Expressing keen awareness of changes in her own body and motor skills, this artist imagines brushing a lion’s teeth, just as she is learning to care for her own teeth. Chapter 8 highlights the close link between the physical growth of early childhood and other aspects of development.

“The Lion’s Toothpaste”
Erika Tomano,
3 years old, Japan

Opener Art Credit TK
For more than a decade, my fourth-floor office window overlooked the preschool and kindergarten play yard of our university laboratory school. On mild fall and spring mornings, the doors of classrooms swung open, and sand table, woodworking bench, easels, and large blocks spilled out into a small, fenced courtyard. Alongside the building was a grassy area with jungle gyms, swings, a playhouse, and a flower garden planted by the children; beyond it, a circular path lined with tricycles and wagons. Each day, the setting was alive with activity.

Even from my distant vantage point, the physical changes of early childhood were evident. Children’s bodies were longer and leaner than they had been a year or two earlier. The awkward gait of toddlerhood had disappeared in favor of more refined movements that included running, climbing, jumping, galloping, and skipping. Children scaled the jungle gym, raced across the lawn, turned somersaults, and vigorously pedaled tricycles. Just as impressive as these gross motor achievements were gains in fine motor skills. At the sand table, children built hills, valleys, caves, and roads and prepared trays of pretend cookies and cupcakes. And as they grew older, their paintings at the outdoor easels took on greater structure and detail as family members, houses, trees, birds, sky, monsters, and letterlike forms appeared in the colorful creations.

The years from 2 to 6 are often called “the play years”—aptly so, since play blossoms during this time and supports every aspect of development. Our discussion of early childhood opens with the physical achievements of this period—growth in body size, improvements in motor coordination, and refinements in perception. We pay special attention to biological and environmental factors that support these changes, as well as to their intimate connection with other domains of development. The children I came to know well, first by watching from my office window and later by observing at close range in their classrooms, will provide many examples of developmental trends and individual differences.

**Body Growth**

In early childhood, the rapid increase in body size of the first two years tapers off into a slower growth pattern. On average, children add 2 to 3 inches in height and about 5 pounds in weight each year. Boys continue to be slightly larger than girls. As
the “baby fat” that began to decline in toddlerhood drops off further, children gradually become thinner, although girls retain somewhat more body fat than boys, who are slightly more muscular. As the torso lengthens and widens, internal organs tuck neatly inside, and the spine straightens. As Figure 8.1 shows, by age 5 the top-heavy, bowlegged, potbellied toddler has become a more streamlined, flat-tummied, longer-legged child with body proportions similar to those of adults. Consequently, posture and balance improve—changes that support the gains in motor coordination.

Individual differences in body size are even more apparent during early childhood than in infancy and toddlerhood. Speeding around the bike path in the play yard, 5-year-old Darryl—at 48 inches tall and 55 pounds—towered over his kindergarten classmates. At the doctor’s office, he was, as his mother put it, “off the growth charts” compared with the average North American 5-year-old boy, who is 43 inches tall and weighs 42 pounds. Priti, an Asian-Indian child, was unusually small because of genetic factors linked to her cultural ancestry. And Lynette and Hal, two Caucasian children with impoverished home lives, were well below average for reasons we will discuss shortly.

The existence of these variations in body size reminds us that growth norms for one population are not good standards for children elsewhere in the world. Consider the Efe of the Republic of Congo, whose typical adult height is less than 5 feet. Between 1 and 6 years, Efe children’s growth tapers off to a greater extent than that of most other preschoolers. By age 5, the average Efe child is shorter than more than 97 percent of North American 5-year-olds. For genetic reasons, the impact of hormones controlling body size is reduced in Efe children (Bailey, 1991). The Efe’s small size probably evolved because it reduced their caloric requirements in the face of food scarcity in the rain forests of Central Africa and permitted them to move easily through the dense forest underbrush (Shea & Bailey, 1996). So we should not view Efe children’s short stature as a sign of problems with growth or health. But for other extremely slow-growing children, such as Lynette and Hal, these concerns are warranted.

Skeletal Growth

The skeletal changes of infancy continue throughout early childhood. Between ages 2 and 6, approximately 45 new epiphyses—or growth centers, in which cartilage hardens into bone—emerge in various parts of the skeleton. Other epiphyses will appear in middle childhood. X-rays of these growth centers enable doctors to estimate children’s skeletal age, or progress toward physical maturity (see page 000 in Chapter 5)—information helpful in diagnosing growth disorders.

By the end of the preschool years, children start to lose their primary, or “baby,” teeth. The age at which they do so is heavily influenced by genetic factors. For example, girls, who are ahead of boys in physical development, lose their primary teeth sooner. Cultural ancestry also makes a difference. North American children typically get their first secondary (permanent) tooth at 6½ years, children in Ghana at just over 5 years, and children in Hong Kong around the sixth birthday (Burns, 2000). But nutritional factors also influence dental development. Prolonged malnutrition delays the appearance of permanent teeth, whereas overweight and obesity accelerate it (Hilgers et al., 2006).

Care of primary teeth is essential because diseased baby teeth can affect the health of permanent teeth. Brushing consistently, avoiding sugary foods, drinking fluoridated water, and getting topical fluoride treatments and sealants (plastic coatings that protect tooth surfaces) prevent cavities. Another factor is protection from exposure to tobacco smoke, which
suppresses children’s immune system, including the ability to fight bacteria responsible for
tooth decay. The risk associated with this suppression is greatest in infancy and early child-
hood, when the immune system is not yet fully mature (Aligne et al., 2003). Young children
in homes with regular smokers are three times more likely than their agemates to have
decayed teeth, even after other factors that influence dental health have been controlled
(Shenkin et al., 2004).

Although tooth decay has declined sharply over the past 40 years, an estimated 40 percent
of North American 5-year-olds have at least some affected teeth (Neurath, 2005). Among
poverty-stricken preschoolers, cavities advance especially rapidly, affecting an average of 2.5
teeth per year. By the time American and Canadian young people graduate from high school,
about 80 percent have decayed or filled teeth (World Health Organization, 2003a, 2004). Causes include poor diet and inadequate health care—factors that are more likely to affect low-SES children.

Asynchronies in Physical Growth

As Figure 8.2 shows, physical growth is asynchronous: Body systems differ in their patterns of growth. Body size (as measured by height and weight) and a variety of internal organs follow the general growth curve: rapid growth during infancy, slower gains in early and middle childhood, and rapid growth again during adolescence. The genitals develop slowly from birth to age 4, change little throughout middle childhood, and then grow rapidly during adolescence. In contrast, the lymph glands grow at an astounding pace in infancy and childhood; in adolescence, lymph tissue declines. The lymph system helps fight infection and assists with absorption of nutrients, thereby supporting children’s health and survival.

Figure 8.2 illustrates another growth trend with which you are already familiar: During the first few years, the brain grows faster than any other part of the body. Let’s look at some highlights of brain development in early childhood.

Brain Development

Between ages 2 and 6, the brain increases from 70 percent of its adult weight to 90 percent. At the same time, preschoolers improve in a wide variety of skills—physical coordination, perception, attention, memory, language, logical thinking, and imagination.

In addition to increasing in weight, the brain undergoes much reshaping and refining. By age 4, many parts of the cortex have overproduced synapses. In some regions, such as the frontal lobes, the number of synapses is nearly double the adult value. Together, synaptic growth and myelination of neural fibers result in a high energy need. In fact, fMRI evidence reveals that energy metabolism in the cerebral cortex reaches a peak around this age (Huttenlocher, 2002; Johnson, 1998).

Recall from Chapter 5 that overabundance of synaptic connections supports plasticity of the young brain, helping to ensure that the child will acquire certain abilities even if some areas are damaged. Synaptic pruning follows: Neurons that are seldom stimulated lose their connective fibers, and the number of synapses is reduced (see page 000). As the structures of stimulated neurons become more elaborate and require more space, surrounding neurons die, and brain plasticity declines. By age 8 to 10, energy consumption of most cortical regions declines to near-adult levels (Nelson, 2002).

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EEG and fMRI measures of neural activity in various cortical regions reveal especially rapid growth from 3 to 6 years in frontal-lobe...
areas devoted to attention and planning and organizing behavior. Furthermore, for most children, the left hemisphere is especially active between 3 and 6 years, then levels off. In contrast, right-hemispheric activity increases steadily throughout early and middle childhood, with a slight spurt between ages 8 and 10 (Thatcher, Walker, & Giudice, 1987; Thompson et al., 2000). Studies of the brains of children who have died confirm these trends. For example, Figure 8.3 shows age-related changes in density of synapses in three left-hemispheric cortical areas involved in language processing: the primary auditory area, Broca’s area, and Wernicke’s area. (To review the location of these structures, refer to page 000.) Notice how synaptic density rises during the first three years and then, as a result of pruning, falls to an adult level around age 10.

These findings fit nicely with what we know about several aspects of cognitive development. Early childhood is a time of marked gains on tasks that depend on the frontal cortex—ones that require inhibiting impulses and substituting thoughtful responses (Diamond, 2004; Nelson, Thomas, & de Haan, 2006). Further, language skills (typically housed in the left hemisphere) increase at an astonishing pace in early childhood, and they support children’s increasing control over behavior, also mediated by the frontal lobes. In contrast, spatial skills (usually located in the right hemisphere), such as giving directions, drawing pictures, and recognizing geometric shapes, develop gradually over childhood and adolescence.

Differences in rate of development between the two hemispheres suggest that they are continuing to lateralize (specialize in functions). Let’s take a closer look at brain lateralization during early childhood by focusing on handedness.

**Handedness**

On a visit to the preschool, I watched 3-year-old Moira as she drew pictures, worked puzzles, joined in snack time, and played outside. Unlike most of her classmates, Moira does most things—drawing, eating, and zipping her jacket—with her left hand. But she uses her right hand for a few activities, such as throwing a ball. Research on handedness, along with other evidence covered in Chapter 5, supports the joint contribution of nature and nurture to brain lateralization.

By the end of the first year, children typically display a hand preference that, over the next few years, gradually extends to a wider range of skills (Hinojosa, Sheu, & Michael, 2003). 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 (Szafirski et al., 2002). This indicates that the brains of left-handers tend to be less strongly lateralized than those of right-handers. Consistent with this idea, many
left-handed individuals (like Moira) are also ambidextrous. Although they prefer their left hand, they sometimes use their right hand skillfully as well (McManus et al., 1988).

Left-handed parents show only a weak tendency to have left-handed children. 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. Newborns’ bias in head position causes them to spend more time looking at and using one hand, which contributes to greater skillfulness of that hand (Hinojosa, Sheu, & Michael, 2003). Handedness is strongest for complex skills requiring extensive training, such as eating with utensils, writing, and engaging in athletic activities. Also, wide cultural differences exist in rates of left-handedness. 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 left-handedness occurs more frequently among severely retarded and mentally ill people than in the general population, 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, Rh incompatibility, and breech delivery (O’Callaghan et al., 1993; Powls et al., 1996).

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

Twins typically lie in the uterus in opposite orientations, which may explain why they are more often opposite-handed than are ordinary siblings. Although left-handedness is associated with certain developmental problems, atypical lateralization is probably not responsible. Most left-handers show typical development, and some show outstanding verbal or mathematical talent.

Other Advances in Brain Development

Besides the cerebral cortex, several other areas of the brain make strides during early childhood (see Figure 8.4). All of these changes involve establishing links between parts of the brain, increasing the coordinated functioning of the central nervous system.

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. This change contributes to dramatic gains in motor coordination: By the end of the preschool years, children can play hopscotch, throw a ball with a well-organized set of 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 throughout early childhood and into adolescence.
Neurons in the reticular formation send out fibers to other areas of the brain. Many go to the frontal 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 formation of synapses and myelination in the second half of the first year, when recall memory and independent movement emerge (see page 000 in Chapter 5). Over the preschool and elementary school years, the hippocampus, along with surrounding areas of the cerebral cortex, continue their swift development, establishing connections with one another and with the frontal lobes (Nelson, Thomas, & de Haan, 2006). These changes make possible the dramatic gains in memory and spatial understanding of early and middle childhood—ability to use strategies to store and retrieve information, expansion of autobiographical memory (which brings an end to infantile amnesia), and drawing and reading of maps (which we will take up in Chapter 9).

The corpus callosum is a large bundle of fibers that connects the two cerebral hemispheres. Production of synapses and myelination of the corpus callosum increase at 1 year, peak between 3 and 6 years, 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 many aspects of thinking, including perception, attention, memory, language, and problem solving. The more complex the task, the more critical is communication between the hemispheres.

Ask Yourself

Review What aspects of brain development support the tremendous gains in language, thinking, and motor control of early childhood?

Apply Both Crystal and Shana are shorter and lighter than 97 percent of North American 4-year-old girls. What are the possible causes of their very short stature?

Connect What stance on the nature–nurture issue does evidence on development of handedness support? Document your answer with research findings.

Reflect How early, and to what extent, did you experience tooth decay in childhood? What factors might have been responsible?
Lead is a highly toxic element that, at blood levels exceeding 60 μg/dL (micrograms per deciliter), causes brain swelling and hemorrhaging. Risk of death rises as blood-lead level exceeds 100 μg/dL. Before 1980, exposure to lead resulted from the use of lead-based paints for the interiors of residences (where infants and young children often ate paint chips that flaked off walls) and from the use of leaded gasoline (car exhaust resulted in a highly breathable form of lead). The passage of 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 1.9 μg/dL today (Centers for Disease Control and Prevention, 2005; Meyer et al., 2003). But in neighborhoods near industries that use lead production processes, or where lead-based paint remains in older homes, children's blood levels are still markedly elevated. About 16 percent of low-SES children who live in large central cities, and 37 percent of African-American children in these areas, have blood-level levels exceeding 10 μg/dL (the official “level of concern” in the United States and Canada), warranting immediate efforts to reduce exposure (Centers for Disease Control and Prevention, 2005; Health Canada, 2006).

How much lead exposure is too much? Is lead contamination a “silent epidemic,” impairing children’s mental functioning even in small quantities? 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 SES, home environmental quality, and nutrition) that might account for the findings.

Over the past two decades, seven longitudinal studies of the developmental consequences of lead have been conducted—three in the United States, two in Australia, one in Mexico City, and one in Yugoslavia. Some focused on inner-city, low-SES minority children, others on middle- and upper-middle SES 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.

Consistent findings emerged: In five sites, negative relationships between lead exposure and children’s IQs emerged (Hubbs-Tait et al., 2006). Higher blood levels were also associated with deficits in verbal and visual-motor skills and with distractibility, overactivity, poor organization, and behavior problems. And an array of findings suggested that persistent childhood lead exposure contributes to antisocial behavior in adolescence (Dietrich et al., 2001; Needleman et al., 2002; Nevin, 2000; Stretesky & Lynch, 2001).

Influences on Physical Growth and Health

As we discuss growth and health during early childhood, you will encounter some familiar themes. Heredity remains important, but environmental factors continue to play a crucial role. Emotional well-being, restful sleep, good nutrition, relative freedom from disease, and physical safety are essential. And as the Biology and Environment box illustrates, environmental pollutants can threaten children’s healthy development. The extent to which low-level lead—one of the most common—undermines children’s mental and emotional functioning is the focus of intensive research.

Heredity and Hormones

The impact of heredity on physical growth is evident throughout childhood. Children’s physical size and rate of growth are related to those of their parents (Bogin, 2001). Genes influence
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 a similar susceptibility to 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 in long-term outcomes (Dietrich et al., 2004; Rogan et al., 2001). And negative lead-related cognitive consequences were evident at all levels of exposure—even below 10 μg/dL (Lamphear et al., 2005).

Although the overall impact of low-level lead exposure on all outcomes is modest, in three longitudinal investigations, cognitive consequences were much greater for low-SES than higher-SES children (see, for example, Figure 8.5) (Bellinger, Leviton, & Sloman, 1990; Ris et al., 2004; Tong, McMichael, & Baghurst, 2000). A stressed, disorganized home life seems to heighten lead-induced damage, whereas an organized, stimulating home and school may offset it. Dietary factors can also magnify or reduce lead's toxic effects. Iron deficiency, common in low-SES children, increases lead concentration in the blood, whereas iron supplements decrease it. Similarly, exposed children absorb less lead when their diets contain enough zinc (Noonan et al., 2003; Wolf, Jimenez, & Lozoff, 2003; Wright et al., 2003).

In sum, lead impairs learning and contributes to behavior problems—findings confirmed by rigorous animal experiments (Cory-Slechta, 2003; Delville, 1999; Li et al., 2003). Low-SES children 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 and limit children's exposure, interventions that reduce the negative impact of lead—through involved parenting, better schools, and dietary enrichment—are vital.

![FIGURE 8.5](image)

**Relationship of lifetime average lead exposure to 11-to-13-year-old IQ by SES.** 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. Among both low-SES and higher-SES participants, increases in lifetime average blood-lead concentrations were associated with poorer mental test scores. But the lead-exposure-related drop in IQ was much greater for low-SES children. (Adapted from Tong, McMichael, & Baghurst, 2000.)

growth by controlling the body’s production of hormones. The pituitary gland, located at the base of the brain (refer to Figure 8.4), plays a critical role by releasing two hormones that induce growth.

The first, growth hormone (GH), is necessary from birth on for development of all body tissues except the central nervous system and genitals. Children who lack GH reach an average mature height of only 4 feet, 4 inches. When treated early with injections of GH, such children show catch-up growth and then grow at a normal rate, becoming much taller than they would have without treatment (Saenger, 2003).

The availability of synthetic GH has also made it possible to treat short, normal-GH children with hormone injections, in hopes of increasing their final height. Thousands of parents, concerned that their children will suffer social stigma because of their shortness, have sought this GH therapy. But most normal-GH children given GH treatment grow only slightly taller than their previously predicted mature height (Guyda, 1999). And contrary to popular belief, normal-GH short children are not deficient in self-esteem or other aspects of psychological...
thyroid-stimulating hormone (TSH)  A pituitary hormone that stimulates the thyroid gland to release thyroxine, which is necessary for normal brain development and body growth.

psychosocial dwarfism  A growth disorder, observed between 2 and 15 years of age, characterized by very short stature, decreased GH secretion, immature skeletal age, and serious adjustment problems.

adjustment (Sandberg & Voss, 2002). So despite the existence of “heightism” in Western cultures, little justification exists for medically intervening in short stature that is merely the result of biologically normal human diversity.

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, children with too little thyroxine grow at a below-average rate, but the central nervous system is no longer affected. With prompt treatment, such children catch up in body growth and eventually reach normal size (Salerno et al., 2001).

**Emotional Well-Being**

In childhood as in infancy, emotional well-being can have a profound effect on growth and health. Preschoolers with very stressful home lives (due to divorce, financial difficulties, or parental job loss) suffer more respiratory and intestinal illnesses and more unintentional injuries than others (Cohen & Herbert, 1996; Kemeny, 2003).

Extreme emotional deprivation can interfere with the production of GH and lead to psychosocial dwarfism, a growth disorder that appears between ages 2 and 15. Typical characteristics include very short stature, decreased GH secretion, immature skeletal age, and serious adjustment problems, which help distinguish psychosocial dwarfism from normal shortness (Doeker et al., 1999; Voss, Mulligan, & Betts, 1998). Lynette, the 4-year-old mentioned earlier in this chapter, was diagnosed with this condition. She was placed in foster care after child welfare authorities discovered that she spent most of the day at home alone, unsupervised, and also might have been physically abused. When children like Lynette 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.

**Sleep Habits and Problems**

Sleep contributes to body growth, since GH is released during the child’s sleeping hours. A well-rested child is better able to play, learn, and contribute positively to family functioning. Also, children who sleep poorly disrupt their parents’ sleep, which can contribute to significant family stress—a major reason that sleep difficulties are among the most common concerns parents raise with their preschooler’s doctor (Mindell, Owens, & Carskadon, 1999; Mindell, 2005).

On average, total sleep declines in early childhood; 2- and 3-year-olds sleep 11 to 12 hours, 4- to 6-year-olds 10 to 11 hours (National Sleep Foundation, 2004). Younger preschoolers typically take a 1- to 2-hour nap in the early afternoon, although their daytime sleep needs vary widely. Some continue to take two naps, as they did in toddlerhood; others give up napping entirely. Most children stop napping between ages 3 and 4, although a quiet play period or rest after lunch helps them rejuvenate for the rest of the day (Howard & Wong, 2001). In some cultures, daytime naps persist through adulthood.

Western preschoolers often become rigid about bedtime rituals, such as using the toilet, listening to a story, getting a drink of water, taking a security object to bed, and hugging and kissing before turning off the light. These practices, which can take as long as 30 minutes, help young children adjust to feelings of uneasiness at being left by themselves in a darkened room. Difficulty falling asleep—calling to the parent or asking for another drink of water—is common in early childhood. When it occurs repeatedly, it is usually due to typical fears of the preschool
years or to parental problems in setting bedtime limits. The problem usually subsides when parents follow the recommendations given in Applying What We Know below. Intense bedtime struggles sometimes result from family turmoil, as children worry about how their parents may get along when they are asleep and not available to distract them. In these cases, addressing family stress and conflict is the key to improving children’s sleep.

In early childhood, parent–child cosleeping remains the usual practice in non-Western cultures and many ethnic minority groups. North American Caucasian parents who cosleep with their preschoolers tend to be reluctant to tell others about the practice, out of fear of disapproval, so how many do so is uncertain. In most cases, cosleeping is not associated with problems during the preschool years, other than more frequent night wakeings by parents due to children’s movements during sleep (Gaylor et al., 2005; Thiedke, 2001). Western cosleeping children generally ask to sleep in their own bed by age 6 or 7.

Finally, most children waken during the night from time to time, and those who cannot return to sleep on their own may suffer from a sleep disorder. Because young children have vivid imaginations and difficulty separating fantasy from reality, nightmares are common; half of 3- to 6-year-olds experience them from time to time. And about 4 percent of children are frequent sleepwalkers, who are unaware of their wanderings during the night. Gently awakening and returning the child to bed helps avoid self-injury. Sleep terrors, which affect 3 percent of young children, are perhaps

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**Applying What We Know**

**Helping Young Children Get a Good Night’s Sleep**

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>EXPLANATION</th>
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<tbody>
<tr>
<td>Establish a regular bedtime, early enough to ensure, on average, 10 to 11 hours of nightly sleep.</td>
<td>Children who go to sleep too late in the evening—after 9:30 or 10 P.M.—get less sleep than those who go to sleep earlier and are sleepier and more irritable during the day.</td>
</tr>
<tr>
<td>Provide special bedtime attire.</td>
<td>Changing into bedtime attire, such as pajamas or a nightshirt, provides the child with clear psychological separation between daytime and bedtime.</td>
</tr>
<tr>
<td>Avoid watching television or playing computer games before bedtime.</td>
<td>Preschoolers’ difficulty distinguishing fantasy from reality can lead to disturbing thoughts and emotions that interfere with sleep.</td>
</tr>
<tr>
<td>If the child resists going to bed, respond with kind but firm insistence.</td>
<td>Discuss the next day’s activities with the child, emphasizing that tomorrow will be a good day. Initiate the bedtime ritual without introducing other enjoyable activities and, if necessary, stay with the child until he or she falls asleep.</td>
</tr>
<tr>
<td>If the child awakens repeatedly during the night, establish a routine to follow.</td>
<td>Respond to an upset child. Letting preschoolers cry themselves to sleep undermines trust in the parent and, instead of enhancing self-control, increases clingy and demanding behavior during the day. Use a predictable, but boring, routine that ends with the last two or three steps of the child’s bedtime ritual—rubbing the child’s back, hugging and kissing the child, and sitting quietly with the child until he or she returns to sleep.</td>
</tr>
<tr>
<td>Do not give a child who resists sleep over-the-counter sleeping medication of any kind.</td>
<td>These brain-altering chemicals can affect children differently than adults. They also cause “rebound” insomnia—sleeplessness after medication is discontinued. And they prevent children from developing their own effective strategies for falling asleep. Children with sleep disorders may require prescription medication, which must be carefully supervised by the child’s doctor.</td>
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the most upsetting sleep problem to parents. In these panic-stricken arousals from deep sleep, the child may scream, thrash, speak incoherently, show a sharp rise in heart rate and breathing, and initially be unresponsive to parents’ attempts to comfort. Sleepwalking and sleep terrors tend to run in families, suggesting a genetic influence (Guilleminault et al., 2003; Thorpy & Yager, 2001). But they can also be triggered by stress or extreme fatigue.

Fortunately, sleep disorders of early childhood usually subside without treatment. In the few cases that persist, children require a medical and psychological evaluation. Their disturbed sleep may be a sign of neurological or emotional difficulties (Gregory et al., 2004). And the resulting daytime sleepiness often contributes to attention, learning, and behavior problems.

**Nutrition**

With the transition to early childhood, appetite tends to become unpredictable. Preschoolers eat well at one meal and barely touch their food at the next. And many become picky eaters. One father I know wistfully recalled how his son, as a toddler, eagerly sampled Chinese food: “He ate rice, chicken chow mein, egg rolls—and now, at age 3, the only thing he’ll try is the ice cream!”

Preschoolers’ appetites decline because their growth has slowed. Their wariness of new foods is also 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).

Though they eat less, preschoolers need a high-quality diet, including the same foods adults need, but in smaller amounts. Milk and milk products, meat or meat alternatives (such as eggs, dried peas or beans, and peanut butter), vegetables and fruits, and breads and cereals should be included. Fats, oils, and salt should be kept to a minimum because of their link to high blood pressure and heart disease in adulthood. Foods high in sugar should also be avoided. In addition to causing tooth decay, they lessen young children’s appetite for healthy foods and increase their risk of overweight and obesity—a topic we will take up in Chapter 11.

The social environment powerfully influences young children’s food preferences. 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 North American children reject them (Birch, Zimmerman, & Hind, 1980).

Repeated, unpressured exposure to a new food also increases acceptance (Fuller et al., 2005). In one study, preschoolers were given one of three versions of a food they had never eaten before (sweet, salty, or plain tofu). After 8 to 15 exposures, they readily ate the food. But they preferred the version they had already tasted. For example, children in the “sweet” condition liked sweet tofu best, and those in the “plain” condition liked plain tofu best (Sullivan & Birch, 1990). These findings reveal that adding sugar or salt in hopes of increasing a young child’s willingness to eat healthy foods simply strengthens the child’s desire for a sugary or salty taste. Similarly, offering children sweet fruit or soft drinks promotes “milk avoidance.” Compared to their milk-drinking agemates, milk-avoiders are shorter in stature and have a lower bone density—a condition that leads to a lifelong reduction in strength and to increased risk of bone fractures (Black et al., 2002).

The emotional climate at mealtimes has a powerful impact on children’s eating habits. When parents are worried
about how well their preschoolers are eating, meals can become unpleasant and stressful. Offering bribes (“Finish your vegetables, and you can have an extra cookie”), as some parents do, causes children to like the healthy food less and the treat more. Although children’s healthy eating depends on a healthy food environment, too much parental control over children’s eating limits their opportunities to develop self-control, thereby promoting overeating (Birch, Fisher, & Davison, 2003). For ways to encourage healthy, varied eating in young children, refer to Applying What We Know above.

Finally, as indicated in earlier chapters, many children in North America and in developing countries lack access to sufficient high-quality food to support healthy growth. Five-year-old Hal rode a bus from a poor neighborhood to our laboratory preschool. His mother’s welfare check barely covered her rent, let alone food. Hal’s diet was deficient in protein and in essential vitamins and minerals—iron (to prevent anemia), calcium (to support development of bones and teeth), zinc (to support immune system functioning, neural communication, and cell duplication), vitamin A (to help maintain eyes, skin, and a variety of internal organs), and vitamin C (to facilitate iron absorption and wound healing). These are the most common dietary deficiencies of the preschool years (Ganji, Hampl, & Betts, 2003).

Hal was small for his age, pale, inattentive, and unruly at preschool. By the school years, North American low-SES children are, on average, about $\frac{1}{2}$ to 1 inch shorter than their economically advantaged counterparts (Cecil et al., 2005; Yip, Scanlon, & Trowbridge, 1993). And throughout childhood and adolescence, a nutritionally deficient diet is associated with attention difficulties, poorer mental test scores, and behavior problems—especially hyperactivity and aggression—even after family factors that might account for these relationships (such as stressors, parental psychological health, education, warmth, and stimulation of the child) are controlled (Liu et al., 2004; Pollitt, 2001; Slack & Yoo, 2005).

### Infectious Disease

Two weeks into the school year, I looked outside my window and noticed that Hal was absent from the play yard. Several weeks passed, and I still did not see him, so I asked Leslie, his
preschool teacher, what was wrong. “Hal’s been hospitalized with the measles,” she explained. He’s had difficulty recovering—lost weight when there wasn’t much to lose in the first place. In well-nourished children, ordinary childhood illnesses have no effect on physical growth. But when children are undernourished, disease interacts with malnutrition in a vicious spiral, with potentially severe consequences.

**INFECTIOUS DISEASE AND MALNUTRITION**

Hal’s reaction to the measles would be commonplace in developing nations, where a large proportion of the population lives in poverty and children do not receive routine immunizations. 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 10 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, 2005).

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 several million childhood deaths each year (Tharpar & Sanders, 2004). 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 (Bhandari et al., 2002). Because of these interventions, the lives of millions of children are saved each year.

**IMMUNIZATION**

In industrialized nations, childhood diseases have declined dramatically over the past half-century, largely because of widespread immunization of infants and young children. Hal got the measles because, unlike his classmates from more advantaged homes, he did not receive a full program of immunizations.

About 20 percent of American 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, 24 percent of American preschoolers lack essential immunizations, a rate that rises to 27 percent for poverty-stricken children and is especially high for Native Americans, at 33 percent. Many of these preschoolers 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, 2006). In contrast, fewer than 10 percent of preschoolers lack immunizations in Denmark and Norway, and fewer than 7 percent in Great Britain, Canada, the Netherlands, and Sweden (United Nations, 2002, UNICEF, 2006).

Why does the United States lag behind these other countries in immunization? In earlier chapters, we noted that many children in the United States do not have access to the health care they need. The Cultural Influences box on the following page compares child health care in the United States with that in other Western nations.

Inability to pay for vaccines is only one cause of inadequate immunization. Parents with stressful daily lives often fail to schedule vaccination appointments, and those without a
In the United States, strongly individualistic values, which emphasize parental responsibility for the care and rearing of children, join with powerful economic interests in the medical community to prevent government-sponsored health services from being offered to all American children. Health insurance in the United States is generally an optional, employment-related fringe benefit. Businesses that rely on low-wage and part-time help often do not insure their employees; others do not cover employees’ family members, including children.

The largest U.S. public health insurance program, Medicaid, serves only very-low-income people. This leaves about 8 million children (9 percent of the child population), many of whom have working parents, uninsured and, therefore, without affordable health care (U.S. Census Bureau, 2007). In the United States, uninsured children are three times as likely as insured children to go without needed doctor visits (Newacheck et al., 2002). Consequently, an estimated one-third of children younger than age 5 who come from economically disadvantaged families are in less than very good health. Partly because of weak health care services, 13 percent of children living in poverty have activity limitations due to chronic illnesses—a rate nearly double the national average (U.S. Department of Health and Human Services, 2006).

The inadequacies of U.S. child health care stand in sharp contrast to services provided in Australia, Canada, New Zealand, Western Europe, and other industrialized nations, where government-sponsored health insurance is regarded as a fundamental human right and is made available to all citizens. Let’s look at two examples.

In the Netherlands, every child receives free medical examinations from birth through adolescence. Children’s health care also includes parental counseling in nutrition, disease prevention, and child development (de Winter, Balle-dux, & de Mare, 1997). The Netherlands achieves its extraordinarily high childhood immunization rate by giving parents of every newborn baby a written schedule that shows exactly when and where the child should be immunized. If a parent does not bring the child at the specified time, a public health nurse calls the family.

When appointments are missed repeatedly, the nurse goes to the home to ensure that the child receives the recommended immunizations (de Pree-Geerlings, de Pree, & Bulk-Bunschoten, 2001).

In Norway, federal law requires that all communities establish well-baby and child clinics and that health checkups occur three times in the first year, then at ages 2 and 4. On other occasions, children are seen by specialized nurses who monitor their development, provide immunizations, and counsel parents on physical and mental health (AWC Oslo, 2005). Although citizens pay a small fee for routine medical visits, hospital services are free.

Currently, many organizations, government officials, and concerned citizens committed to improving child health are working to ensure that every American child receives basic health care. Under the State Children’s Health Insurance Program (SCHIP), launched in 1997, the states receive $4 billion a year in federal matching funds for upgrading children’s health insurance. State control over program implementation enables each state to adapt insurance coverage to meet its unique needs. But it also means that child advocates must continually exert pressure for family-friendly policies. For example, a state can require that families share health care costs, despite the fact that for low-income parents, even a small premium or copayment generally makes SCHIP unaffordable. Currently, many states are experiencing funding shortfalls and, without additional government allocations, will have to reduce SCHIP enrollment or medical coverage rates (Trapp, 2007).

Even many insured U.S. children do not see a doctor regularly. Parents with no health benefits of their own are less inclined to make appointments for their children. And because of low insurance-reimbursement rates, many doctors refuse to take public-aid patients. As a result, children with public insurance frequently do not have a primary care physician. Instead, they endure long waits in crowded public health clinics, and their parents often say they cannot gain access to needed services (Dombrowski, Lantz, & Freed, 2004; Hughes & Ng, 2003).

Finally, millions of eligible children are not enrolled in SCHIP because their parents either do not understand the eligibility requirements or find the application process confusing. Clearly, the United States has a long way to go to ensure that all its children receive excellent health care.
primary care physician do not want to endure long waits in crowded U.S. public health clinics. Misconceptions about vaccine safety also contribute—for example, the notion that vaccines do not work or that they weaken the immune system (Gellin, Maibach, & Marcuse, 2000). Furthermore, some parents have been influenced by media reports suggesting a link between the measles–mumps–rubella vaccine and a rise in the number of children diagnosed with autism, although large-scale studies show no such association (Dales, Hammer, & Smith, 2001; Richler et al., 2006; Stehr-Green et al., 2003). In areas where many parents have refused to immunize their children, disease outbreaks of whooping cough and rubella have occurred, with life-threatening consequences (Tuyen & Bisgard, 2003). Public education programs directed at increasing parental knowledge about the importance of timely immunizations are badly needed.

A final point regarding communicable disease in early childhood deserves mention. Childhood illness rises with child-care attendance. On average, a child-care infant becomes sick 9 to 10 times a year, a child-care preschool child 6 to 7 times. The diseases that spread most rapidly are those most frequently suffered by young children—diarrhea and respiratory infections. The risk that a respiratory infection will result in otitis media, or middle ear infection, is almost double that for children remaining at home (Nafstad et al., 1999). To learn about the consequences of otitis media and how to prevent it, consult the Social Issues: Health box on the following page.

Childhood Injuries

More than any other child in the preschool classroom, 3-year-old Tommy had trouble sitting still and paying attention. Instead, he darted from one place and activity to another. One day, I read in our local newspaper that Tommy had narrowly escaped serious injury when he put his mother’s car in gear while she was outside scraping ice from its windows. The vehicle rolled through a guardrail and over the side of a 10-foot concrete underpass, where it hung until rescue workers arrived. Police charged Tommy’s mother with failing to use a restraint seat for a child younger than age 8.

Unintentional injuries—auto collisions, pedestrian accidents, drownings, poisonings, firearm wounds, burns, falls, and swallowing of foreign objects—are the leading causes of childhood mortality in industrialized nations. As Figure 8.6 reveals, the United States and, to a lesser extent, Canada rank poorly in these largely preventable events. In North America, nearly 40 percent of childhood deaths and 70 percent of adolescent deaths are due to injury (Children’s Defense Fund, 2006; Health Canada, 2005). And among injured children and youths who survive, thousands suffer pain, brain damage, and permanent physical disabilities.

Auto and traffic accidents, drownings, burns, falls, and poisonings are the most common injuries during early childhood. Motor vehicle collisions are by far the most frequent source of injury at all ages, ranking as the leading cause of death among children more than 1 year old.

FACTORS RELATED TO CHILDHOOD INJURIES

The common view of childhood injuries as “accidental”
During his first year in child care, 2-year-old Alex caught five colds, had the flu on two occasions, and experienced repeated otitis media (middle ear infection). Alex is not unusual. By age 3, 75 percent of North American children have had respiratory illnesses that resulted in at least one bout of otitis media; nearly half of these have had three or more bouts (Aronson & Henderson, 2006). Although antibiotics eliminate the bacteria responsible for otitis media, they do not reduce fluid buildup in the middle ear, which causes mild to moderate hearing loss that can last for weeks or months. The incidence of otitis media is greatest between 6 months and 3 years, when children are first acquiring language. Frequent infections predict delayed language progress in early childhood and poorer academic performance after school entry that, in one study, was still evident in adolescence (Bennett et al., 2001; Casby, 2001; Miccio et al., 2002).

How might otitis media disrupt language and academic progress? Difficulties in perceiving and processing speech sounds, particularly in noisy settings, may be responsible (Polka & Rvachew, 2005). Children with many bouts are less attentive to others’ speech and less persistent at tasks (Asbjornsen et al., 2005; Petinou et al., 2001). Their distractibility may result from an inability to make out what people around them are saying—which, in turn, may reduce the quality of others’ interactions with them.

Because otitis media is so widespread, current evidence argues strongly in favor of early prevention. Crowded living conditions and exposure to cigarette smoke and other pollutants are linked to the disease, probably accounting for its high incidence among low-SES children. And child care creates opportunities for close contact, greatly increasing otitis media episodes.

Early otitis media can be prevented in the following ways:

- **Preventive doses of xylitol, a sweetener derived from birch bark.** Research in Finland revealed that children given a daily dose of xylitol, in gum or syrup form, showed a 30 to 40 percent drop in otitis media compared with controls given gum or syrup without the sweetener. Xylitol appears to have natural bacteria-fighting ingredients (Blazek-O’Neill, 2005). However, dosage must be carefully monitored—too much xylitol can cause abdominal pain and diarrhea.

- **Frequent screening for the disease, followed by prompt medical intervention.** Plastic tubes that drain the inner ear often are used to treat chronic otitis media, although their effectiveness was questioned.

- **Verbally stimulating adult–child interaction.** Developmental problems associated with otitis media are reduced or eliminated in high-quality child-care centers. When caregivers are verbally stimulating and keep noise to a minimum, children have more opportunities to hear, and benefit from, spoken language (Roberts et al., 1998; VernonFeagans, Hurley, 2005).

This 2-year-old Inuit child of Canada’s Northwest Territory has her hearing tested. Frequent otitis media infections can lead to persistent hearing problems, which interfere with language development and later academic progress. About one-fourth of Inuit children are affected.
Part Four: Early Childhood: Two to Six Years

saw in Chapter 7, children with these traits present child-rearing challenges. They are likely to protest when placed in auto seat restraints, to refuse to take a companion’s hand when crossing the street, and to disobey after repeated instruction and discipline.

Other factors strongly associated with injury are poverty, low parental education, and more children in the home (Ramsey et al., 2003). Parents who must cope with many daily stresses often have little time and energy to monitor the safety of their youngsters. And their homes and neighborhoods are likely to be noisy, crowded, and run-down, posing further risks (Dal Santo et al., 2004).

Broad societal conditions also affect childhood injury. In developing countries, the rate of death from injury before age 15 is five times higher than in developed nations and soon may exceed disease as the leading cause of childhood mortality. Widespread poverty, rapid population growth, overcrowding in cities, and heavy road traffic combined with weak safety measures are major causes. Safety devices, such as car safety seats and bicycle helmets, are neither readily available nor affordable. To purchase a child safety seat requires more than 100 hours of wages in Vietnam and 53 hours in China, but only 2.5 hours in the United States (Safe Kids Worldwide, 2002).

Why, among developed nations, are injury rates so high in Canada and the United States? Major factors are poverty, shortages of high-quality child care (to supervise children in their parents’ absence), and—especially in the United States—a high rate of births to teenagers, who are neither psychologically nor financially ready for parenthood. But North American children from advantaged families are also at somewhat greater risk for injury than children in Western Europe (Safe Kids Worldwide, 2002). This indicates that besides reducing poverty and teenage pregnancy and upgrading the status of child care, additional steps are needed to ensure children’s safety.

PREVENTING CHILDHOOD INJURIES

Childhood injuries have many causes, so a variety of approaches are needed to control them. Laws prevent many injuries by requiring car safety seats, child-resistant caps on medicine bottles, flameproof clothing, and fencing around backyard swimming pools (the site of 50 percent of early childhood drownings) (Brenner et al., 2003). Communities can help by modifying their physical environments. Providing inexpensive and widely available public transportation can reduce the amount of time that children spend in cars. Playgrounds, a common site of injury, can be covered with protective surfaces (National Safe Kids Campaign, 2005). Families living in high-rise apartment buildings can be given free, easily installed window guards to prevent falls. And widespread media and information campaigns can inform parents and children about safety issues.

But even though they know better, many parents and children behave in ways that compromise safety. For example, about 10 percent of Canadian parents and 40 percent of American parents (like Tommy’s mother) fail to place their preschoolers in car safety seats (Howard, 2002). And when parents do use safety seats, 82 percent either install or use them incorrectly (Howard, 2002; National Safe Kids Campaign, 2005). Americans, especially, seem willing to ignore familiar safety practices, perhaps because of the high value they place on individual rights and personal freedom (Damashek & Peterson, 2002).

Many North American parents begin relying on children’s knowledge of safety rules, rather than monitoring and controlling access to hazards, as early as 2 or 3 years of age—a premature transition associated with a rise in home injuries (Morrongiello, Ondejko, & Littlejohn, 2004). But even older preschoolers spontaneously recall only about half the safety
rules their parents teach them. And even with well-learned rules, they need supervision to ensure that they comply (Morrongiello, Midgett, & Shields, 2001).

Programs based on behavior modification (modeling and reinforcement) have been used to improve parent and child safety practices. But such efforts focus narrowly on specific risks. Attention must also be paid to family conditions that can prevent childhood injury: relieving crowding in the home, providing social supports to ease parental stress, and teaching parents to use effective discipline—a topic we will take up in Chapter 10. Positive parenting—an affectionate, supportive relationship with the child; consistent, reasonable expectations for maturity; and oversight—substantially reduces injury rates, especially in overactive and temperamentally difficult children (Schwebel et al., 2004), But to implement these strategies, parents must have ample time and emotional resources as well as relevant skills. Refer to Applying What We Know above for ways to minimize unintentional injuries in early childhood.

### Reducing Unintentional Injuries in Early Childhood

<table>
<thead>
<tr>
<th>SUGGESTION</th>
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<tbody>
<tr>
<td>Provide age-appropriate supervision and safety instruction.</td>
<td>Despite increasing understanding and self-control, preschoolers need nearly constant supervision. Establish and enforce safety rules, explain the reasons behind them, and praise children for following them, thereby encouraging the child to remember and obey.</td>
</tr>
<tr>
<td>Know the child’s temperament.</td>
<td>Children who are unusually active, distractible, negative, or curious have more than their share of injuries and need extra monitoring.</td>
</tr>
<tr>
<td>Eliminate the most serious dangers from the home.</td>
<td>Examine all spaces for safety. For example, in the kitchen, store dangerous products in high cabinets out of sight, and keep sharp implements in a latched drawer. Remove guns; if that is impossible, store them unloaded in a locked cabinet. Always accompany young preschoolers to the bathroom, and keep all medicines in containers with safety caps.</td>
</tr>
<tr>
<td>During automobile travel, always restrain the child properly in the back seat of the car.</td>
<td>Use an age-appropriate, properly installed car safety seat or booster seat up to age 8 or until the child is 4 feet 9 inches tall, and strap the child in correctly every time. Children should always ride in the back seat; passenger-side air bags in the front seat deploy so forcefully that they can cause injury or death to a child.</td>
</tr>
<tr>
<td>Select safe playground equipment and sites.</td>
<td>Make sure sand, wood chips, or rubberized matting has been placed under swings, seesaws, and jungle gyms. Check yards for dangerous plants. Always supervise outdoor play.</td>
</tr>
<tr>
<td>Be extra cautious around water.</td>
<td>Constantly observe children during water play; even shallow, inflatable pools are frequent sites of drownings. While they are swimming, young children’s heads should not be immersed in water; they may swallow so much that they develop water intoxication, which can lead to convulsions and death.</td>
</tr>
<tr>
<td>Practice safety around animals.</td>
<td>Wait to get a pet until the child is mature enough to handle and care for it—usually around age 5 or 6. Never leave a young child alone with an animal; bites often occur during playful roughhousing. Model and teach humane pet treatment.</td>
</tr>
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Source: Damashek & Peterson, 2002.

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**Ask Yourself**

**Review**

What sleep problems can Western parents anticipate during the preschool years, and what factors contribute to those problems?

**Apply**

One day, Leslie prepared a new snack to serve at preschool: celery stuffed with ricotta cheese and pineapple. The first time she served it, few children touched it. How can Leslie do encourage her students to accept the snack? What tactics should she avoid?

**Connect**

Using research on malnutrition or on unintentional injuries, show how physical growth and health in early childhood result from a continuous, complex interplay between heredity and environment.

**Reflect**

Ask a parent or other family member whether, as a preschooler, you were a picky eater, suffered from many infectious diseases, or sustained any serious injuries. In each instance, what factors might have been responsible?
Motor Development

**TAKE A MOMENT...** Observe several 2- to 6-year-olds at play in a neighborhood park, preschool, or child-care center. You will see that an explosion of new motor skills occurs in early childhood, each of which builds on the simpler movement patterns of toddlerhood.

During the preschool years, children continue to integrate previously acquired skills into more complex, *dynamic systems*. Then they revise each new skill as their bodies grow larger and stronger, their central nervous systems develop, their environments present new challenges, and they set new goals, aided by gains in perceptual and cognitive capacities.

**Gross Motor Development**

As children’s bodies become more streamlined and less top-heavy, their center of gravity shifts downward, toward the trunk. As a result, balance improves greatly, paving the way for new motor skills involving large muscles of the body. By age 2, preschoolers’ gaits become smooth and rhythmic—secure enough that soon they leave the ground, at first by running and later by jumping, hopping, galloping, and skipping.

As children become steadier on their feet, their arms and torsos are freed to experiment with new skills—throwing and catching balls, steering tricycles, and swinging on horizontal bars and rings. Then upper- and lower-body skills combine into more refined actions. Five- and 6-year-olds simultaneously steer and pedal a tricycle and flexibly move their whole body when jumping. By the end of the preschool years, all skills are performed with greater speed and endurance. Table 8.1 provides an overview of gross motor development in early childhood.

Changes in ball skills provide an excellent illustration of preschoolers’ gross motor progress. **TAKE A MOMENT...** Play a game of catch with a 2- or 3-year-old, and watch the child’s body. Young preschoolers stand still, facing the target, throwing with their arm thrust forward. Catching is equally awkward. Two-year-olds extend their arms and hands rigidly, using...
them as a single unit to trap the ball. By age 3, children flex their elbows enough to trap the ball against the chest. But if the ball arrives too quickly, they cannot adapt, and it may bounce off the body (Haywood & Getchell, 2005).

Gradually, children call on the shoulders, torso, trunk, and legs to support throwing and catching. By age 4, the body rotates as the child throws, and at 5 years, preschoolers shift their weight forward, stepping as they release the ball. As a result, the ball travels faster and farther. When the ball is returned, older preschoolers predict its place of landing by moving forward, backward, or sideways (see Figure 8.7). Soon, they will catch it with their hands and fingers, “giving” with arms and body to absorb the force of the ball.

**Fine Motor Development**

Like gross motor development, fine motor skills take a giant leap forward in the preschool years. Because control of the hands and fingers improves, young children put puzzles together, build with small blocks, cut and paste, and string beads. To parents, fine motor progress is most apparent in two areas: (1) children’s care of their own bodies, and (2) the drawings and paintings that fill the walls at home, child care, and preschool.

**SELF-HELP SKILLS**

As Table 8.1 shows, young children gradually become self-sufficient at dressing and feeding. Two-year-olds put on and take off simple items of clothing. By age 3, children can do so well enough to take care of toileting needs by themselves. Between ages 4 and 5, children can dress and undress without supervision. At mealtimes, young preschoolers use a spoon well, and they can serve themselves. By age 4 they are adept with a fork, and around 5 to 6 years they can use a knife to cut soft foods. Roomy clothing with large buttons and zippers and child-sized eating utensils help children master these skills.

Preschoolers get great satisfaction from managing their own bodies. They are proud of their independence, and their new skills also make life easier for adults. But parents must be patient about these abilities. When tired and in a hurry, young children often revert to eating with their fingers. And the 3-year-old who dresses himself in the morning sometimes ends up with his shirt on inside out, his pants on backward, and his left snow boot on his right foot! Perhaps the most complex self-help skill of early childhood is shoe tying, mastered around age 6. Success requires a longer attention span, memory for an intricate series of hand movements, and the dexterity to perform them. Shoe tying illustrates the close connection between cognitive and motor development. Drawing and writing offer additional examples.

**DRAWING**

When given crayon and paper, even toddlers scribble in imitation of others. As the young child’s ability to mentally represent the world expands, marks on the page take on meaning. A variety of factors combine with fine motor control in the development of children’s artful representations (Golumb, 2004). These include the realization that pictures can serve as symbols, improved planning and spatial understanding, and the emphasis that the child’s culture places on artistic expression.

Typically, drawing progresses through the following sequence:

1. *Scribbles.* Western children begin to draw during the second year. At first, the intended representation is contained in gestures rather than in the resulting marks on the page. For
example, one 18-month-old made her crayon hop and, as it produced a series of dots, explained, “Rabbit goes hop-hop” (Winner, 1986).

2. **First representational forms.** Around age 3, children’s scribbles start to become pictures. Often children make a gesture with the crayon, notice that they have drawn a recognizable shape, and then decide to label it. In one case, a 2-year-old made some random marks on a page and then, realizing the resemblance between his scribbles and noodles, named the creation “chicken pie and noodles” (Winner, 1986).

Few 3-year-olds spontaneously draw so others can tell what their picture represents. However, after an adult demonstrated how pictures can be used to stand for objects in a game, more 3-year-olds drew recognizable forms (Callaghan & Rankin, 2002). Western parents and teachers spend much time promoting 2- and 3-year-olds’ language and make-believe play but relatively little time showing them how they can use drawings to represent their world. When adults draw with children and point out the resemblances between drawings and objects, preschoolers’ pictures become more comprehensible and detailed (Braswell & Callanan, 2003).

A major milestone in drawing occurs when children use lines to represent the boundaries of objects. This enables 3- and 4-year-olds to draw their first picture of a person. Look at the tadpole image—a circular shape with lines attached—on the left in Figure 8.8. Fine motor and cognitive limitations lead the preschooler to create this universal image, which reduces the figure to the simplest form that still looks human. Four-year-olds add features, such as eyes, nose, mouth, hair, fingers, and feet, as the tadpole drawings illustrate.

3. **More realistic drawings.** Young children do not demand that a drawing be realistic. But as cognitive and fine motor skills improve, they learn to desire greater realism. As a result, they create more complex drawings, like the one by a 6-year-old shown on the right in Figure 8.8. Older preschoolers include more conventional figures, in which the head and

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**FIGURE 8.8**

body are differentiated and arms and legs appear. (Note the human and animal figures in the 6-year-old’s drawing.) Still, because they have just begun to represent depth, their drawings contain perceptual distortions (Braine et al., 1993).

Greater realism in drawing occurs gradually, as perception, language (ability to describe visual details), memory, and fine motor capacities improve (Toomela, 2002). Drawing of geometric objects follows the steps illustrated in Figure 8.9. (1) Three- to 7-year olds draw a single unit to stand for an object. To represent a cube, they draw a square; to represent a cylinder, they draw a circle, an oval, or a rectangle. (2) During the late preschool and school years, children represent salient object parts. They draw several squares to stand for a cube’s sides and draw two circles and some lines to represent a cylinder. However, the parts are not joined properly. (3) Older school-age children and adolescents integrate object parts into a realistic whole (Toomela, 1999).

Preschoolers’ free depiction of reality makes their artwork look fanciful and inventive. When accomplished artists try to represent people and objects freely, they often must work hard to achieve what they did effortlessly as 5- and 6-year-olds.

**Cultural Variations in Development of Drawing**

In cultures with rich artistic traditions, children create elaborate drawings that reflect the conventions of their culture. For example, the women of Walbiri, an Aboriginal group in Australia, draw symbols in sand to illustrate stories for preschoolers. Walbiri children often mix these symbols with more realistic images (Wales, 1990).

In cultures with little interest in art, even older children and adolescents produce simple forms. In the Jimi Valley—a remote region of Papua New Guinea with no indigenous pictorial art—many children do not go to school and therefore have little opportunity to develop drawing skills. When a Western researcher asked nonschooled Jimi 10- to 15-year-olds to draw a human figure for the first time, most produced nonrepresentational scribbles and shapes or simple “stick” or “contour” images resembling those of preschoolers (see Figure 8.10) (Martlew & Connolly, 1996). These forms seem to be a universal beginning in drawing. Once children realize that lines must evoke human features, they find solutions to figure drawing that vary somewhat from culture to culture but, overall, follow the sequence described earlier.

**Early Printing**

At first, preschoolers do not distinguish writing from drawing. When they try to write, they scribble, just as they do when they draw. As they experiment with lines and shapes, notice print in storybooks, and observe people writing, they attempt to print letters and, later, words. Around age 4, children’s writing shows some distinctive features of print, such as separate forms arranged in a line on the page. But children often include picturlike devices in their writing—for example, using a circular shape to write “sun” (Levin & Bus, 2003). Applying their understanding of the symbolic function of drawings, 4-year-olds who are asked to write typically make a “drawing of print.” Only gradually—between ages 4 and 6—do children realize that writing stands for language.

Preschoolers’ first attempts to print often involve their name, generally using a single letter. “How do you make a D?” my older son, David, asked at age 3½. When I printed a
large uppercase D, he tried to copy. “D for David,” he said as he wrote, quite satisfied with his backward, imperfect creation. A year later, David added several letters, and around age 5, he wrote his name clearly enough that others could read it.

Between ages 3 and 5, children acquire skill in gripping a pencil. As Figure 8.11 shows, 3-year-olds display diverse grip patterns and pencil angles, varying their grip depending on the direction and location of the marks they want to make. By trying out different forms of pencil-holding, they discover the grip and angle that maximize stability and writing efficiency. By age 5, most children use an adult grip pattern and a fairly constant pencil angle across a range of drawing and writing conditions (Greer & Lockman, 1998).

In addition to gains in fine motor control, advances in perception contribute to the ability to print. Like many children, David continued to reverse letters until well into second grade. Once preschoolers distinguish writing from nonwriting around age 4, they make progress in identifying individual letters. Many preschoolers confuse letter pairs that are alike in shape with subtle distinctive features, such as C and G, E and F, and M and W (Bornstein & Arteberry, 1999; Gibson, 1970). Mirror-image letter pairs (b and d, p and q) are especially hard to discriminate. Until children start to read, they do not find it especially useful to notice the difference between these forms.

The ability to tune in to mirror images and to scan a printed line from left to right improves as children gain experience with written materials (Casey, 1986). The more parents and teachers assist preschoolers in their efforts to print, the more advanced children are in writing and in other aspects of literacy development (Aram & Levin, 2001, 2002). We will consider early childhood literacy in greater detail in Chapter 9.

**Individual Differences in Motor Skills**

Wide individual differences exist in the ages at which children reach motor milestones. A child with a tall, muscular body tends to move more quickly and to acquire certain skills earlier than a short, stocky youngster. And as in other domains, parents and teachers probably provide more encouragement to children with biologically based motor-skill advantages.
Sex differences in motor skills are evident in early childhood. Boys are ahead of girls in skills that emphasize force and power. By age 5, they can jump slightly farther, run slightly faster, and throw a ball about 5 feet farther. Girls have an edge in fine motor skills and in certain gross motor skills that require a combination of good balance and foot movement, such as hopping and skipping (Fischman, Moore, & Steele, 1992; Thomas & French, 1985). Boys’ greater muscle mass and, in the case of throwing, slightly longer forearms, contribute to their skill advantages. And girls’ greater overall physical maturity may be partly responsible for their better balance and precision of movement.

From an early age, boys and girls are usually channelled into different physical activities. Fathers are more likely to play catch with their sons than with their daughters. Baseballs and footballs are purchased for boys, jump ropes and sewing materials for girls. And though differences in physical capacity remain small until adolescence, sex differences in motor skills increase as children get older. This suggests that social pressures for boys to be active and physically skilled and for girls to play quietly at fine motor activities exaggerate small, genetically based sex differences (Greendorfer, Lewko, & Rosengren, 1996). In support of this view, boys can throw a ball much farther than girls only when using their dominant hand. When they use their nondominant hand, the sex difference is minimal (Williams, Haywood, & Painter, 1996). Boys’ superior throwing largely results from practice.

Enhancing Early Childhood Motor Development

Many Western parents provide preschoolers with early training in gymnastics, tumbling, and other physical activities. These experiences offer excellent opportunities for exercise and social interaction. But aside from throwing (where direct instruction is helpful), formal lessons during the preschool years have little impact on motor development. Rather, children master the motor skills of early childhood naturally, as part of their everyday play.

Nevertheless, the physical environment in which informal play takes place can affect mastery of complex motor skills. The U.S. National Association for Sport and Physical Education (2002) recommends that preschoolers engage in at least 60 minutes, and up to several hours, of unstructured physical activity every day. When children have play spaces and equipment appropriate for running, climbing, jumping, and throwing and are encouraged to use them, they respond eagerly to these challenges. But if balls are too large and heavy to be properly grasped and thrown, or jungle gyms, ladders, and horizontal bars are suitable for only the largest and strongest children, then preschoolers cannot easily acquire new motor skills. Playgrounds must offer a range of equipment to meet the diverse needs of individual children.

Similarly, fine motor development is supported by daily routines, such as pouring juice and dressing, and play that involves puzzles, construction sets, drawing, painting, sculpting, cutting, and pasting. Exposure to artwork of their own culture and others enhances children’s awareness of the creative possibilities of artistic media. And opportunities to represent their own ideas and feelings, rather than coloring in predrawn forms, foster artistic development.

Finally, the social climate created by adults can enhance or dampen preschoolers’ motor development. When parents and teachers criticize a child’s performance, push specific motor skills, or promote a competitive attitude, they risk undermining children’s self-confidence and, in turn, their motor progress (Berk, 2006). Adult involvement in young children’s motor activities should focus on “fun” rather than on winning or perfecting the “correct” technique.
Ask Yourself

**Review** Describe typical changes in children’s drawings in early childhood, along with factors that contribute to those changes.

**Review** Explain how physical and social factors jointly contribute to sex differences in motor skills during early childhood.

**Apply** Mabel and Chad want to do everything they can to support their 3-year-old daughter’s athletic development. What advice would you give them?

**Connect** Does preschoolers’ developing skill at gripping a pencil fit with dynamic systems theory of motor development? Explain, returning to Chapter 5, page 000, if you need to review.

Summary

**Body Growth**

Describe changes in body size, proportions, and skeletal maturity during early childhood.

- Gains in body size taper off in early childhood. Body fat also declines, and children become longer and leaner. In various parts of the skeleton, new epiphyses emerge, where cartilage hardens into bone. Individual differences in body size and rate of physical growth are more apparent than in infancy and toddlerhood.

- By the end of the preschool years, children start to lose their primary teeth. Care of primary teeth is essential because diseased baby teeth can affect the health of permanent teeth. Childhood tooth decay remains common, especially among low-SES children.

**What makes physical growth an asynchronous process?**

- Body systems differ in their rates of growth. The general growth curve describes change in body size: rapid during infancy, slower in early and middle childhood, rapid again during adolescence. Exceptions to this trend include the genitals, the lymph tissue, and the brain.

**Brain Development**

Describe brain development in early childhood.

- During the preschool years, neural fibers in the brain continue to form synapses and myelinate. By this time, many cortical regions have overproduced synapses, and synaptic pruning occurs. To make room for the connective structures of active neurons, many surrounding neurons die, leading to reduced brain plasticity.

- For most children, the left hemisphere of the cerebral cortex develops ahead of the right hemisphere, supporting young children’s rapidly expanding language skills.

- Hand preference, which reflects an individual’s dominant cerebral hemisphere, strengthens during early childhood. Research on handedness supports the joint contribution of nature and nurture to brain lateralization.

- Although left-handedness is associated with developmental problems, the great majority of left-handed children have no such problems. Left- and mixed-handed youngsters are more likely to display outstanding verbal and mathematical talents.

- During early childhood, connections are established between brain structures. Fibers linking the cerebellum to the cerebral cortex grow and myelinate, enhancing motor coordination. The reticular formation, responsible for alertness and consciousness; the hippocampus, which plays a vital role in memory; and the corpus callosum, which connects the two cortical hemispheres, also form synapses and myelinate.

**Influences on Physical Growth and Health**

Explain how heredity influences physical growth.

- Heredity influences physical growth by controlling production and release of two vital hormones from the pituitary gland: growth hormone (GH), which affects the development of almost all body tissues, and thyroid-stimulating hormone (TSH), which affects brain growth and body size.
Describe the effects of emotional well-being, restful sleep, nutrition, and infectious disease on physical growth and health in early childhood.

- Emotional well-being continues to influence body growth and health in early childhood. Extreme emotional deprivation can lead to psychosocial dwarfism.

- Restful sleep contributes to body growth directly, through the release of GH during sleep, and indirectly, by contributing positively to family functioning. Bedtime routines are helpful for Western children, who—unlike children in many non-Western cultures—generally sleep alone. Most preschoolers awaken occasionally at night, and some may suffer from sleep disorders. A few experience sleepwalking or sleep terrors, which run in families, suggesting a genetic influence, but can also be triggered by stress or extreme fatigue.

- As growth rate slows, preschoolers’ appetites decline, and they often become picky eaters. Young children’s social environments powerfully influence their food preferences. Modeling by others, repeated exposure to new foods, and a positive emotional climate at mealtimes can promote healthy, varied eating in young children.

- Many children in North America and in developing countries suffer from dietary deficiencies—most commonly, a lack of sufficient protein and essential vitamins and minerals. These deficiencies are associated with attention difficulties, academic and behavior problems, and greater susceptibility to infectious diseases. Disease also contributes to malnutrition, especially when intestinal infections cause persistent diarrhea. In developing countries, inexpensive oral rehydration therapy (ORT) can prevent most developmental impairments and deaths due to diarrhea.

- Immunization 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 also contributes, as do widespread misconceptions about the dangers of immunization.

- Child-care attendance is associated with a rise in childhood illness, especially otitis media, or middle ear infection. Frequent ear infections predict delayed language progress, social isolation, and poorer academic performance after school entry—outcomes that can be prevented by high-quality child care and screening for otitis media.

What factors increase the risk of unintentional injuries, and how can childhood injuries be prevented?

- Unintentional injuries are the leading cause of childhood mortality. Injury victims are more likely to be boys; to be temperamentally irritable, inattentive, and negative; and to live in stressed, poverty-stricken, crowded family environments. Among developed nations, injury deaths are high in the United States and Canada. They are even higher in developing countries, where they may soon exceed disease as the leading cause of childhood deaths.

- Effective approaches to preventing childhood injuries include passing laws that promote child safety; creating safer home, travel, and play environments; relieving sources of family stress; improving public education; and changing parent and child behaviors.

Motor Development

Cite major milestones of gross and fine motor development in early childhood.

- During early childhood, children continue to integrate previously acquired motor skills into more complex dynamic systems of action. As the child’s center of gravity shifts toward the trunk, balance improves, paving the way for new gross motor achievements. Preschoolers’ gait becomes smooth and rhythmic; they run, jump, hop, gallop; eventually skip, throw, and catch; and generally become better coordinated.

- Increasing control of the hands and fingers leads to dramatic improvements in fine motor skills. Preschoolers gradually dress themselves and use a fork and knife.

- By age 3, children’s scribbles become pictures. As perception, language, memory, and fine motor capacities improve with age, children’s drawings increase in complexity and realism. Children’s drawings are also influenced by their culture’s artistic traditions.

- Around age 4, children’s writing shows some distinctive features of print, but only gradually do children realize that writing stands for language. Between 3 and 5 years, children experiment with pencil grip; by age 5, most use an adultlike grip that maximizes stability and writing efficiency.

- Advances in perception and exposure to written materials contribute to progress in discriminating individual letters. When parents and teachers support children’s efforts to print, preschoolers are more advanced in writing and other aspects of literacy development.

Describe individual differences in preschoolers’ motor skills and ways to enhance motor development in early childhood.

- Body build and opportunity for physical play affect early childhood motor development. Sex differences that favor boys in skills requiring force and power and girls in skills requiring good balance and fine movements are partly genetic, but social pressures exaggerate them.

- Children master the motor skills of early childhood through informal play experiences, with little benefit from exposure to formal training. Richly equipped play environments that accommodate a wide range of physical abilities are important. Emphasizing pleasure in motor activities is the best way to foster motor development during the preschool years.

Important Terms and Concepts

- cerebellum (p. 000)
- corpus callosum (p. 000)
- dominant cerebral hemisphere (p. 000)
- general growth curve (p. 000)
- growth hormone (GH) (p. 000)
- hippocampus (p. 000)
- pituitary gland (p. 000)
- psychosocial dwarfism (p. 000)
- reticular formation (p. 000)
- thyroid-stimulating hormone (TSH) (p. 000)