 11 percent of U.S. girls and 5 percent of boys say they were pressured to have intercourse when they were unwilling (U.S. Department of Health and Human Services, 2010d).

In contrast, teenagers who report good relationships with parents and who talk openly with them about sex and contraception are more likely to use birth control (Henrich et al., 2006; Kirby, 2002a). But few adolescents believe their parents would be understanding and supportive. School sex education classes, as well, often leave teenagers with incomplete or incorrect knowledge. Some do not know where to get birth control counseling and devices; those who do often worry that a doctor or family planning clinic might not keep their visits confidential. About 20 percent of adolescents using health services say that if their parents were notified, they would still have sex, but without contraception (Jones et al., 2005).

Sexual Orientation

So far, we have focused only on heterosexual behavior. About 4 percent of U.S. 15- to 44-year-olds identify as lesbian, gay, or bisexual (Mosher, Chandra, & Jones, 2005). An unknown number experience same-sex attraction but have not come out to friends or family (see the Social Issues: Health box on page 216). Adolescence is an equally crucial time for the sexual development of these individuals, and societal attitudes, again, loom large in how well they fare.

Heredity makes an important contribution to homosexuality: Identical twins of both sexes are more likely than fraternal twins to share a homosexual orientation; so are biological (as opposed to adoptive) relatives (Kendler et al., 2000; Kirk et al., 2000). Furthermore, male homosexuality tends to be more common on the maternal than on the paternal side of families, suggesting that it may be X-linked (see Chapter 3). Indeed, one gene-mapping study found that among 40 pairs of homosexual brothers, 33 (82 percent) had an identical segment of DNA on the X chromosome. One or several genes in that region might predispose males to become homosexual (Hamer et al., 1993).

How might heredity lead to homosexuality? According to some researchers, certain genes affect the level or impact of prenatal sex hormones, which modify brain structures in ways that induce homosexual feelings and behavior (Bailey et al., 1995; LeVay, 1993). Keep in mind, however, that both genetic and environmental factors can alter prenatal hormones. Girls exposed prenatally to very high levels of androgens or estrogens—either because of a genetic defect or from drugs given to the mother to prevent miscarriage—are more likely to become lesbian or bisexual (Meyer-Bahlburg et al., 1995). Furthermore, gay men also tend to be later in birth order and to have a higher-than-average number of older brothers (Blanchard & Bogaert, 2004). One possibility is that mothers with several male children sometimes produce antibodies to androgens, reducing the prenatal impact of male sex hormones on the brains of later-born boys.

Stereotypes and misconceptions about homosexuality and bisexuality continue to be widespread. For example, contrary to common belief, most homosexual adolescents are not “gender-deviant” in dress or behavior. Also, attraction to members of the same sex is not limited to lesbian, gay, and bisexual teenagers. About 50 to 60 percent of adolescents who report having engaged in homosexual acts identify as heterosexual (Savin-Williams & Diamond, 2004). And a study of lesbian, bisexual, and “unlabeled” young women confirmed that bisexuality is not, as often assumed, a transient state (Diamond, 2008). Over a 10-year period, few bisexuals changed to a lesbian or heterosexual orientation, and most reported stable proportions of same-sex versus other-sex attractions over time.

The evidence to date indicates that genetic and prenatal biological influences are largely responsible for homosexuality; the origins of bisexuality are not yet known. In our evolutionary past, homosexuality may have served the adaptive function of reducing aggressive competition for other-sex mates, thereby promoting the survival of group members (Rahman & Wilson, 2003).
Cultures vary as much in their acceptance of homosexuality as in their approval of extramarital sex. In the United States, homosexuals are stigmatized, as shown by the degrading language often used to describe them. This makes forming a sexual identity a much greater challenge for lesbian, gay, and bisexual youths than for their heterosexual counterparts.

Wide variations in sexual identity formation exist, depending on personal, family, and community factors. Yet interviews with gay and lesbian adolescents and adults reveal that many (though not all) move through a three-phase sequence in coming out to themselves and others.

Feeling Different
Many gay men and lesbians say they felt different from other children when they were young. Typically, this first sense of their biologically determined sexual orientation appears between ages 6 and 12, in play interests more like those of the other gender (Rahman & Wilson, 2003). Boys may find that they are less interested in sports, more drawn to quieter activities, and more emotionally sensitive than other boys; girls that they are more athletic and active than other girls.

By age 10, many of these children start to engage in sexual questioning—wondering why the typical heterosexual orientation does not apply to them. Often, they experience their sense of being different as deeply distressing. Compared with children who are confident of their homosexuality, sexual-questioning children report greater anxiety about peer relationships and greater dissatisfaction with their biological gender over time (Carver, Egan, & Perry, 2004).

Confusion
With the arrival of puberty, feeling different clearly encompasses feeling sexually different. In research on ethnically diverse lesbian, gay, and bisexual youths, awareness of a same-sex physical attraction occurred, on average, between ages 11 and 12 for boys and 14 and 15 for girls, perhaps because adolescent social pressures toward heterosexuality are particularly intense for girls (D’Augelli, 2006; Diamond, 1998).

Realizing that homosexuality has personal relevance generally sparks additional confusion. A few adolescents resolve their discomfort by crystallizing a lesbian, gay, or bisexual identity quickly, with a flash of insight into their sense of being different. But most experience an inner struggle and a deep sense of isolation—outcomes intensified by lack of role models and social support (D’Augelli, 2002; Safren & Pantalone, 2006).

Some throw themselves into activities they associate with heterosexuality. Boys may go out for athletic teams; girls may drop softball and basketball in favor of dance. And many homosexual youths (more females than males) try heterosexual dating, sometimes to hide their sexual orientation and at other times to develop intimacy skills that they later apply to same-sex relationships (D’Augelli, 2006; Dubé, Savin-Williams, & Diamond, 2001). Those who are extremely troubled and guilt-ridden may escape into alcohol, drugs, and suicidal thinking. Suicide attempts are unusually high among lesbian, gay, and bisexual young people (Morrow, 2006; Teasdale & Bradley-Engen, 2010).

Self-Acceptance
By the end of adolescence, the majority of gay, lesbian, and bisexual teenagers accept their sexual identity. But they face another crossroad: whether to tell others. Powerful stigma against their sexual orientation leads some to decide that disclosure is impossible: While self-defining as gay, they otherwise “pass” as heterosexual (Savin-Williams, 2001). When homosexual youths do come out, they often face intense hostility, including verbal abuse and physical attacks because of their sexual orientation. These experiences trigger emotional distress, depression, suicidal thoughts, school truancy, and drug use in victims (Almeida et al., 2009; Birkett, Espelage, & Koenig, 2009).

Nevertheless, many young people eventually acknowledge their sexual orientation publicly, usually by telling trusted friends first. Once teenagers establish a same-sex sexual or romantic relationship, many come out to parents. Few parents respond with severe rejection; most are either positive or slightly negative and disbelieving. Still, lesbian, gay, and bisexual young people report lower levels of family support than their heterosexual agemates (Needham & Austin, 2010; Savin-Williams & Ream, 2003). Yet parental understanding is the strongest predictor of favorable adjustment—including reduced internalized homophobia, or societal prejudice turned against the self (D’Augelli, Grossman, & Starks, 2005, 2008).

When people react positively, coming out strengthens the young person’s view of homosexuality as a valid, meaningful, and fulfilling identity. Contact with other gays and lesbians is important for reaching this phase, and changes in society permit many adolescents in urban areas to attain it earlier than their counterparts did a decade or two ago. Gay and lesbian communities exist in large cities, along with specialized interest groups, social clubs, religious groups, newspapers, and periodicals. But teenagers in small towns and rural areas may have difficulty meeting other gay and lesbian youths and finding a supportive environment. These adolescents have a special need for caring adults and peers who can help them find self- and social acceptance.

Lesbian, gay, and bisexual teenagers who succeed in coming out to themselves and others integrate their sexual orientation into a broader sense of identity, a process we will address in Chapter 11. As a result, energy is freed for other aspects of psychological growth. In sum, coming out can foster many aspects of adolescent development, including self-esteem, psychological well-being, and relationships with family and friends.
Sexually Transmitted Disease

Sexually active adolescents, both homosexual and heterosexual, are at risk for sexually transmitted diseases (STDs). Adolescents have the highest incidence of STDs of all age groups. Despite a recent decline in STDs in the United States, one out of six sexually active teenagers contracts one of these illnesses each year—a rate three or more times as high as that of Canada and Western Europe (Health Canada, 2008; U.S. Department of Health and Human Services, 2009b). Teenagers at greatest risk are the same ones most likely to engage in irresponsible sexual behavior—poverty-stricken young people who feel a sense of hopelessness (Niccolai et al., 2004). Left untreated, STDs can lead to sterility and life-threatening complications.

By far the most serious STD is AIDS. In contrast to other Western nations, where the incidence of AIDS among people under age 30 is low, one-fifth of U.S. AIDS cases occur in young people between ages 20 and 29. Because AIDS symptoms typically do not emerge until 8 to 10 years after infection with the HIV virus, nearly all these cases originated in adolescence. Drug-abusing teenagers who share needles and male adolescents who have sex with HIV-positive same-sex partners account for most cases, but heterosexual spread of the disease remains high, especially among teenagers with more than one partner in the previous 18 months. It is at least twice as easy for a male to infect a female with any STD, including AIDS, as for a female to infect a male. Currently, females account for about 25 percent of new U.S. cases among adolescents and young adults (U.S. Department of Health and Human Services, 2010a).

As a result of school courses and media campaigns, about 60 percent of U.S. middle-school students and 90 percent of high school students are aware of basic facts about AIDS. But most have limited understanding of other STDs and their consequences, underestimate their own susceptibility, and are poorly informed about how to protect themselves (Ethier et al., 2003; U.S. Centers for Disease Control and Prevention, 2007).

Furthermore, high school students report engaging in oral sex much more often than intercourse, and with more partners. But few say they are consistently using STD protection during oral sex, which is a significant mode of transmission of several STDs, including chlamydia, gonorrhea, herpes, and perhaps AIDS (Prinstein, Meade, & Cohen, 2003; U.S. Centers for Disease Control and Prevention, 2010). Concerted efforts are needed to educate young people about the full range of STDs and risky sexual behaviors.

Adolescent Pregnancy and Parenthood

About 740,000 U.S. teenage girls (15,000 of them younger than age 15)—an estimated 20 percent of those who had sexual intercourse—became pregnant in the most recently reported year. Although the U.S. adolescent pregnancy rate declined steadily over the past two decades, it remains higher than that of most other industrialized countries. Three factors heighten the incidence of adolescent pregnancy: (1) Effective sex education reaches too few teenagers; (2) convenient, low-cost contraceptive services for adolescents are scarce; and (3) many families live in poverty, which encourages young people to take risks without considering the future implications of their behavior.

Because nearly one-third of U.S. adolescent pregnancies end in abortion, the number of American teenage births is considerably lower than it was 50 years ago (Alan Guttmacher Institute, 2011). Still, it is up to nine times higher than in most other developed nations (see Figure 5.16). But teenage parenthood is a much greater problem today because adolescents are far less likely to marry before childbirth. In 1960, only 15 percent of teenage births were to unmarried females, compared
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with 87 percent today (Child Trends, 2011). Increased social acceptance of single motherhood, along with the belief of many teenage girls that a baby might fill a void in their lives, means that very few girls give up their infants for adoption.

**Correlates and Consequences of Adolescent Parenthood**

Becoming a parent is especially challenging for adolescents, who have not yet established a clear sense of direction for their own lives. Longitudinal research tracking girls from birth through adolescence reveals that life conditions and personal attributes jointly contribute to adolescent childbearing and also interfere with teenage mothers’ capacity to parent effectively (Jaffee et al., 2001).

Teenage parents are far more likely to be poor than their agemates who postpone childbearing. Their backgrounds often include low parental warmth and involvement, domestic violence and child abuse, repeated parental divorce and remarriage, adult models of unmarried parenthood, and residence in neighborhoods where other adolescents display these risks. Girls at risk for early pregnancy do poorly in school, engage in alcohol and drug use, have a childhood history of aggressive and antisocial behavior, associate with deviant peers, and experience high rates of depression (Elfenbein & Felice, 2003; Hillis et al., 2004; Luster & Haddow, 2005). A high percentage of out-of-wedlock births are to low-income minority teenagers. Many turn to early parenthood as a way to move into adulthood when educational and career avenues are unavailable.

The lives of expectant teenagers, already troubled in many ways, tend to worsen in several respects after the baby is born:

- **Educational attainment.** Only about 70 percent of U.S. adolescent mothers graduate from high school, compared with 95 percent of girls who wait to become parents (National Women’s Law Center, 2007). Lack of material resources—often due to living apart from one’s own parents and not having access to child care—greatly reduces the likelihood of earning a high school diploma (Mollborn, 2007).

- **Marital patterns.** Teenage motherhood reduces the chances of marriage and, for those who do marry, increases the likelihood of divorce compared with peers who delay childbearing (Moore & Brooks-Gunn, 2002). Consequently, teenage mothers spend more of their parenting years as single parents. About 35 percent become pregnant again within two years. Of these, about half go on to deliver a second child (Child Trends, 2011).

- **Economic circumstances.** Because of low educational attainment, marital instability, and poverty, many teenage mothers are on welfare. If they are employed, their limited education restricts them to unsatisfying, low-paid jobs. Many adolescent fathers, as well, are unemployed or work at unskilled jobs, usually earning too little to provide their children with basic necessities (Bunting & McAuley, 2004). An estimated 50 percent have committed illegal acts resulting in imprisonment (Elfenbein & Felice, 2003). And for both mothers and fathers, reduced educational and occupational attainment often persists well into adulthood (Furstenberg, 2007; Taylor, 2009).

Because many pregnant teenage girls have inadequate diets, smoke, use alcohol and other drugs, and do not receive early prenatal care, their babies often experience pregnancy and birth complications—especially preterm and low birth weight (Khaskan, Baker, & Kenny, 2010). And compared with adult mothers, adolescent mothers know less about child development, have unrealistically high expectations of their infants, perceive their babies as more difficult, interact less effectively with them, and more often engage in child abuse (Moore & Florsheim, 2001; Pomerleau, Scuccimarri, & Malcuit, 2003; Sieger & Renk, 2007). Their children tend to score low on intelligence tests, achieve poorly in school, and engage in disruptive social behavior.

Furthermore, adolescent parenthood frequently is repeated in the next generation (Brooks-Gunn, Schley, & Hardy, 2002). In longitudinal studies that followed mothers—some
who gave birth as teenagers, others who postponed parenting—and their children for several decades, mothers’ age at first childbirth strongly predicted the age at which their offspring, both daughters and sons, became parents (Barber, 2001; Campa & Eckenrode, 2006; Hardy et al., 1998; Meade, Kershaw, & Ickovics, 2008). The researchers found that adolescent parenthood was linked to a set of related, unfavorable family conditions and personal characteristics that negatively influenced development over an extended time and, therefore, often transferred to the next generation.

One important factor was quality of the home environment: Compared with children in other families, children of unmarried adolescent mothers had families that were less warm, supportive, and stimulating, even after mothers’ prebirth education and income were controlled. Younger mothers’ cognitive deficits and reduced educational attainment played a part, increasing the likelihood that their children would experience long-term poor-quality home environments. Another factor was father absence: Consistent with findings reported earlier for sexual activity and pregnancy (see page 214), several studies found far greater intergenerational continuity in adolescent parenthood, especially for daughters, when teenage mothers remained unmarried (Barber, 2001; Campa & Eckenrode, 2006; Meade, Kershaw, & Ickovics, 2008).

Even when children born to teenage mothers do not become early childbearers, their development is often compromised in terms of likelihood of high school graduation, financial independence in adulthood, and long-term physical and mental health (Moore, Morrison, & Greene, 1997; Pogarsky, Thornberry, & Lizotte, 2006). Still, outcomes vary widely. If a teenage mother finishes high school, secures gainful employment, avoids additional births, and finds a stable partner, long-term disruptions in her own and her child’s development will be less severe.

**Prevention Strategies** Preventing teenage pregnancy means addressing the many factors underlying early sexual activity and lack of contraceptive use. Too often, sex education courses are given late (after sexual activity has begun), last only a few sessions, and are limited to a catalog of facts about anatomy and reproduction. Sex education that goes beyond this minimum does not encourage early sex, as some opponents claim (Kirby, 2002c). It does improve awareness of sexual facts—knowledge that is necessary for responsible sexual behavior.

Knowledge, however, is not enough. Sex education must help teenagers build a bridge between what they know and what they do. Today, the most effective sex education programs combine these key elements:

- They teach techniques for handling sexual situations—including refusal skills for avoiding risky sexual behaviors and communication skills for improving contraceptive use—through role-playing and other activities in which young people practice those behaviors.
- They deliver clear, accurate messages that are appropriate for participating adolescents’ culture and sexual experiences.
- They last long enough to have an impact.
- They provide specific information about contraceptives and ready access to them.

Many studies show that sex education that includes these components can delay the initiation of sexual activity, increase contraceptive use, change attitudes (for example, strengthen future orientation), and reduce pregnancy rates (Kirby, 2002b, 2008; Thomas & Dimitrov, 2007).

Proposals to increase access to contraceptives are the most controversial aspect of U.S. adolescent pregnancy prevention efforts. Many adults argue that placing birth control pills or condoms in the hands of teenagers is equivalent to approving of early sex. Yet sex education programs focusing on abstinence have little or no impact on delaying teenage sexual activity or preventing pregnancy (Rosenbaum, 2009; Underhill, Montgomery, & Operario, 2007).

In Canada and Western Europe, where community- and school-based clinics offer adolescents contraceptives and where universal health insurance helps pay for them, teenage sexual activity is no higher than in the United States—but pregnancy, childbirth, and abortion rates are much lower (Schalet, 2007). Radio and TV campaigns promoting contraceptive use—used widely in Africa, Europe, India, and South America—are associated with a reduction in early sexual activity and with an increase in teenagers’ use of birth control (Keller & Brown, 2002).
Efforts to prevent adolescent pregnancy and parenthood must go beyond improving sex education and access to contraception to build academic and social competence (Allen, Seitz, & Apfel, 2007). In one study, researchers randomly assigned at-risk high school students to either a year-long community service class, called Teen Outreach, or regular classroom experiences in health or social studies. In Teen Outreach, adolescents spent at least 20 hours per week in volunteer work tailored to their interests. They returned to school for discussions that focused on enhancing their community service skills and ability to cope with everyday challenges. At the end of the school year, pregnancy, school failure, and school suspension were substantially lower in the group enrolled in Teen Outreach, which fostered social skills, connection to the community, and self-respect (Allen et al., 1997).

Finally, school involvement is linked to delayed initiation of sexual activity and to reduced teenage pregnancy, perhaps because it increases interaction with and attachment to adults who discourage risk taking, and it strengthens belief in a promising future (Harris, 2008). We will take up factors that promote adolescents’ commitment to school in Chapter 15.

Intervening with Adolescent Parents The most difficult and costly way to deal with adolescent parenthood is to wait until it happens. Young mothers need health care, encouragement to stay in school, job training, instruction in parenting and life-management skills, and high-quality, affordable child care. School programs that provide these services reduce the incidence of low-birth-weight babies, increase mothers’ educational success, and prevent additional childbearing (Key et al., 2008; Seitz & Apfel, 2005).

Adolescent mothers also benefit from relationships with family members and other adults who are sensitive to their developmental needs. In one study, African-American teenage mothers who had a long-term “mentor” relationship—an aunt, neighbor, or teacher who provided emotional support and guidance—were far more likely than those without a mentor to stay in school and graduate (Klaw, Rhodes, & Fitzgerald, 2003). Home visiting programs are also helpful. The Nurse–Family Partnership, currently implemented in hundreds of counties across 29 U.S. states, aims to reduce pregnancy and birth complications, promote competent parenting, and improve family conditions for first time, low-income expectant mothers, many of them teenagers. A registered nurse visits the home regularly during pregnancy and the baby’s first two years to provide intensive social support—a sympathetic ear; assistance in accessing community services and the help of family members; and encouragement to finish high school, find work, and engage in future family planning.

To evaluate the intervention, researchers randomly assigned over 1,000 mothers to nurse-visiting or comparison conditions (just prenatal care, or prenatal care plus infant referral for developmental problems) and followed the families through the child’s first three years of elementary school (Olds et al., 2004, 2007). From their baby’s birth on, home visited mothers were on a more favorable life course: They had fewer subsequent births, longer intervals between births, more frequent contact with the child’s father, more stable intimate partnerships, less welfare dependence, and a greater sense of control over their lives. At school age, intervention children exceeded comparison children in language development, intelligence test scores, and academic achievement, and they also displayed fewer behavior problems.

Programs focusing on fathers attempt to increase their financial and emotional commitment to the baby. Although nearly half of young fathers visit their children during the first few years, contact usually diminishes. By the time the child starts school, fewer than one-fourth have regular paternal contact. As with teenage mothers, support from family members helps fathers stay involved (Bunting & McAuley, 2004). Teenage mothers who receive financial and child-care assistance and emotional support from the child’s father are less distressed and more likely to sustain a relationship with him (Cutrona et al., 1998; Gee & Rhodes, 2003). And infants with lasting ties to their teenage fathers receive warmer, more stimulating caregiving and show better long-term adjustment (Florsheim & Smith, 2005; Furstenberg & Harris, 1993).
A Concluding Note

The rapid, complex physical and psychological changes of puberty make teenagers vulnerable to certain problems. Yet adolescents' unhealthy behaviors are not an irrational response to inner turmoil, as theorists once believed. Rather, every level of the ecological system affects teenagers' well-being.

Furthermore, we have seen that teenagers with one problem frequently display others—a co-occurrence that you will encounter again when we look at delinquency, depression, suicide, substance abuse, and school underachievement and failure. To design more powerful interventions, researchers must deal with simultaneous risks and the multiple factors that contribute to them. TAKE A MOMENT... Think back to the successful intervention efforts discussed in the preceding sections. Notice how they employ several strategies, target multiple behaviors, and involve several contexts.

Finally, adolescence is not only a time of risk but also a time of tremendous opportunity. Teenagers gain a better understanding of how the world works, greater control over their own social contexts, broader access to social support, and increased ability to avoid or alter risky behaviors. Families, schools, communities, and nations must create conditions that enable adolescents to exercise their expanding capacity for positive health practices. This is a theme we will revisit in later chapters.

ASK YOURSELF

Review ■ Compare risk factors for anorexia nervosa and bulimia nervosa. How do treatments and outcomes differ for the two disorders?

Connect ■ Explain how unfavorable life experiences and personal attributes associated with teenage parenthood increase the chances that it will be repeated in the next generation.

Apply ■ At age 17, Veronica dropped out of school, moved in with her boyfriend Todd, and gave birth to Ben. A few months later, Todd left Veronica, saying he couldn’t stand being tied down with the baby. Suggest interventions likely to protect Veronica and Ben from lasting hardships.

Reflect ■ Describe sex education classes that you experienced in school. Did they help you postpone early sex and engage in more responsible sexual behavior? Explain.

SUMMARY

**The Course of Physical Growth**  (p. 176)

Describe the course of physical growth, including changes in body size, proportions, muscle–fat makeup, and skeleton, and their relationship to gains in gross-motor skills.

- Distance and velocity curves show the overall pattern of change in body size: Gains in height and weight are rapid during infancy, slower during early and middle childhood, and rapid again during puberty.
- In childhood, physical growth follows cephalocaudal and proximodistal trends. During puberty, growth proceeds in the reverse direction, and sex differences in body proportions appear. Body fat increases quickly during the first nine months, then rapidly again at adolescence for girls. Muscle accumulates slowly until puberty, when it rises dramatically, especially for boys.

- The best measure of a child’s physical maturity is skeletal age, which is based on the number of epiphyses and the extent to which they are fused. Girls are ahead of boys, a gap that widens over infancy and childhood.
- In early childhood, body growth causes the child’s center of gravity to shift toward the trunk, which paves the way for new gross-motor skills. During the school years, improved balance, strength, agility, and flexibility support refinements in running, jumping, hopping, and ball skills. Increased body size and muscle strength lead to continued motor gains in adolescence. As they develop, children integrate previously acquired motor skills into more complex, dynamic systems of action.
- In childhood, boys’ advantage over girls in many gross-motor skills largely reflects parental expectations and practice. By adolescence, sex differences in size and strength play a greater role.

**Describe hormonal influences on physical growth.**

- Physical growth is controlled by two vital hormones released by the pituitary gland, located at the base of the brain near the hypothalamus, which initiates and regulates pituitary secretions: growth hormone (GH), which affects the development of almost all body tissues; and thyroid-stimulating hormone (TSH), which—by prompting the thyroid gland to release thyroxine—affects brain development and body size. Sexual maturation is controlled by the sex hormones—estrogens and androgens.

**Discuss factors that contribute to worldwide variations and secular trends in physical growth.**

- Worldwide variations in body size are the combined result of heredity and environment, including evolutionary adaptations to climate, availability of food, and prevalence of disease.
Secular trends in physical growth have occurred in industrialized nations, where, because of improved health and nutrition, most children are taller and heavier than their ancestors and reach puberty earlier.

Brain Development (p. 184)

Cite major milestones in brain development, at the level of individual brain cells and at the level of the cerebral cortex.

- The human brain reaches its adult size earlier than any other organ. Once neurons are in place, they rapidly form synapses and release neurotransmitters, which cross synapses to send messages to other neurons. As the brain grows, programmed cell death occurs, making room for growth of neural fibers that form synaptic connections.
- Stimulation determines which neurons will continue to establish new synapses and which will undergo synaptic pruning. Glial cells, responsible for myelination, multiply rapidly through the second year and continue to do so more slowly through adolescence, contributing to large gains in brain weight.
- Regions of the cerebral cortex develop in the order in which various capacities emerge in the infant and child. The frontal lobes, which contain the prefrontal cortex, have the most extended period of development, reaching an adult level of synapses in adolescence. Although some lateralization, or specialization of the cerebral hemispheres, exists at birth, brain plasticity remains high for the first few years. Both heredity and early experience contribute to brain organization.
- Hand preference, which reflects an individual's dominant cerebral hemisphere, first appears in infancy and gradually extends to a wider range of skills. Research on handedness supports the joint contribution of nature and nurture to brain lateralization.

Describe changes in other brain structures and in the adolescent brain, and discuss evidence on sensitive periods in brain development.

- In childhood and adolescence, connections strengthen among parts of the brain, fibers linking the cerebellum to the cerebral cortex grow and myelinate, enhancing motor coordination and cognition. The reticular formation, responsible for alertness and consciousness; the hippocampus, which plays a vital role in memory and spatial orientation; and the amygdala, which is centrally involved in processing emotional information, also develop and link with the cerebral cortex. The corpus callosum, which connects the two cerebral hemispheres, supports coordinated movement and cognitive activities.

Factors Affecting Physical Growth (p. 192)

How do heredity, nutrition, infectious disease, and parental affection contribute to physical growth and health?

- Pruning of unused synapses in the cerebral cortex continues during adolescence, and growth and myelination of stimulated neural fibers accelerate, supporting diverse cognitive skills. Because advances in cognitive control are gradual, teenagers tend to perform less well than adults on tasks requiring inhibition, planning, and future orientation.
- Neurons become more responsive to excitatory neurotransmitters during adolescence, contributing to teenagers’ drive for novel experiences. Heightened sensitivity to oxytocin increases responsiveness to emotional and social stimuli, including peer influence. These changes in the brain’s emotional/social network outpace those in the cognitive-control network, resulting in self-regulation difficulties.
- Animal and human studies reveal the existence of sensitive periods in which appropriate stimulation is necessary for optimal brain development. Experience-expectant brain growth depends on ordinary experiences—early opportunities to interact with people, hear language, and explore the environment. No evidence exists for a sensitive period in the first five or six years of life for experience-dependent brain growth, which relies on specific learning experiences. Environments that overwhelm children with inappropriately advanced expectations can harm the brain’s potential.

Puberty: The Physical Transition to Adulthood (p. 203)

Describe sexual maturation in girls and boys, noting genetic and environmental influences on pubertal timing.

- Many children in developing countries suffer from marasmus and kwashiorkor, two diseases caused by malnutrition that can permanently impair body growth and brain development. Food insecurity affects children even in industrialized countries.
- Obesity is a growing problem in both industrialized and developing nations. Although heredity contributes to obesity, parental feeding practices, maladaptive eating habits, reduced sleep, lack of exercise, and Western high-fat diets are more powerful influences. Obese children are often socially isolated and display more emotional, social, and school difficulties than their normal-weight peers. Effective treatments for obesity are family-based; schools can also help by serving healthier meals and ensuring physical activity.
- Malnutrition interacts with infectious disease to undermine physical growth. In developing countries, where diarrhea leads to millions of childhood deaths, oral rehydration therapy (ORT) and zinc supplements can save lives. Widespread immunization has led to a dramatic decline in childhood diseases, but rates are lower in the United States than in other industrialized nations because many economically disadvantaged children lack access to necessary health care. Parental stress and misconceptions about vaccine safety also contribute.
- Growth faltering illustrates the importance of parental affection for healthy infant physical growth. Extreme and prolonged emotional deprivation in childhood can lead to psychosocial dwarfism.
The Psychological Impact of Pubertal Events (p. 205)

What factors influence adolescents’ reactions to the physical changes of puberty?

- Puberty is not a biologically determined period of storm and stress. Adjustment varies widely and is a product of biological, psychological, and social forces.

- Girls generally react to menarche with mixed emotions, although those who receive advance information and support from family members respond more positively. Boys, who receive less social support than girls for the physical changes of puberty, react to spermarche with mixed feelings.

- Besides higher pubertal hormone levels, negative life events, sleep loss, and adult-structured situations are associated with adolescents’ negative moods. Psychological distancing between parent and child at puberty may be a modern substitute for physical departure from the family, which typically occurs at puberty in primate species. Parent-adolescent conflict also reflects teenagers’ new powers of reasoning and efforts by their parents to protect teenagers from risky situations.

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Describe the impact of pubertal timing on adolescent adjustment, noting sex differences.

- Early-maturing boys and late-maturing girls have a more positive body image and usually adjust well in adolescence. In contrast, early-maturing girls and late-maturing boys experience emotional and social difficulties, which— for girls—persist into young adulthood.

Puberty and Adolescent Health (p. 210)

What factors contribute to eating disorders in adolescence?

- Girls who reach puberty early, who are dissatisfied with their body image, and who grow up in families where thinness is emphasized are at risk for eating disorders. Heredity seems to make some adolescents more susceptible.

- Anorexia nervosa typically affects girls who are perfectionists and have overprotective, controlling mothers and emotionally distant fathers. Bulimia nervosa is often associated with lack of self-control and disengaged parenting.

Discuss cultural, social, and personal influences on adolescent sexual attitudes and behavior.

- North American attitudes toward adolescent sex are relatively restrictive, and parents and the mass media deliver contradictory messages. Over the past 40 years, sexual attitudes and behavior of adolescents have become more liberal.

- Early, frequent sexual activity is linked to factors associated with economic disadvantage, including weak parental monitoring and hazardous neighborhoods. Many sexually active teenagers do not practice contraception consistently. Adolescent cognitive processes and weak social supports for responsible sexual behavior, including access to birth control, underlie this failure to take precautions against pregnancy.

Cite factors involved in the development of homosexuality.

- Biological factors, including heredity and prenatal hormone levels, play an important role in homosexuality. Lesbian, gay, and bisexual teenagers face special challenges in establishing a positive sexual identity.

Discuss factors related to sexually transmitted disease and teenage pregnancy and parenthood, noting prevention and intervention strategies.

- Early sexual activity, combined with inconsistent contraceptive use, results in high rates of sexually transmitted diseases (STDs) among U.S. teenagers.

Life conditions linked to poverty, along with personal attributes, contribute to adolescent childbearing. Teenage parenthood is associated with school dropout, reduced chances of marriage, greater likelihood of divorce, and long-term economic disadvantage.

Effective sex education, access to contraceptives, and programs that build academic and social competence help prevent early pregnancy. Young mothers need school programs that provide job training, instruction in parenting and life-management skills, and child care. They also benefit from positive family relationships and from home visiting programs that provide intensive social support. When teenage fathers stay involved, children develop more favorably.

IMPORTANT TERMS AND CONCEPTS

- amygdala (p. 190)
- androgens (p. 183)
- anorexia nervosa (p. 210)
- body image (p. 209)
- brain plasticity (p. 187)
- bulimia nervosa (p. 211)
- cephalocaudal trend (p. 176)
- cerebellum (p. 189)
- cerebral cortex (p. 186)
- corpus callosum (p. 190)
- distance curve (p. 176)
- dominant cerebral hemisphere (p. 189)
- epiphyses (p. 178)
- estrogens (p. 183)
- experience-dependent brain growth (p. 191)
- experience-expectant brain growth (p. 191)
- glial cells (p. 186)
- growth faltering (p. 202)
- growth hormone (GH) (p. 182)
- hippocampus (p. 190)
- hypothalamus (p. 181)
- kwashiorkor (p. 196)
- lateralization (p. 187)
- marasmus (p. 196)
- menarche (p. 203)
- myelination (p. 186)
- neurons (p. 185)
- neurotransmitters (p. 185)
- obesity (p. 198)
- pituitary gland (p. 181)
- prefrontal cortex (p. 186)
- primary sexual characteristics (p. 203)
- programmed cell death (p. 185)
- proximodistal trend (p. 176)
- psychosocial dwarfism (p. 202)
- puberty (p. 203)
- reticular formation (p. 190)
- secondary sexual characteristics (p. 203)
- secular trends in physical growth (p. 184)
- skeletal age (p. 178)
- spermarche (p. 203)
- synapses (p. 185)
- synaptic pruning (p. 185)
- thyroid-stimulating hormone (p. 183)
- velocity curve (p. 176)