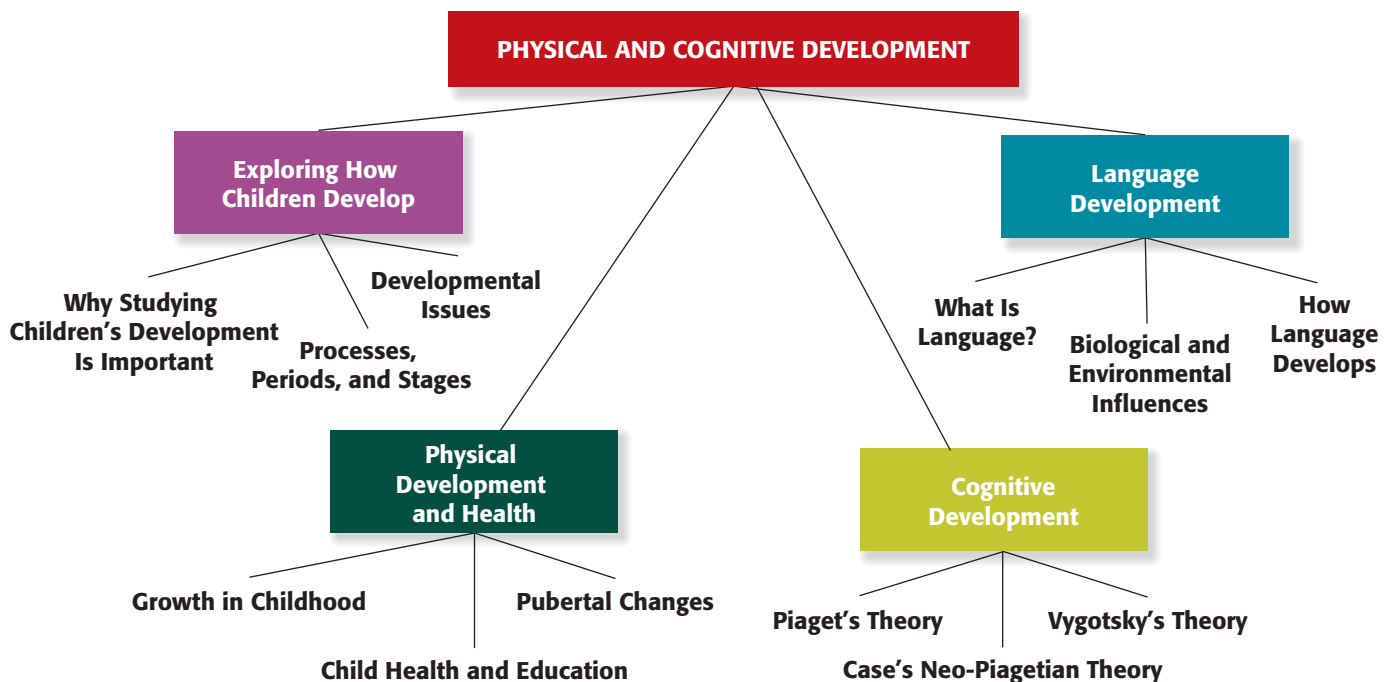# 2 Physical and Cognitive Development

Preview

Examining the shape of children's development allows us to understand it better. Every childhood is distinct, and is the first chapter in a new biography. This chapter is about children's physical and cognitive development. These are some of the questions we will explore:

- Do children develop in distinct stages, or is their development smoother and more continuous?

- How do children develop physically, and how does this affect their behaviour and learning?

- What is the best way to characterize students' cognitive development? How might knowledge of students' cognitive development influence the way you teach?

- How does language develop? What is the best way to teach students to communicate verbally?

PHYSICAL AND COGNITIVE DEVELOPMENT

Exploring How Children Develop
- Why Studying Children's Development Is Important
- Developmental Issues
- Processes, Periods, and Stages

Physical Development and Health
- Growth in Childhood
- Pubertal Changes
- Child Health and Education

Cognitive Development
- Piaget's Theory
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Language Development
- What Is Language?
- Biological and Environmental Influences
- How Language Develops

Teaching Stories: Debra Bankay

Debra Bankay is an elementary-school teacher who, prior to her certification in Ontario, taught at a private school based in the Froebel philosophy. Friedrich Froebel, best known as the founder of kindergarten, believed that play is critical for healthy child development. Below, Debra explains how she incorporates the Froebel methodology into her classroom instruction.

"I was fortunate to have received training in the Froebel approach prior to teaching in the public system. I try to incorporate the elements of this very child-centred approach in my classes. The Froebelian approach encourages teachers to consider students' emotional, spiritual, mental, physical, and social experiences when planning lessons or assessing student learning.
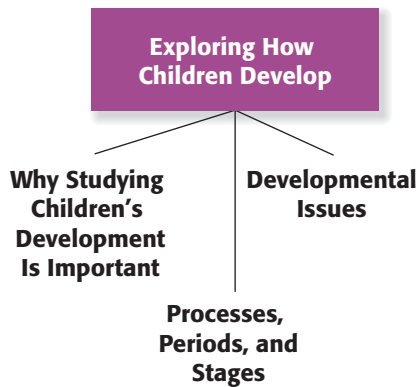
"Based on my experiences, I believe that play is an important tool for encouraging students' language skills and cognitive development. However, I have also come to realize that as students progress through the elementary grades the nature and design of this play needs to be modified in order to be developmentally appropriate. For instance, while teaching a Grade 7–8 unit on Canadian history, I wanted students to use their research skills to learn about the Fathers of Confederation. I also wanted to incorporate play-based activities that would help them develop a deeper understanding of these early Canadians.

"As part of the unit, students were required to use their research findings to create a detailed character sketch of one of the "Fathers." Specifically, they needed to know how their characters lived and behaved. Toward the end of the unit, students re-enacted the Day of Confederation. They came dressed in costume, made oral presentations, and participated in debates using language that was consistent with the 1800s. They also created activities and games that were representative of the era. The next day, the class discussed the meaning and impact of Confederation on modern-day Canada. The students loved the project and I was able to integrate many elements of the curriculum into the unit. By providing students with opportunities to express their learning across a number of authentic, playful activities, I was able to tailor instruction to meet their diverse developmental levels and learning styles."

Exploring How Children Develop

Why Studying Children's Development Is Important

Developmental Issues

Processes, Periods, and Stages

EXPLORING HOW CHILDREN DEVELOP

Twentieth-century philosopher George Santayana once reflected, "Children are on a different plane. They belong to a generation and way of feeling properly their own." Let's explore what that plane is like.

Why Studying Children's Development Is Important

Why study children's development? As a teacher, you will be responsible for a new wave of children each year in your classroom. The more you learn about children's development, the more you can understand at what level it is appropriate to teach them.

Childhood has become such a distinct phase of the human life span that it is hard to imagine that it was not always thought of in that way. However, in medieval times, laws generally did not distinguish between child and adult offences and children were often treated like miniature adults.

Today we view children quite differently than was the case in medieval times. We conceive of childhood as a highly eventful and unique time of life that lays an important foundation for the adult years and is highly differentiated from them. We identify distinct periods within childhood in which children master special skills and confront new life tasks. We value childhood as a special time of growth and change, and we invest great resources in caring for and educating our children. We protect them from the excesses of adult work through tough child labour laws, treat their crimes against society under a special system of juvenile justice, and have government provisions for helping children when ordinary family support systems fail or when a family seriously threatens a child's well-being.

Each child develops partly like all other children, partly like some other children, and partly like no other children. We often direct our attention to a child's uniqueness. But psychologists who study development often are drawn to children's shared characteristics—as are teachers who must manage and educate groups of same- or similar-age children. As humans, every person travels some common paths—Leonardo da Vinci, Margaret Atwood, Wayne Gretzky, Mother Teresa, and most likely you yourself all walked at about one year, engaged in fantasy play as a child, developed an expanded vocabulary in the elementary-school years, and became more independent as a youth.

Just what do psychologists mean when they speak of a person's "development"? **Development** *is the pattern of biological, cognitive, and socioemotional changes that begins at conception and continues through the life span.* Most development involves growth, although it also eventually involves decay (dying).

An important concept in education related to development is that education should be age-appropriate. That is, teaching should take place at a level that is neither too difficult and stressful nor too easy and boring. As we discuss development in this chapter and the next, keep in mind how the developmental changes we describe can help you understand the optimal level for teaching and learning. For example, it is not a good strategy to try to push children to read before they are developmentally ready; but when they are ready, reading materials should be presented at the appropriate level.

Processes, Periods, and Stages

The pattern of development is complex because it is the product of several processes: biological, cognitive, and socioemotional. Development also can be described in terms of periods and stages.

Biological, Cognitive, and Socioemotional Processes   **Biological processes** *involve changes in the child's body. Genetic inheritance plays a large part.* Biological processes underlie the development of the brain, height and weight gains, changes in motor skills, and puberty's hormonal changes.

Children are the legacy we leave for a time we will not live to see.

Aristotle
Greek Philosopher, 4th Century B.C.

www.mcgrawhill.ca/college/santrock

Cognitive processes *involve changes in the child's thinking, intelligence, and language.* Cognitive developmental processes enable a growing child to memorize a poem, imagine how to solve a math problem, come up with a creative strategy, or string together meaningfully connected sentences.

Socioemotional processes *involve changes in the child's relationships with other people, changes in emotion, and changes in personality.* Parents' nurturance toward their child, a girl's aggressive attack on a peer, a boy's empathetic feelings for a sick or hurt classmate, and an adolescent's feelings of joy after getting good grades all reflect socioemotional processes in development.

In this chapter, we will focus on physical (biological) and cognitive processes. In the next chapter, we will explore socioemotional processes. Remember as you read about biological, cognitive, and socioemotional processes that they are interwoven. Socioemotional processes can shape cognitive processes, cognitive processes can promote or restrict socioemotional processes, biological processes can influence cognitive processes, and so on.

Periods of Development   For the purposes of organization and understanding, we commonly describe development in terms of periods. In the most widely used system of classification, the developmental periods are infancy, early childhood, middle and late childhood, adolescence, early adulthood, middle adulthood, and late adulthood.

Infancy *extends from birth to 18–24 months.* It is a time of extreme dependence on adults. Many activities, such as language development, symbolic thought, sensorimotor coordination, and social learning, are just beginning.

Early childhood *(sometimes called the "preschool years") extends from the end of infancy to about 5 or 6 years.* During this period, children become more self-sufficient, develop school-readiness skills (such as learning to follow instructions and identify letters), and spend many hours with peers. Grade 1 typically marks the end of early childhood.

Middle and late childhood *(sometimes called the "elementary-school years") extends from about 6 to 11 years of age.* Children master the fundamental skills of reading, writing, and math at this time. Achievement becomes a more central theme of children's lives and they increase their self-control. In this period, they interact more with the wider social world beyond their family.

Adolescence *involves the transition from childhood to adulthood.* It begins around ages 10 to 12 and ends around 18 to 22. Adolescence starts with rapid physical changes, including gains in height and weight and the development of sexual functions. In adolescence, individuals more intensely pursue independence and seek their own identity. Their thought becomes more abstract, logical, and idealistic.

Early adulthood *begins in the late teens or early twenties and stretches into the thirties.* It is a time when work and love become main themes in life. Individuals make important career decisions and usually seek to have an intimate relationship through marriage or a relationship with a significant other. Other developmental periods have been described for older adults, but we will confine our discussion to the periods most relevant for children's education.

Developmental Issues

Three broad theoretical questions repeatedly come up when we study children's development:

- Is a child's development due more to maturation (nature, heredity) or more to experience (nurture, environment)?
- Is a child's development more continuous and smooth or more discontinuous and stagelike?
- Is a child's development due more to early experiences or more to later experiences?

Maturation and Experience (Nature and Nurture)   We can think of development as produced not only by the interplay of biological, cognitive, and socioemotional processes, but also by the interaction of maturation and experience. **Maturation** *is the orderly sequence*

of changes dictated by the child's genetic blueprint. Just as a sunflower grows in an orderly way (unless defeated by an unfriendly environment), so does a child grow in an orderly way, according to the maturational view. We walk before we talk, speak one word before two words, grow rapidly in infancy and less so in childhood, and experience a rush of sexual hormones in puberty after a lull in childhood. The maturationists acknowledge that extreme environments (those that are physically or psychologically barren and hostile) can harm development. However, they believe that basic growth tendencies are genetically wired into the child's makeup.

In contrast, other psychologists emphasize the importance of experiences in children's development. Experiences run the gamut of inputs from the biological environment (nutrition, medical care, drugs, physical accidents) to the social environment (family, peers, schools, communities, media, culture).

The debate about whether development is influenced primarily by maturation or by experience, which is often called the **nature–nurture controversy**, has been a part of psychology since its beginning. Nature refers to the child's biological inheritance, nurture to environmental experiences. The "nature" proponents claim that biological inheritance is what mainly determines development. The "nurture" proponents argue that environmental experiences are more important.

Continuity and Discontinuity   Think about your development for a moment. Did you gradually grow to become the person you are, in the slow cumulative way a seedling grows into a giant oak? Or did you experience sudden, distinct changes as you grew, like the change of a caterpillar into a butterfly? (See Figure 2.1.)

Continuity in development *refers to gradual, cumulative change.* For example, consider the continuity in development when students gradually become better at math or come to understand the importance of treating others fairly. For the most part, psychologists who emphasize experience describe development as gradual and continuous. **Discontinuity in development** *refers to more distinctive, stagelike change.* In this view, each of us passes through a sequence of stages in which change is qualitative rather than quantitative. That is, development does not just produce more of something, it produces something different (Marini & Case, 1994). As a caterpillar changes into a butterfly, it becomes a different kind of organism. Its development is discontinuous. Similarly, at some point in development a student becomes capable of writing a meaningful sentence, which the student could not have done before. This is qualitative, discontinuous change.

Early and Later Experience   The **early–later experience issue** *focuses on the degree to which early experiences (especially in infancy and/or early childhood)* or later experiences are the key determinants of development. For example, if infants and young children experience highly stressful circumstances, can those experiences be overcome by later, more positive experiences?
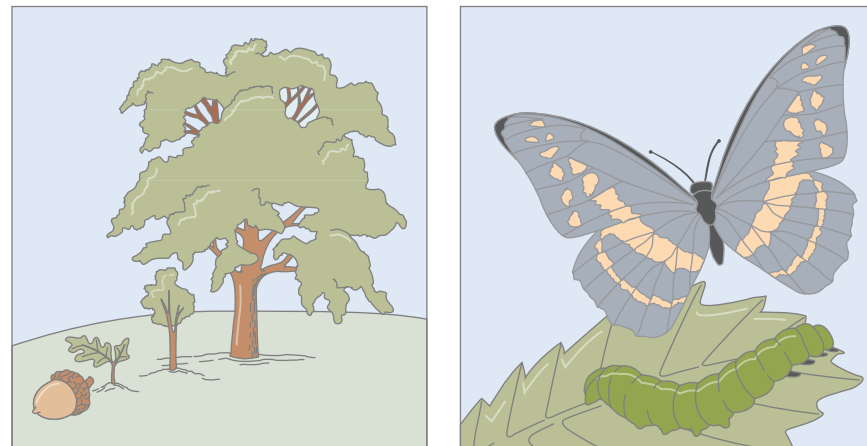
FIGURE 2.1   Continuity and Discontinuity in Development
Is human development like a seedling gradually growing into a giant oak? Or is it more like a caterpillar suddenly becoming a butterfly?

The early–later experience issue has a long history and continues to be hotly debated. Some developmentalists believe that unless infants experience warm, nurturant caregiving in the first year or so of life, their development will never be optimal (Bowlby, 1989). Plato was sure that infants who are rocked become better athletes. Nineteenth-century New England ministers told parents in Sunday sermons that the way they handled their infants determined their children's future character. The emphasis on early experience rests on the belief that each life is an unbroken trail on which a psychological quality can be traced back to a specific origin early in development (Kagan, 1992; 1998).

In contrast, proponents of the influence of later experience argue that development ebbs and flows like an ocean. They say that children are capable of change and that later competent caregiving is just as important as, or more important than, early competent caregiving.

People in Western cultures tend to support the early-experience side of this issue. Many of them have been influenced by the views of famous psychoanalytic theorist Sigmund Freud, who believed that virtually all of a person's important life experiences occur in the first five years of life, especially in relationships with parents. Many people in Eastern cultures, on the other hand, believe that experiences in the elementary-school years are more important than earlier experiences. This stance stems from their view that the key changes in children's cognitive skills, especially their ability to reason, occur after the infant and early-childhood years.

Evaluating the Developmental Issues   Most developmentalists believe it is unwise to take an extreme position on these three developmental questions. Development is not all nature, not all nurture (Plomin, 2000; Wahlsteni, 2000). It is not all continuous, not all discontinuous (Case, 1998). And it is not all early experience or all later experience. Yet how you lean regarding these questions has a bearing on issues that will affect your teaching. For example, are girls less likely than boys to do well in math and science? And if they are, is this because of their "feminine" nature, or because of society's masculine bias? Depending on how you answer this question, you will find different ways to resolve the teaching problem it implies. For children who grew up with poverty, parental neglect, and poor schooling, can enriched experiences in adolescence remove the "deficits"? Your stance on such issues as nature versus nurture also will influence your answer to that question.
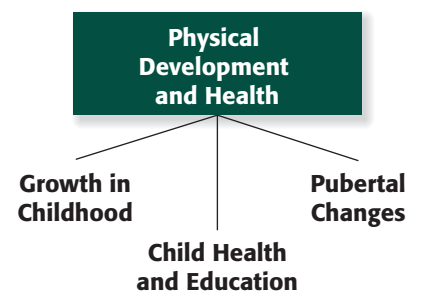
PHYSICAL DEVELOPMENT AND HEALTH

As twentieth-century Welsh poet Dylan Thomas artfully observed, children "run all the sun long." And as their physical development advances, their small worlds widen. In this section, we will focus mainly on the normal aspects of physical development.

Growth in Childhood

The infant's growth is extremely rapid. The young child's growth is slower. This slower rate continues through middle and late childhood. Otherwise, we would be giants.

An important aspect of physical growth is the development of the brain and nervous system. The number and size of the brain's nerve endings continue to grow at least until adolescence. Some of the brain's increase in size also is due to **myelination**, *a process in which many cells of the brain and nervous system are covered with an insulating layer of fat cells. This increases the speed at which information travels through the nervous system.* Myelination in the areas of the brain related to hand–eye coordination is not complete until about four years of age. Myelination in brain areas that are important in focusing attention is not complete until the end of the elementary-school years (Case, 1992a, 1999; Tanner, 1978). The implications for teaching are that students will have more difficulty focusing their attention and maintaining it for very long in early childhood, but their attention will improve as they move through the elementary-school years. Even in elementary school and later, many educators believe occasional short breaks sustain students' energy and motivation to learn.

Physical Development and Health

Growth in Childhood

Child Health and Education

Pubertal Changes

Gross motor and fine motor skills develop extensively during childhood. **Gross motor skills** *involve large-muscle activities, such as running and playing basketball.* **Fine motor skills** *involve finely tuned movements, such as the finger dexterity required for writing and drawing.* Children become increasingly venturesome as their gross motor skills improve.

Preschool and kindergarten teachers should implement developmentally appropriate activities for the exercise of gross motor skills. In early childhood, these include exercises that involve fundamental movement, daily fitness, and perceptual–motor activities (Poest et al., 1990). Walking on a beam is one example of an exercise that promotes fundamental movement skills. Daily fitness activities can include a run accompanied by music. Combining fitness with creative movement, music, and children's imagination is a good strategy. Children enjoy moving like snakes, cats, kangaroos, and airplanes.

Avoid recordings and activities that "program" children or involve group calisthenics that are not appropriate for young children. To develop young children's gross motor skills, also include perceptual–motor activities. Teachers can ask students to copy their movements, tap and march to the tune of nursery rhymes, and complete safe obstacle courses.

The development of young children's fine motor skills allows them to draw with more control and skill. Art provides considerable insight into children's perceptual worlds. These insights include what children are attending to, how they view space and distance, and how they experience patterns and forms. Teachers can give students a positive context for artistic expression by providing them a work space where they don't have to be worried about being messy or damaging things.

During the elementary-school years, children's motor development becomes much smoother and more coordinated. Children gain greater control over their bodies and can sit and attend for longer periods of time. However, classes should still be active and activity-oriented. Throughout childhood, boys tend to be better at gross motor skills, while girls tend to be better at fine motor skills.

Reading is to the mind what exercise is to the body.

Joseph Addison
English Poet, 17th Century

Child Health and Education

Although we have become a health-conscious country, many children as well as adults do not practise good health habits. All too many children eat too much junk food and spend too much time being couch potatoes.

Physical Education Classes   For too long, exercise was relegated to a back seat in children's education. Even today, too little attention is given to the quality of physical education classes, whether children are getting adequate exercise, and whether they eat properly. Recall our earlier discussion of how physical, cognitive, and socioemotional development are interrelated. Children who come to school hungry and who do not exercise regularly (physical development) often do not attend as efficiently in school and are less motivated to study (cognitive development) than their healthier counterparts.

Even when students take a physical education class, they do not always actively participate. Observations of physical education classes at four elementary schools found that students moved through space only 50 percent of the time they were in class, and moved continuously only an average of 2.2 minutes (Parcel et al., 1987).

Does it make a difference if students are encouraged to exercise vigorously in elementary school? One study says yes (Tuckman & Hinkle, 1988). Students were randomly assigned either to three 30-minute running programs per week or to regular attendance in physical education classes. In cardiovascular fitness and creative thinking, the students in the running program were superior to the students who regularly attended traditional physical education classes.

Are Television, Video Games, and the Internet the Culprits?   Some experts argue that television, computer games, and the Internet might be partly to blame for the poor physical fitness of our country's children. Gingras (2001) argues that such claims may be simplistic. She maintains that obesity is a complex problem that is partly genetic and partly environmental. She suggests that it is not uncommon, and certainly is an environmental

As children move through the elementary-school years, they gain greater control over their bodies. Physical action is essential for them to refine their developing skills.

factor of concern, for children to spend three to four hours daily watching television or engaged in computer entertainment. Thus, reducing time spent viewing television, playing video games, or surfing the Net is a wise strategy, not only for improved physical fitness but also for increasing time spent on homework and school-related activities. The amount of time a child spends on these activities may be a topic you will want to explore with parents of students who are having difficulty in school.

A Model School-Health Program: A research report in the *Canadian Medical Association Journal* (Tremblay & Willms, 2000) highlighted an alarming rise in the incidence of child and youth obesity. For example, from 1981 to 1996 the prevalence of overweight children increased from 15 percent to 35.4 percent for boys, and from 15 percent to 29.2 percent for girls. During the same interval the prevalence of obesity in children tripled, from 5 percent to 16.6 percent for boys and from 5 percent to 14.6 percent for girls.

A major concern regarding childhood obesity is that obese children tend to become obese adults, facing an increased risk of diabetes, heart disease, orthopaedic problems, and many other chronic diseases. Increasingly, pediatricians are seeing a rise in the incidences of childhood hyperlipidemia, hypertension, and diabetes.

Efforts are being made to combat the problem. One model school-health program is the Heart Healthy Kids™ physical activity program. Heart Healthy Kids introduces and combines a wide range of movements and skills that could form the basis of daily physical activity in the classroom. Locomotion and travelling skills for each grade level are combined in a variety of sequences to increase cardiovascular fitness, flexibility, and balance. Stability skills are sequenced into easy-to-follow routines. The program also provides students with accurate and detailed information about the heart and how to maintain it. For instance, the program promotes the development of proper eating habits, exercise, and healthy lifestyle choices by including life experiences to which students can readily make personal connections. Heart Healthy Kids supports the healthy living and active participation strands in health and physical education programs at all grade levels.
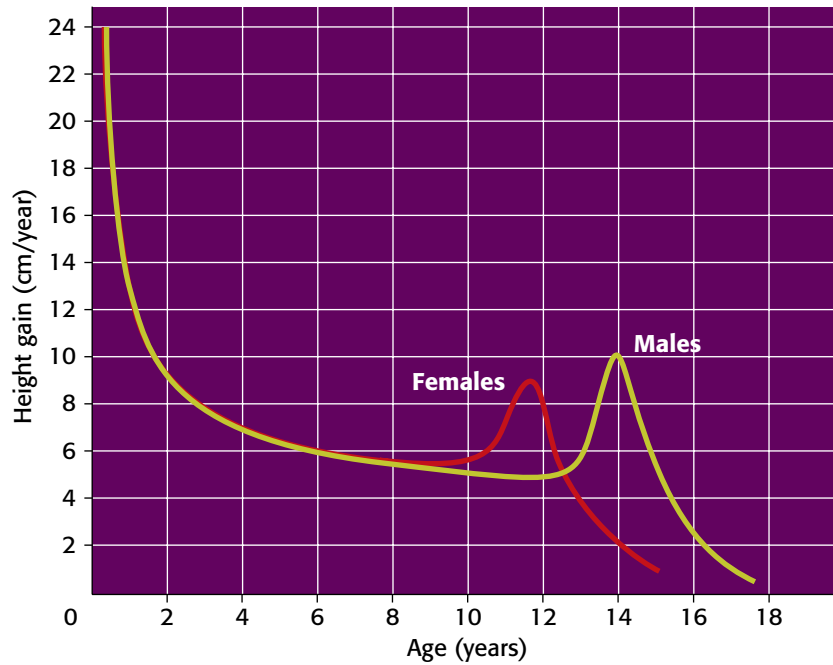
Am I Physically and Mentally Healthy?

For each item, respond 1 = Never, 2 = Sometimes, or 3 = Always.

	1	2	3

Exercise/Fitness

1. I maintain a desired weight and avoid being overweight or underweight.

2. I do vigorous exercises (such as running, swimming, walking briskly) for 15 to 30 minutes at least 3 times a week.

3. I do exercises that improve my muscle tone (such as yoga, calisthenics, and lifting weights) for 15 to 30 minutes at least 3 times a week.

4. I use part of my leisure time to participate in individual, family, or team activities that increase my fitness level (such as gardening, bowling, golf, and baseball).

Eating Habits

5. I eat a variety of foods each day, such as fruits and vegetables, whole-grain breads and cereals, lean meats, dairy products, dry peas and beans, and nuts and seeds.

6. I limit the amount of fat, saturated fat, and cholesterol I eat.

7. I limit the amount of salt I eat.

8. I avoid eating too much sugar (especially frequent candy snacks or soft drinks).

Alcohol/Drugs, Smoking

9. I avoid drinking alcoholic beverages or I drink no more than one or two drinks a day.

10. I avoid using alcohol or other drugs as a way of handling stressful situations or problems in my life.

11. I avoid smoking cigarettes or using other nicotine substances.

Stress Control

12. I have a job or do other work that I enjoy.

13. I find it easy to relax and I express my feelings freely.

14. I have good resources, such as close friends or relatives, whom I can call on in times of stress.

15. I participate in group activities (such as community organizations) or hobbies that I enjoy.

Scoring and Interpretation

40–45	Excellent role model	Excellent physical and mental health
35–39	Good role model	Good physical and mental health
30–34	Potential to be an effective role model	Physical and mental health need some work
15–29	Poor role model	Poor physical and mental health

Pubertal Changes

Puberty *is a phase of maturation that occurs mainly in early adolescence. The changes involve a height and weight spurt and sexual maturation.* The changes start on the average at about $10\frac{1}{2}$ years in females and $12\frac{1}{2}$ years in males (see Figure 2.2). One of the most remarkable

FIGURE 2.2 **Pubertal Growth Spurt**
On the average, the growth spurt that characterizes pubertal change occurs 2 years earlier for girls ($10\frac{1}{2}$) than for boys ($12\frac{1}{2}$).

Youth is the only season for enjoyment, and the first twenty–five years of one's life are worth all of the rest of the longest life of man, even though those five–and–twenty be spent in penury and contempt, and the rest in the possession of wealth, honours, respectability.

George Borrow
English Writer and Traveller, 19th Century

normal variations is that, of two boys (or two girls) of the same chronological age, one might complete the pubertal sequence before the other has begun it. For example, the onset of puberty can occur as early as 8 years of age in girls and $9\frac{1}{2}$ years in boys, or as late as 13 in girls and $13\frac{1}{2}$ in boys, and still be considered within the normal range.

Puberty is coming earlier and has been doing so since the beginning of the twentieth century as a result of improved health and nutrition, although the changes in pubertal timing have begun to taper off. Menstruation is a very late pubertal event, with the height/weight spurt usually appearing about two years earlier. In 1900, a girl's first menstruation (called menarche) occurred at an average of 14 years of age, whereas today it occurs at about 12 years of age.

Because puberty is coming so much earlier, elementary-school teachers are seeing far more students in the late elementary-school grades who have entered puberty, especially girls. Today, an increasing number of nine-year-old girls are entering puberty. The increasingly early appearance of puberty calls attention to the importance of including competent instruction in health and sex education in the elementary-school years.

Think back to when you were in Grade 6 or 7. Some of your classmates had not yet entered puberty, others were just starting, and yet others were far along the pubertal path. Boys and girls who enter puberty earlier or later than their peers might perceive themselves differently. Today, there is a special concern about early maturation in girls. A host of studies in the last decade have documented that early-maturing girls are vulnerable to developing a number of problems (Brooks-Gunn, 1996; Brooks-Gunn & Paikoff, 1997; Petersen, 2000). Early-maturing girls are more likely to smoke, drink, be depressed, have an eating disorder, request earlier independence from their parents, have older friends, and date earlier. Apparently as a result of their

Through the Eyes of Teachers

Growing Up Is Hard Work

Adolescence is a time of difficult decision-making. Adolescents are called upon to overcome many challenges as they face an increased emphasis on body image; drug, alcohol, and sexual experimentation; and school competition. Many of the decisions that these students make will affect them long after they leave high school. As educators, we need to help students understand the implications of their decisions without telling them what to do. We need to help them acquire the skills and perspectives to make decisions that are right for them. For instance, many counsellors use a "decisional balance grid" when educating students about drugs and alcohol. By considering all factors, many students begin to realize that alcohol and drug use is not in their best interests. When students begin to make better decisions for themselves, they can become positive role models for others.

Peter Henderson
School Counsellor
British Columbia

socioemotional and cognitive immaturity, combined with their early physical development, early-maturing girls are easily lured into problem behaviours.

At this point we have discussed a number of ideas about exploring how children develop and children's physical development and health. A review of these ideas is presented in Summary Table 2.1.

SUMMARY TABLE 2.1
Exploring How Children Develop, and Physical Development and Health

Why study child development?	• The more you learn about students' development, the more you can understand how to appropriately teach them.
What are the processes, periods, and stages of development?	• Development is the pattern of biological, cognitive, and socioemotional changes that begins at conception and continues through the life span. These processes are often intertwined. • Periods and stages of development include infancy, early childhood, middle and late childhood, adolescence, early adulthood, and late adulthood.
What are the issues that characterize development?	• Three main dichotomies that characterize virtually all facets of development are maturation versus experience (nature and nurture), continuity versus discontinuity, and early versus later experience. • Maturation is the orderly sequence of changes dictated by children's genetic blueprints. Experience includes the biological and the social environment. • Continuity refers to smooth, gradual growth. Discontinuity involves distinct, stage-like change. • The early–later experiences debate focuses on the degree to which early experiences or later experiences determine development.
What are some distinct childhood growth patterns?	• An especially important part of physical growth is the development of the brain and nervous system. • Myelination involving hand–eye coordination is complete at 4 years of age, and myelination involving focusing attention is finished at about 10 years. • Children's gross and fine motor skills develop extensively in the childhood years. Boys are often better at gross motor skills, girls at fine motor skills.
What are some child health and education issues?	• When children exercise vigorously in the elementary-school years, their cardiovascular fitness increases and their thinking skills improve. • Excessive TV, video game, and Internet use is related to poor physical fitness in children. • One model school-health program is Heart Healthy Kids™. The program promotes proper eating habits, exercise, and healthy lifestyles choices.
What changes occur in puberty?	• Puberty is a phase of maturation that occurs mainly in early adolescence and involves height, weight, and sexual changes. • Females enter puberty about two years earlier than males ($10\frac{1}{2}$ vs. $12\frac{1}{2}$), and puberty is coming much earlier than it did a century ago. • Early-maturing girls are vulnerable to a number of risk factors including tobacco and alcohol use, eating disorders, and depression.
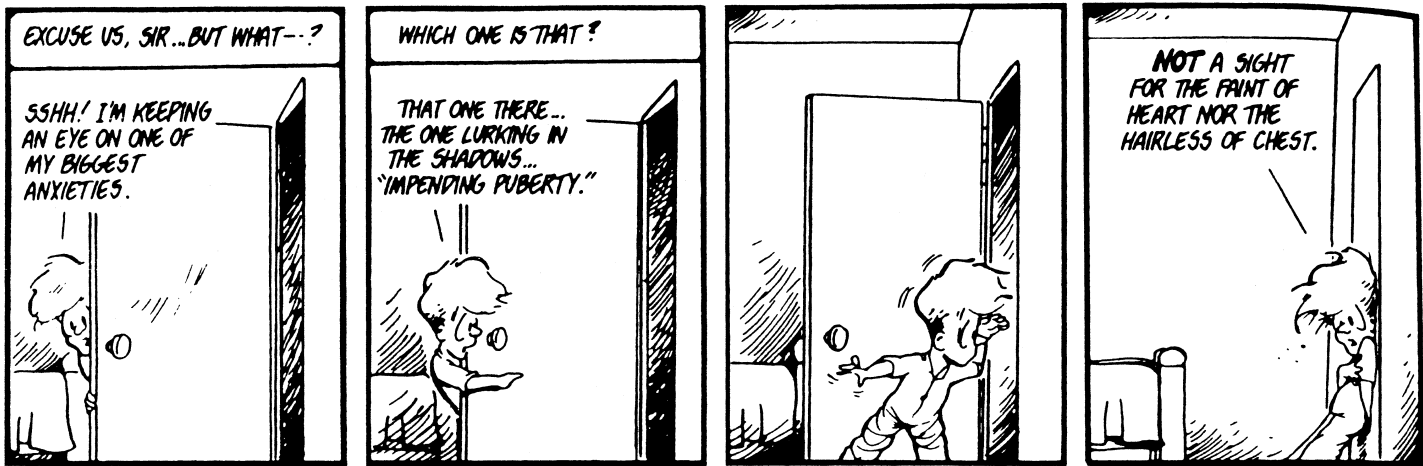
From Penguin Dreams and Stranger Things by Berke D. Breathed. Copyright © 1985 by The Washington Post Company. By permission of Little, Brown, and Company.

COGNITIVE DEVELOPMENT

How the mind develops has intrigued many psychologists. We explore three main approaches to how children's thoughts develop: Piaget's theory, Case's neo-Piagetian theory, and Vygotsky's theory. All three theorists are constructivists: they believe that children actively construct knowledge and understanding.
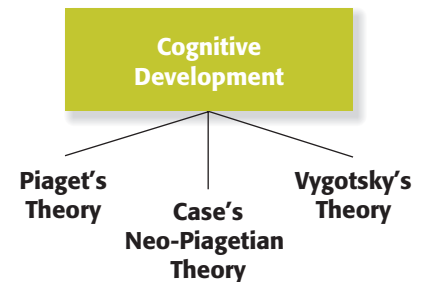

Piaget's Theory

Cognitive Processes   In actively constructing their world, children use schemas. A **schema** *is a concept or framework that exists in an individual's mind to organize and interpret information.* Piaget's interest in schemas focused on how children organize and make sense out of their current experiences.

Piaget (1952) said that two processes are responsible for how children use and adapt their schemas: assimilation and accommodation. **Assimilation** *occurs when a child incorporates new knowledge into existing knowledge*; that is, when children add information about the environment into a schema. **Accommodation** *occurs when a child adjusts to new information*; that is, when children adjust their schemas to the environment.

Consider an eight-year-old girl who is given a hammer and nail to hang a picture on the wall. She has never used a hammer, but from observing others do this she realizes that a hammer is an object to be held, that it is swung by the handle to hit the nail, and that it usually is swung a number of times. Recognizing each of these things, she fits her behaviour into this schema she already has (assimilation). But the hammer is heavy, so she holds it near the top. She swings too hard and the nail bends, so she adjusts the pressure of her strikes. These adjustments reflect her ability to alter her conception of the world (accommodation). Both assimilation and accommodation are required in this example, as they are in many thinking challenges.

Piagetian Stages   Piaget also believed that cognitive development unfolds in a sequence of four stages. Each of the stages is age-related and consists of distinctive ways of thinking. It is the different way of thinking that makes one stage discontinuous from and more advanced than another. Knowing more information does not make the child's thinking more advanced, according to Piaget. The advance is qualitatively different. Piaget's stages are called sensorimotor, preoperational, concrete operational, and formal operational (see Figure 2.3).

Piaget is shown here with his family. Piaget's careful observations of his three children—Lucienne, Laurent, and Jacqueline—contributed to the development of his cognitive theory.
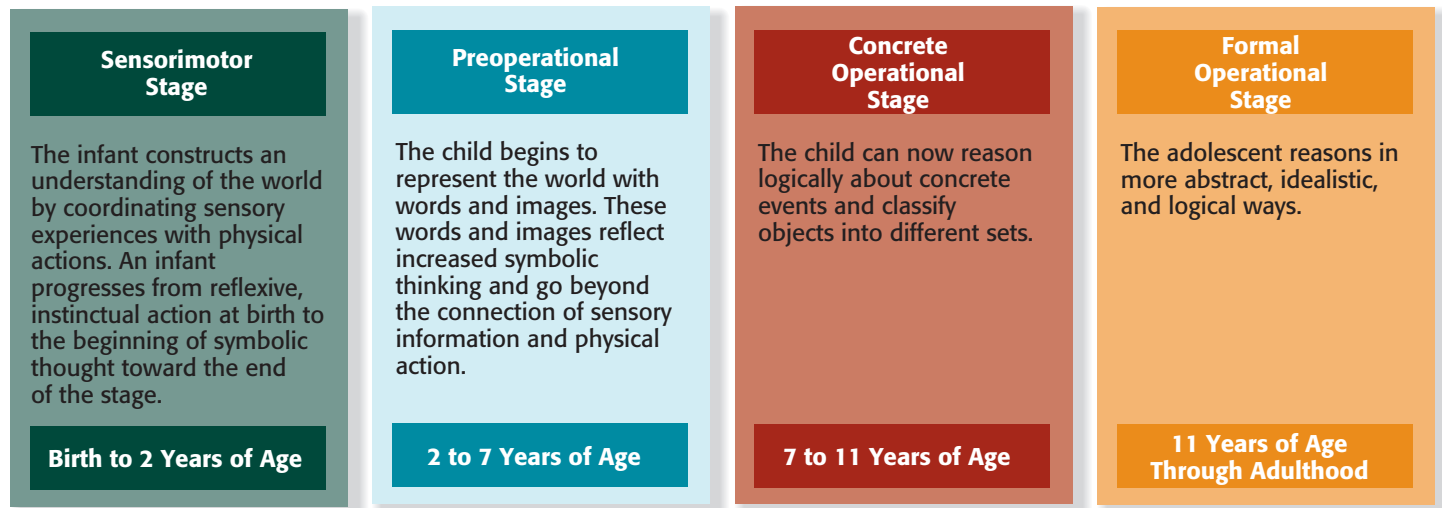
Sensorimotor Stage	Preoperational Stage	Concrete Operational Stage	Formal Operational Stage
The infant constructs an understanding of the world by coordinating sensory experiences with physical actions. An infant progresses from reflexive, instinctual action at birth to the beginning of symbolic thought toward the end of the stage.	The child begins to represent the world with words and images. These words and images reflect increased symbolic thinking and go beyond the connection of sensory information and physical action.	The child can now reason logically about concrete events and classify objects into different sets.	The adolescent reasons in more abstract, idealistic, and logical ways.
Birth to 2 Years of Age	**2 to 7 Years of Age**	**7 to 11 Years of Age**	**11 Years of Age Through Adulthood**

FIGURE 2.3 **Piaget's Four Stages of Cognitive Development**

The Sensorimotor Stage   The **sensorimotor stage** *lasts from birth to about two years of age. In this stage, infants construct an understanding of the world by coordinating sensory experiences (such as seeing and hearing) with motor actions (reaching, touching).* At the beginning of this stage, infants show little more than reflexive patterns to adapt to the world. By the end of the stage, they display far more complex sensorimotor patterns.

Piaget believed that *an especially important cognitive accomplishment in infancy is* **object permanence**. *This involves understanding that objects and events continue to exist even when they cannot be seen, heard, or touched.* A second accomplishment is the gradual realization that there is a difference or boundary between oneself and the surrounding environment.

The Preoperational Stage   The **preoperational stage** *lasts from approximately two to seven years of age; it is more symbolic than sensorimotor thought. It is egocentric, and intuitive rather than logical.*

Preoperational thought can be subdivided into two substages: symbolic function and intuitive thought. The **symbolic function substage** *occurs roughly between two and four years of age. In this substage, the young child gains the ability to represent mentally an object that is not present.* Expanded use of language and the emergence of pretend play are other examples of an increase in symbolic thought during this substage. Young children begin to use scribbled designs to represent people, houses, cars, clouds, and many other aspects of the world. Their drawings are fanciful and inventive. Suns are blue, skies are green, and cars float on clouds in their imaginative world. The symbolism is simple but strong, not unlike abstractions found in some modern art. As the famous twentieth-century Spanish artist Pablo Picasso once remarked, "I used to draw like Raphael but it has taken me a lifetime to draw like young children." In the elementary-school years, children's drawings become more realistic, neat, and precise (see Figure 2.4a, 2.4b).

Even though young children make distinctive progress in this substage, their preoperational thought still has two important limitations: egocentrism and animism. **Egocentrism** *is the inability to distinguish between one's own perspective and someone else's perspective.*

Piaget and Barbel Inhelder (1969) initially studied young children's egocentrism by devising the three-mountains task (see Figure 2.5). The child walks around the model of the mountains and becomes familiar with what the mountains look like from different perspectives. The child also can see that there are different objects on the mountains. The child then is seated on one side of the table on which the mountains are placed. The experimenter moves a doll to different locations around the table. At each location the child is asked to select from a series of photos the one that most accurately reflects the view the doll is seeing. Children in the preoperational stage often pick the view that reflects where they are sitting rather than the doll's view.

Animism *also characterizes preoperational thought. It is the belief that inanimate objects have "lifelike" qualities and are capable of action.* A young child might show animism by saying, "That tree pushed the leaf off and it fell down" or "The sidewalk made me mad. It made me fall down."

The **intuitive thought substage** *is the second substage of preoperational thought, starting at about four years of age and lasting until about seven years of age. At this substage, children begin to use primitive reasoning and want to know the answers to all sorts of questions. Piaget called this substage "intuitive" because the children seem so sure about their knowledge and understanding, yet are unaware of how they know what they know.* That is, they say they know something but know it without the use of rational thinking.

An important characteristic of preoperational thought is called **centration**. *It involves focusing (or centring) attention on one characteristic to the exclusion of all others.* Centration is most clearly present in young children's lack of **conservation**, *the idea that some characteristic of an object stays the same even though the object might change in appearance.* For example, to adults it is obvious that a certain amount of liquid stays the same regardless of a container's shape. But this is not obvious at all to young children. Rather, they are struck by the height of the liquid in the container. In this type of conservation task (Piaget's most famous), a child is presented with two identical beakers, each filled to the same level with liquid. The child is asked if the beakers have the same amount of liquid. The child usually says yes. Then the liquid from one beaker is poured into a third beaker, which is taller and thinner. The child now is asked if the amount of liquid in the tall, thin beaker is equal to the liquid that remains in the second original beaker. Children younger than seven or eight usually say no. They justify their answer by referring to the differing height or width of the beakers. Older children usually answer yes. They justify their answers appropriately: If you poured the liquid back, the amount would still be the same.

In Piaget's view, failing the conservation-of-liquid task indicates that the child is at the preoperational stage of thinking. Passing the test suggests the child is at the concrete operational stage of thinking.

In our definition of the preoperational stage we indicated that preschool children cannot perform operations. In Piaget's theory, **operations** *are mental representations that are reversible.* As in the beaker task, preschool children have difficulty understanding that reversing an action brings about the original conditions from which the action began. A young student might know that $4 + 2 = 6$ but not understand
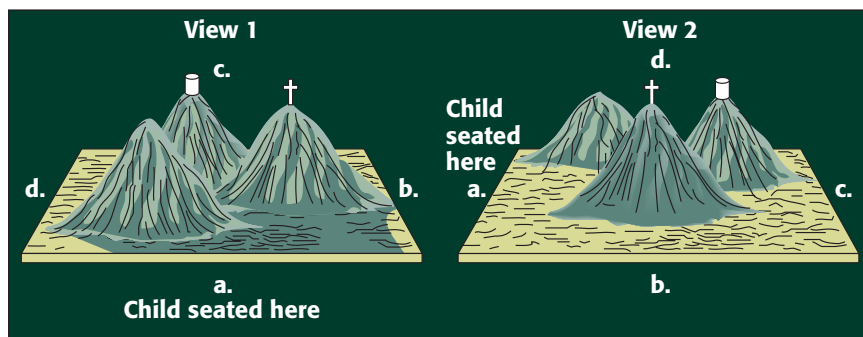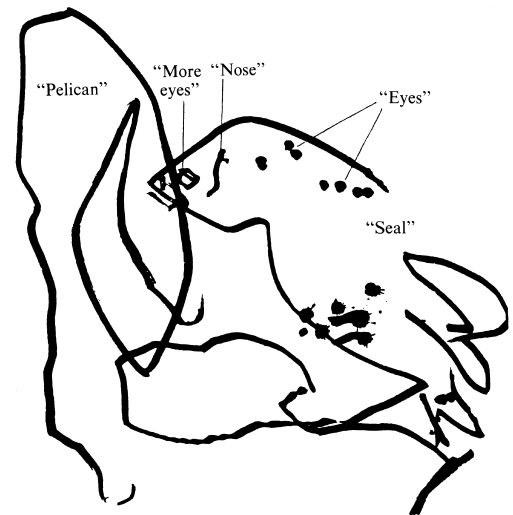

FIGURE 2.4 Developmental Changes in Children's Drawings

(a) A 3½-year-old's symbolic drawing. Halfway into this drawing, the 3½-year-old said it was "a pelican kissing a seal."

(b) This 11-year-old's drawing is neater and more realistic but also less inventive.

FIGURE 2.5 The Three-Mountains Task

View 1 shows the child's perspective from where he or she is sitting. View 2 is an example of the photograph the child would be shown, mixed in with others from different perspectives. To correctly identify this view, the child has to take the perspective of a person sitting at spot *b*. Invariably, a preschool child who thinks in a preoperational way cannot perform this task. When asked what a view of the mountains looks like from position *b*, the child selects a photograph taken from location *a*, the child's view at the time.

"I still don't have all the answers, but I'm beginning to ask the right questions."
Drawing by Lorenz; © 1989 The New Yorker Magazine, Inc.

that the reverse, $6 - 2 = 4$, is also true. Or let's say a preschooler walks to his friend's house each day but always gets a ride home. If asked to walk home from his friend's house, he probably would reply that he didn't know the way because he never had walked home before.

Yet another characteristic of preoperational children is that they ask a lot of questions. The barrage begins around age three. By about five, they have just about exhausted the adults around them with "Why?" "Why" questions signal the emergence of the child's interest in figuring out why things are the way they are.

The Concrete Operational Stage   The **concrete operational stage** *lasts from about 7 to about 11 years of age. Concrete operational thought involves using operations. Logical reasoning replaces intuitive reasoning, but only in concrete situations. Classification skills are present, but abstract problems are difficult.*

Many of the concrete operations identified by Piaget focus on the way children reason about the properties of objects. At the concrete operational level, children can do mentally what they previously could do only physically, and they can reverse concrete operations. For example, to test conservation of matter, the child is presented with two identical balls of clay. The experimenter rolls one ball into a long, thin shape. The child is asked if there is more clay in the ball or in the long, thin piece of clay. By the time children are seven or eight years old, most answer that the amount of clay is the same. To answer this problem correctly, children have to imagine that the clay ball can be rolled out into a long, thin strip and then returned to its original round shape. This type of imagination involves a reversible mental action.

Concrete operations allow the child to coordinate several characteristics rather than focus on a single property of an object. In the clay example, the preoperational child focuses on height or width. The concrete operational child coordinates information about both dimensions.

An important concrete operation is **classifying**, *or dividing things into different sets or subsets and considering their interrelationships.* Reasoning about a family tree of four generations reveals a child's concrete operational skills (Furth & Wachs, 1975). Concrete operational thinkers understand that a person can at the same time be father, brother, and grandson. A preoperational thinker cannot.

Some Piagetian tasks require children to reason about relations between classes. One such task is **seriation**, *the concrete operation that involves ordering stimuli along some quantitative dimension (such as length).* To see if students can serialize, a teacher might place eight sticks of different lengths in a haphazard way on a table. The teacher then asks the student to order the sticks by length. Many young children end up with two or three small groups of "big" sticks or "little" sticks rather than a correct ordering of all eight sticks. Another strategy they use is to evenly line up the tops of the sticks but ignore the bottoms. The concrete operational thinker simultaneously understands that each stick must be longer than the one that precedes it and shorter than the one that follows it.

Another aspect of reasoning about the relations between classes is **transitivity**. *This involves the ability to logically combine relations to understand certain conclusions.* In this case, consider three sticks (A, B, and C) of differing lengths. A is the longest, B is intermediate in length, and C is the shortest. Does the child understand that if A > B, and B > C, then A > C? In Piaget's theory, concrete operational thinkers do, preoperational thinkers do not.

The Formal Operational Stage   The **formal operational stage**, *which emerges at about 11 to 15 years of age, is Piaget's fourth and final cognitive stage. At this stage, individuals move beyond reasoning about only concrete experiences and think in more abstract, idealistic, and logical ways.*

Teaching Strategies
For Primary–, Intermediate–, and Secondary–School Students

Primary Grades: Preoperational Thinkers	Intermediate Grades: Concrete Operational Thinkers	Secondary School: Formal Operational Thinkers
Have students manipulate objects	Encourage students to discover concepts and principles	Recognize the wide range of individual variability across students
Involve students in social interactions	Involve students in operational tasks using concrete materials	Present students with real-world problems and invite them to propose multiple solutions
Ask students to make comparisons	Have students practise the concepts of ascending and descending classification hierarchies	Guide students' efforts when generating potential solutions
Have students draw scenes from different perspectives	Include activities that require conservation of area, weight, and displaced volume	Have students evaluate the effectiveness of potential solutions and select the best one
Ask students to justify their answers when they draw conclusions	Create activities in which students order and reverse order	Ask students to reflect on their cognitive processes when problem-solving
	Ask students to justify their answers when solving problems	Encourage students to create hierarchical outlines for writing and other tasks
	Encourage students to work in groups and exchange thoughts	
	Provide students with materials that stimulate questions	
	Create props and visual aids for complex concepts	
	Actively engage students in the learning process	
Source: Sund (1976)	Source: Labinowicz (1980) and Sund (1976)	Source: Santrock (1998)

The abstract quality of formal operational thinking is evident in verbal problem solving. The concrete operational thinker needs to see the concrete elements A, B, and C to make the logical inference that if A = B and B = C, then A = C. In contrast, the formal operational thinker can solve this problem when it is verbally presented.

Accompanying the abstract nature of formal operational thought are the abilities to idealize and imagine possibilities. At this stage, adolescents engage in extended speculation about the ideal qualities they desire in themselves and others.

At the same time as adolescents are thinking more abstractly and idealistically, they also are beginning to think more logically. As formal operational thinkers, they think more like scientists. They devise plans to solve problems and systematically test solutions. Piaget's term **hypothetical-deductive reasoning** *embodies the concept that adolescents can develop hypotheses (best hunches) about ways to solve problems and systematically reach a conclusion.*

One example of hypothetical-deductive reasoning involves a modification of the familiar game "Twenty Questions." Individuals are shown a set of 42 colour pictures displayed in a rectangular array (six rows of seven pictures each) and asked to determine which picture the experimenter has in mind (that is, which is "correct"). The subjects are allowed to ask only questions to which the experimenter can answer yes or no. The object of the game is to select the correct picture by asking as few questions as possible.

Adolescents who are deductive hypothesis testers formulate a plan and test a series of hypotheses, which considerably narrows the field of choices. The most effective plan is a "halving" strategy (*Q:* Is the picture in the right half of the array? *A:* No. *Q:* Okay. Is it in the top half? And so on). A correct halving strategy guarantees the answer in seven questions or less. In contrast, the concrete operational thinker might persist with questions that continue to test some of the same possibilities that previous questions could have eliminated. For example, they might ask whether the correct picture is in row 1 and are told that it is not. Later, they ask whether the picture is *X*, which is in row 1.

A form of egocentrism also emerges in adolescence (Elkind, 1978). **Adolescent egocentrism** *is the heightened self-consciousness that is reflected in adolescents' beliefs that others are as interested in them as they themselves are. Adolescent egocentrism also includes a sense of personal uniqueness.* It involves the desire to be noticed, visible, and "on stage." Consider 12-year-old Tracy, who states, "Everyone in here is looking at me. This one hair won't stay in place," as she rushes to the restroom to plaster it with hair spray. Perceived uniqueness also is evident in 16-year-old Margaret's feelings after her boyfriend has broken up with her. She tells her mother, "You have no idea how I feel. You have never experienced this kind of pain."

Egocentrism is a normal adolescent occurrence, more common in the intermediate grades than in the high-school years. However, for some individuals, adolescent egocentrism can contribute to reckless behaviour, including suicidal thoughts, drug use, and failure to use contraceptives during sexual intercourse. Egocentricity leads some adolescents to think that they are invulnerable.

Evaluating Piaget's Theory   Piaget's theory has not gone unchallenged. Questions have been raised about these areas: estimates of children's competence at different developmental levels; stages; training children to reason at higher levels; and culture and education.

- *Estimates of children's competence.* Some cognitive abilities emerge earlier than Piaget thought. For example, conservation of number has been demonstrated as early as age three, although Piaget did not think it emerged until seven.

  Other cognitive abilities can emerge later than Piaget thought. Many adolescents and adults still think in concrete operational ways or are just beginning to master formal operations. In sum, recent theoretical revisions highlight more cognitive competencies of infants and young children and more cognitive shortcomings of adolescents and adults (Flavell, Miller, & Miller, 1993; Wertsch, 2000).

- *Stages.* Piaget conceived of stages as unitary structures of thought. Thus, his theory assumes developmental synchrony. That is, various aspects of a stage should emerge at the same time. However, some concrete operational concepts do not appear in synchrony. For example, children do not learn to conserve at the same time as they learn to cross-classify. Thus, most contemporary developmentalists agree that children's cognitive development is not as stagelike as Piaget thought (Bjorklund, 2000; Case, 1998, 1999, 2000).

From you have I been absent
  in the spring,
When proud—pied April,
  dress'd in all his trim,
Hath put a spirit of youth
  in everything.

William Shakespeare, Sonnet 98
English Poet and Dramatist, 17th Century

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- *Training children to reason at a higher level.* Some children who are at one cognitive stage (preoperational) can be trained to reason at a higher cognitive stage (concrete operational).
- *Culture and education.* Culture and education exert stronger influences on children's development than Piaget believed (Gelman & Brenneman, 1994; Greenfield, 2000). The age at which children acquire conservation skills is related to the extent to which their culture provides relevant practice (Cole, 1999).

Still, some developmental psychologists believe we should not throw out Piaget altogether. These **neo-Piagetians** *argue that Piaget got some things right, but that his theory needs considerable revision. In their revision of Piaget, more emphasis is given to how students process information through attention, memory, and using strategies* (Case, 1987, 1997, 1998).

Case's Neo-Piagetian Theory

Growing criticism of Piagetian theory in the late 1960s and the rise of cognitive science in the early 1970s marked the beginning of a new movement in cognitive development dominated by a group of researchers known as the neo-Piagetians (Case, 1985; Pascual-Leone, 1970; Pascual-Leone & Smith, 1969). The neo-Piagetian group built on the important work done by Piaget by taking some of his most classical theoretical components and combining them with more current concepts that provided greater explanatory power (Case, 1998; Pascual-Leone, 1990). One well-known member of this group is Canada's Robbie Case.

Case played a major role in the development of the neo-Piagetian movement. His contributions to educational psychology extend well beyond the confines of cognitive development (Case & McKeough, 1990; Marini, 2000). Case had a genuine interest in both developmental and educational psychology; his theory of cognition allows predictions about development from birth to adulthood and provides new insights about learning and instruction across different content areas (e.g., mathematics, language arts).

Like Piaget, Case characterizes development as a progression though four major stages:

- Sensorimotor stage ($0–1\frac{1}{2}$ years)
- Interrelational stage ($1\frac{1}{2}–5$ years)
- Dimensional stage (5–11 years)
- Vectorial stage (11–19 years)

At the sensorimotor stage ($0–1\frac{1}{2}$ years), children attempt to understand the world by using a range of sensory experiences, particularly touch. At this stage children are particularly interested in cause and effect, such as the dropping of a spoon and the resulting noise (Case, 1992a).

At the interrelational stage ($1\frac{1}{2}–5$ years), children's mental representation consists of objects, people, and actions. Children's thinking is still dominated by relationships between cause and effect, such as the pushing of a button to make a bell ring or the comforting behaviour that produces a smile (Marini & Case, 1989).

Children in the dimensional stage (5–11 years) can focus on multiple dimensions simultaneously, and they begin to make finer discriminations between these operations. Their mental representations involve categories of relationals and dimensions such as *height and weight* and *happy and sad.* For example, children at this stage can consider information related to the discrepancy between what people expect and what they receive when assessing the degree of happiness or disappointment they feel (Marini, 1992).

At the vectorial stage (11–19 years), individuals can operate on mental elements that are second-order categories. These elements tend to be abstract concepts and have properties similar to vectors. An example would be solving two ratios to predict which side of a balance beam would fall. Similarly, in the social domain students at this stage can assess an individual's personality from information provided and then use that information to make predictions about future behaviour (Marini & Case, 1994).

Case believed that children's developmental progression across the stages is a function of more efficient use of working memory, which provides them with a greater ability to

process more complex information. An analogy can be drawn between a blackboard and children's working-memory storage capacity (described in greater detail in Chapter 8). A blackboard has a fixed amount of space that can be used to record/store information. The amount of space on the blackboard cannot be changed. However, the working capacity of the blackboard can change depending on how effectively the available space is used. If one writes in very large scribbles and in a messy and unorganized fashion, then the amount of information stored is limited. Similarly, the ability to remember what was written and where it was recorded is also compromised.

If, on the other hand, one writes neatly with small print and presents information in a systematic and organized manner, then much more information can be placed on the blackboard. In this instance, it appears that more space is available even though the surface area (or storage capacity) of the blackboard has not changed. In addition, by presenting the information in an organized manner, the ability to retrieve it is greatly improved.

According to Case, four factors contribute to maturational gains in the capacity of working memory: 1) myelination, 2) automatization through practice, 3) social experience and cultural variation, and 4) the development of central conceptual structures.

1) *Myelination.* Case asserts that synaptic growth and pruning and the increased development of myelin sheaths (which act as a neural insulator and improve neural transmission) increases the efficiency of mental operations and facilitates children's progression from one stage to the next (Case, 1985; 1992b).

2) *Automatization through practice.* Case maintains that by practising certain operations repeatedly, children achieve automaticity in those processes. Automatization frees up attention resources that in turn can be used for other activities, including the execution of more complex operations. An example of this process occurs when people learn to drive. At the beginning, all of the driver's attentional capacity is allocated to keeping the car on the road. However, as operations such as checking the rearview mirror become automatic, other operations such as reading street signs or adjusting the radio can be performed more readily.

3) *Social experiences and cultural variation.* Case argued that social experience and cultural variation plays a major role in children's development. He was quite sensitive to the importance of family and school experiences as well as cultural variation in shaping children's problem-solving abilities. Culture can be interpreted as referring to immediate environments such as school as well as more general contexts such as the larger dominant culture with its scientific paradigms, artistic traditions, and social customs (Case et al., 1996).

4) *The development of central conceptual structures.* As a result of automatization children acquire *central conceptual structures*, networks of concepts that permit them to think about a range of situations in a more complex and advanced manner. Central conceptual structures are best thought of as cognitive structures that are not as broad and universal as Piaget's notion of stages and not as narrow as those of domain-specific proponents. These cognitive structures allow children to understand events that spring from similar concepts and themes such as the behaviours, norms, and expectations surrounding social events (Case, 1997). These structures have large implications for educational and curriculum issues (Griffin & Case, 1997; Kalchman & Case, 1998; Case, Griffin, & Kelly, 1999).

Vygotsky's Theory

Like Piaget, Lev Vygotsky (1896–1934) also believed that children actively construct their knowledge. Vygotsky was born in Russia in the same year as Piaget was born, but died much younger than Piaget did, at the age of 37. Both Piaget's and Vygotsky's ideas remained virtually unknown to North American scholars for many years, not being introduced to North American audiences through English translations until the 1960s. In the last several decades, psychologists and educators have shown increased interest in Vygotsky's (1962) views.

Vygotsky's Assumptions   Three claims capture the heart of Vygotsky's views (Tappan, 1998): (1) The child's cognitive skills can be understood only when they are developmentally analyzed and interpreted; (2) cognitive skills are mediated by words, language, and forms of discourse, which serve as psychological tools for facilitating and transforming mental activity; and (3) cognitive skills have their origins in social relations and are embedded in a sociocultural backdrop.

For Vygotsky, taking a developmental approach means that in order to understand any aspect of the child's cognitive functioning, one must examine its origins and transformations from earlier to later forms. Thus, a particular mental act such as using inner speech (see below) cannot be viewed accurately in isolation but should be evaluated as a step in a gradual developmental process.

Vygotsky's second claim, that to understand cognitive functioning it is necessary to examine the tools that mediate and shape it, led him to believe that language is the most important of these tools. Vygotsky argued that in early childhood language begins to be used as a tool that helps the child plan activities and solve problems.

Vygotsky's third claim was that cognitive skills originate in social relations and culture. Vygotsky portrayed the child's development as inseparable from social and cultural activities. He believed that the development of memory, attention, and reasoning involves learning to use the inventions of society, such as language, mathematical systems, and memory strategies. In one culture this could consist of learning to count with the help of a computer; in another it could consist of counting on one's fingers or using beads.

Vygotsky's theory has stimulated considerable interest in the view that knowledge is *situated* and *collaborative* (Greeno, Collins, & Resnick, 1996; Rogoff, 1998). That is, knowledge is distributed among people and environments, which include objects, artifacts, tools, books, and the communities in which people live. This suggests that knowing can best be advanced through interaction with others in cooperative activities.

Within these basic claims, Vygotsky articulated unique and influential ideas about the relation between learning and development. These ideas especially reflect his view that cognitive functioning has social origins. One of Vygotsky's unique ideas was his concept of the zone of proximal development.

The Zone of Proximal Development   **Zone of proximal development (ZPD)** *is Vygotsky's term for the range of tasks that are too difficult for children to master alone but that can be learned with guidance and assistance from adults or more-skilled children.* Thus, the lower limit of the ZPD is the level of problem solving reached by the child working independently. The upper limit is the level of additional responsibility the child can accept with the assistance of an able instructor (see Figure 2.6). Vygotsky's emphasis on the ZPD underscores his belief in the importance of social influences, especially instruction, on children's cognitive development.

Vygotsky (1987) gave this example of how to assess a child's ZPD: Suppose that, by an intelligence test, the mental age of two children is determined to be eight years. With Vygotsky in mind, we can't stop there. To go on, we seek to determine how each of these children will attempt to solve problems meant for older children. We assist each child by demonstrating, asking leading questions, and introducing the initial elements of the solution. With this help or collaboration with the adult, one of these children solves problems at the level of a 12-year-old child and the other solves problems at the level of a 9-year-old child. This difference between the children's mental ages and the level of performance they achieve in collaboration with an adult defines the zone of proximal development. Thus, the ZPD involves the child's cognitive skills that are in the process of maturing, and their performance level, with the assistance of a more-skilled person (Panofsky, 1999). Vygotsky (1978) called these the "buds" or "flowers" of development, to distinguish them from the "fruits" of development, which the child already can accomplish independently. An application of Vygotsky's concept of the zone of proximal development is the one-on-one instruction provided by many Canadian teachers using the Australian-based Reading Recovery program (Clay & Cazden, 1990). Over time, students participating in these sessions can attain average or close to average grade-cohort reading levels (see Begoray, 2001 for an example of a Canadian-based Reading Recovery program).
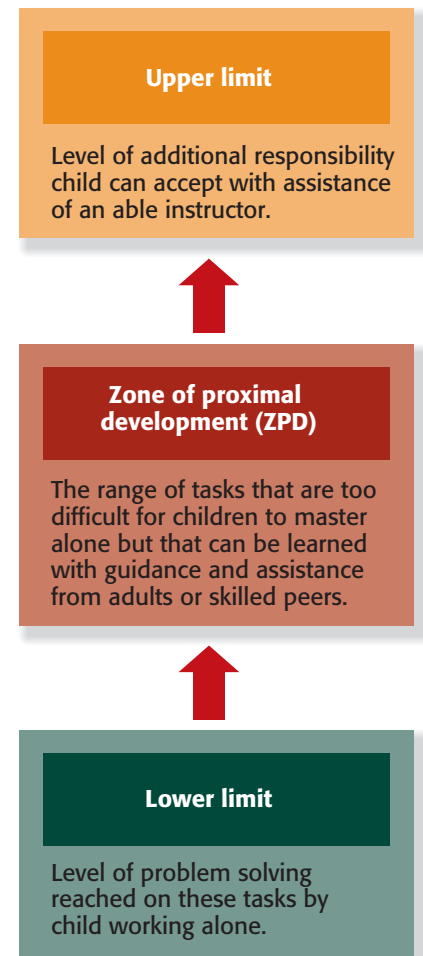
Upper limit

Level of additional responsibility child can accept with assistance of an able instructor.

Zone of proximal development (ZPD)

The range of tasks that are too difficult for children to master alone but that can be learned with guidance and assistance from adults or skilled peers.

Lower limit

Level of problem solving reached on these tasks by child working alone.

FIGURE 2.6   Vygotsky's Zone of Proximal Development
Vygotsky's zone of proximal development has a lower limit and an upper limit. Tasks in the ZPD are too difficult for the child to perform alone. They require assistance from an adult or a more-skilled child. As children experience the verbal instruction or demonstration, they organize the information in their existing mental structures, so they can eventually perform the skill or task alone.

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Through the Eyes of Teachers

The Importance of Scaffolding Instruction

While home schooling my son, I quickly came to understand the importance of scaffolding, or "talking through tasks," in order to help him understand new content and maintain his interest in learning. Over time, my son knew to "talk it out" whenever he ran into a problem. My job was to listen to his thoughts and provide instructional hints and encouragement. By gently guiding his learning, I was able to improve his skills and confidence to learn new things.

For example, while reading *The Underground Railroad* we spent a lot of time exploring the themes of democracy, freedom, slavery, human rights, and political dissent. My son became so involved with the novel that he researched and wrote his own book about the secret symbols and language used by members of the underground railroad. Watching him "talk" his way through the writing of this book convinced me that every skill you teach a child is a springboard for another one. Teaching children means helping them learn to talk their way through activities so that they will gain the confidence to explore new concepts and skills.

Barb Gallant
Home Schooled Three Sons over Four Years
Elementary Teacher
New Brunswick

Scaffolding   Closely linked to the idea of the zone of proximal development is the concept of **scaffolding**. *Scaffolding is a technique of changing the level of support. Over the course of a teaching session, a more-skilled person (a teacher or a more-advanced peer of the child) adjusts the amount of guidance to fit the student's current performance level.* When the task the student is learning is new, the more-skilled person might use direct instruction. As the student's competence increases, less guidance is given.

Dialogue is an important tool of scaffolding in the zone of proximal development (John-Steiner & Mahn, 1996; Tappan, 1998). Vygotsky viewed children as having rich but unsystematic, disorganized, and spontaneous concepts. These meet with the skilled helper's more systematic, logical, and rational concepts. As a result of the meeting and dialogue between the child and the skilled helper, the child's concepts become more systematic, logical, and rational. We will have much more to say about scaffolding and other social interactive aspects of learning in Chapter 9, Social Constructivist Approaches, Domain-Specific Approaches, and Teaching.

Language and Thought   Vygotsky (1962) believed that young children use language not only for social communication but also to plan, guide, and monitor their behaviour in a self-regulatory fashion. The use of language for self-regulation is called *inner speech* or *private speech*. For Piaget, private speech was egocentric and immature, but for Vygotsky it was an important tool of thought during the early childhood years.

Vygotsky believed that language and thought initially develop independently of each other and then merge. He said that all mental functions have external or social origins. Children must use language to communicate with others before they can focus inward on their own thoughts. Children also must communicate externally and use language for a long period of time before the transition from external to internal speech takes place. This transition period occurs between the ages of three and seven and involves talking to oneself. After a while, the self-talk becomes second nature to children and they can act without verbalizing. When this occurs, children have internalized their egocentric speech in the form of inner speech, which becomes their thoughts. Vygotsky believed that children who use a lot of private speech are more socially competent than those who don't. He argued that private speech represents an early transition in becoming more socially communicative.

Vygotsky's view challenged Piaget's ideas on language and thought. Vygotsky said that language, even in its earliest forms, is socially based, whereas Piaget emphasized young children's egocentric and nonsocial speech. For Vygotsky, when young children talk to themselves they are using language to govern their behaviour and guide themselves, whereas Piaget believed that such self-talk reflects immaturity. Researchers have found support for Vygotsky's view of the positive role of private speech in children's development (Winsler, Diaz, & Montero, 1997).

Evaluating and Comparing Cognitive and Social Constructivist Theories
Constructivist theories emphasize that children actively construct knowledge and understanding rather than being passive receptacles of learning. However, the various theories differ in focus and approach to how such learning takes place. Vygotsky's theory is a social constructivist approach that focuses on the social contexts of learning. Piaget's theory does not have such a strong social emphasis, focusing instead on cognitive development and its impact on learning (Hogan & Tudge, 1999). Case's theory combines elements of

Vygotsky's social constructivism and Piaget's cognitive development theories, proposing that students' capabilities for constructing knowledge is facilitated by a skilfully directed social process (McKeough, 2000; Morra, 2002).

All three constructivist theories presented here have been embraced by teachers and applied to education (Doolittle, 1997; McKeough, 2000; Morra, 2001). For example, Vygotsky's view of the importance of sociocultural influences on children's development is consistent with contemporary societal beliefs about the importance of context and culture on learning. Moving from Piaget to Vygotsky to Case, the conceptual shift is from the individual to collaboration, social interaction, and sociocultural activity (Rogoff, 1998). In Piaget's model, students construct knowledge by transforming, organizing, and reorganizing previous knowledge. For Vygotsky, students construct knowledge through social interaction with others (Kozulin, 2000). Case's model argues that, while children construct knowledge by organizing information into more meaningful cognitive structures, this process is facilitated by social interaction and instructional design that is sensitive to their individual memory capabilities.

Teaching Strategies
For Applying Constructivist Theories in the Classroom

✔ Actively engage students in the learning process
  - acknowledge students' prior knowledge and experiences and begin instruction at that level
  - do not push students to achieve too much too early—emphasis on speed of learning and intellectual development encourages passive learning
  - provide maximum amount of instruction, practice, and support
  - encourage students to ask questions, make discoveries, and reflect on them
  - gradually reduce number of explanations, hints, and demonstrations as students begin to master skills
✔ Use scaffolding
  - observe students carefully to discover how they think versus what they think and the product of their thinking
  - provide support for students' self-initiated learning attempts
  - provide instructional assistance and direction only when needed
  - ask questions that stimulate students' thinking
  - ask students to explain their answers
  - provide encouragement and encourage practice
✔ Use skilled peers
  - encourage students to serve as tutors
  - provide structure for small-group work
  - encourage cooperative learning
✔ Monitor and encourage students' use of private speech
  - acknowledge developmental changes from external talk (preschool years) to internal talk (elementary-school years) during problem solving
  - encourage students to internalize and self-regulate their talk
  - balance instructional memory capabilities with task requirements
✔ Use ongoing assessment
  - use tasks of varying difficulty to determine where to begin instruction
  - acknowledge the limitations of standardized tests
  - use authentic assessment measures that reflect students' ongoing efforts, as well as their final products (e.g., portfolios, student–teacher conferences, written and verbal reasoning)

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All three theories have implications for classroom teachers. Piaget's theory stresses the need to have students explore the world around them and discover knowledge. Vygotsky's theory suggests that discovery and learning are facilitated by skilful teachers and students' interactions with more-skilled peers. Case's theory calls attention to the need for teachers to plan learning activities that balance learners' individual memory capabilities with the complexity of task requirements and a supportive social environment. In each of these theories, teachers function as facilitators rather than directors of student learning. Figure 2.7 compares the three theories based on their major ideas and their implications for teaching and learning.

At this point we have studied a number of ideas about children's cognitive development. A review of these ideas is presented in Summary Table 2.2. Next, we will explore another key aspect of children's development—language.

TOPIC	PIAGET	CASE	VYGOTSKY
Constructivism	Cognitive constructivist	Cognitive and social constructivist	Social constructivist
Stages	Strong emphasis on stages (sensorimotor, preoperational, concrete operational, and formal operational)	Emphasis on stages (sensorimotor, interrelational, dimensional, and vectorial)	No general stages of development proposed
Key processes	Schema, assimilation, accommodation, operations, conservation, classification, hypothetical-deductive reasoning	Working memory, myelination, automatization through practice, and central conceptual structures	Zone of proximal development, language, dialogue, tools of the culture
Role of language	Minimal; cognition primarily directs language	Language plays a central role in the development of strategies	Major; language plays a powerful role in shaping thought
View on education	Education merely refines the child's cognitive skills that already have emerged	Education plays a critical role in the transmission of knowledge from one generation to the next	Education plays a central role, helping children learn the tools of the culture
Teaching implications	Also views the teacher as a facilitator and guide, not a director; provide support for children to explore their world and discover knowledge	The teacher guides students' learning by providing instruction that is a good fit with their working memory capacity and capabilities	The teacher is a facilitator and guide, not a director; establish many opportunities for students to learn with the teacher and more-skilled peers

FIGURE 2.7 **Comparing Constructivists' Theories**

SUMMARY TABLE 2.2
## Cognitive Development

What is Piaget's theory of cognitive development?	• There are two main processes in children's cognitive development: assimilation and accommodation. Both involve schemas. • Cognitive development unfolds in four stages: sensorimotor (ages 0–2), preoperational (ages 3–7), concrete operational (ages 7–11), and formal operational (ages 11–15). • Sensorimotor stage—infants construct an understanding of the world by coordinating sensory experiences with motor actions and accomplish object permanence. • Preoperational stage—thought is more symbolic and intuitive. Egocentrism, animism, and centration are constraints. • Concrete operational stage—children can perform operations and logical thought replaces intuitive thought when reasoning can be applied to concrete examples. Classification, seriation, and transitivity are concrete operational skills. • Formal operational stage—thinking is abstract, idealistic, and logical. Hypothetical-deductive reasoning becomes important. Adolescent egocentrism characterizes many young adolescents.
What is Case's stage theory?	• Progression through the stages occurs because of improvements in working memory capacity, which result in a greater ability to process information. • Three factors are responsible for capacity gains: 1) myelination, 2) automatization through practice, and 3) the development of central conceptual structures.
What is Vygotsky's theory?	• Cognitive skills need to be interpreted developmentally. Cognitive skills are mediated by language and have their origins in social relations and culture. • Zone of proximal development is the range of tasks that are too difficult for students to master alone but that can be learned with the guidance and assistance of adults and more-skilled peers. • Scaffolding is a teaching strategy that involves changing the level of support over the course of a teaching session, with the more-skilled persons adjusting their guidance to fit the students' current performance levels. • Language plays a key role in guiding cognition.
How do Piaget, Case, and Vygotsky's theories compare?	• Piaget contributed to the current vision of the child as an active, constructivist thinker. Piaget is a cognitive constructivist. • Case's theory provides a finer-grained analysis about how children develop and learn. Case is a neo-Piagetian theorist. Vygotsky's ideas related to sociocultural influences on children's development and learning have been applied to education. Vygotsky is a social constructivist.

LANGUAGE DEVELOPMENT

Think about how important language is in teachers' and students' lives. They need language to speak to others, listen to others, read, and write. They need language to describe past events in detail and to plan for the future.

What Is Language?

Language *is a form of communication, whether spoken, written, or signed, that is based on a system of symbols.* All human languages are generative. **Infinite generativity** *is the ability*
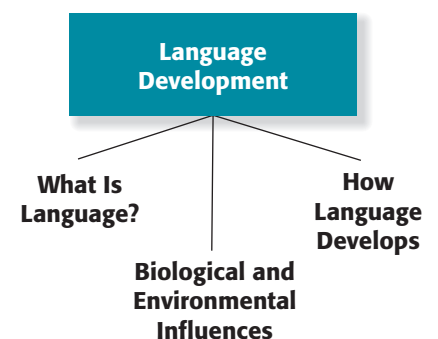
to produce an endless number of meaningful sentences using a finite set of words and rules. This quality makes language a highly creative enterprise. All human language also follows the organizational rules of phonology, morphology, syntax, semantics, and pragmatics.

Spoken language is made up of basic sounds, or phonemes. An example of a phoneme in the English language is /k/, the sound represented by the letter *k* in the word *ski*, the letter *c* in the word *cat*, and the letters *ch* in *Christmas*. **Phonology** *is a language's sound system.* Phonological rules allow some sound sequences to occur (such as *sp*, *ba*, or *ar*) and prohibit others (such as *zx* or *qp*). To learn the phonology of a language, children must learn its sound inventory and permissible sequences of sounds, which are important later for reading (Oller, 2000).

Morphology *refers to the rules for combining morphemes, which are meaningful strings of sounds that contain no smaller meaningful parts.* Every word in the English language is made up of one or more morphemes. Some words consist of a single morpheme (such as *help*). Others are made up of more than one morpheme (such as *helper*, which has two morphemes, *help + er*; though not a word itself, the morpheme *-er* means "one who"— in this case, "one who helps"). Just as the rules that govern phonemes ensure that certain sound sequences occur, the rules that govern morphemes ensure that certain strings of sounds occur in particular sequences and conform with other rules (Vander Lely & Ullman, 2001). For example, we cannot reorder *helper* to *erhelp* and we cannot talk about an *undog* or about *desking*.

Syntax *involves the way words are combined to form acceptable phrases and sentences.* If someone says to you "Chelsea gave the pencil to Dominique," you know who was the giver and who was the receiver because you understand the sentence structure. This concept of "who does what to whom" is an important type of syntactic information. You also understand that the sentence *You didn't stay, did you?* is a grammatical sentence but *You didn't stay, didn't you?* is not.

Semantics *refers to the meaning of words and sentences.* Every word has a set of semantic features. For example, *girl* and *woman* share the same semantic denotations of *female* and *human* but differ in their meanings regarding age. Words have semantic restrictions on how they can be used with each other in sentences (Townsend & Bever, 2001). The sentence *The bicycle talked the boy into buying it candy* is syntactically correct but semantically incorrect. The sentence violates our semantic knowledge that bicycles do not talk!

Pragmatics *involves the use of appropriate conversation.* This involves knowledge about context in which to say what to whom and how to say it (Nakamura, 2001). For example, pragmatics is involved when children learn the difference between polite and rude language, as well as when they learn to tell a joke in such a way that it comes across as funny.

Biological and Environmental Influences

Famous linguist Noam Chomsky (1957) argued that humans are prewired to learn language at a certain time and in a certain way. The strongest evidence for the biological basis of language is that children all over the world acquire language milestones at about the same time developmentally and in about the same order, despite vast variations in the language input they receive. For example, in some cultures adults never talk to their infants under one year of age, yet these infants still acquire language.

Children vary in their acquisition of language in ways that cannot be explained by environmental input alone (Hoff, 2001). For example, pioneering language researcher Roger Brown (1973) searched for evidence that parents reinforce their children for speaking grammatically. He found that they sometimes smiled and praised their children for sentences they liked, but they also reinforced sentences that were ungrammatical. From these observations, Brown concluded that processes operating within the child were overriding the environmental input of reinforcement.

However, children do not learn language in a social vacuum (Snow & Beals, 2001). Enough variation occurs in language development when children's caregivers differ substantially in input styles to know that the environment plays a significant role in language development, especially in the acquisition of vocabulary (Tamis-LeMonda, Born-

stein, & Baumwell, 2001). Even before they go to school, most children have already been steeped in language. In or out of school, encouragement of language development, not drill and practice, is the key (de Villiers, 1996; de Villiers & de Villiers, 1999). Language development is not simply a matter of being rewarded for saying things correctly and imitating a speaker. Children benefit when their parents and teachers actively engage them in conversation, ask them questions, and emphasize interactive rather than directive language. In one recent study, Farkas (2001) observed that three-year-olds living in poverty showed vocabulary deficits compared to their counterparts in middle-income families, and that these deficits remained when they entered school at six years of age.

Verbal behaviour and its effect on language has been studied by University of Guelph researcher Mary Ann Evans (1996). She found that more than two-thirds of kindergarten students who were nonverbal in the fall term remained nonverbal in the spring term. Evans tracked these students into Grade 1 and noted that the nonverbal kindergarten students obtained lower scores than their verbally active peers on a variety of language tests. The study implies that language and communication skills are a substantial component of verbal participation in the primary classroom.

In sum, children are neither exclusively biological linguists nor exclusively social architects of language (Berko-Gleason, 2000; Gleason & Ratner, 1998). No matter how long you converse with a dog it won't learn to talk, because it doesn't have the human child's biological capacity for language; unfortunately, some children fail to develop good language skills even in the presence of very good role models and interaction. An interactionist view emphasizes the contributions of both biology and experience in language development. That is, children are biologically prepared to learn language as they and their teachers interact. To read about how Frontier College promotes life-long language learning for all Canadians, see the Diversity and Education box on page 58.

"No, Timmy, not 'I sawed the chair'; it's I saw the chair' or 'I have seen the chair.'"
© *Glenn Bernhardt*

How Language Develops

Language acquisition advances through a number of milestones (Bloom, 1998). Babbling begins at about 3 to 6 months. Infants usually utter their first word at about 10 to 13 months. By 18 to 24 months, infants usually have begun to string two words together. In this two-word stage, they quickly grasp the importance of language in communication, creating phrases such as "Book there," "My candy," "Mama walk," and "Give Papa."

As they move beyond two-word utterances, children clearly show that they know some morphological rules (the rules of language that tell how sounds must be combined). Children begin using the plural and possessive forms of nouns (*dogs* and *dog's*); put appropriate endings on verbs (*-s* when the subject is third-person singular, *-ed* for the past tense); use prepositions (*in* and *on*), articles (*a* and *the*), and various forms of the verb *to be* ("I *was going* to the store"). They also tend to overgeneralize these rules. Have you ever heard a preschool child say "foots" instead of "feet," or "goed" instead of "went"? Ask parents who have young children or talk to a young child; you will likely hear some interesting morphological errors.

Some of the best evidence that children develop morphological rules rather than memorize individual words was demonstrated in a classic experiment by Jean Berko-

Diversity and Education
Frontier College Promotes Life-Long Learning for All Canadians

Frontier College is an institution with a reputation for unlocking opportunity for learners who face closed doors. Alfred Fitzpatrick, the founder of Frontier College, devoutly believed that education should be the right of all people, not just the wealthy. Frontier College is a Canada-wide, volunteer-based literacy organization. The organization focuses on developing an individual's communication and literacy skills by fostering an environment favourable to life-long learning (Fernandez & Thompson, 2000).

At the turn of the twentieth century, Frontier College instructors began to educate labourers at their work sites. In tents and boxcars, some of these men began by learning to write their names. Decades later, in the mid-1960s, Frontier College embarked on the Elliot Lake Project. Due to the decline in the uranium market, laid-off workers in this Northern Ontario town found themselves unemployable due to their lack of literacy skills. Over the course of two years, Frontier College teachers immersed themselves in this community and taught basic reading and writing to hundreds of men. Throughout the 1980s, the College's Beat the Street programs provided peer tutoring in Winnipeg, Regina, and Toronto.

The modern focus for Frontier College is to provide support for students who are disadvantaged by poverty, geographic isolation, or social oppression. It is their belief that life-long learning contributes to individuals' abilities to be self-sufficient and accomplish their goals. Currently, Frontier College runs evening tutorials in inner-city Toronto schools for immigrant children. English instruction is delivered by students from the neighbouring University of Toronto. In fact, Canada-wide there are more than 2,000 university students and community volunteers acting as literacy tutors. Work has begun in isolated locales such as Labrador, the Northwest Territories, and Nunavut to provide distance learning in areas such as literacy and health education. More than 100 years after it was founded, Frontier College is keeping the doors of opportunity open for all Canadians to be life-long learners.

Gleason (1958). Preschool and Grade 1 children were presented with cards like the one shown in Figure 2.8. The children were asked to look at the card while the experimenter read the words on it aloud. Then the children were asked to supply the missing word. Berko was interested in their ability to recall the right word and their ability to say it "correctly." The children showed they knew the morphological rules involved by generating the plural forms of the fictional words (i.e., "wugs").

Although the children's answers were not perfect, they were much better than chance. Moreover, the children demonstrated their knowledge of morphological rules, not only with plural forms of nouns ("There are two wugs") but also with possessive forms of nouns and the third-person-singular and past-tense forms of verbs. What makes Berko's study impressive is that most of the words were nonsensical or made up. Thus, the children could not base their responses on remembering past instances of hearing the words. Instead, they were forced to rely on *rules*.

Young children also learn to manipulate syntax. They can generate questions, passive constructions, clauses, and all the major syntactical structure of their language. Similar evidence that children learn and actively apply rules occurs at the level of syntax. After advancing beyond two-word utterances, children speak word sequences that reflect a growing mastery of complex rules for how words should be ordered. Consider *wh*-questions, such as "Where is Daddy going?" Children typically learn by age three where to put the *wh*- word but might continue for another year learning to put the question as "Where Daddy is going?"

As children move into the elementary-school years, they become skilled at using syntactical rules (the rules about how to combine words to form acceptable phrases and sentences) to construct lengthy and complex sentences (Goldin-Meadow, 2000). They might say something like, "After the man cut the grass, he left and went home." By the end of elementary school, most children can apply appropriate rules of grammar.

Regarding semantics (the rules about the meaning of words and sentences), as children move beyond the two-word stage their knowledge of meanings also rapidly advances (Sanford, 2000). The speaking vocabulary of a six-year-old child ranges from 8,000 to 14,000 words. Assuming that word learning began when the child was 12 months old, this translates into a rate of five to eight new word meanings a day between the ages of one and six. After five years of learning words, the six-year-old child does not slow down. Some children are moving along at the awe-inspiring rate of learning more than 22 words a day. By the time children reach the end of elementary school, many have added another 5,000 to 7,000 words to their vocabulary.

Children who begin elementary school with a small vocabulary may be at risk when it comes to learning to read (Berko-Gleason, 2002). In a two-year longitudinal study of students in Grades 4, 5, and 6, it was found that exposure to print can support vocabulary development and cognitive growth in the verbal domain (Echols, West, Stanovich, & Zehr, 1996). Print exposure is critical for the development of reading and verbal skills (e.g., receptive vocabulary, spelling, reading vocabulary, and reading comprehension).

Changes in pragmatics (the rules about appropriate conversation) also characterize children's language development. A six-year-old is a much better conversationalist than a three-year-old. At about three years of age, children improve in their ability to talk about things that are not physically present. That is, they improve their command of the characteristic of language known as "displacement." Children become increasingly removed from the here and now and are able to talk about things that are not physically present, as well as things that happened in the past, or that may happen in the future. Preschoolers can tell you what they want for lunch tomorrow, something that would not have been possible at the two-word stage in infancy. Preschool children also become increasingly able to talk in different ways to different people. Elementary-school children are more sensitive to the needs of others in conversation than preschool children are. They aren't perfect conversationalists (and neither are most adults), but they are better at talking *with* rather than just *to* someone.

The advances in language that take place in early childhood lay the foundation for later development in the elementary-school years. Children gain new skills as they enter school that make it possible to learn to read and write. Such skills include using language in a displaced way, learning what constitutes a word, and learning how to recognize and talk about sounds (Berko-Gleason, 2002). They have to learn that the alphabet letters represent sounds of the language (alphabet principle). As children develop during middle and late childhood, changes in their vocabulary and grammar also take place.

During middle and late childhood, a change occurs in the way children think about words. They become less tied to the actions and perceptual dimensions associated with words, and they become more analytical in their approach to words.

When asked to say the first word that comes to mind after hearing a prompt, young children typically provide a word that often follows in a sentence. For example, when asked to respond to "dog" the young child may say "barks," or say "lunch" at the prompt "eat." At about seven years of age, children begin to respond with a word that represents the same part of speech as the prompt. For example, a child may now respond to the prompt "dog" with "cat" or "horse." To the prompt "eat," they now might say "drink." This is evidence that children have begun to categorize their vocabulary by parts of speech (Berko-Gleason, 2002).

This is a wug.

Now there is another one. There are two of them. There are two _____.

FIGURE 2.8   Stimuli in Berko-Gleason's Study of Young Children's Understanding of Morphological Rules In Jean Berko-Gleason's (1958) study, young children were presented cards such as this one with a "wug" on it. Then the children were asked to supply the missing word and say it correctly. "Wugs" is the correct response here.

Through the Eyes of Students

Learning the Meaning of New Words

It is important to know what words mean so that you can understand what people are telling you. A good place to learn new words is at school. You can also learn new words at home. I learned the new word "concentrate" at school when my desk partner kept talking to me. I told the teacher and she told my desk partner to let me "concentrate." He did not know what that word meant, so the teacher explained that he was to let me do my work without any interruptions. That is how I learned about the word "concentrate."

Beckie
Grade 2 Student
Likes to Play with Friends; Jujitsu, Soccer, and Bowling Enthusiast
Ontario

Children make similar advances in grammar. The elementary-school student's improvement in logical reasoning and analytical skills helps in the understanding of such constructions as the appropriate use of comparatives (shorter, deeper) and subjectives ("If you were prime minister…").

In adolescence, vocabulary increases with the addition of more abstract words. More complex grammar forms are better understood, as is the function a word plays in a sentence. Adolescents also show an increased understanding of metaphor and satire. In late adolescence, individuals can better appreciate adult literary works. Figure 2.9 summarizes some of the main milestones in language.

Children pick up words as pigeons pick up peas.

John Ray
English Author, 17th Century

FIGURE 2.9   Language Milestones

AGE PERIOD	CHILD'S DEVELOPMENT/BEHAVIOUR
0–6 Months	Cooing Discrimination of vowels Babbling present by end of period
6–12 Months	Babbling expands to include sounds of spoken language Gestures used to communicate about objects
12–18 Months	First words spoken Understand vocabulary 50+ words on the average
18–24 Months	Vocabulary increases to an average of 200 words Two-word combinations
2 Years	Vocabulary rapidly increases Correct use of plurals Use of past tense Use of some prepositions
3–4 Years	Mean length of utterances increases to 3–4 morphemes a sentence Use of "yes" "no" questions, *wh-* questions Use of negatives and imperatives Increased awareness of pragmatics
5–6 Years	Vocabulary reaches an average of about 10,000 words Coordination of simple sentences
6–8 Years	Vocabulary continues to increase rapidly More skilled use of syntactical rules Conversational skills improve
9–11 Years	Word definitions include synonyms Conversational strategies continue to improve
11–14 Years	Vocabulary increases with addition of more abstract words Understanding of complex grammar forms Increased understanding of function a word plays in a sentence Understanding of metaphor and satire
15–20 Years	Can understand adult literary works

Note:
1. This is not an exhaustive list.
2. There is a great deal of variation in the ages at which children can reach these milestones and still be considered within the normal range of language development.

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Technology and Verbal Language Development

A growing body of research suggests that technology can be used to enhance the social, language, and cognitive skills of students by providing them with appealing and motivating opportunities for language use and social interaction (Senge, 2000). Children acquire spoken language skills in part by participating in dialogue with other people. Computers, games, and technologies equipped with voice-synthesis and text-reader software can help children develop an understanding of sound patterns and language communication patterns. These technologies can also provide students with opportunities for meaningful play and social interactions, from which language skills can further develop.

Tape recorders, talking books, and computer programs can be useful in integrating the many aspects of literacy including speaking, listening, reading, and writing (Novick, 1998). Tape recorders allow students to record stories, songs, or poems and to hear themselves speak aloud. Talking books and computer programs combine audio and visual information in storybook or game formats that enable children to control the pace at which information is presented. Talking books allow learners to see and hear what they are reading as they view accompanying illustrations. Hearing a word or phrase paired with a picture helps young students draw associations between the pictures and verbal language. Talking books encourage vocalizations and word approximations from children, allowing them to control the action and providing them with consistent auditory feedback.

Computer programs such as Symbol Writer (Don Johnston), Muppets on Stage (Sunburst), and Word Heads (Theatrix Interactive) combine graphics, animation, music, and speech-synthesis technologies. For example, Word Heads is a CD-ROM designed for 10- to 14-year-olds that focuses on improving students' vocabulary skills. Students design personalized characters by scanning their own faces from photographs, or drawing custom heads, or importing pictures to use while playing various game shows. Students create narratives by inserting nouns, adjectives, verbs, and idioms into story templates. When the narratives are played back, students learn more about the importance of context for verbal communication.

While games and talking books are useful tools in teaching verbal language, having a teacher or adult participate or supervise is a vital part of providing the scaffolding and guidance needed to make the most of this technology. The critical role of the teacher or parent is in being a receptive and supportive human communication partner.

At this point we have discussed a number of ideas about the nature of language, biological and environmental influences, and language development. A review of these ideas is presented in Summary Table 2.3.

SUMMARY TABLE 2.3

What Language Is, Biological and Environmental Influences, and How Language Develops

What is language?	• Language is a form of communication, whether spoken, written, or signed, that is based on a system of symbols. • Human languages are generative and have organizational rules. • Phonology is a language's sound system. • Morphology is the rules for combining morphemes (the meaningful strings of sounds that contain no smaller meaningful parts). • Syntax is the rules for combining words to form acceptable phrases and sentences. • Semantics is the meanings of words and sentences. • Pragmatics is the use of appropriate conversation.
What are the biological and environmental influences on language?	• Children all over the world reach language milestones at about the same age despite vast differences in their environmental experiences. • Biology and experience interact to produce language development. • Children do not learn language in a social vacuum. • Children benefit when parents and teachers actively engage them in conversation, ask them questions, and talk with, not just to, them. • Language and communication skills are a substantial component of verbal participation in the primary classroom.
How does language develop?	• Language acquistion advances through stages. • Babbling occurs at about 3 to 6 months, the first word at 10 to 13 months, and two-word utterances at 18 to 24 months. • As children move beyond two-word utterances, they acquire some morphological rules. • Children also advance in their understanding of syntax, semantics, and pragmatics and begin to categorize their vocabulary by parts of speech. • By the end of elementary school, most students can apply appropriate rules of grammar. • In adolescence, vocabulary increases with the addition of more abstract words.

Every year, Ms. Nohara required her secondary-school senior history class to read two books about "government or political systems" and to write a brief report about each text.

One student in her class, Liam, selected *1984* and *Animal Farm* by George Orwell. In 1984, the world turns into a terrible place in which "Big Brother" monitors everyone's actions via two-way television-like screens. Infractions of minor rules are punished severely. *Animal Farm* is a short novel about political systems in which the characters are portrayed as farm animals such as pigs and dogs. Liam enjoyed both books and finished them both before mid-term. His reports were insightful, reflecting on the symbolism contained in the novels and the implications for present-day government.

Liam's friend, Pita, had put off reading her first book until a few days before the reports were due. She knew Liam enjoyed reading about government and had finished his reports. Pita asked Liam if he knew of any "skinny" books that she could read. Liam gladly shared his copy of *Animal Farm* with her. Pita accepted the book, very pleased that it was so short. However, as she began reading the book, she wondered why Liam had given it to her. It didn't seem to fit the requirements of the assignment at all.

The day before the reports were due, Ms. Nohara overheard the students talking. Pita complained to Liam, "I don't get it. It's a story about pigs and dogs." Liam responded, "They aren't really supposed to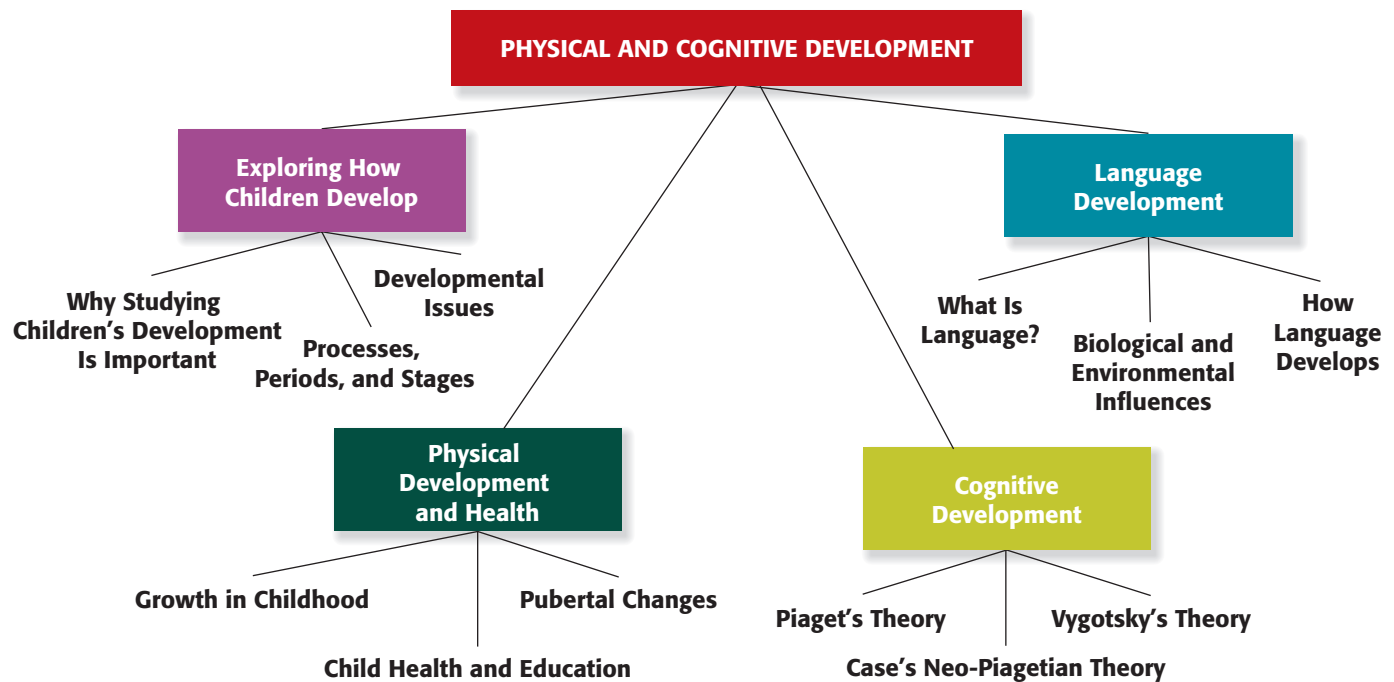 be farm animals. It's a story about the promises of communism and what happened in the Soviet Union once the communists took over. It's a great story! Don't you see? The pigs represent the communist regime that overthrew the czars during the Russian Revolution. They made all kinds of promises about equality. The people supported them because they were tired of the rich and powerful running everything while they starved. Once the czars were expelled, the communists set up a new government. But they didn't keep any of their promises. Instead, they controlled everything and began acting just like the czars. They even began a secret police force—like the dogs in the story. Remember how they bullied the other animals? That was just like the secret police in the Soviet Union."

"I still don't get it. How can a pig or a dog be a communist or a police officer? They're just animals."

Liam looked at his friend, dumbfounded. How could she *not* understand this book? It was so obvious.

- Using Piaget's theory, explain why Liam understood the book and Pita didn't.
- What could Ms. Nohara do to help Pita better understand the novel?
- How could Ms. Nohara have structured this assignment so that Pita would not need to rush through the texts to complete the assignment?

CHAPTER REVIEW

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                    PHYSICAL AND COGNITIVE DEVELOPMENT

        Exploring How                                          Language
       Children Develop                                       Development

   Why Studying         Developmental        What Is                        How
Children's Development     Issues           Language?     Biological and   Language
   Is Important                                           Environmental    Develops
              Processes,                                    Influences
           Periods, and Stages

                Physical                         Cognitive
              Development                        Development
              and Health

  Growth in Childhood    Pubertal Changes    Piaget's Theory      Vygotsky's Theory

        Child Health and Education              Case's Neo-Piagetian Theory
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To obtain a detailed review of this chapter, study these three summary tables:

KEY TERMS

development 34
biological processes 34
cognitive processes 35
socioemotional processes 35
infancy 35
early childhood 35
middle and late childhood 35
adolescence 35
early adulthood 35
maturation 35
nature–nurture controversy 36
continuity in development 36
discontinuity in development 36

early–later experience issue 36
myelination 37
gross motor skills 38
fine motor skills 38
puberty 40
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sensorimotor stage 44
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preoperational stage 44
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animism 45
intuitive thought substage 45
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concrete operational stage 46
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    (ZPD) 51
scaffolding 52
language 55
infinite generativity 55
phonology 56
morphology 56
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PROFESSIONAL DEVELOPMENT/PORTFOLIO ACTIVITIES

1. Kids Will Be Kids

Do children of the same age all think and behave in the same manner? Consider the students whom you hope to teach. Based on your observations of children and the information presented in this chapter, develop a list of characteristics. How do children think? How do they behave? Then make a second list of the ways in which you, as an adult, think and act. Compare the lists and note the differences between how the children and adults cognate. How will you ensure that you are teaching these students in a manner that is appropriate for their cognitive development level?

2. Thinking about Thinking

Understanding how children think is a step toward helping them learn. Make two lists: one of the characteristics of students who are thinking in formal operational ways, and the other of students who are thinking in concrete operational ways. Below the lists of characteristics, note how you might help these students develop better study skills. Use your ideas to write lesson activity plans that aim to help each of these groups develop study skills. Place the lesson activities in your portfolio as examples of your planning for instruction.

3. Developing Language Skills

Language development is complex, but it generally follows a natural progression in child development. Recall the sections related to language development in this chapter. What information and ideas did you find that were insightful? How will you use these ideas in your own teaching practice? Create some activities based on these ideas for use with Grade 1, Grade 3, and Grade 5 students. What do the activities have in common and how do they differ?

4. Thinking about Learning

Piaget, Case, and Vygotsky are developmental theorists who presented different perspectives on how children learn. Piaget believed in the personal discovery of ideas. Vygotsky believed in the social discovery of ideas. Case presented elements of both views, in combination with aspects of information-processing theory. Based on your experiences, readings, and reflections, how do you view learning? Is learning an individualized discovery of ideas, is it socially constructed, or is it a combination of both? Write a 500-word essay outlining your views and include it in your portfolio.

INTERNET ACTIVITIES

1. Reading, Writing, and E-mail

Giving students frequent opportunities for reading, writing, oral presentations, or collaborative group work can reinforce language skills. The Internet provides some interesting ways for students to practise their reading and writing skills. Access the Flat Stanley Website (**http://flatstanley.enoreo.on.ca**) and explore how the site uses e-mail and a clever story to promote language and literacy skills. What are the potential problems that you might need to address when using e-mail as a vehicle for teaching writing?

2. Physical Development and Learning

Healthy physical development is an important factor in students' academic achievement. Working with a partner, develop a list of the health risk factors that might inhibit students' success. Discuss and note local programs or resources that are accessible to address these risk factors. What Internet resources are available to help teachers working with these students? Retain this information for future reference.

Connect to the Online Learning Centre at www.mcgrawhill.ca/college/santrock to explore possible answers.

Visit the *Educational Psychology* Online Learning Centre at
www.mcgrawhill.ca/college/santrock
to access Websites related to the above Internet Activities as well as chapter quizzes, a searchable glossary, and other learning and study tools.