CHAPTER OUTLINE

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Cognitive and Linguistic Development

Practice for Your Licensure Exam: Stones Lesson

Think for a moment about your early elementary school years. What topics did you study, and what instructional strategies did your teachers use to teach them? Now think about your high school years. In what ways were the subject matter and instructional methods different from those in elementary school? Certainly many differences come to mind. For instance, in the early elementary grades you probably focused on basic knowledge and skills: learning letter-sound correspondences, reading simple prose, using correct capitalization and punctuation, adding and subtracting two-digit numbers, and so on. Your teachers probably provided a great deal of structure and guidance, giving you small, concrete tasks that would enable you to practice and eventually master certain information and procedures. By high school you were studying complex topics—biological classification systems, historical events, symbolism in literature and poetry, and so on—that were abstract and multifaceted, and your teachers put much of the burden of mastering those topics on you. Such differences reflect the fact that classroom instruction must be developmentally appropriate: It must take into account the physical, cognitive, social, and emotional characteristics and abilities that a particular age-group is likely to have.

We'll look at developmental differences in children's thinking and behavior in every chapter of this book. But the nature of child and adolescent development will be our particular focus in Chapters 2 and 3. In this chapter we'll look at general principles of development and then focus on developmental changes in thinking and reasoning (development) and in understanding and using language (linguistic development). In the process we'll address the following questions:

• What six principles can help you understand the general course of students' development through childhood and adolescence?
• In what ways do children's brains change as they grow older? What implications might such changes have for you as a teacher?
• What insights can two classic theories of cognitive development—those of Jean Piaget and Lev Vygotsky—offer about how to assess and foster children's cognitive growth?
• What language capabilities can you typically expect in students at different grade levels? How might you nurture such capabilities?
• What strategies can help you accommodate diversity in students' cognitive and linguistic development?

Case Study: Economic Activities

The students in Mr. Sand's advanced high school geography course are struggling with their reading assignments, and they readily share their frustration with their teacher.

"The textbook is really hard. I can't understand it at all!" Lucy whines.

"Same here!" Mike shouts out. "I'm really trying, Mr. Sand, but most of the time I have no idea what I'm reading." Many other students nod their heads in agreement.

"OK," Mr. Sand responds. "Let's see if we can figure out why you might be having trouble. Look at the section called 'Economic Activity' on page 55, which was part of last night's reading."

(continued)
The class peruses this excerpt from the book:

Economic activities are those in which human beings engage to acquire food and satisfy other wants. They are the most basic of all activities and are found wherever there are people. Economic activity is divided into four sections. **Primary activity** involves the direct harvesting of the earth’s resources. Fishing off the coast of Peru, pumping oil from wells in Libya, extracting iron ore from mines in Minnesota, harvesting trees for lumber in Chile, and growing wheat in China are all examples of primary production. The commodities that result from those activities acquire value from the effort required in production and from consumer demand.

The processing of commodities is classified as a **secondary activity**. In this sector items are increased in value by having their forms changed to enhance their usefulness. Thus, a primary commodity such as cotton might be processed into fabric, and that fabric might be cut and assembled as apparel. Textile manufacturing and apparel manufacturing are both secondary activities.

An economic activity in which a service is performed is classified as a **tertiary activity**. Wholesaling and retailing are tertiary activities by which primary and secondary projects are made available to consumers. Other tertiary activities include governmental, banking, educational, medical, and legal services, as well as journalism and the arts.

The service economy of the technologically most developed countries has become so large and complex that a fourth sector of **quaternary activity** is sometimes included. Institutions and corporations that provide information are in the quaternary sector. (Clawson & Fisher, 1998, p. 55)

“Tell me the kinds of problems you had when you read this passage,” Mr. Sand suggests. “Then maybe I can help you understand it better.”

The students eagerly describe their difficulties.

“I never heard of some of the words. What’s **tertiary** mean? What’s **quaternary**?”

“Yeah. And what are **commodities**?”

“There’s too much to learn. Do you expect us to memorize all of this stuff?”

“OK, I see your point,” Mr. Sand responds. “I guess this stuff can be pretty abstract. No, I don’t want you to memorize it all. What’s most important is that you get the main idea, which in this case is that different levels of economic activity build on one another. Here, let me show you what I mean. We start out with primary activities, which involve direct use of natural resources.”

Mr. Sand writes “Primary activity—using natural resources” on the chalkboard.

“Who can give me some examples of natural resources we use right here in Pennsylvania?”

“Coal,” Sam suggests.

“Milk,” Kristen adds.

“And vegetables,” Nikki says.

“Excellent examples!” Mr. Sand exclaims. “Now in secondary activities, people change those items into other things that can be used.” Mr. Sand writes “Secondary activity—changing natural resources into other products” on the board.

“Let’s identify some possible examples for this one.”

Why are the students having trouble making sense of their textbook? What characteristics of the text seem to be interfering with their understanding?

What strategies does Mr. Sand use to help the students understand the passage about economic activities?
Basic Principles of Human Development

The college-level textbook Mr. Sand has chosen for his advanced geography class is obviously a very challenging one for his high school students. As he points out, the book’s content is quite abstract—it is almost completely removed from the concrete, everyday world his students regularly encounter. The book also uses words that are not part of students’ existing vocabularies—*tertiary, quaternary, commodities*, and so on. Without further information it is difficult to know whether Mr. Sand’s choice of textbook is developmentally appropriate for the students in his class. But Mr. Sand does do a couple of things that probably are appropriate for his students’ developmental levels. First, he describes what his students need to do as they read and think about chapter content; in particular, he tells them to find the main ideas in what they are reading. Second, he shows them two things to do while studying: write down key concepts and generate new examples.

As we study various theories of cognitive and linguistic development in the pages ahead, we’ll gain additional insights into this case. But before we look at specific developmental theories, let’s consider several general principles that seem to hold true regardless of developmental domain.

- **The sequence of development is somewhat predictable.** Human development is often characterized by *developmental milestones*—new, developmentally more advanced behaviors—which appear in a predictable sequence. For example, children usually learn to walk only after they have already learned to sit up and crawl. They begin to think logically about abstract ideas only after they have learned to think logically about concrete objects and observable events. They become concerned about what other people think of them only after they realize that other people do think about them. To some extent, then, we see *universals* in development—similar patterns in how children change over time despite considerable diversity in the environments in which they grow up.

- **Children develop at different rates.** Many descriptive research studies tell us the average ages at which children reach various developmental milestones. For example, the average child can draw square and triangular shapes at age 3, starts using repetition as a way of learning information at age 7 or 8, and begins puberty at age 10 (for girls) or 11 1/2 (for boys) (McDevitt & Ormrod, 2007). But not all children reach developmental milestones at the average age. Some reach them earlier, some later. Accordingly, we are apt to see considerable variability in students’ developmental accomplishments at any single grade level.

  Determining the approximate ages at which children can perform certain behaviors and think in certain ways allows us to form general expectations about the capabilities of children at a particular age level and to design our educational curriculum and instructional strategies around such expectations. At the same time, we should never jump to conclusions about what individual students can and cannot do based on age alone.

- **Development is often marked by spurts and plateaus.** Development does not necessarily proceed at a constant rate. Instead, periods of relatively rapid growth (*spurts*) may appear between periods of slower growth (*plateaus*). For example, toddlers may speak with a limited vocabulary and one-word “sentences” for several months, yet sometime around their second birthday a virtual explosion in language use occurs, with vocabulary expanding rapidly and sentences becoming longer and longer within just a few weeks. As another

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1Puberty and other aspects of physical development during the school years are discussed in the chapter “Physical Development Across Childhood and Adolescence” in the *Study Guide and Reader* that accompanies this book.
example, during the early elementary school years, children gain an average of two or three inches in height per year. In contrast, during their adolescent growth spurt, they may grow as much as five inches per year (Berk, 2003; A. C. Harris, 1986).

Some theorists use such patterns of uneven growth and change as evidence of distinct, qualitatively different periods in development. In a stage theory, development is characterized as progressing through a predictable sequence of stages, with earlier stages typically providing the foundation for, and so being prerequisite to, later ones. You'll see examples of stage theories in our discussion of Piaget's work in this chapter and our discussions of Erikson's and Kohlberg's ideas in Chapter 3.

- **Heredity guides development to some extent.** Virtually all aspects of development are affected either directly or indirectly by a child's genetic makeup. Not all inherited characteristics appear at birth, however. Heredity continues to guide a child's growth through the process of maturation, an unfolding of genetically controlled changes as the child develops. For example, motor skills such as walking, running, and jumping develop primarily as a result of neurological development, increased strength, and increased muscular control—changes that are largely determined by inherited biological “instructions.” Furthermore, children are genetically endowed with predispositions to respond to physical and social events in certain ways—perhaps to be calm or irritable, outgoing or shy, adventuresome or cautious, cheerful or fearful. We'll look more closely at such differences in temperament in Chapter 3.

- **Environmental factors also make substantial contributions to development.** Environmental conditions even affect characteristics that are largely driven by heredity. For example, although height and body build are primarily inherited characteristics, the nutritional value of a child's food affects the specific height and body build the child ultimately acquires. And although children's behaviors are partly the result of inherited temperaments, the ways in which their environment encourages them to behave are just as influential, sometimes even more so.

Any large society (e.g., a state, province, or country) encompasses various “layers” of environment that affect children's development in one way or another (Bronfenbrenner, 1989, 2005; Bronfenbrenner & Morris, 1998). At a very basic level for most children is the family, which can potentially support development in a number of ways—for instance, by providing good nutrition, helping with homework assignments, working cooperatively with teachers to address learning and behavior problems, and so on. Surrounding the family is another layer, the neighborhood and community, which can offer additional support, perhaps in the form of preschools, after-school homework assistance programs, libraries, museums, zoos, and internships in local businesses. At a still broader level, the state (or province) and country in which children reside influence development through legislation that governs school policy, tax dollars that flow back to local schools, agencies and professional groups that offer information and training in new teaching strategies, and so on. Figure 2.1 illustrates the kinds of environmental influences that the different layers might involve.

Permeating all of the layers is a child's culture—the behaviors and belief systems that characterize the long-standing social group of which the child is a member. Culture is pervasive in many aspects of a child's environment—for instance, in the behaviors that family members encourage, the disciplinary practices parents use, the books children have access to, the television shows they watch, and so on. But culture is an inside-the-head thing as well as an out-there-in-the-world thing: It provides an overall framework by which a child comes to determine what things are normal and abnormal, true and not true, rational and irrational, good and bad (M. Cole, 2006; Shweder et al., 1998).

- **Heredity and environment interact in their effects.** Historically, many researchers sought to determine the degree to which certain human characteristics (intelligence, personality, etc.) are the result of heredity versus environment—a question they often referred to as nature versus nurture. But increasingly, psychologists have come to realize that heredity and environment interact in ways we can probably never disentangle (e.g., Gottlieb, 2000; Halpern, 2006; Kolb, Gibb, & Robinson, 2003). First and foremost, genes need environmental support in

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**stage theory** Theory that depicts development as a series of relatively discrete periods, stages.

**maturation** Unfolding of genetically controlled changes as a child develops.

**culture** Behaviors and belief systems of a long-standing social group.

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1Bronfenbrenner’s ecological systems theory, presented in an abridged form here, is described in more depth in the chapter “Ecological Systems Perspectives of Child Development” in the Study Guide and Reader that accompanies this book.
order to do their work. For instance, a child with “tall” genes can become tall only if good nutrition supports such growth. In addition, children’s inherited characteristics may lead other people to treat them in particular ways (Scarr & McCartney, 1983). For instance, a physically attractive child will be accepted more readily by peers than a less attractive one, and a temperamentally hyperactive child may be disciplined more harshly than a quieter one. Furthermore, children can choose their environments to some extent, especially as they get older, and they are apt to seek out situations that match their inherited temperaments and abilities (Scarr & McCartney, 1983).

For some characteristics and abilities, inherited predispositions may set a sensitive period, a point in development during which a growing child can be especially influenced by environmental conditions (you may also see the term critical period). As we will discover later in this chapter, some theorists have found evidence that children learn a language more easily when they are exposed to it in their early years rather than in adolescence or adulthood. Others speculate about possible sensitive periods in brain development, as we shall see in the following section.

**Role of the Brain in Learning and Development**

The human brain is an incredibly complicated organ that includes roughly one hundred billion nerve cells (Goodman & Tessier-Lavigne, 1997; Siegel, 1999). These nerve cells, known as neurons, are microscopic in size and interconnected in innumerable ways. Some neurons...
receive information from the rest of the body, others synthesize and interpret that information, and still others send messages that tell the body how to respond to its present circumstances.

Although neurons vary in shape and size, all of them have several features in common (see Figure 2.2). First, like other cells in the body, they have a cell body, which contains the cell’s nucleus and is responsible for the cell’s health and well-being. Furthermore, they have a number of branchlike structures called dendrites, which receive messages from other neurons. They also have an axon, a long, armlike structure that transmits information to other neurons. The axon may branch out many times, and the ends of its tiny branches have terminal buttons that contain certain chemical substances (more about these substances in a moment). For some (but not all) neurons, much of the axon has a white, fatty coating called a myelin sheath.

When a neuron’s dendrites are stimulated by other neurons (either those in the brain or those extending from other parts of the body), the dendrites become electrically charged. If the total charge reaches a certain level, the neuron “fires,” sending an electrical impulse along its axon to the terminal buttons. If the axon has a myelin sheath, the impulse travels quite rapidly because it leaps from one gap in the myelin to the next, almost as if it were playing leap frog. If the axon does not have a myelin sheath, the impulse travels more slowly.

Curiously, neurons don’t actually touch one another. Instead, they send chemical messages to their neighbors across tiny spaces known as synapses. When an electrical impulse moves along a neuron’s axon, it signals the terminal buttons to release chemicals known as neurotransmitters. These chemicals travel across the synapses and stimulate the dendrites or cell bodies of neighboring neurons. Any single neuron may have synaptic connections with hundreds or even thousands of other neurons (Goodman & Tessier-Lavigne, 1997; Lichtman, 2001).

Groups of neurons in different parts of the brain seem to specialize in different things. Structures in the lower and middle parts of the brain specialize in essential physiological processes (e.g., breathing, heart rate), bodily movements (e.g., walking, riding a bicycle), and basic perceptual skills (e.g., coordinating eye movements, diverting attention to potentially life-threatening stimuli). Complex, conscious thinking takes place primarily in the cortex, which rests on the top and sides of the brain like a thick, bumpy toupee (see Figure 2.3). The portion of the cortex located near the forehead, known as the prefrontal cortex, is largely responsible for a wide variety of very human activities, including sustained attention, reasoning, planning, decision making, coordination of complex activities, and inhibition of nonproductive thoughts and behaviors. Other parts of the cortex are important as well, as they are actively

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**FIGURE 2.2 Neurons and their interconnections.**

![Neurons and their interconnections](image)
involved in interpreting visual and auditory information, identifying the spatial characteristics of objects and events, and keeping track of general knowledge about the world.

With these basics in mind, let’s consider four key points about the brain’s role in learning and cognitive development:

- **Most learning probably involves changes in neurons and synapses.** Many researchers believe that the physiological basis for learning (and thus for a good deal of cognitive development) lies in changes in the interconnections among neurons. In particular, learning often involves strengthening existing synapses or forming new ones. In some instances, however, making progress actually involves eliminating synapses. Effective learning requires not only that people think and do certain things, but also that they **not** think or do other things—in other words, that they inhibit tendencies to think or behave in particular ways (Bruer & Greenough, 2001; Lichtman, 2001; Merzenich, 2001). Another phenomenon may be involved in learning as well. Until recently, it was common “knowledge” that all the neurons a person would ever have are produced in the first few weeks after conception—that is, many months before a child is born. Researchers are finding, however, that some formation of new neurons continues throughout life in the hippocampus, a small structure in the middle of the brain, and possibly also in certain areas of the cortex (Gould, Beylin, Tanapat, Reeves, & Shors, 1999; C. A. Nelson, Thomas, & de Haan, 2006; R. A. Thompson & Nelson, 2001). Neuron formation appears to be stimulated by new learning experiences, although its exact role in the learning process is still unknown.

- **Developmental changes in the brain enable increasingly complex and efficient thought.** Neurons begin to form synapses well before a child is born. But shortly after birth the rate of synapse formation increases dramatically. Neurons sprout new dendrites in many directions and come into contact with many of their neighbors, especially in the first two or three years of life. Much of this early **synaptogenesis** appears to be driven primarily by genetic programming rather than by learning experiences. Thanks to synaptogenesis, children in the elementary grades have many more synapses than adults do (Bruer, 1999; C. A. Nelson et al., 2006). Theorists speculate that by generating a large number of synapses in the early years, children have the potential to adapt to a wide variety of conditions and circumstances. As they encounter different stimuli and experiences in their daily lives, some synapses come in quite handy and are used repeatedly. Other synapses are largely useless, and these gradually fade away through a process known as **synaptic pruning**. Synaptic pruning is a good thing, not a bad one, as it eliminates “nuisance” synapses that are inconsistent with typical environmental events and behavioral patterns (Bruer & Greenough, 2001; Byrnes, 2001). In some parts of the brain, intensive synaptic pruning occurs fairly early (e.g., in the preschool or early elementary years). In other parts it begins later and extends into adolescence and beyond (Bortfeld & Whitehurst, 2001; Bruer, 1999; Huttenlocher & Dabholkar, 1997; M. H. Johnson & de Haan, 2001). But even as synaptic pruning is occurring, children and adolescents—in fact, people of all ages—continue to form new synapses in response to their experiences (R. D. Brown & Bjorklund, 1998; Fischer & Rose, 1996; O’Boyle & Gill, 1998).

Another important developmental process in the brain is **myelination**. When neurons first develop, their axons have no myelin coating. As they acquire this myelin over time, they fire much more quickly, greatly enhancing the brain’s overall efficiency. Myelination continues throughout childhood, adolescence, and early adulthood, especially in the cortex (Merzenich, 2001; Paus et al., 1999). In addition, the onset of puberty is marked by significant changes in hormone levels, which affect the continuing maturation of brain structures and possibly also affect the production and effectiveness of neurotransmitters (Eisenberg, Martin, & Fabels, 1996; Kolb et al., 2003; E. F. Walker, 2002). Theorists have speculated that such changes may have an impact on adolescents’ functioning in a variety of areas, including attention, planning, and impulse control.

- **Many parts of the brain work in harmony to enable complex thinking and behavior.** To some degree, the left and right halves, or hemispheres, of the cortex have different specialities. For most people (perhaps 80%), the left hemisphere takes primary responsibility for

| **synaptogenesis** | Universal process in early brain development in which many new synapses spontaneously appear. |
| **synaptic pruning** | Universal process in brain development in which many previously formed synapses wither away. |
| **myelination** | Growth of a fatty sheath (myelin) around the axons of neurons, enabling faster transmission of messages. |

Keep in mind that adolescents’ brains have not yet fully matured. In particular, they may have trouble with maintaining attention, planning, and controlling impulses.
language and logical thinking, whereas the right hemisphere is more dominant in visual and spatial tasks (Byrnes, 2001; Ornstein, 1997; Siegel, 1999). Yet contrary to popular belief, people rarely, if ever, think exclusively in one part of the brain or even in one hemisphere. There is no such thing as “left-brain” or “right-brain” thinking: The two hemispheres constantly collaborate in day-to-day tasks. In fact, the various parts of the brain all communicate continually with one another. In essence, learning or thinking about virtually anything tends to be distributed across many parts of the brain. A task as seemingly simple as identifying a particular word in speech or print involves numerous areas of the cortex (Bressler, 2002; Byrnes, 2001; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001).

Figure 2.4 shows a computer-generated average of brain activation patterns measured in six adults who were asked to look at various photographs of single objects (Haxby et al., 2001). The figure shows two horizontal “slices” of the brain from the perspective of someone looking at the brain from above. Although the specific activation patterns differed somewhat depending on the kind of object being viewed (e.g., faces, cats, houses, or shoes), multiple parts of both the left and right hemispheres were activated for each of the objects.

- The brain remains adaptable throughout life. Some well-meaning educators have proposed that the proliferation of synapses in the preschool and early elementary years points to a sensitive period in brain development. Accordingly, they urge us to maximize children’s educational experiences—providing reading instruction, violin lessons, art classes, and so on—during this time period. But before you, too, jump to such a conclusion, consider this point: Although adequate nutrition and everyday forms of stimulation are critical for normal brain development, there is no evidence that jam-packed, information- and skill-intensive experiences in the early years enhance brain power over the long run (Brainerd, 1999; R. A. Thompson & Nelson, 2001). Certainly, if infants don’t have normal exposure to patterns of light (e.g., if they are born with cataracts), they may soon lose the ability to see normally, and if children don’t hear spoken language until age 5, they may never acquire the language’s subtle grammatical complexities (Bialystok, 1994a; Brainerd, 1999; Levay, Wiesel, & Hubel, 1980). But seeing patterned light and hearing spoken language are normal experiences, not exceptional ones. There is no evidence to indicate that sensitive periods exist for traditional academic subjects such as reading or mathematics (Brainerd, 1999; Geary, 1998; Greenough, Black, & Wallace, 1987).

From a physiological standpoint, the brain’s ability to adapt to changing circumstances—that is, its ability to learn—continues throughout the life span (Kolb et al., 2003; C. A. Nelson et al., 2006). The early years are important for development, to be sure, but so are the later years. For most topics and skills, there is not a single “best” or “only” time to learn (R. D. Brown & Bjorklund, 1998; Brainerd, 1999; Byrnes & Fox, 1998).

Even as researchers gradually pin down how the brain works and develops, current knowledge of brain physiology doesn’t tell us very much about how best to foster students’ learning and cognitive development. For instance, brain research cannot tell us what information and skills are most important for children to acquire in a particular community and culture (L. Bloom & Tinker, 2001; D. J. Chalmers, 1996; Gardner, 2000b). Nor does it provide many clues about the instructional strategies that are most likely to promote children’s mental growth (Bandura, 2006; Byrnes, 2001; Mayer, 1998). In fact, educators who talk about “using brain research” or “brain-based learning” are, in most instances, actually talking about what psychologists have learned from studies of human behavior rather than from studies of brain anatomy and physiology.

By and large, if we want to understand the nature of human learning and cognitive development, we must look primarily at what psychologists, rather than neurologists, have discovered. Over the years psychologists have offered numerous explanations of how and why children’s thinking processes develop and change over time. Two theories—those of Jean Piaget and Lev Vygotsky—have been especially influential. These theories approach cognitive development from different angles, but each can give us considerable guidance about how best to foster students’ cognitive growth.

Piaget’s Theory of Cognitive Development

Do you think of yourself as a logical individual? Just how logical are you? Try your logical reasoning abilities in the following exercise.
You undoubtedly found the first problem ridiculously easy; there are, of course, more wooden beads than brown beads. You may have found the second problem more difficult but were probably able to conclude fairly quickly that, yes, all children must be living creatures. The third problem is a bit tricky: It follows the same line of reasoning as the second, but the conclusion it leads to—all children must be jellybeans—contradicts what is true in reality.

In the early 1920s the Swiss biologist Jean Piaget began studying children’s responses to problems similar to these. He found, for instance, that 4-year-olds often have difficulty with the beads problem—they are likely to say that there are more brown beads than wooden beads—but that 7- and 8-year-olds almost always answer the question correctly. He found, too, that 10-year-olds have an easier time with logic problems that involve real-world phenomena (such as categories and subcategories of living creatures) rather than hypothetical and contrary-to-fact ideas (such as jellybean children). Only adolescents can effectively deal with the latter kinds of problems. Through a variety of thought-provoking questions and tasks, Piaget and his research colleagues discovered a great deal about how children think and learn about the world around them (e.g., Inhelder & Piaget, 1958; Piaget, 1928, 1952, 1959, 1970, 1980).

Piaget’s Basic Assumptions

Piaget introduced a number of ideas and concepts to describe and explain the changes in logical thinking he observed in children and adolescents:

- **Children are active and motivated learners.** Piaget believed that children are naturally curious about the world and actively seek out information to help them understand and make sense of it. They continually experiment with the objects they encounter, manipulating them and observing the effects of their actions. You can see 2-year-old Maddie exhibit such curiosity and experimentation in the “Cognitive Development–Early Childhood” video clip online at the Ormrod Teacher Prep Course.

- **Children construct knowledge from their experiences.** Children don’t just amass the things they learn into a collection of isolated facts. Instead, they pull their experiences together into an integrated view of how the world operates. For example, by observing that food, toys, and other objects always fall down (never up) when released, children begin to construct a rudimentary understanding of gravity. As they interact with family pets, visit zoos, look at picture books, and so on, they develop an increasingly complex understanding of animals. Because Piaget proposed that children construct their own beliefs and understandings from their experiences, his theory is sometimes called a constructivistic theory or, more generally, constructivism.

In Piaget’s terminology the things that children learn and can do are organized as schemes—groups of similar actions or thoughts that are used repeatedly in response to the environment. Initially, schemes are largely behavioral in nature, but over time they become increasingly mental and, eventually, abstract. For example, an infant may have a putting-things-in-mouth scheme that she calls on when dealing with a variety of objects, including her thumb, cookies, and toys. A 7-year-old may have a scheme for identifying snakes that includes their long, thin bodies, their lack of legs, and their slithery nature. A 13-year-old may have a scheme for what constitutes fashion, allowing her to classify her peers as being either totally awesome or complete dorks.
assimilation. Process of dealing with a new event in a way that is consistent with an existing scheme.

accommodation. Process of dealing with a new event by either modifying an existing scheme or forming a new one.

equilibrium. State of being able to address new events with existing schemes.

disequilibrium. State of being unable to address new events with existing schemes; typically accompanied by some mental discomfort.

equilibration. Movement from equilibrium to disequilibrium and back to equilibrium, a process that promotes development of more complex thought and understandings.

Over time, children’s schemes are modified with experience and become integrated with one another. For instance, children begin to take hierarchical interrelationships into account: They learn that poodles and cocker spaniels are both dogs, that dogs and cats are both animals, and so on. A progressively more organized body of knowledge and thought processes allows children to think in increasingly complex and logical ways.

Children learn through the two complementary processes of assimilation and accommodation. Although children’s schemes change over time, the processes by which children develop them remain the same. Piaget proposed that learning and cognitive development occur as a result of two complementary processes: assimilation and accommodation. Assimilation entails dealing with an object or event in a way that is consistent with an existing scheme. For example, an infant may assimilate a new teddy bear into her putting-things-in-mouth scheme. A 7-year-old may quickly identify a new slithery object in the backyard as a snake. A 13-year-old may readily label a classmate’s clothing as being either quite fashionable or “soooo yesterday.”

But sometimes children cannot easily relate to a new object or event with existing schemes. In these situations one of two forms of accommodation occurs. Children either modify an existing scheme to account for the new object or event or else form an entirely new scheme to deal with it. For example, an infant may have to open her mouth wider than usual to accommodate a teddy bear’s fat paw. And a 13-year-old may have to revise her existing scheme of fashion according to changes in what’s hot and what’s not. But a 7-year-old may find a long, thin, slithery thing that can’t possibly be a snake because it has four legs. After some research he may develop a new scheme—salamander—for this creature.

Assimilation and accommodation typically work hand in hand as children develop their knowledge and understanding of the world. Children interpret each new event within the context of their existing knowledge (assimilation) but at the same time may modify their knowledge as a result of the new event (accommodation). Accommodation rarely happens without assimilation: Children can benefit from, or accommodate to, new experiences only when they can relate those experiences to their current knowledge and beliefs.

Interactions with one’s physical and social environments are essential for cognitive development. According to Piaget, active experimentation with the physical world is critical for cognitive growth. By exploring and manipulating physical objects—fiddling with sand and water, playing games with balls and bats, experimenting in a science lab, and so on—children learn the nature of such characteristics as volume and weight, discover principles related to force and gravity, acquire a better understanding of cause-effect relationships, and so on. Thus, Piaget’s theory leads us to conclude that discovery learning should be an important aspect of classroom instruction (we’ll look at discovery learning in Chapter 13).

In Piaget’s view, social interaction is equally important for cognitive development. Through interactions with other people—both pleasant (e.g., conversations) and unpleasant (e.g., conflicts about sharing and fair play)—young children gradually come to realize that different individuals see things differently and that their own view of the world is not necessarily a completely accurate or logical one. Elementary school children may begin to recognize logical inconsistencies in what they say and do when someone else points them out. And through discussions with peers or adults about social and political issues, high school students may modify their beliefs about how the world ideally should “be.”

The process of equilibration promotes progression toward increasingly complex thought. Piaget suggested that children are often in a state of equilibrium: They can comfortably interpret and respond to new events using existing schemes. But this equilibrium doesn’t continue indefinitely. As children grow, they sometimes encounter situations for which their current knowledge and skills are inadequate. Such situations create disequilibrium, a sort of mental discomfort that spurs them to try to make sense of what they are observing. By replacing, reorganizing, or better integrating their schemes (i.e., through accommodation), children eventually are able to understand and address previously puzzling events. The process of moving from equilibrium to disequilibrium and back to equilibrium again is known as equilibration. In Piaget’s view, equilibration and children’s intrinsic desire to achieve equilibrium promote the development of more complex levels of thought and knowledge.

As an example, let’s return to the beads problem I gave you earlier. Imagine that we show the ten wooden beads (eight brown and two white) to 4-year-old Abby and ask her,
“Are there more brown beads or more wooden beads?” Abby tells us there are more brown beads and seems quite comfortable with this response; she is in equilibrium. Apparently Abby is having trouble thinking of the brown beads as belonging to two categories (brown and wooden) at the same time and so is actually comparing the brown beads to the beads left over (the white ones). So we ask her to count the brown beads (she counts eight of them) and then to count the wooden beads (she counts ten). “So then, Abby,” we say, “there are eight brown beads and ten wooden beads. Are there more brown beads or more wooden beads?” If Abby can recognize the inconsistency in her reasoning—that eight cannot possibly be more than ten—she will experience disequilibrium. At this point she may reorganize her thinking to accommodate the idea that some beads are both brown and wooden and so should simultaneously be included in both categories.

*In part as a result of maturational changes in the brain, children think in qualitatively different ways at different ages.* Long before we knew much about how the brain changes with age, Piaget speculated that it does change in significant ways and that such changes enable more complex thought processes. He suggested that major neurological changes take place when children are about 2 years old, again when they are 6 or 7, and again around puberty. Changes at each of these times allow new abilities to emerge, such that children progress through a sequence of stages that reflect increasingly sophisticated thought. As we’ve seen, the brain does, in fact, continue to develop in childhood and adolescence, but whether such changes are specifically related to the cognitive changes Piaget described is still an open question.

**Piaget’s Stages of Cognitive Development**

An important aspect of Piaget’s theory is his description of four distinct stages of cognitive development, each with its own unique patterns of thought. Because every stage builds on the accomplishments of any preceding stages, children progress through the stages in the same, invariant sequence. The four stages are summarized in Figure 2.5. The age ranges presented in the figure are averages; some children reach a stage a bit earlier, others a bit later. Also, children are sometimes in transition from one stage to the next, displaying characteristics of two adjacent stages at the same time.

For reasons described later, many psychologists question whether cognitive development is as stage-like as Piaget proposed. Nevertheless, because Piaget’s stages provide insights into the nature of children’s thinking at different age levels, we will look at them more closely.

**Sensorimotor Stage (birth to age 2)** Imagine that we show a colorful stuffed clown to 6-month-old Karen. She reaches for it in much the same way that she reaches for her teddy bear and her stacking blocks. In other words, she has a reaching-and-grasping scheme into which she assimilates this new object. Karen then drops the clown and watches it fall to the floor, applying her letting-go and visually-following-a-moving-object schemes in the process. Now imagine that we put Karen’s clown inside a box so that she can no longer see it. Karen seems to forget the clown and turns to play with something else, acting as if she cannot think about a clown she cannot actually see.

Piaget proposed that for much of the sensorimotor stage, children focus on what they are doing and seeing at the moment; their schemes are based primarily on behaviors and perceptions. Yet important cognitive capabilities appear during this period, especially as children begin to experiment with their environments through trial and error. For example, shortly before their first birthday, children develop object permanence, the realization that objects continue to exist even when removed from view. After repeatedly observing that certain actions lead to certain consequences, children at this stage begin to develop an understanding of cause-and-effect relationships.

In the latter half of the second year, Piaget suggested, true thinking emerges. In particular, children acquire symbolic thought, an ability to represent and think about objects and events in terms of internal mental entities, or symbols. Often these symbols take the form of words that children hear around them and use in their early one-word “sentences.” At this point Karen will be able to think about a clown without having one...
preoperational stage Piaget's second stage of cognitive development, in which children can think about objects and events beyond their immediate view but do not yet reason in logical, adultlike ways.

preoperational egocentrism Inability of children in Piaget's preoperational stage to view situations from another person's perspective.

egocentric speech Act of speaking without taking the perspective and knowledge of the listener into account.

conservation Realization that if nothing is added or taken away, amount stays the same regardless of alterations in shape or arrangement.

concrete operations stage Piaget's third stage of cognitive development, in which adultlike logic appears but is limited to concrete reality.

deductive reasoning Process of drawing a logical inference about something that must be true, given other information that has already been presented as true.

Before

A

B

C

After

A

B

C

FIGURE 2.6 Conservation of liquid: Do Glasses A and C contain the same amount of water?

directly in front of her, in part because she knows the word clown. Once children acquire symbolic thought, they may “experiment” with objects in their minds, first predicting what will happen if they do something to an object and then putting their plans into action.

Preoperational Stage (age 2 until age 6 or 7) In the early part of the preoperational stage, children's language skills virtually explode, and their rapidly increasing vocabularies enable them to represent and think about a wide variety of objects and events. Language also provides the basis for a new form of social interaction—verbal communication. Children can now express their thoughts and receive information in a way that was previously not possible.

Yet preoperational thinking has some definite limitations, especially as compared to the concrete operational thinking that appears later (see Table 2.1). For example, children in this stage exhibit preoperational egocentrism, an inability to view situations from another person's perspective. They may have trouble understanding why they must share school supplies with a classmate or why they must be careful not to hurt someone else's feelings. Preoperational egocentrism sometimes manifests itself in egocentric speech, whereby children say things without taking into account what a listener is likely to know and not know about a topic.

Preoperational thinking can also be illogical (at least from an adult's point of view), especially during the preschool years. Recall 4-year-old Abby's insistence that the ten wooden beads included more brown beads than wooden beads; her reasoning reflects an inability to engage in class inclusion (see Table 2.1). And consider the following situation:

We show 5-year-old Nathan the three glasses in Figure 2.6. We ask him whether Glasses A and B contain the same amount of water, and he replies confidently that they do. We then pour the water from Glass B into Glass C and ask him whether A and C have the same amount. Nathan replies, “No, that glass [pointing to Glass A] has more because it's taller.”

Nathan's response reflects lack of conservation: He does not realize that because no water has been added or taken away, the amounts of water in the two glasses must be equivalent. Young children such as Nathan often confuse changes in appearance with changes in amount.

As children approach the later part of the preoperational stage, perhaps at around age 4 or 5, they show early signs of adultlike logic. For example, they sometimes draw correct conclusions about class inclusion problems (e.g., the wooden beads problem) and conservation problems (e.g., the water glasses problem). But they base their reasoning on hunches and intuition rather than on any conscious awareness of underlying logical principles and cannot yet explain why their conclusions are correct.

Concrete Operations Stage (age 6 or 7 until age 11 or 12) Piaget proposed that as children enter the concrete operations stage, their thought processes become organized into larger systems of mental processes—operations—that allow them to think more logically than they have previously (see Table 2.1). They now realize that their own perspectives and feelings are not necessarily shared by others and may reflect personal opinion rather than reality. They also show conservation: They readily understand that amount stays the same, despite changes in shape or arrangement, if nothing is added or taken away. (For example, see 10-year-old Kent demonstrate conservation of number in the “Cognitive Development” video clip on the Ormrod Teacher Prep Course). And they are capable of deductive reasoning: They can draw logical inferences from information they are given.

Children continue to refine their newly acquired thinking capabilities for several years. For instance, some forms of conservation, such as conservation of liquid and conservation of number, appear at age 6 or 7. Other forms don't emerge until later. Consider the problem in Figure 2.7. Using a balance scale, an adult shows a child that two balls of clay have the same weight. One ball is removed from the scale and smashed into a pancake shape. Does the pancake weigh the same as the unsmashed ball, or are the weights different? Children typically do not achieve conservation of weight—they don't realize that the flattened pancake weighs the same as the round ball it was earlier—until sometime between ages 9 and 12 (Sund, 1976).
### TABLE 2.1
**COMPARE/CONTRAST**

<table>
<thead>
<tr>
<th>Preoperational Thought</th>
<th>Concrete Operational Thought</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preoperational Egocentrism</strong></td>
<td>Students think their own perspective is the only one possible.</td>
</tr>
<tr>
<td>Example: A student tells a story without considering what prior knowledge the listener is likely to have.</td>
<td></td>
</tr>
<tr>
<td><strong>Lack of Class Inclusion</strong></td>
<td>Students can classify objects in only one Way at any given time.</td>
</tr>
<tr>
<td>Example: A student who is shown 10 wooden beads, 8 of which are brown and 2 of which are white, declares that there are more brown beads than wooden beads.</td>
<td></td>
</tr>
<tr>
<td><strong>Lack of Conservation</strong></td>
<td>Students believe that amount (e.g., number, mass) changes when a substance is reshaped or rearranged, even though nothing has been added or taken away.</td>
</tr>
<tr>
<td>Example: A student asserts that two rows of five pennies similarly spaced have equal amounts; but when one row is spread out and so is longer than the other, she says that it has more pennies.</td>
<td></td>
</tr>
<tr>
<td><strong>Irreversibility</strong></td>
<td>Students don’t recognize that certain Processes can be undone, or reversed.</td>
</tr>
<tr>
<td>Example: A student treats addition and subtraction as two unrelated processes.</td>
<td></td>
</tr>
<tr>
<td><strong>Inability to Reason About Transformations</strong></td>
<td>Students focus on static situations; they have difficulty thinking about change processes.</td>
</tr>
<tr>
<td>Example: A student refuses to believe that a caterpillar can turn into a butterfly, instead insisting that the caterpillar crawls away and the butterfly comes to replace it (K. R. Harris, 1986).</td>
<td></td>
</tr>
<tr>
<td><strong>Transductive Reasoning</strong></td>
<td>Students reason by combining unrelated facts; for instance, they infer a cause-effect relationship simply because two events occur close together in time and space.</td>
</tr>
<tr>
<td>Example: A student believes that clouds make the moon grow (Piaget, 1928).</td>
<td></td>
</tr>
<tr>
<td><strong>Differentiation of One’s Own Perspective from the Perspectives of Others</strong></td>
<td>Students recognize the others see things differently than they do and that their own ideas may be incorrect.</td>
</tr>
<tr>
<td>Example: A student seeks validation of his own thoughts (e.g., “Did I get that right?”).</td>
<td></td>
</tr>
<tr>
<td><strong>Class Inclusion</strong></td>
<td>Students realize that objects can simultaneously be members of a category and one of its subcategories.</td>
</tr>
<tr>
<td>Example: A student who is shown 10 wooden beads, 8 brown and 2 white, realizes that logically there must be more wooden beads than brown beads.</td>
<td></td>
</tr>
<tr>
<td><strong>Conservation</strong></td>
<td>Students recognize that amount stays the same if nothing has been added or taken away, even if the substance is reshaped or rearranged.</td>
</tr>
<tr>
<td>Example: A student asserts that two rows of five pennies have the same number of pennies regardless of their spacing.</td>
<td></td>
</tr>
<tr>
<td><strong>Reversibility</strong></td>
<td>Students understand that certain processes Can be reversed.</td>
</tr>
<tr>
<td>Example: A student recognizes that subtraction is the reverse of addition; for instance, she realizes that $7 - 4 = 3$ essentially undoes $3 + 4 = 7$.</td>
<td></td>
</tr>
<tr>
<td><strong>Ability to Reason About Transformations</strong></td>
<td>Students can reason about change and its effects.</td>
</tr>
<tr>
<td>Example: A student can comprehend that a caterpillar becomes a butterfly through the process of metamorphosis.</td>
<td></td>
</tr>
<tr>
<td><strong>Deductive Reasoning</strong></td>
<td>Students can draw a logical inference from two or more pieces of information.</td>
</tr>
<tr>
<td>Example: A student deduces that if all children are human beings and if all human beings are living things, then all children must be living things.</td>
<td></td>
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</tbody>
</table>

**FIGURE 2.7** Conservation of weight: Ball A and Ball B initially weigh the same. When Ball B is flattened into a pancake shape, how does its weight now compare with that of Ball A?
Concrete Operational Versus Formal Operational Thought

**Concrete Operational Thought**

| Dependence on Concrete Reality | Students can reason logically about things they can observe or easily imagine; they are unable to reason about abstract, hypothetical, or contrary-to-fact ideas.  
Example: A student has difficulty with the concept of negative numbers, wondering how something can possibly be less than zero. |
| Inability to Formulate and Test Multiple Hypotheses | When seeking an explanation for a scientific phenomenon, students identify and test only one hypothesis.  
Example: When asked what makes a pendulum swing fast or more slowly, a student says that the weight of the pendulum is the determining factor. |
| Inability to Separate and Control Variables | When attempting to confirm or disprove a particular hypothesis about cause-and-effect relationships, students change two or more variables simultaneously and so confound their possible effects.  
Example: In testing possible factors influencing a pendulum’s oscillation rate, a student adds more weight to the pendulum while at the same time also shortening the length of the pendulum. |
| Lack of Proportional Reasoning | Students do not understand the general nature of proportions.  
Example: A student cannot make sense of the procedure a teacher demonstrates for converting fractions to decimals. |

**Formal Operational Thought**

| Ability to Reason About Abstract, Hypothetical, and Contrary-to-Fact Ideas | Students can reason about things that are not tied directly to concrete, observable reality.  
Example: A student understands negative numbers and is able to use them effectively in mathematical procedures. |
| Formulation and Testing of Multiple Hypotheses | When seeking an explanation for a scientific phenomenon, students can identify and test several hypotheses about possible cause-and-effect relationships.  
Example: When asked what makes a pendulum swing fast or more slowly, a student says that weight, length, and strength of the initial push are all possible explanations. |
| Separation and Control of Variables | When attempting to confirm or disprove a particular hypothesis, students identify and test several hypotheses at a time while holding all other variables constant.  
Example: In testing factors that influence a pendulum’s oscillation rate, a student tests the effect of weight while keeping pendulum length and strength of push constant; the student then tests the effect of length while keeping weight and push constant. |
| Proportional Reasoning | Students understand proportions and can use them effectively in mathematical problem solving.  
Example: A student works easily with fractions, decimals, and ratios. |

Although students displaying concrete operational thought show many signs of logical thinking, their cognitive development is not yet complete (see Table 2.2). For instance, they have trouble understanding abstract ideas, and they struggle with problems involving multiple hypotheses or variables. Such capabilities emerge in the final stage, formal operations.

**Formal Operations Stage (age 11 or 12 through adulthood)** In the poem in Figure 2.8, 11-year-old Erin uses several abstract ideas—for instance, *war darkens the day, honor is divine*—as she laments the pointlessness of war. Children and adolescents in the formal operations stage can think about concepts that have little or no basis in concrete reality. Furthermore, they recognize that what is logically valid is different from what is true in the real world. For example, recall the earlier children-basketballs-jellybeans problem: *If* all children are basketballs and *if* all basketballs are jellybeans, then formal operational thinkers can logically conclude that all children must be jellybeans, even though in the real world children *aren’t* jellybeans. Several abilities essential for sophisticated scientific and mathematical reasoning—formulating and testing multiple hypotheses, separating and controlling variables, and proportional reasoning—also emerge in the formal operations stage (see Table 2.2).

From Piaget’s perspective, students’ capabilities in mathematics are likely to improve once formal operational thinking develops. Abstract problems, such as mathematical word problems, should become easier to solve. And students should become capable of understanding such concepts as *negative number*, *π* (**π**), and *infinity*. For instance, they should now comprehend how temperature can be below zero and how two parallel lines will never touch even if they go on forever. In addition, because they can now understand proportions, they can use fractions, decimals, and ratios when solving problems.

Scientific reasoning is also likely to improve once students are capable of formal operational thought. Three formal operational abilities—reasoning logically about
hypothesized ideas, formulating and testing hypotheses, and separating and controlling variables—together allow formal operations individuals to use a scientific method, in which several possible explanations for an observed phenomenon are proposed and tested in a systematic manner. As an example, consider the pendulum problem in the exercise that follows.

What hypotheses did you generate? Four common hypotheses are the weight of the object, the length of the string, the force with which the pendulum is pushed, and the height from which the object is first released.

Did you test each hypothesis in a systematic fashion? A student capable of formal operational thinking separates and controls variables, testing one at a time while holding all others constant (recall our discussion of this idea in Chapter 1). For example, if you were testing the hypothesis that weight makes a difference, you might have tried objects of different weights while keeping constant the length of the string, the force with which you pushed each object, and the height from which you released or pushed each one. Similarly, if you hypothesized that the length of the string was a critical factor, you might have varied the length while continuing to use the same object and setting the pendulum in motion in a consistent manner. If you carefully separated and controlled each variable, then you would have come to the correct conclusion: Only length affects a pendulum’s oscillation rate. The “Designing Experiments” video clip on the Ormrod Teacher Prep Course shows the difficulty that four seventh graders have with the pendulum problem: They repeatedly vary both length and weight until their teacher nudges them toward the realization that this approach prevents them from drawing a firm conclusion.

Because students capable of formal operational reasoning can deal with hypothetical and contrary-to-fact ideas, they can envision how the world might be different from—and possibly better than—the way it actually is. Thus, they may become quite idealistic about social, political, and ethical issues. Many adolescents begin to show concern about world problems and to devote energy to worthy causes, such as global warming, world hunger, or animal rights. However, they may offer recommendations for change that seem logical but aren’t practical in today’s world. For example, a teenager might argue that racism could disappear overnight if people would just begin to “love one another,” or that a nation should disband its armed forces and eliminate all its weaponry as a way of moving toward world peace. Piaget proposed that adolescent idealism reflects formal operational egocentrism, an inability to separate one’s own logical abstractions from the perspectives of others and from practical

Poem by Erin, age 11.

VIDEO CLASSROOM
Go to the Homework and Exercises folder in Chapter 2 of the Ormrod Teacher Prep Course to watch the “Designing Experiments” video and observe seventh graders’ difficulty with separation and control of variables.

**FIGURE 2.8** As students become increasingly able to reason about abstract, hypothetical, and contrary-to-fact ideas, they also become increasingly idealistic about how the world should be.

In the absence of other forces, an object suspended by a rope or string—a pendulum—swings at a constant rate. (A playground swing and the pendulum of a grandfather clock are two everyday examples.) Some pendulums swing back and forth rather slowly, others more quickly. What characteristics of a pendulum determine how fast it swings? Write down at least three hypotheses about the variable(s) that might affect a pendulum’s oscillation rate.

Now gather several small, heavy objects (an eraser, a metal bolt, and a fishing sinker are three possibilities) and a piece of string. Tie one of the objects to one end of the string, and set your pendulum in motion. Conduct one or more experiments to test each of your hypotheses.

What can you conclude? What variable(s) affect the rate with which a pendulum swings?
considerations. Only through experience do adolescents eventually begin to temper their optimism with some realism about what is possible in a given time frame and with limited resources.

Now that you’ve learned something about each of Piaget’s stages, put your understanding to the test in the following assessment exercise.

**Current Perspectives on Piaget’s Theory**

Perhaps Piaget’s greatest contribution to our understanding of cognitive development was the nature of the questions he asked and sought to answer about how children think and reason. Furthermore, some of his basic assumptions—for instance, that children construct their own knowledge about the world, that they must relate new experiences to what they already know, and that encountering puzzling phenomena can sometimes spur them to revise their understandings—have stood the test of time.

Piaget’s descriptions of processes that propel development—especially assimilation, accommodation, and equilibration—can be frustratingly vague, however (diSessa, 2006; Klahr, 1982). And interaction with one’s physical environment, while certainly valuable, may be less critical than Piaget believed. For instance, children with significant physical disabilities, who cannot actively experiment with physical objects, learn a great deal about the world simply by observing what happens around them (Bebko, Burke, Craven, & Sarlo, 1992; Brainerd, 2003). In contrast, social interaction—not only with peers but also with adults—is probably even more influential than Piaget realized (Callanan & Oakes, 1992; Gauvain, 2001). Lev Vygotsky’s theory, which we turn to shortly, describes the many ways in which interaction with both adults and peers can foster cognitive growth.

Piaget’s proposal that cognitive development progresses in stages has sparked a great deal of follow-up research. In general, this research supports Piaget’s proposed sequence in which different abilities emerge (Flavell, Miller, & Miller, 2002). For example, the ability to
reason about abstract ideas emerges only after children are already capable of reasoning about concrete objects and events, and the order in which various conservation tasks are mastered is much as Piaget described. But researchers question the ages at which various abilities actually appear. They are also finding that children’s logical reasoning capabilities may vary considerably depending on their experiences and knowledge about a topic. And most researchers seriously doubt that cognitive development occurs in the discrete stages that Piaget described.

Capabilities of Different Age-Groups  
Infants and preschoolers are apparently more competent than Piaget’s descriptions of the sensorimotor and preoperational stages suggest. For instance, infants show preliminary signs of object permanence as young as 21/2 months and continue to firm up this understanding over a period of many months (Baillargeon, 2004; Cohen & Cashon, 2006). And preschoolers don’t always show egocentrism: For instance, they can often identify the emotions that others are feeling, and they sometimes realize that other people don’t know what they themselves know (Lennon, Eisenberg, & Carroll, 1983; Wellman, Cross, & Watson, 2001). Also, under some circumstances preschoolers are capable of class inclusion and conservation (M. Donaldson, 1978; Gelman & Baillargeon, 1983; Rosser, 1994).

Piaget may have underestimated the capabilities of elementary school students as well. Many elementary students occasionally show some ability to think abstractly and hypothetically (S. Carey, 1985; Metz, 1995). Also, some elementary school children can separate and control variables when a task is simplified in some way (Barchfeld, Sodian, Thoermer, & Bullock, 2005; Metz, 1995; Ruffman, Perner, Olson, & Doherty, 1993). And even first and second graders have some ability to understand and use simple proportions (e.g., fractions such as 1/2, 1/3, and 1/4) if they can relate the proportions to everyday objects (Empson, 1999; Van Dooren, De Bock, Hessels, Janssens, & Verschaffel, 2005).

But Piaget probably overestimated what adolescents can do. Formal operational thinking processes emerge more gradually than Piaget suggested, and even high school students don’t use them as regularly as Piaget would have us believe (Flieller, 1999; Kuhn & Franklin, 2006; Schauble, 1996; Tourniaire & Pulos, 1985). Furthermore, students may demonstrate formal operational thought in one content domain while thinking concretely in another. Evidence of formal operational reasoning typically appears in the physical sciences earlier than in such subjects as history and geography. Students often have difficulty thinking about abstract and hypothetical ideas in history and geography until well into the high school years (Lovell, 1979; Tamburrini, 1982). Recall, for example, that in the opening case study, Mr. Sand’s high school geography students have considerable difficulty understanding an abstract college textbook.

Effects of Experience and Prior Knowledge  
Explicit training and other experiences can help youngsters acquire reasoning abilities sooner than Piaget thought was possible (Brainerd, 2003; Kuhn, 2006). For instance, children as young as age 4 or 5 begin to show conservation after having experience with conservation tasks, especially if they can actively manipulate the task materials and discuss their reasoning with someone who already exhibits conservation (Field, 1987; Halford & Andrews, 2006; Mayer, 1992). In a recent study by Siegler and Svetina (2006), 5-year-olds soon grasped class inclusion if they repeatedly heard explanations about the logic underlying it—for instance, if an adult told them that “dogs are a type of animal, so if there are some dogs and some other animals, there must be more animals than there are dogs” (p. 1003).

Experience helps youngsters acquire formal operational reasoning abilities as well. Concrete manipulatives can help children as young as 9 grasp the general nature of proportions (Fujimura, 2001). Children ages 10 and 11 can more easily solve logical problems involving hypothetical ideas if they are taught relevant problem-solving strategies, and they become increasingly able to separate and control variables with practice (Kuhn & Franklin, 2006; S. Lee, 1985; Schauble, 1990).

Furthermore, adolescents (adults, too) often apply formal operational thought to topics about which they have a great deal of knowledge and yet think concretely about topics with which they are unfamiliar (Girotto & Light, 1993; M. C. Linn, Clement, Pulos, & Sullivan, 1989; Schliemann & Carraher, 1993). As an example, consider the fishing pond
in Figure 2.9. In a study by Pulos and Linn (1981), 13-year-olds were shown a similar picture and told, “These four children go fishing every week, and one child, Herb, always catches the most fish. The other children wonder why.” If you look at the picture, it is obvious that Herb differs from the other children in several ways, including the kind of bait he uses, the length of his fishing rod, and his location by the pond. Students who were avid fishermen more effectively separated and controlled variables for this situation than they did for the pendulum problem described earlier, whereas the reverse was true for nonfishermen. In the “Cognitive Development” video clip on the Ormrod Teacher Prep Course, 10-year-old Kent and 14-year-old Alicia both look at the picture in Figure 2.9. In the excerpts that follow, notice that Kent, who has had some experience with fishing, considers several relevant variables. In contrast, Alicia, who is older but admittedly a non-fisherman, considers only two:

**Kent:** He has live . . . live worms, I think. Fish like live worms more, I guess ‘cause they’re live and they’d rather have that than the lures, plastic worms . . . . Because he might be more patient or that might be a good side of the place. Maybe since Bill has a boombox thing [referring to the radio], I don’t think they would really like that because . . . and he doesn’t really have anything that’s extra . . . . But he’s the standing one. I don’t get that. But Bill, that could scare the fish away to Herb because he’s closer . . . .

**Alicia:** Because of the spot he’s standing in, probably . . . . I don’t know anything about fishing. Oh, OK! He actually has live worms for bait. The other girl’s using saltine crackers [she misreads *crickets*]. . . . She’s using plastic worms, he’s using lures, and she’s using crackers and he’s actually using live worms. So obviously the fish like the live worms the best.

**Reconsidering Piaget’s Stages** In light of all the evidence, does it still make sense to talk about discrete stages of cognitive development? A few contemporary theorists have offered stage-based theories that may more adequately account for current findings about children’s logical thinking (e.g., Case & Okamoto, 1996; Fischer & Immordino-Yang, 2006). But most now believe that cognitive development can more accurately be described in terms of gradual trends rather than discrete stages. They further suggest that Piaget’s stages may better describe how children can think, rather than how they typically do think, and that the nature of cognitive development may be somewhat specific to different contexts, content areas, and cultures (Flavell, 1994; Halford & Andrews, 2006; Klaczynski, 2001; Rogoff, 2003). When we consider information processing theory in Chapter 6, we’ll examine some of the developmental trends these researchers have identified.

Despite the concerns I’ve raised about Piaget’s theory, the various tasks he created to assess children’s reasoning abilities (e.g., conservation, classification, separation and control of variables) can give us valuable insights into the logic students use when thinking about their world. And educators have found many of Piaget’s ideas—egocentrism, disequilibrium, the progression from concrete to abstract thought—quite useful in instructional settings. The Into the Classroom feature “Applying Piaget’s Theory” offers several suggestions for putting Piaget’s theory into practice in the classroom.

**Vygotsky’s Theory of Cognitive Development**

Lev Vygotsky conducted numerous studies of children’s thinking from the 1920s until his premature death from tuberculosis in 1934 at the age of 37. Many Western psychologists were largely unfamiliar with his work until several decades later, when his major writings were translated into English (e.g., Vygotsky, 1962, 1978, 1987, 1997).
Although Vygotsky never had the chance to develop his theory fully, his ideas have been highly influential in our views of child development, learning, and instructional practice today.

**Vygotsky’s Basic Assumptions**

As you should recall, Piaget proposed that through assimilation and accommodation, children develop increasingly advanced and integrated schemes over time. In Piaget’s view, then, children are largely in control of their own cognitive development. In contrast, Vygotsky believed that the adults in a society foster children’s cognitive development in an intentional and somewhat systematic manner. Adults continually engage children in meaningful and challenging activities and help them perform the activities successfully. Because Vygotsky emphasized the importance of society and culture in promoting cognitive growth, his theory is sometimes referred to as the **sociocultural perspective**. The following major assumptions provide a summary of this perspective:

- **Through both informal conversations and formal schooling, adults convey to children the ways in which their culture interprets and responds to the world.** Let’s return again to the opening case study. The geography textbook Mr. Sand’s class is using describes four kinds of economic activities: primary, secondary, tertiary, and quaternary. By presenting these four concepts, the text shows the students how geographers conceptualize and categorize (i.e., how they think about) economic activities. Vygotsky proposed that as adults interact with children, adults share the meanings they attach to objects, events, and, more generally, human experience. In the process they transform, or mediate, the situations that children encounter. Meanings are conveyed through a variety of mechanisms, including language (spoken words, writing, etc.), mathematical symbols, art, music, literature, and so on.

**INTO THE CLASSROOM**

**Applying Piaget’s Theory**

- Provide hands-on experiences with physical objects, especially when working with elementary school students. Allow and encourage students to explore and manipulate things.
  A kindergarten teacher and his students work with small objects (e.g., blocks, buttons, pennies) to explore such basic elements of arithmetic as conservation of number and the reversibility of addition and subtraction.
- When students show signs of egocentric thought, express confusion or explain that others think differently.
  A first grader asks, “What’s this?” about an object that is out of the teacher’s view. The teacher responds, “What’s what? I can’t see the object you’re looking at.”
- Ask students to explain their reasoning, and challenge illogical explanations.
  When learning about pendulums, cooperative groups in a seventh-grade science class conduct experiments with three variables (weight, length, and height from which the pendulum is first dropped) to see which variable(s) determine the rate at which a pendulum swings. When a student in one group asserts that weight affects oscillation rate, her teacher points out that the student’s group has simultaneously varied both weight and length in its experiments. (This example is depicted in the “Designing Experiments” clip in the Homework and Exercises folder on the Ormrod Teacher Prep Course.)

- Be sure students have certain capabilities for mathematical and scientific reasoning (e.g., conservation of number, reversibility, proportional reasoning, separation and control of variables) before requiring them to perform complex tasks that depend on these capabilities.
  In a unit on fractions in a sixth-grade math class, students express confusion about why \( \frac{2}{3}, \ \frac{4}{6}, \ \text{and} \ \frac{8}{12} \) are all equivalent. Before beginning a lesson about how to add and subtract fractions with different denominators—processes that require an understanding of such equivalencies—their teacher uses concrete objects (e.g., sliced pizza pies, plastic rods that can be broken into small segments) to help students understand how two different fractions can be equal.

- Relate abstract and hypothetical ideas to concrete objects and observable events.
  To illustrate the idea that heavy and light objects fall at the same speed, a high school science teacher has students drop objects of various weights from a second-story window.
Informal conversations are one common method through which adults pass along culturally relevant ways of interpreting situations. But even more important is formal education, through which teachers systematically impart the ideas, concepts, and terminology used in various academic disciplines (Vygotsky, 1962). Although Vygotsky, like Piaget, saw value in allowing children to make some discoveries themselves, he also saw value in having adults describe the discoveries of previous generations (Karpov & Haywood, 1998; Vygotsky, 1962).

To the extent that specific cultures pass along unique concepts, ideas, and beliefs, children of different cultural backgrounds will acquire somewhat different knowledge, skills, and ways of thinking. Thus, Vygotsky’s theory leads us to expect greater diversity among children, at least in cognitive development, than Piaget’s theory does. For example, some cultures use a wide variety of maps—road maps, maps of subway systems, shopping mall layouts—and expose children to them early and frequently, whereas other cultures rarely if ever use maps (Trawick-Smith, 2003; Whiting & Edwards, 1988).

Every culture passes along physical and cognitive tools that make daily living more productive and efficient. Not only do adults teach children specific ways of interpreting experience, but they also pass along specific tools that can help children tackle the various tasks and problems they are apt to face. Some tools (e.g., scissors, sewing machines, and computers) are physical objects. Others (e.g., writing systems, maps, and spreadsheets) involve symbols as well as physical entities. Still others (e.g., strategies for studying a textbook or mentally calculating change from a dollar) may have no physical basis at all. In Vygotsky’s view, acquiring tools that are at least partly symbolic or mental in nature—cognitive tools—greatly enhances children’s thinking abilities.

Thought and language become increasingly interdependent in the first few years of life. One very important cognitive tool is language. For us as adults, thought and language are closely interconnected. We often think by using specific words that our language provides; for example, when we think about household pets, our thoughts contain words such as dog and cat. In addition, we usually express our thoughts when we converse with others. As we sometimes put it, we speak our minds.

Vygotsky proposed that thought and language are separate functions for infants and young toddlers. In these early years, thinking occurs independently of language, and when language appears, it is first used primarily as a means of communication rather than as a mechanism of thought. But sometime around age 2, thought and language become intertwined: Children begin to express their thoughts when they speak, and they begin to think in words.

When thought and language first merge, children often talk to themselves, a phenomenon known as self-talk (also known as private speech). Recall Piaget’s notion of egocentric speech, based on his observation that young children often say things without taking into account the listener’s perspective. Vygotsky proposed that on such occasions children may be talking to themselves rather than to others. Self-talk serves an important function in cognitive development: By talking to themselves, children learn to guide and direct their own behaviors through difficult tasks and complex maneuvers in much the same way that adults may have previously guided them. Self-talk eventually evolves into inner speech, in which children “talk” to themselves mentally rather than aloud. They continue to direct themselves verbally through tasks and activities, but others can no longer see and hear them do it.

Recent research has supported Vygotsky’s views regarding the progression and role of self-talk and inner speech. The frequency of children’s audible self-talk decreases during the preschool and early elementary years, but this decrease is accompanied by an increase in whispered mumbling and silent lip movements, presumably reflecting a transition to inner speech (Bivens & Berk, 1990; Winsler & Naglieri, 2003). Furthermore, self-talk increases when children are performing more challenging tasks, at which they must exert considerable effort to be successful (Berk, 1994; Schimmoeller, 1998). As you undoubtedly know from your own experience, even adults occasionally talk to themselves when they face new challenges!
Complex mental processes begin as social activities; as children develop, they gradually internalize processes they use in social contexts and begin to use them independently. Vygotsky proposed that many complex thought processes have their roots in social interactions. As children discuss objects, events, tasks, and problems with adults and other knowledgeable individuals—often within the context of everyday activities—they gradually incorporate into their own thinking the ways in which the people around them talk about and interpret the world, and they begin to use the words, concepts, symbols, and strategies—in essence, the cognitive tools—that are typical of their culture.

Let's return once again to Mr. Sand's classroom. The textbook introduces concepts (e.g., primary, secondary, tertiary, and quaternary activities) that social scientists have developed to help them understand how various economic enterprises build on one another. When Mr. Sand discovers that students are having trouble understanding these concepts, he encourages a study strategy—relating new ideas to prior knowledge—that they can use when reading challenging textbook passages on their own in the future. (Unfortunately, he does so fairly late in the game; after his students have experienced considerable frustration with the reading assignment.)

The process through which social activities evolve into internal mental activities is called internalization. The progression from self-talk to inner speech just described illustrates this process: Over time, children internalize adults' directions so that they are eventually giving themselves the directions. Yet keep in mind that children do not necessarily internalize exactly what they see and hear in a social context. Rather, internalization often involves transforming ideas and processes to make them uniquely one's own. For instance, different students in Mr. Sand's class may interpret tertiary activity somewhat differently, and they are apt to apply the new study strategy in idiosyncratic ways.

Not all mental processes emerge as children interact with adults, however; some also develop as children interact with peers. As an example, children frequently argue with one another about a variety of matters—how best to carry out an activity, what games to play, who did what to whom, and so on. According to Vygotsky, childhood arguments help children discover that there are often several ways to view the same situation. Eventually, children can, in essence, internalize the arguing process, developing the ability to look at a situation from several different angles on their own.

Children can perform more challenging tasks when they have the assistance of someone more advanced and competent than they are. Vygotsky distinguished between two kinds of abilities that characterize children's skills at any particular point in development. A child's actual developmental level is the upper limit of tasks that he or she can perform independently, without help from anyone else. A child's level of potential development is the upper limit of tasks that he or she can perform with the assistance of a more competent individual. To get a true sense of children's cognitive development, Vygotsky suggested, we should assess their capabilities both when performing alone and when performing with assistance.

Children can typically do more difficult things in collaboration with adults than they can do on their own. For instance, as we saw in the opening case study, they can read more complex prose with the assistance of a teacher than they are likely to read independently. And notice how this student who cannot independently solve division problems with remainders begins to learn the correct procedure through an interaction with her teacher:

Teacher: 6 × 7 is 42. (Pettito, 1985, p. 251)
Teacher: What's 6 times 8? (writes 6)
Child: 48.
Teacher: 36. Can you get one that's any closer? [erasing the 6]
Child: 8.
Teacher: What's 6 times 8? (writes 6)
Child: 64 . . . 48.
Child: 6 times 7 is 42. (Pettito, 1985, p. 251)
Challenging tasks promote maximum cognitive growth. The range of tasks that children cannot yet perform independently but can perform with the help and guidance of others is, in Vygotsky's terminology, the zone of proximal development, or ZPD (see Figure 2.10). A child's zone of proximal development includes learning and problem-solving abilities that are just beginning to emerge and develop—abilities that are in an immature, embryonic form. Naturally, any child's ZPD will change over time; as some tasks are mastered, more complex ones will appear on the horizon to take their place.

Vygotsky proposed that children learn very little from performing tasks they can already do independently. Instead, they develop primarily by attempting tasks they can accomplish only with assistance and support—that is, when they attempt tasks within their zone of proximal development. In a nutshell, it is the challenges in life, not the easy successes, that promote cognitive development.

Whereas challenging tasks are beneficial, impossible tasks, which children cannot do even with considerable structure and guidance, are of no benefit whatsoever. Essentially, a child's ZPD sets an upper limit on what he or she is cognitively capable of learning.

As teachers, then, we should assign some tasks that students can accomplish successfully only with other people's support. In some instances this support must come from more skilled individuals, such as adults or older students. In other situations students of equal ability can work together to jointly accomplish difficult assignments, with each student bringing unique strengths to contribute to the overall effort. Occasionally students with different zones of proximal development need individualized tasks and assignments to give them the challenges that can optimally promote their personal cognitive growth.

Play allows children to stretch themselves cognitively: As a kindergartner, my son Jeff often played restaurant with his friend Scott. In a corner of our basement, the boys created a restaurant kitchen with a toy sink and stove and stocked it with plastic dishes, cooking utensils, and “food” items. They created a separate dining area with child-sized tables and chairs and made menus for their customers. On one occasion they invited both sets of parents to “dine” at the restaurant, taking our orders, serving us our food, and eventually giving us our bills. (Fortunately, they seemed quite happy with the few pennies we paid them for our meals.)

In their restaurant play, the two boys took on several adult roles (restaurant manager, waiter, cook) and practiced a variety of adultlike behaviors. In real life such a scenario would, of course, be impossible: Very few 5-year-old children have the cooking, reading, writing, mathematical, or organizational skills necessary to run a restaurant. Yet the element of make-believe brought these tasks within the boys’ reach. In Vygotsky’s words,

In play a child is always above his average age, above his daily behavior, in play it is as though he were a head taller than himself. (Vygotsky, 1978, p. 102)

Furthermore, as children play, their behaviors must conform to certain standards or expectations. In the early elementary school years, children often act in accordance with how a daddy, teacher, or waiter would behave. In the organized group games and sports that come later, children must follow a specific set of rules. By adhering to such restrictions on
their behavior, children learn to plan ahead, to think before they act, and to engage in self-restraint—skills critical for successful participation in the adult world.

Play, then, is hardly a waste of time. Instead, it provides a valuable training ground for the adult world, and perhaps for this reason it is seen in virtually all cultures worldwide.

**Current Perspectives on Vygotsky’s Theory**

Vygotsky’s descriptions of developmental processes were, like Piaget’s, often imprecise and lacking in detail. But in addition, Vygotsky said little about the specific characteristics that children of particular ages are likely to exhibit. For such reasons, Vygotsky’s theory has been especially difficult for researchers to test and either verify or disprove (Gauvain, 2001; Haenan, 1996; Wertsch, 1984).

Nevertheless, contemporary theorists and educators have found Vygotsky’s ideas quite insightful and helpful. First and foremost, his theory points out the many ways in which culture influences cognitive development. A society’s culture ensures that each new generation benefits from the wisdom that preceding generations have accumulated. It guides children in certain directions by encouraging them to pay attention to particular stimuli (and not to others) and to engage in particular activities (and not in others). And it provides a lens through which children come to view and interpret their experiences in culturally appropriate ways. We see obvious effects of culture in many of children’s everyday activities—in the books they read, the jokes they tell, the roles they enact in pretend play, the extracurricular activities they pursue—but we must remember that culture permeates their unobservable thinking processes as well.

The Into the Classroom feature “Applying Vygotsky’s Theory” presents concrete examples of how teachers might make use of Vygotsky’s ideas. In the next few pages, we’ll also consider several ways in which contemporary theorists and educators have built upon the foundation that Vygotsky laid, and we’ll continue to apply Vygotsky’s ideas in the chapters ahead.

**Social Construction of Meaning**

As mentioned earlier, Vygotsky proposed that adults help children attach meaning to the objects and events around them. More recently, theorists have elaborated on this idea. They point out that an adult often helps a child make sense of the world through joint discussion of a phenomenon or event they have mutually experienced (Crowley & Jacobs, 2002; Eacott, 1999; Feuerstein, 1990; John-Steiner & Mahn, 1996). Such an interaction, sometimes called a mediated learning experience, encourages the child to think about the phenomenon or event in particular ways—to attach labels to it, recognize principles that underlie it, draw certain conclusions from it, and so on.

As an example, consider the following exchange, in which a 5-year-old boy and his mother are talking about a prehistoric animal exhibit at a natural history museum:

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mom</td>
<td>He looks like a saber tooth. Do you think he eats meat or plants?</td>
</tr>
<tr>
<td>Boy</td>
<td>Mom, look at his giant little tooth, look at his teeth in his mouth, so big.</td>
</tr>
<tr>
<td>Mom</td>
<td>He looks like a saber tooth, doesn’t he. Do you think he eats plants or meat?</td>
</tr>
<tr>
<td>Boy</td>
<td>Ouch, ouch, ouch, ouch. (referring to sharp tooth)</td>
</tr>
<tr>
<td>Mom</td>
<td>Do you think he eats plants or meat?</td>
</tr>
<tr>
<td>Boy</td>
<td>Meat.</td>
</tr>
<tr>
<td>Mom</td>
<td>How come?</td>
</tr>
<tr>
<td>Boy</td>
<td>Because he has sharp teeth. (growling noises) (Ash, 2002, p. 378)</td>
</tr>
</tbody>
</table>

Even without his mother’s assistance, the boy would almost certainly have learned something about the characteristics of saber tooth tigers from his museum visit. Yet Mom has helped her son make better sense of the experience than he might have done on his own, for instance by using the label saber tooth and helping him connect tooth characteristics to eating preferences. Notice how persistent Mom is in asking her son to make the tooth-food connection. She continues to ask her question about meat versus plants until the boy finally infers, correctly, that saber tooth tigers must have been meat eaters.
In addition to co-constructing meanings with adults, children often talk among themselves to make sense of their experiences. School provides an ideal setting in which young learners can toss around ideas and perhaps reach consensus about how best to interpret and understand an issue or problem. As an example, let’s consider a discussion in Keisha Coleman’s third-grade class. The students are debating how they might solve the problem $x = \frac{2(4 \times 9)^2}{6} + 3$?. They are using a number line like the one shown here to facilitate their discussion.

An elementary physical education teacher begins a lesson on tumbling by demonstrating forward and backward rolls in slow motion and physically guiding her students through the correct movements. As the students become more skillful, she stands back from the mat and gives verbal feedback about how to improve.

A junior high school mathematics teacher gives students a mnemonic (Please excuse my dear Aunt Sally) they might repeat to themselves to help them remember the order in which they should perform various operations (parentheses, exponents, multiplication and division, addition, and subtraction).

Provide cognitive tools that students can use to make difficult tasks easier.

A high school chemistry teacher places two equal-size inflated balloons into two beakers of water, one heated to 25°C and the other heated to 50°C. The students all agree that the balloon placed in the warmer water expands more. “Now how much more did the 50-degree balloon expand?” the teacher asks. “Let’s use Charles’s law to figure it out.”

A fifth-grade teacher assigns students their first research paper, knowing that he will have to give them a great deal of guidance as they work on it.

Provide sufficient support, or scaffolding, to enable students to perform challenging tasks successfully; gradually withdraw the support as they become more proficient.

A middle school art teacher asks his students to work in groups of four or five to design large murals that depict various ecosystems—rain forest, desert, grassland, tundra, and so on—and the kinds of plant and animal species that live in each one. The groups then paint their murals on the walls in the school corridors.

Engage students in adult activities that are common in their culture.

A high school publishes a monthly school newspaper with news articles, editorials, cartoons, announcements of upcoming events, advertisements for local businesses, and classified ads. Students assume various roles, including reporters, cartoonists, marketers, editors, proofreaders, photocopiers, and distributors.

Give young children time to practice adult roles and behaviors through play.

A kindergarten teacher equips his classroom with many household items (dress-up clothes, cooking utensils, a toy telephone, etc.) so that students can play house during free-play time.

An elementary physical education teacher begins a lesson on tumbling by demonstrating forward and backward rolls in slow motion and physically guiding her students through the correct movements. As the students become more skillful, she stands back from the mat and gives verbal feedback about how to improve.

Several students, including Tessa, agree that the solution is zero but disagree about how to use the number line to arrive at that answer. Excerpts from a discussion between Tessa and her classmate Chang, facilitated by Ms. Coleman, follow:

**Tessa:** You have to count numbers to the right. If you count numbers to the right, then you couldn’t get to zero. You’d have to count to the left.

**Ms. Coleman:** Could you explain a little bit more about what you mean by that? I’m not quite sure I follow you . . . .

**Tessa:** Because if you went that way [points to the right] then it would have to be a higher number. . . .

**Chang:** I disagree with what she’s trying to say . . . . Tessa says if you’re counting right, then the number is—I don’t really understand. She said, “If you count right, then the number has to go smaller.” I don’t know what she’s talking about. Negative ten plus ten is zero. . . . What do you mean by counting to the right?
Tessa: If you count from ten up, you can't get zero. If you count from ten left, you can get zero.

Chang: Well, negative ten is a negative number—smaller than zero.

Tessa: I know.

Chang: Then why do you say you can't get to zero when you're adding to negative ten, which is smaller than zero?

Tessa: OHHHH! NOW I GET IT! This is positive. . . . You have to count right.

[Ms. Coleman]: You're saying in order to get to zero, you have to count to the right? From where, Tessa?


The class continues in its efforts to pin down precisely how to use the number line to solve the problem. Eventually, Tessa offers a revised and more complete explanation. Pointing to the appropriate location on the number line, she says, “You start at negative 10. Then you add 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.” She moves her finger one number to the right for each number she counts. She reaches the zero point on the number line when she counts “10” and concludes, “That equals zero” (P. L. Peterson, 1992, p. 168).

Notice that at no time does Ms. Coleman impose her own interpretations on either the problem itself or what Tessa and Chang have to say about it. Instead, she lets the two children struggle to make sense of the problem and, eventually, to agree on how best to solve it.

Many contemporary theorists have become convinced of the value of joint meaning-making discussions in helping children acquire more complex understandings of their physical, social, and academic worlds. We will pursue this idea, generally known as social constructivism, in more depth in Chapter 7.

Scaffolding Theorists have given considerable thought to the kinds of assistance that can help children complete challenging tasks and activities. The term scaffolding is often used when adults or other more competent individuals provide some form of guidance or structure that enables children to perform tasks in their zone of proximal development. To understand this concept, let's first think about how scaffolding is used in the construction of a new building. The scaffold is an external structure that provides support for the workers (e.g., a place where they can stand) until the building itself is strong enough to support them. As the building gains stability, the scaffold becomes less necessary and so is gradually removed.

In much the same way, an adult guiding a child through a new task may provide an initial scaffold to support the child’s early efforts. In the teacher–student dialogue about the division problem 6 \( \div \) 44 presented earlier, the teacher provided clues about how to proceed, such as searching for the multiple of 6 closest to, but still less than, 44. Following are other support mechanisms that can help students master tasks within their zone of proximal development:

- Help students develop a plan for dealing with a new task.
- Demonstrate the proper performance of the task in a way that students can easily imitate.
- Divide a complex task into several smaller, simpler tasks.
- Give specific guidelines for accomplishing the task.
- Provide a calculator, computer software (word processing program, spreadsheet, etc.), or other technology that makes some aspects of the task easier.
- Keep students’ attention focused on the relevant aspects of the task.
- Ask questions that get students thinking about the task in productive ways.
- Keep students motivated to complete the task.
- Remind students what their goals are in performing the task (e.g., what a problem solution should look like).
- Give frequent feedback about how students are progressing. (A. Collins, 2006; Hmelo-Silver, 2006; Lajoie & Derry, 1993; Lodewyk & Winne, 2005; P. F. Merrill et al., 1996; Rogoff, 1990; Rosenshine & Meister, 1992; D. Wood, Bruner, & Ross, 1976)
As students become more adept at performing a task, scaffolding is ideally modified to nurture newly emerging skills (Puntambekar & Hübscher, 2005). And over time it is gradually phased out—a process known as fading—until the students can complete the task entirely on their own.

Sometimes scaffolding involves giving students new cognitive tools they can use when performing a task. Writing is one area in which providing cognitive tools seems to make an appreciable difference in what students are capable of doing (Scardamalia & Bereiter, 1985; Zellermayer, Salomon, Globerson, & Givon, 1991). In teacher Sharon McManus's combined third- and fourth-grade classroom, students acquire a variety of tools that either directly or indirectly help them plan and focus their writing and also make their stories and essays interesting, rich in detail, and easy to understand. For instance, Ms. McManus gives her students graphic note-writing sheets that can help them brainstorm and organize ideas before they begin to write. And she provides a variety of criteria that they should consider as they evaluate early drafts. In Figure 2.11 we see the considerable improvement in writing that a boy named Kyle shows over a little more than a year's time. The upper left-hand corner of the figure

1. In September of third grade, Kyle writes only a single paragraph, with little in the way of a story line. (The last word on the first line is his version of awesome.)

2. Kyle learns how to frame his compositions using a variety of structures. Here he uses a web format to brainstorm the things he wants to say about a hockey game.

3. After writing, evaluating, and editing a first draft, Kyle writes and illustrates a final version of his narrative.

FIGURE 2.11 In writing a narrative about hockey, Kyle uses several cognitive tools, all of which revolve around essential elements of good writing. Notice how the quality of Kyle's writing improves from September of his third-grade year to December of his fourth-grade year.

The “Framing a Paper” form shown here and the three evaluation criteria presented in the text are reprinted by permission from the program Empowering Young Writers, developed and copyrighted by Frederick M. Jervis and Janis P. Williams of The Center for Constructive Change, 16 Strafford Avenue, Durham, NH 03824 (603-868-5433).
shows the typical quality of Kyle's writing when he begins third grade. By his fourth-grade year, Kyle has mastered many cognitive writing tools, and he uses one of them (the web graphic shown) to organize his thoughts about a hockey game he wants to describe. After Kyle writes his first draft, he and his teacher use several criteria to evaluate it (e.g., “uses examples and comparisons,” “uses one or more of the five senses,” “uses variety in language and sentence structure”). His teacher also evaluates and provides feedback about Kyle’s self-evaluation. Kyle’s final draft, written in December of fourth grade, is entitled “House Hockey” (see Figure 2.11).

As Ms. McManus has used this cognitive-tools approach over the past several years, she has seen many of her students internalize the tools—eventually using them without any prompting from her—and the quality of writing has improved dramatically for children of all ability levels and backgrounds. Kyle, for instance, has learning disabilities, and until his grandparents gained custody of him at age 8, he had lived an unstable, transient life with a single mother who had significant substance abuse problems.

**Guided Participation in Adult Activities**  When you were a young child, did you sometimes help a parent or older sibling bake things in the kitchen? Did the cook let you pour, measure, and mix ingredients when you were old enough to do so? Did the cook also give you directions or suggestions as you performed these tasks?

Virtually all cultures allow—and in fact usually require—children to be involved in adult activities to some degree. Children’s early experiences often occur at the fringe of an activity, and their involvement is mediated, scaffolded, and supervised through what is sometimes known as *guided participation* (Rogoff, 2003). From a Vygotskian perspective, gradual entry into adult activities enables children to engage in behaviors and thinking skills within their zone of proximal development. It also helps children tie newly acquired skills and thinking abilities to the specific contexts in which they are apt to be useful later on (more on this point in Chapter 8). As children acquire greater competence, they gradually take a more central role in a particular activity until, eventually, they are full-fledged participants (Gaskins, 1999; Guberman, 1999; Lave & Wenger, 1991).

Adultlike activities can take many forms in the classroom. For instance, we might ask students to conduct laboratory experiments, write letters to government officials, or search the Internet for specific information, while always providing the support the students need to accomplish such tasks successfully. As we engage students in these activities, we might also use some of the language that adults frequently use in such contexts. For example, when students conduct scientific experiments, we should use words such as *hypothesis*, *evidence*, and *theory* as we help them evaluate their procedures and results (Perkins, 1992).

**Apprenticeships**  An especially intensive form of guided participation is an *apprenticeship*, in which a novice works with an expert for a lengthy period to learn how to perform complex tasks within a particular domain. The expert provides considerable structure and guidance throughout the process, gradually removing scaffolding and giving the novice more responsibility as competence increases (A. Collins, 2006; Rogoff, 1990, 1991). Many cultures use apprenticeships as a way of gradually introducing children to particular skills and trades—perhaps weaving or tailoring—in the adult community (Lave & Wenger, 1991; Rogoff, 1990). Apprenticeships are also common in teaching a child how to play a musical instrument (D. J. Elliott, 1995).

Through an apprenticeship a student often learns not only how to perform a task but also how to *think about* the task—a situation known as a *cognitive apprenticeship* (J. S. Brown, Collins, & Duguid, 1989; A. Collins, 2006; Roth & Bowen, 1995). For instance, a student and a teacher might work together to accomplish a challenging task or solve a difficult problem—perhaps collecting data samples in biology fieldwork, solving a mathematical brainteaser, or translating a difficult passage from German to English. In the process of talking about various aspects of the task or problem, the teacher and the student together analyze the situation and develop the best approach to take, and the teacher models effective ways of thinking about and mentally processing the situation.
Although apprenticeships can differ widely from one context to another, they typically have some or all of these features (A. Collins, 2006; A. Collins, Brown, & Newman, 1989):

- **Modeling.** The teacher demonstrates the task while simultaneously thinking aloud about the process, and the student observes and listens.
- **Coaching.** As the student performs the task, the teacher gives frequent suggestions, hints, and feedback.
- **Scaffolding.** The teacher provides various forms of support for the student, perhaps by simplifying the task, breaking it into smaller and more manageable components, or providing less complicated equipment.
- **Articulation.** The student explains what he or she is doing and why, allowing the teacher to examine the student’s knowledge, reasoning, and problem-solving strategies.
- **Reflection.** The teacher asks the student to compare his or her performance with that of experts, or perhaps with an ideal model of how the task should be done.
- **Increasing complexity and diversity of tasks.** As the student gains greater proficiency, the teacher presents more complex, challenging, and varied tasks to be completed.
- **Exploration.** The teacher encourages the student to frame questions and problems on his or her own and thereby expand and refine acquired skills.

Because apprenticeships are clearly labor intensive, their use in the classroom is not always practical or logistically feasible (De Corte, Greer, & Verschaffel, 1996). Even so, we can certainly use elements of an apprenticeship to help students develop more complex skills. For example, prompts such as the following help students think about writing tasks in the same ways that expert writers do (Scardamalia & Bereiter, 1985):

- My main point is . . .
- An example of this is . . .
- To liven this up, I'll . . .
- I'm not being very clear about what I just said, so . . .
- This isn't very convincing because . . .
- I can tie this together by . . .

Such prompts provide the same sort of scaffolding that an expert writer might provide, and they help students develop more sophisticated writing strategies (Scardamalia & Bereiter, 1985).

**Peer Interaction**  Contemporary theorists suggest that interacting with peers plays somewhat different roles in development than interacting with adults does. Adults usually have more experience and expertise than age-mates do, and they tend to be more skillful teachers. Accordingly, adults are often the partners of choice when children are trying to master complex new tasks and procedures (Gauvain, 2001; Radziszewska & Rogoff, 1988). Yet working with peers has its own advantages, three of which we have already noted. First, by discussing various peer perspectives on a situation or problem, children can often construct a more complete understanding of a topic. Second, to the extent that their discussions involve debate and disagreement, children may internalize the arguing process and so acquire an ability to look at other situations from multiple angles. Third, children can often accomplish more difficult tasks when they work together rather than alone; in such situations they are essentially providing scaffolding for one another’s efforts. A fourth advantage is that children learn valuable social behaviors—how to plan a joint enterprise, how to coordinate differing roles, and so on—when they work on cognitive tasks with their peers (Gauvain, 2001).

Piaget and Vygotsky have each given us groundbreaking insights into the nature of children’s learning and thinking, and each of their theories has had a profound influence on contemporary views of learning, thinking, and cognitive development. Piaget’s and Vygotsky’s theories complement each other to some extent, with the former helping us understand how children often reason on their own and the latter providing ideas about how adults can help them reason more effectively.

Both Piaget and Vygotsky argued that language plays key roles in cognitive development. Piaget suggested that words help children mentally represent and think about external objects and events and that language is necessary for the social exchange of ideas that enables
children to think less egocentrically and more logically. In Vygotsky’s view, language is even more critical for cognitive growth. Children’s thought processes are internalized versions of social interactions that are largely verbal in nature. Furthermore, in their conversations with adults, children learn the meanings that their culture ascribes to particular events and gradually begin to interpret the world in cultural-specific ways. In addition, through two language-based phenomena—self-talk and inner speech—children begin to guide their own behaviors in ways that others have previously guided them.

Many contemporary theorists share Piaget’s and Vygotsky’s belief that acquiring language is an important—perhaps the most important—factor in cognitive development (e.g., K. Nelson, 1996; Premack, 2004; Spelke, 2003). We can better understand cognitive development, then, when we also know something about linguistic development.

**Linguistic Development**

For us human beings, using language effectively is a very complex endeavor. We must know thousands of words and put them together in particular ways. We must be able to articulate such vowel sounds as “ay” and “ee” and such consonants and consonant blends as “buh,” “duh,” and “struh.” To be truly effective communicators, we also must follow certain social conventions. For instance, we should respond to someone else’s greeting (e.g., “How are you?”) with a greeting of our own (e.g., “Fine, thanks, and how about you?”), and we should let a conversation partner finish a sentence before we speak.

As teachers, we need to know what linguistic knowledge and skills students of different ages are likely to have so that we can form realistic expectations for their performance. In the pages that follow, we will examine theoretical perspectives on linguistic development and look at how various aspects of language change over time. We will also consider research findings related to second-language learning and bilingualism.\(^3\)

**Theoretical Issues Regarding Linguistic Development**

Without question a child’s environment plays a significant role in linguistic development. Children can learn a language only if the people around them regularly converse in it. And the richer the language that young children hear—that is, the greater the variety of words and the greater the complexity of syntactic structures that people around them use—the faster their vocabulary develops (B. Hart & Risley, 1995; Hoff, 2003). Yet children do not simply absorb the language spoken around them. Instead, they appear to use what they hear to construct their own understanding of the language, including knowledge about what words mean, rules governing how words can be combined into meaningful sentences, and so on (Cairns, 1996; Cromer, 1993; Karmiloff-Smith, 1993). Thus, we see in language development some of the knowledge construction of which Piaget spoke.

Most developmental theorists agree that heredity is also involved in linguistic development to some degree. Human beings have the capacity to acquire a far more complex language than any other species on the planet. Exactly *ubiq* human beings inherit that enables them to learn language is a matter of considerable controversy, however. At a minimum, children inherit a few key predispositions—for instance, an interest in human voices and an ability to hear very subtle differences among speech sounds—that make language learning possible (DeCasper & Fifer, 1980; Jusczyk, 1995; Kuhl, 2004; Locke, 1993). In addition, some theorists believe that part of our genetic heritage is a language acquisition device, a language-specific learning mechanism that enables infants and toddlers to acquire many intricacies of language in an amazingly short

\(^3\)Our focus here will be on spoken language. You can learn more about the development of written language (reading and writing) in the chapter “Learning in the Content Areas” in the Study Guide and Reader that accompanies this book.
amount of time (Chomsky, 1972; Gopnik, 1997; Karmiloff-Smith, 1993; Lenneberg, 1967). Other theorists believe instead that children learn language in much the same way they learn other things about their environment and culture: through detecting and making use of regular patterns of input from their social environment (Salfran, 2003; Salfran, Aslin, & Newport, 1996).

Research evidence does point to a language-specific developmental mechanism for at least some aspects of language learning (Flavell et al., 2002; Maratsos, 1998; Siegler & Alibali, 2005; Trout, 2003). Children of all cultures learn language very quickly and acquire complex syntactic structures even when those structures are unnecessary for effective communication. In addition, children with mental retardation show marked differences in language development depending on their particular disability (N. G. S. Harris, Bellugi, Bates, Jones, & Rossen, 1997). Let's compare children with two genetically based disabilities, Down syndrome and Williams syndrome. Children with both conditions typically have IQ scores in the bottom 2 percent of their age-group. However, children with Down syndrome usually have delayed language development consistent with their cognitive development, whereas children with Williams syndrome have such good language skills that they are often initially perceived as having normal intellectual abilities. A difference in language skills between the two groups makes sense only if a language-specific mechanism guides language development somewhat independently of other aspects of cognitive development.

Another source of potential evidence is the apparent existence of sensitive periods during which children benefit most from exposure to their first language. For instance, children have an easier time mastering various verb tenses and learning how to pronounce words flawlessly when they are immersed in the language within the first five to ten years of life (Bialystok, 1994a; Bortfeld & Whitehurst, 2001; Bruer, 1999). Such sensitive periods may reflect biologically built-in time frames for learning language. Or perhaps what appear to be predetermined “best” times for learning particular aspects of language are simply the result of the brain’s tendency to adapt fairly quickly to whatever form its early auditory environment takes (Kuhl, 2004; Kuhl, Conboy, Padden, Nelson, & Pruitt, 2005).

**Trends in Linguistic Development**

The vast majority of children are consistently immersed in a language-rich environment. In such cases children begin using recognizable words sometime around their first birthday and are putting these words together by their second birthday. During the preschool years they become capable of forming longer and more complex sentences. By the time they begin school at age 5 or 6, they use language that seems adultlike in many respects. Yet their language capabilities continue to develop and mature throughout childhood and adolescence. Examples of linguistic abilities at different grade levels are shown in Table 2.3.

**Development of Vocabulary** One obvious change in students’ language during the school years is the increase in their vocabulary (see Table 2.3). Children learn some words through direct vocabulary instruction at school, but they probably learn many more by inferring meaning from the contexts in which they hear or read the words (Nippold, 1988; Pinker, 1987; Thelen & Smith, 1998).

Students’ knowledge of word meanings, known as **semantics**, is not always an all-or-none situation. Sometimes their initial understandings are vague and imprecise. One common error, undergeneralization, occurs when the meaning attached to a word is too restricted. For instance, I once asked my son Jeff, then age 6, to tell me what an animal is. He replied, “It has a head, tail, feet, paws, eyes, noses, ears, lots of hair.” Like Jeff, young elementary school children often restrict the meaning of animal primarily to mammals, such as dogs and horses, and insist that fish, birds, and insects are not animals (S. Carey, 1985; Saltz, 1971). Another common error, overgeneralization, occurs when the meaning attached to a word is too broad, so that the word is sometimes used when it doesn’t apply. For instance, when I asked...

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4For more information on characteristics associated with both syndromes, go to the National Association for Down Syndrome Web site at www.nads.org and the Williams Syndrome Association Web site at www.williams-syndrome.org.
### TABLE 2.3
Examples of Linguistic Characteristics and Abilities at Different Grade Levels

<table>
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<tr>
<th>Grade Level</th>
<th>Age-Typical Characteristics</th>
<th>Suggested Strategies</th>
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| K–2         | • Knowledge of 8,000–14,000 words by age 6  
• Difficulty understanding complex sentences (e.g., those with multiple clauses)  
• Overdependence on word order and context (instead of syntax) when interpreting messages  
• Superficial understanding of being a “good listener” (e.g., just sitting quietly)  
• Literal interpretations of messages and requests (e.g., not realizing that “Goodness, this class is noisy” means “Be quiet”)  
• Increasing ability to tell a story  
• Mastery of most sounds; some difficulty pronouncing s, th, dr, sl, and str  
• Occasional use of regular word endings (-s, -ed, -er) with irregular words (sheeps, goed, gooder)  
• Basic etiquette in conversations (e.g., taking turns, answering questions)  
• Reluctance to initiate conversations with adults (for many students from Asian and Mexican American backgrounds) | • Read age-appropriate storybooks as a way of enhancing vocabulary.  
• Give corrective feedback when students’ use of words indicates inaccurate understanding.  
• Work on listening skills (e.g., sitting quietly, paying attention, trying to understand and remember).  
• Ask follow-up questions to make sure students accurately understand important messages.  
• Ask students to construct narratives about recent events (e.g., “Tell me about your camping trip last weekend”). |
| 3–5         | • Increasing understanding of temporal words (e.g., before, after) and comparatives (e.g., bigger, as big as)  
• Occasional confusion about when to use the versus a  
• Incomplete knowledge of irregular word forms  
• Increasing awareness of when sentences are and are not grammatically correct  
• Pronunciation of all sounds in one’s language mastered by age 9  
• Sustained conversations about concrete topics  
• Increasing ability to take listeners’ prior knowledge into account during explanations  
• Construction of stories with plots and cause-and-effect relationships  
• Linguistic creativity and word play (e.g., rhymes, word games) | • Teach irregular word forms (e.g., the past tense of ring is rang, the past tense of bring is brought).  
• Begin instruction about parts of speech.  
• Use group discussions as a way to explore academic subject matter.  
• Have students develop short stories to present orally or in writing.  
• When articulation problems are evident in the upper elementary grades, consult with a speech-language pathologist.  
• Encourage jokes and rhymes that capitalize on double meanings and homonyms (i.e., sound-alike words). |
| 6–8         | • Knowledge of about 50,000 words at age 12  
• Increasing awareness of the terminology used in various academic disciplines  
• Some confusion about when to use various connectives (but, yet, although, unless)  
• Ability to understand complex, multiclause sentences  
• Emerging ability to look beyond literal interpretations; comprehension of simple proverbs and increasing ability to detect sarcasm  
• Emerging ability to carry on lengthy conversations about abstract topics  
• Significant growth in metalinguistic awareness | • Assign reading materials that introduce new vocabulary.  
• Introduce some of the terminology used by experts in various academic disciplines (e.g., simile in language arts, molecule in science).  
• Conduct structured debates to explore controversial issues.  
• Present proverbs and ask students to consider their underlying meanings.  
• Explore the nature of words and language as entities in and of themselves. |
| 9–12        | • Knowledge of about 80,000 words  
• Acquisition of many vocabulary words specifically related to various academic disciplines  
• Subtle refinements in syntax, mostly as a result of formal instruction  
• Mastery of a wide variety of connectives (e.g., although, however, nevertheless)  
• General ability to understand figurative language (e.g., metaphors, proverbs, hyperbole) | • Consistently use the terminology associated with various academic disciplines.  
• Distinguish between similar abstract words (e.g., weather vs. climate, velocity vs. acceleration).  
• Explore complex syntactic structures (e.g., multiple embedded clauses).  
• Consider the underlying meanings and messages in poetry and fiction.  
• When students have a native dialect other than Standard English, encourage them to use it in informal conversations and creative writing; encourage Standard English for more formal situations. |

Sources: Bowey, 1986; L. Bradley & Bryant, 1991; Capelli, Nakagawa, & Madden, 1990; S. Carey, 1978; Delgado-Gaitan, 1994; Karmilof-Smith, 1979; Maratos, 1998; McDevitt et al., 1990; McDevitt & Ford, 1987; Nippold, 1988; O’Grady, 1997; Owens, 1996; Reich, 1986; Sheldon, 1974; Stanovich, 2000; Swanborn & de Glopper, 1999; Thelen & Smith, 1998.
Consider students’ existing word knowledge when choosing instructional materials, but teach new words on an ongoing basis.

Provide formal instruction in grammar at all grade levels.

Check young children’s understanding of important information or instructions by asking them to restate the message in their own words.

Syntax Set of rules that one uses, often unconsciously, to put words together into sentences.

Jeff to give me examples of *insects*, he included black widow spiders in his list. Jeff overgeneralized: Because insects have six legs, eight-legged spiders do not qualify.

With age, experience, and instruction, students continue to refine their understandings of words, and many initially concrete definitions become more abstract. For example, when Jeff was 4, he defined *summer* as the time of year when school is out and it’s hot outside. But when he was in middle school, after he had developed a capacity for abstract reasoning and had studied the seasons in his science class, he was able to define summer in terms of the earth’s tilt relative to the sun—a far more abstract notion.

To some extent, we must, of course, tailor lessons and reading materials to students’ vocabulary. Yet we should not restrict instruction only to words that students already know. One way to promote students’ semantic development is to teach vocabulary words and definitions directly, for instance, by having students define new vocabulary in their own words and use new terms in a variety of contexts. We should also correct any misconceptions (e.g., under- or overgeneralizations) that reveal themselves in students’ speech. And we must encourage students to *read, read, read*: Children and adolescents learn many new words through their reading activities (Stanovich, 2000; Swanborn & de Glopper, 1999). We’ll identify additional strategies for teaching word meanings in our discussion of concept learning in Chapter 7.

**Development of Syntax** Rules of *syntax* allow us to put words together into grammatically correct sentences. These rules are incredibly complex, but for the most part we aren’t even aware of them (Chomsky, 1972; N. C. Ellis, 1994). By the time children begin school, they have already acquired many syntactic rules. Their understanding and use of complex constructions (e.g., passive sentences, sentences with multiple clauses) continue to evolve throughout the elementary years, and even more subtle aspects of syntax appear in the middle school and high school grades (see Table 2.3). By sixth or seventh grade, students use more complex syntax in their writing than in their speech (Owens, 1996).

In the later grades most syntactical development probably occurs as the result of formal language instruction—perhaps courses in language arts, English composition, and foreign language (Maratos, 1998). Thus, we should continue instruction and practice in grammar and composition throughout the high school years. Students are more likely to improve their speech and writing when they have ample opportunities to express their ideas orally and on paper and when they receive direct feedback about ambiguities and grammatical errors in their speech and writing.

**Development of Listening Comprehension** Students’ ability to comprehend what they hear is obviously influenced by their knowledge of vocabulary and syntax, but other factors contribute as well. For instance, children’s conceptions of what listening comprehension is seem to change during the elementary school years. Children in the early elementary grades believe they are good listeners if they simply sit quietly without interrupting the teacher. Not until about age 11 do they realize that good listening also requires *understanding* what is said (McDevitt, Spivey, Sheehan, Lennon, & Story, 1990). In addition, elementary school children differ in their beliefs about what to do when they don’t understand something the teacher says. Many children, younger ones especially, apparently believe it is inappropriate to ask for clarification, perhaps because they have previously been discouraged from asking questions at school or at home (McDevitt, 1990; McDevitt et al., 1990). Such a belief is especially common when children’s cultures have taught them that initiating conversation with an adult is disrespectful, as is true in many Asian and Mexican American communities (Delgado-Gaitan, 1994; Grant & Gomez, 2001).

Young children’s comprehension of what they hear is often influenced by the context in which they hear it. Using various nonverbal contextual clues, they may recognize that what is said in a situation is different from what is actually meant. For example, they may realize that a teacher who asks, “Whose jacket is lying on the floor?” is actually requesting the jacket’s owner to pick it up and put it where it belongs. Unfortunately, younger children are sometimes so dependent on context that they don’t listen carefully enough to understand a spoken message accurately. They may hear what they *think* we mean, based on their beliefs about our intentions, rather than hearing what we really do mean (Donaldson, 1978). It is important, then, not only to ask students whether they understand what they hear but also to check their understanding by asking them to rephrase a message in their own words.
As children get older, they become less dependent on context to understand other people’s messages. And with their increasing capacity for abstract thought, they become better able to look beyond the literal meanings of messages (Owens, 1996; Winner, 1988). In contrast, children in the early elementary grades take the words they hear at face value—for instance, interpreting the expression “Your eyes are bigger than your stomach” quite literally (see Figure 2.12). And they have little success drawing generalizations from such proverbs as “Look before you leap” or “Don’t put the cart before the horse.” In the “Cognitive Development” video clip on the Ormrod Teacher Prep Course, you can observe how children’s ability to understand proverbs improves with age. Whereas 10-year-old Kent seems baffled by the old adage “A rolling stone gathers no moss,” 14-year-old Alicia can offer a reasonable explanation: “Maybe when you go through things too fast, you don’t . . . collect anything from it.” Students’ ability to interpret proverbs in a generalized, abstract fashion continues to develop even in the high school years (Owens, 1996).

**Development of Oral Communication Skills** During the preschool and early elementary years, many children have difficulty pronouncing sounds such as s and th (see Table 2.3). By age 8 or 9, most students master the sounds of English. If pronunciation difficulties continue after this time, consultation with the school’s speech pathologist about remediation strategies is probably in order.

However, correct pronunciation is not the only thing students need in order to communicate effectively. They must also consider the characteristics of the people receiving their messages (e.g., age, prior knowledge, perspectives). As noted earlier, young children sometimes say things without really considering the listener’s point of view (Piaget called this egocentric speech). Even students in the upper elementary grades sometimes neglect to take into account what prior information their listeners are apt to have (Glucksberg & Krauss, 1967; McDevitt & Ford, 1987). As teachers, we must let students know when we don’t understand them—for instance, by asking them to explain whom they are talking about when they refer to people we don’t know and by expressing confusion when they describe events and ideas ambiguously.

Another component of effective oral communication is **pragmatics**, the social conventions governing appropriate verbal interactions with others. Pragmatics include not only rules of etiquette—taking turns when conversing with others, saying goodbye when leaving, and so on—but also strategies for beginning and ending conversations, changing the subject, telling stories, and arguing effectively. Children continue to refine their knowledge of pragmatics throughout the elementary grades (Owens, 1996). My own observation has been that this process continues into the middle and high school years, often even longer. When students haven’t mastered certain social conventions—for instance, when they interrupt frequently or change the subject without warning—others may find their behavior irritating or strange. A lack of pragmatic skills, then, can seriously interfere with students’ relationships with peers. Thus, it is important to observe students’ pragmatic skills as they interact both with us and with their classmates and to give students guided practice in any skills they may not have mastered.

**Development of Metalinguistic Awareness** Throughout the school years, students sometimes play with language by reciting rhymes, chants, jokes, puns, and so on (Christie & Johnsen, 1983; Owens, 1996). Such wordplay is almost certainly beneficial. For instance, rhymes help students discover the relationships between sounds and letters, and jokes and puns help students understand that words and phrases often have more than one meaning (L. Bradley & Bryant, 1991; Cazden, 1976). In the latter case students are developing **metalinguistic awareness**: the ability to think about the nature of language itself.

Metalinguistic awareness seems to emerge slowly over time. During the elementary years, students gradually become capable of determining when sentences are grammatically acceptable and when they are not (Bowey, 1986). As they move into the upper elementary and middle school grades, they become increasingly aware of the various functions of words in a sentence (nouns, verbs, adjectives, etc.), in large part as a result of formal instruction about parts of speech. High school students enhance their metalinguistic awareness still further as they consider the figurative nature of words—the nonliteral meanings of proverbs, the symbolism in
Learning a Second Language

As the adult workplace becomes increasingly international in scope, the need is greater than ever for children to learn one or more languages in addition to their native tongue. As noted previously, there may be a sensitive period for learning language, thus making exposure to language in early childhood very important. But not all theorists are convinced that an early sensitive period exists for learning a second language (for diverse perspectives, see Hakuta, Bialystok, & Wiley, 2003; Merzenich, 2001; C. A. Nelson et al., 2006; Stevens, 2004). In general, early exposure to a second language appears to be important for mastering correct pronunciation, especially if the language is very different from a child’s native tongue, and perhaps also for mastering complex grammatical constructions (T. K. Au, Knightly, Jun, & Oh, 2002; Bialystok, 1994a, 1994b; Neville & Bavelier, 2001). Aside from such possible limitations, however, children and adolescents can probably acquire fluency in a second language regardless of when they begin instruction.

Although there may be no hard-and-fast sensitive period for learning a second language, beginning second-language instruction in the early years has definite advantages. For one thing, it appears that learning a second language facilitates achievement in such other academic areas as reading, vocabulary, and grammar (Diaz, 1983; Reich, 1986). Instruction in a foreign language also sensitizes young children to the international and multicultural nature of the world. Students who learn a second language during the elementary school years express more positive attitudes toward people who speak that language and are more likely to enroll in foreign language classes in high school (Reich, 1986).

Bilingualism At least half of the world’s children are bilingual; that is, they speak two (sometimes three or more) languages fluently (Hoff-Ginsberg, 1997). Some bilingual children have been reared in families in which two languages are spoken regularly. Others have lived for a time in a community where one language is spoken and then have moved to a community where a different language is spoken. Still others live in a bilingual society—for example, in Canada (where both English and French are spoken), in Wales (where both English and Welsh are spoken), or in certain ethnic communities in the United States (where a language such as Spanish or Chinese is spoken along with English). Bilingualism does not necessarily involve two spoken languages, however. For example, in the “Teacher Use of Sign Language” video clip on the Ormrod Teacher Prep Course, one language is English, and the other is American Sign Language.

Research reveals clear advantages to being bilingual. Bilingual children appear to have a head start in their development of metalinguistic awareness (Bialystok, 2001; Diaz & Klingler, 1991; Garcia, 1994; C. E. Moran & Hakuta, 1995). For instance, in the early elementary grades, bilingual children have greater phonological awareness—that is, awareness of the individual sounds, or phonemes, that make up spoken words—and such awareness may get them off to an especially good start in learning to read (X. Chen, Anderson, et al., 2004; Rayner et al., 2001). And when children are truly fluent in both languages, they tend to perform better in situations requiring advanced cognitive functioning—for instance, on intelligence tests and on tasks requiring creativity (Bialystok & Senman, 2004; Diaz & Klingler, 1991; E. E. Garcia, 1994; C. E. Moran & Hakuta, 1995).

Being bilingual can have cultural and personal advantages as well. In any English-speaking country, mastery of spoken and written English is, of course, essential for long-term educational and professional success. But when a resident of that country belongs to a cultural group that speaks a different language, maintaining social relationships within the culture
requires knowledge of its language (McBrien, 2005). For instance, in many Native American groups, the ancestral language is important for communicating oral history and cultural heritage and for conducting local business (McCarty & Watahomigie, 1998). And Puerto Rican children in the United States often speak Spanish at home as a way of showing respect to their elders (Torres-Guzmán, 1998).

Bilingualism has additional social benefits in the classroom. In cases where different students speak only one of two different languages (perhaps some speaking only English and others speaking only Spanish), teaching students both languages increases student interaction and cross-cultural understanding (A. Doyle, 1982; Padilla, 2006).

Promoting bilingualism. It appears that the best approach to teaching a second language depends on the circumstances. For English-speaking students learning a second language while still living in their native country, total immersion in the second language—hearing and speaking it almost exclusively within the classroom—is the method of choice. Total immersion helps students become proficient in a second language relatively quickly, and any adverse effects on students’ achievement in other areas of the curriculum appear to be short-lived (Collier, 1992; Cummins, 2004; Cunningham & Graham, 2000; Krashen, 1996).

In contrast, for non-English-speaking students who have recently immigrated to an English-speaking country, total immersion in English may actually be detrimental to their academic progress. For these students, bilingual education—instruction in academic subject areas in students’ native language while simultaneously teaching them to speak and write in English—leads to higher academic achievement, greater self-esteem, and a better attitude toward school (Marsh, Hau, & Kong, 2002; C. E. Snow, 1990; S. C. Wright, Taylor, & Macarthur, 2000).

Why does immersion work better for some students while bilingual education is better for others? Remember that language provides an important foundation for cognitive development: It offers symbols for mentally representing the world, enables children to exchange ideas with others, helps them internalize sophisticated cognitive strategies, and so on. Students in an English-speaking country who are immersed in a different language at school still have many opportunities—at home, with their friends, and in the local community—to continue using and developing their English. In contrast, non-native English speakers may have few opportunities outside their homes to use their native language. If they are taught exclusively in English, they may very well lose proficiency in their native language before developing adequate proficiency in English, and their cognitive development will suffer in the process. In such cases bilingual education, which is designed to foster growth in both languages, is more likely to promote cognitive as well as linguistic growth (Pérez, 1998; Winsler, Díaz, Espinosa, & Rodriguez, 1999; S. C. Wright et al., 2000).

Given the many advantages of second-language learning and bilingualism, we should think seriously about promoting bilingualism in all students. Doing so would not only promote students’ cognitive and linguistic development but also enhance communication, interaction, and interpersonal understanding among students with diverse linguistic and cultural backgrounds.

**Diversity in Cognitive and Linguistic Development**

Although the order in which various cognitive and linguistic abilities emerge tends to be fairly predictable, the rate at which they emerge is different for every child. Thus, we are apt to find considerable diversity in any particular age-group. For example, from the perspective of Piaget’s theory, we may see signs of both preoperational and concrete operational thinking in the primary grades, as well as evidence of both concrete and formal operational thinking at the middle school and high school levels. From Vygotsky’s point of view, we will inevitably have students with different zones of proximal development: Tasks that are easy for some students may be quite challenging for others. We will also find diversity in students’ language capabilities—for instance, in the size of their vocabularies—in part as the result of their prior exposure to various words through storybook reading, trips to museums, and so on (e.g., Hoff, 2003; Raikes et al., 2006).
As teachers we must continually be aware of the specific cognitive and linguistic abilities that individual students do and do not have and then tailor instruction accordingly. Three groups of students are especially worthy of note here: members of minority cultural groups, English language learners, and students with special educational needs.

**Considering Cultural and Ethnic Differences**

In his early writings, Piaget suggested that his stages were universal—that they applied to children and adolescents throughout the world—but research indicates that the course of cognitive development differs somewhat from one culture to another. For example, Mexican children whose families make pottery for a living acquire conservation skills much earlier than Piaget proposed (Price-Williams, Gordon, & Ramirez, 1969). Apparently, making pottery requires children to make frequent judgments about needed quantities of clay and water—judgments that must be fairly accurate regardless of the specific shape or form of the clay or water container. In other cultures, especially in some in which children don't attend school, conservation and other concrete operational abilities may appear several years later than they do in Western societies (Artman & Cahan, 1993; Fahrmeier, 1978).

Formal operational reasoning skills—abstract thought, separating and controlling variables, and so on—vary from culture to culture as well (Flieller, 1999; Rogoff, 2003). Mainstream Western culture actively nurtures these skills through formal instruction in such academic content domains as science, mathematics, literature, and social studies. In other cultures, however, such skills may have little relevance to people's daily lives and activities (M. Cole, 1990; J. G. Miller, 1997).

Different cultures also pass along different cognitive tools. For instance, children are more likely to acquire map-reading skills if maps (perhaps of roads, subway systems, and shopping malls) are a prominent part of their community and family life (Trawick-Smith, 2003; Whiting & Edwards, 1988). And they are more apt to have a keen sense of time if cultural activities are tightly regulated by clocks and calendars (K. Nelson, 1996).

Cultural differences partly account for diversity in language development, too, even among children who have been reared by English-speaking families. Some children may express themselves using a dialect—a distinct form of English characteristic of a particular ethnic group or geographic region. And youngsters are likely to have acquired various social conventions about human interaction and dialogue (i.e., various pragmatic skills) from their families and ethnic groups. We'll look more closely at such differences in Chapter 4.

Occasionally a culture or ethnic group specifically nurtures certain aspects of language development. For example, many inner-city African American communities make heavy use of figurative language—such as similes, metaphors, and hyperbole (intentional exaggeration)—in their day-to-day conversations, jokes, and stories (Hale-Benson, 1986; Ortony, Turner, and Larson-Shapiro, 1985; H. L. Smith, 1998). The following anecdote illustrates this point:

> I once asked my mother, upon her arrival from church, "Mom, was it a good sermon?" To which she replied, "Son, by the time the minister finished preaching, the men were crying and the women had passed out on the floor." (H. L. Smith, 1998, p. 202)

With such a rich oral tradition, it is not surprising that inner-city African American youth are especially advanced in their ability to comprehend figurative language (Ortony et al., 1985).

**Addressing the Unique Needs of English Language Learners**

Although federal immigration policies continue to be a source of considerable controversy, the fact is that most Western countries welcome large numbers of immigrant families every year. Many of these families bring children who enroll in school knowing very little English. Not only must these students learn a new language, but they must also tackle a new school curriculum for which they may not have an adequate academic background (Krashen, 1996; McKeon, 1994).

As we've seen, bilingual education programs—those in which English is taught as a second language while school subject matter is taught in students' first language—are typically
more effective than immersion programs for these children. Ideally, the transition from instruction in a student’s native language to instruction in English should occur very gradually over a period of several years, enabling the student to gain proficiency in both languages (Padilla, 2006). Simple knowledge of basic conversational English is not enough for success in an English-only curriculum, however. Ultimately, students must have sufficient mastery of English vocabulary and grammar that they can readily understand and learn from English-based textbooks and lectures, and such mastery takes considerable time to achieve—often five to seven years (Cummins, 1981, 1984, 2000).

We must remember that students’ native languages are very much a part of their sense of identity—their sense of who they are as people (Nieto, 1995a; Tatum, 1997). A high school student named Marisol made the point this way:

“I’m proud of being Puerto Rican. I guess I speak Spanish whenever I can... I used to have a lot of problems with one of my teachers ‘cause she didn’t want us to talk Spanish in class and I thought that was like an insult to us, you know? (Nieto, 1995a, p. 127)

Incorporating children’s culture as well as their native language into the classroom curriculum can further promote their academic success (Igoa, 1995; U.S. Dept. of Education, 1993). The strategies in the Into the Classroom feature “Working with English Language Learners” take language, sense of identity, and culture into account.

Accommodating Students with Special Needs

We are especially likely to see differences in cognitive and linguistic development in students who have special educational needs. For instance, we may have a few students who show especially advanced cognitive development and other students whose cognitive abilities—either in specific areas or across the board—are well below those of their peers. In addition, we may have students who display impairments in speech or other aspects of language development that significantly interfere with their classroom performance.

Table 2.4 presents specific characteristics related to cognitive and linguistic development that we may see in students with a variety of special needs. It also presents strategies for helping such students achieve academic success.
**Cognitive and Linguistic Development in Students with Special Educational Needs**

<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics You Might Observe</th>
<th>Suggested Classroom Strategies</th>
</tr>
</thead>
</table>
| Students with specific cognitive or academic difficulties | • Possible difficulties with abstract reasoning  
• Delays in internalization of self-talk (for some students with attention-deficit hyperactivity disorder)  
• Difficulties in listening comprehension  
• Difficulties in oral communication (e.g., with syntax) | • Use concrete objects and experiences to help students understand abstract ideas.  
• Encourage students to use self-talk to help themselves handle challenging situations.  
• Seek assistance from a speech pathologist when students have unusual difficulties with listening comprehension or spoken language. |
| Students with social or behavioral problems | • Uneven performance on cognitive tasks (for some students with autism)  
• Delayed language development (for some students with autism)  
• Difficulty understanding figurative language and sarcasm (for most students with autism) | • Provide intensive instruction and practice for any delayed cognitive or linguistic skills. (Also use strategies identified for students with specific cognitive or academic difficulties.) |
| Students with general delays in cognitive and social functioning | • Reasoning abilities characteristic of younger children (e.g., preoperational thought in the upper elementary grades, inability to think abstractly in the secondary grades)  
• Delayed language development (e.g., delays in vocabulary, listening comprehension) | • Present new information in a concrete, hands-on fashion.  
• Give instructions in concrete and specific terms. |
| Students with physical or sensory challenges | • Possible cognitive or language deficiencies or both (if brain damage is present)  
• Possible delays in language development in children who have sensory impairments (e.g., children who are blind cannot see what others are talking about, and children with hearing loss may have had only limited exposure to sign language)  
• Difficulties with articulation (if students have limited muscular control or are congenitally deaf) | • Identify any specific cognitive and language deficiencies, and adjust instruction and assessment practices accordingly.  
• Provide intensive instruction in the cognitive and language skills that students are lacking. |
| Students with advanced cognitive development | • Appearance of formal operational thinking (e.g., abstract thought) at an earlier age  
• Tendency for many regular classroom tasks to be below students’ zone of proximal development  
• Advanced vocabulary  
• More sophisticated language structures in speech | • Provide opportunities for students to explore classroom topics in greater depth or complexity.  
• Provide opportunities for students to proceed through the curriculum at a more rapid pace. |


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**The Big Picture**

Even though our explorations of brain development, Piaget’s and Vygotsky’s theories, and linguistic development have taken us in a variety of directions, several common themes have repeatedly appeared in one form or another:

- **Children actively construct, rather than passively absorb, their knowledge.** Piaget described cognitive development as a process of constructing one’s own unique understandings of the world. Vygotsky and his followers have suggested that children and adults often work together to make sense of and find meaning in events. Constructive processes appear to be important in language development as well—for instance, in acquiring word meanings and syntactical rules. We’ll pursue the process of knowledge construction further in Chapter 7.

- **With age children become capable of increasingly complex thought.** Both Piaget and Vygotsky suggested that children acquire many new cognitive abilities as they grow older. Piaget described such development in terms of four qualitatively different stages, whereas Vygotsky theorized that children internalize many of the processes they initially use in social interactions. Regardless of which theorist’s perspective we take, we may reasonably speculate that developmental changes in the brain—synaptic pruning, increasing myelination of neurons, hormonal changes after puberty, and so on—provide increasingly sophisticated mental “hardware” that enables many new cognitive acquisitions over time.
■ **Language provides a foundation for many cognitive advancements.** Words provide the basis for much of the symbolic thought about which Piaget spoke. And many words and phrases specific to various academic disciplines—for example, *square root, atom, tertiary activities*—become cognitive tools that, in Vygotsky’s view, help children take advantage of and build on the accumulating wisdom of previous generations.

Language also propels cognitive development in a very different way: It enables children to exchange ideas with adults and peers. In Piaget’s view, the people in a child’s life can present information and arguments that create disequilibrium and foster greater perspective taking. In Vygotsky’s view, internalization of complex thought processes comes only after children first use such processes in their verbal interactions with others.

■ **Challenging situations and tasks promote development.** The importance of challenge is most evident in Vygotsky’s concept of the *zone of proximal development*: Children benefit most from tasks they can perform only with the assistance of more competent individuals. However, challenge—albeit of a somewhat different sort—also lies at the heart of Piaget’s theory: Children develop more sophisticated knowledge and thought processes only when they encounter phenomena they cannot adequately understand using their existing schemes—in other words, phenomena that create *disequilibrium*.

We must not take this idea of challenge too far, though. As we noted in our earlier discussion of brain development, bombarding children with a great deal of information every day is unlikely to nurture their cognitive development any more than a reasonably stimulating but otherwise normal learning environment. Furthermore, asking children to tackle one challenge after another throughout the school day can be unsettling and, especially if children meet with frequent frustration and failure, can adversely affect their self-esteem. We’ll look at self-esteem and more generally at the development of children’s *sense of self* in the next chapter.

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**Practice for Your Licensure Exam: Stones Lesson**

Ms. Hennessey is conducting a demonstration in her first-grade class. She shows the children a large glass tank filled with water. She also shows them two stones. One stone, a piece of granite, is fairly small (about 2 cm in diameter). The other stone, a piece of pumice (i.e., cooled volcanic lava), is much bigger (about 10 cm in diameter). Because Ms. Hennessey does not allow the children to touch or hold the stones, they have no way of knowing that the piece of pumice, which has many small air pockets in it, is much lighter than the piece of granite. The demonstration proceeds as follows:

**Ms. H.:** Would anyone like to predict what he or she thinks will happen to these stones? Yes, Brianna.

**Brianna:** I think the . . . both stones will sink because I know stones sink. I’ve seen lots of stones sink and every time I throw a rock into the water, like it always sinks, yeah, it always does.

(continued)
Ms. H.: You look like you want to say something else.

Brianna: Yeah the water can’t hold up rocks like it holds up boats and I know they’ll sink.

Ms. H.: You sound so sure, let me try another object.

Brianna: No you gotta throw it in, you gotta test my idea first. [Ms. H places the smaller stone in the tank; it sinks.] See, I told you I knew it would sink. [Ms. H. puts the larger, pumice stone down and picks up another object.] No you’ve gotta test the big one too because if the little one sunk the big one’s gotta sunk. [Ms. H places the pumice stone in the tank; it floats.] No! No! That’s not right! That doesn’t go with my mind [Brianna grabs hold of her head], it just doesn’t go with my mind.

(M. G. Hennessey, 2003, pp. 120–121)

1. Constructed-response question:

Brianna is noticeably surprised, maybe even a little upset, when she sees the pumice stone float.

A. Use one or more concepts from Jean Piaget’s theory of cognitive development to explain why Brianna reacts as strongly as she does to the floating pumice.

B. Again drawing on Piaget’s theory, explain why Ms. Hennessey intentionally presents a phenomenon that will surprise the children.

2. Multiple-choice question:

Imagine that you perform the same demonstration with high school students rather than first graders. If you were to follow Lev Vygotsky’s theory of cognitive development, which one of the following approaches would you take in helping the students understand the floating pumice?

a. Before performing the demonstration, ask students to draw a picture of the tank and two stones.

b. Drop several light objects (e.g., a feather, a piece of paper, a small sponge) into the tank before dropping either stone into it.

c. Teach the concept of density, and explain that an object’s average density relative to water determines whether it floats or sinks.

d. Praise students who correctly predict that the larger stone will float, even if they initially give an incorrect explanation about why it will float.

Once you have answered these questions, compare your responses with those presented in Appendix B.
For Further Reading 61

RESEARCH RESOURCES

You can find many articles from the journal Educational Leadership in the Articles and Readings component of the Teacher Preparation Classroom. You can access the Teacher Preparation Classroom from the Ormrod Teacher Prep Course at http://www.prenhall.com/ormrod. The following articles, located in Educational Psychology, Module 1, are especially relevant to this chapter:


For Further Reading

zone of proximal development (ZPD) (p. 42)
mediated learning experience (p. 43)
scaffolding (p. 45)
guided participation (p. 46)
apprenticeship (p. 47)
cognitive apprenticeship (p. 47)
semantics (p. 50)
syntax (p. 52)
pragmatics (p. 53)
metalinguistic awareness (p. 53)
phonological awareness (p. 54)
immersion (p. 55)
bilingual education (p. 55)

Now go to the Ormrod Teacher Prep Course at www.prenhall.com/ormrod to take a Pretest to assess your initial comprehension of chapter content, study chapter content with your individualized Study Plan that contains an E-book, take a Posttest to assess your understanding of chapter content, build your teaching skills with Practicing Teaching Skills exercises, and build a deeper, more applied understanding of chapter content with Homework and Exercises.