GLOBAL EDITION

Educational Psychology

Windows on Classrooms

TENTH EDITION

Paul D. Eggen • Don P. Kauchak

ALWAYS LEARNING

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Educational Psychology

Windows on Classrooms

Global Edition

Tenth Edition

Paul Eggen
University of North Florida

Don Kauchak
University of Utah

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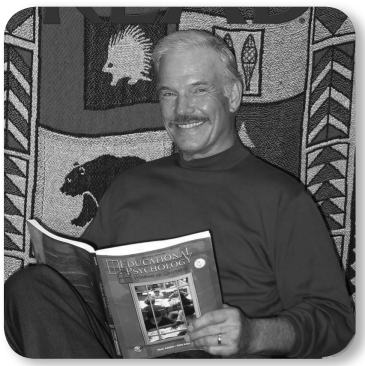
To Judy and Kathy,
teachers who have changed many lives.

About the Authors



Paul Eggen

Paul has worked in higher education for nearly 40 years. He is a consultant for public schools and colleges in his university service area and has provided support to teachers in 12 states. Paul has also worked with teachers in international schools in 23 countries in Africa, South Asia, the Middle East, Central America, South America, and Europe. He has published several articles in national journals, is the co-author or co-editor of six other books, and presents regularly at national and international conferences.

Paul is strongly committed to public education. His wife is a middle school teacher in a public school, and his two children are graduates of public schools and state universities.

Don Kauchak

Don has taught and worked in schools and in higher education in nine states for over 40 years. He has published in a number of scholarly journals, including the *Journal of Educational Research, Journal of Experimental Education, Journal of Research in Science Teaching, Teaching and Teacher Education, Phi Delta Kappan,* and *Educational Leadership.* In addition to this text, he has co-authored or co-edited six other books on education. He has also been a principal investigator on federal and state grants examining teacher development and evaluation practices, and presents regularly at the American Educational Research Association. He currently volunteer-tutors first, second, and third graders in a local elementary school. These students have taught him a lot about educational psychology.

Preface

Welcome to the tenth edition of *Educational Psychology: Windows on Classrooms*. We have redoubled our efforts to make this edition the clearest, most comprehensive, and up-to-date presentation of theory and research, combined with the most specific and usable applications, of any text in the field. Our text is generally recognized as the most applied in educational psychology, and in this edition we've tried to achieve the optimal balance of theory, research, and application.

To meet this goal we have much that is new to this edition. We outline these changes in the sections that follow.

Content New to This Edition

To provide students with the most complete and up-to-date information on recent developments in educational psychology, we have included the following new content in our tenth edition.

- *Major reorganization of the learning section of the book—Chapters 6–9:* Learning is at the heart of educational psychology, and we've reorganized these chapters to reflect recent developments in our understanding of how students in classrooms, and people of all ages, learn.
- *Analyzing Theories:* Research in every field is grounded in theory, but all theories have both strengths and weaknesses. "Analyzing Theories," a new feature in this edition, analyzes all the major theories discussed in the text. For instance, Piaget's and Vygotsky's theories of cognitive development are analyzed in Chapter 2, behaviorism and social cognitive theory are analyzed in Chapter 6, and constructivism is analyzed in Chapter 9. This analysis includes a summary of the major concepts within each theory, together with the contributions the theories make to our understanding of teaching and learning and common criticisms directed at each. We believe the addition of this feature will provide students with a more complete and accurate view of the theoretical foundation of educational psychology.
- *New chapter—Knowledge Construction in Social Contexts:* Educational psychology generally accepts the idea that learners construct their own knowledge and that learning is substantively a social process. This new chapter reflects and integrates these ideas in a comprehensive presentation that explains how these powerful ideas influence teaching and learning.
- *Extensive coverage of the learning sciences:* The learning sciences focus on learning as it exists in real-world settings and how teachers can facilitate that learning. This is the essential message of our text, and this new content explains how to apply these ideas to increase learning for all students.
- *Expanded coverage of technology's impact on learning:* To say that technology is an integral part of our lives is a vast understatement. Expanded coverage of technology throughout the text examines how it influences learning, development, and motivation, in addition to the general impact it is having on the way we live.
- *Greatly expanded coverage of neuroscience:* Neuroscience is providing researchers, educational leaders, teachers, and students with new insights into the teaching–learning process. As one powerful example, the concept of *neuroplasticity* helps us understand that our learning potential is much greater than we once believed possible, and with the right kinds of experiences, we can literally get smarter. This

expanded coverage helps teachers capitalize on this information to increase learning for all students regardless of their backgrounds.

- *Extensive coverage of the role of personality and emotion on learning and development:* Learning and development consist of much more than cognitive processes alone; personality and emotion play an important role in our motivation and how effectively we learn and develop. Further, both home and school environments have an important impact on the healthy development of learners' personalities and emotions. This coverage helps teachers create the kinds of environments that capitalize on these insights.
- *Updated descriptions of standards, accountability, and value-added teacher assessment and how they impact teaching and learning:* Standards—including the Common Core State Standards—combined with accountability, are facts of teaching life, and our discussion of these topics in this edition, including the controversies involved with each, is designed to prepare teachers to adapt to this new reality.

This new content adds to our expanded and detailed descriptions of traditional theories combined with the latest research. Our goal is to make the content presented in this text the most comprehensive and up-to-date discussion of learning, development, motivation, instruction and classroom management, classroom and standardized assessment, and learner diversity of any text in the field.

Applications New to This Edition

The content of educational psychology isn't useful if teachers don't know how to apply it to increase their students' learning and shape their development. To prepare teachers for the real world, and to help all students understand how educational psychology applies to their lives today, we have again redoubled our efforts to improve what is already the most applied educational psychology text in the field.

The following applications are new to this edition:

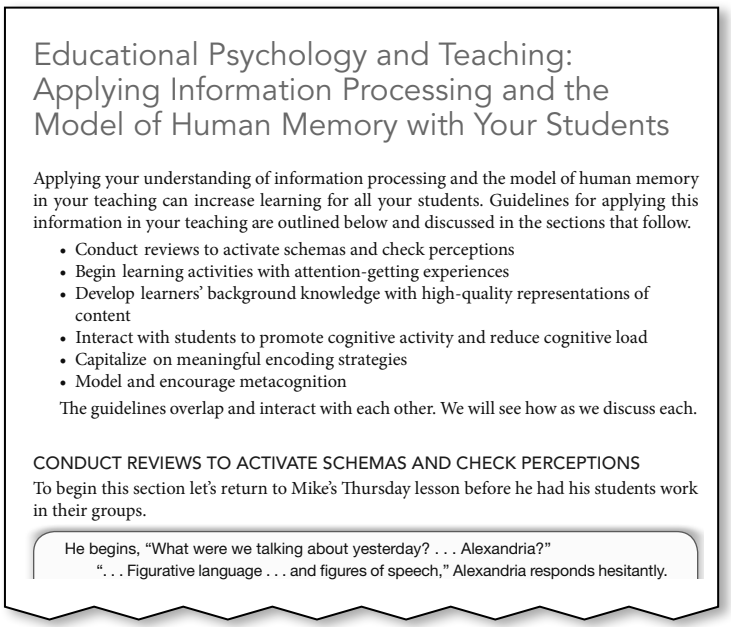
- *Explicit suggestions for applying educational psychology in teaching:* Instructors often tell us that their students can describe the theories and research that make up educational psychology, but these same students "don't know what to do with the content" when they go out into the real world of teaching. We attempt to solve this problem in this edition. Each chapter now includes specific sections titled "Educational Psychology and Teaching," which provide teachers with specific and concrete suggestions for applying the content of each chapter in their teaching. For instance, in Chapter 2, "Educational Psychology and Teaching: Applying Piaget's Theory with Your Students" provides teachers with specific suggestions for using Piaget's theory to advance their students' development, and a similar section does the same with Vygotsky's theory. As another example, in Chapter 4, "Educational Psychology and Teaching: Teaching Students in Your Classes Who Are Culturally and Linguistically Diverse" provides specific suggestions for accommodating and capitalizing on the diversity that our students are increasingly bringing to our classes. These suggestions are combined with concrete illustrations of teachers in the real world demonstrating these applications. "Educational Psychology and Teaching" sections are included in every chapter in the text.
- *Case studies linked to standards*: Standards have become a part of teachers' lives in today's classrooms. Case studies that introduce each chapter in the book are now linked to standards so prospective teachers can now see how their colleagues in the real world have adjusted to this new reality and have incorporated standards into their instruction.

- *Case studies in both written and video formats:* In the etext version of this edition, students can read case studies embedded in the text and can now see in video form the very lesson on which the case study is based. So they can read the case studies, and then with a simple click of their mouse see the actual lesson and how the teacher in the lesson applies the content of educational psychology to the real world of classrooms. No other text in the field applies the content of educational psychology to classrooms in this way.
- *Ed Psych and You:* This feature, which first appeared in our ninth edition, has been expanded to help students see that educational psychology applies not only to teaching but also to our lives as we live them every day. This feature is also designed to make the content of educational psychology more meaningful to students who may not plan to be teachers.

These new applications, combined with other features such as "Classroom Connections" and "Developmentally Appropriate Practice," make this edition even more usable in the real world of teaching. Further, we would like to believe that the text can be a resource for both new and veteran teachers as they move through their careers.

The Most Applied Educational Psychology Book in the Field

This is the most applied text in the field. The following illustrate these applications.



Educational Psychology and Teaching: Applying Information Processing and the Model of Human Memory with Your Students

Applying your understanding of information processing and the model of human memory in your teaching can increase learning for all your students. Guidelines for applying this information in your teaching are outlined below and discussed in the sections that follow.

- Conduct reviews to activate schemas and check perceptions
- Begin learning activities with attention-getting experiences
- Develop learners' background knowledge with high-quality representations of content
- Interact with students to promote cognitive activity and reduce cognitive load
- Capitalize on meaningful encoding strategies
- Model and encourage metacognition

The guidelines overlap and interact with each other. We will see how as we discuss each.

CONDUCT REVIEWS TO ACTIVATE SCHEMAS AND CHECK PERCEPTIONS

To begin this section let's return to Mike's Thursday lesson before he had his students work in their groups.

He begins, "What were we talking about yesterday? . . . Alexandria?"

". . . Figurative language . . . and figures of speech," Alexandria responds hesitantly.

Explicit Suggestions for Applying Educational Psychology in Teaching. "Educational Psychology and Teaching," which appears in every chapter, provides teachers with specific suggestions for applying the content of educational psychology to increase learning for all their students. The excerpt you see here appears on page 320 of Chapter 7 in the text.

Ed Psych and You. This feature helps students see how educational psychology applies to our lives and the people around us. The example you see here appears on page 66 in Chapter 2 of the text.

Ed Psych and You

Are you bothered when something doesn't make sense? Do you want, and even expect, the world to be predictable? Are you more comfortable in classes where the instructor specifies the requirements, outlines the grading practices, and consistently follows through? For most people, the answer to these questions is "Yes." Why do you think this is the case?

The students in this case are third graders, and their teacher, Alicia Evans, is working with them on *Common Core State Standard* ***CCSS.ELA-Literacy.L.3.1f "Ensure subject-verb and pronoun-antecedent agreement"*** (Common Core State Standards Initiative, 2014f).

After completing her routines for the beginning of language arts, Alicia explains and demonstrates the rules with some examples on the board. She then displays the following short paragraph on her document camera.

Bill takes his lunch to the cafeteria when it's time to eat. His friend Leroy and his other friend Antonio (takes, take) (his, theirs) to the cafeteria, too. Each of the boys has (his, their) own lunch box with pictures of cars on (it, them). Bill doesn't like apples, so he will give his to anyone else if (he, they) (wants, want) it.

"Now," she directs, "Read the paragraph carefully, . . . think about it, and then decide which one of the words in the parentheses in each case is correct. Remember, our reasons and thinking are as important as the actual answers."

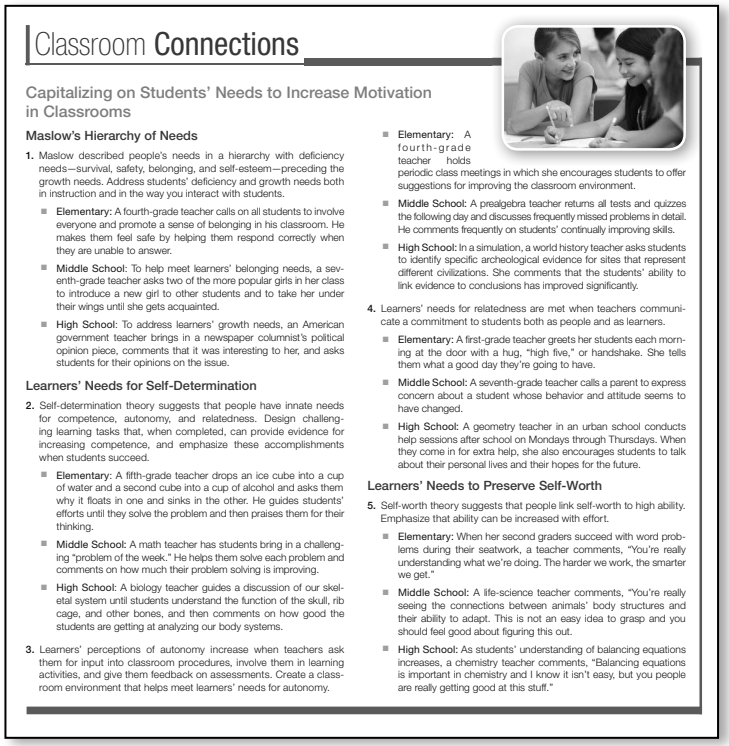
After giving the students a couple minutes to study the paragraph, she begins, "How about the first one?" pointing to the first set of parentheses (takes, take) in the paragraph.

The students conclude that "take" is correct in the sentence because "Leroy and Antonio" is a plural subject, so it requires the plural verb "take." They also conclude that "theirs" is correct in the sentence because "theirs" agrees with its antecedent (Leroy and Antonio).

"Now, how about this one?" she asks, pointing to the next set of parentheses (his, their) in the third sentence—Each of the boys has (his, their) own lunch box with pictures of cars on (it, them). "What do you think, and why do you think so . . . Brittany?"

Case Studies Linked to Standards. The case studies that appear in this edition are now linked to standards. The excerpt you see here appears on page 379–380 in Chapter 9 of the text.

Classroom Connections at Elementary, Middle School, and High School Levels. These features in each chapter offer suggestions and illustrations for applying topics discussed in the chapter at different grade levels. Each strategy is illustrated with a classroom example, derived from teachers' experiences in elementary, middle, and high schools. The example you see here appears on page 427 of Chapter 10 of the text.



Classroom Connections

Capitalizing on Students' Needs to Increase Motivation in Classrooms

Maslow's Hierarchy of Needs

1. Maslow described people's needs in a hierarchy with deficiency needs—survival, safety, belonging, and self-esteem—preceding the growth needs. Address students' deficiency and growth needs both in instruction and in the way you interact with students.
   - **Elementary:** A fourth-grade teacher calls on all students to involve everyone and promote a sense of belonging in his classroom. He makes them feel safe by helping them respond correctly when they are unable to answer.
   - **Middle School:** To help meet learners' belonging needs, a seventh-grade teacher asks two of the more popular girls in her class to introduce a new girl to other students and to take her under their wings until she gets acquainted.
   - **High School:** To address learners' growth needs, an American government teacher brings in a newspaper columnist's political opinion piece, comments that it was interesting to her, and asks students for their opinions on the issue.

Learners' Needs for Self-Determination

2. Self-determination theory suggests that people have innate needs for competence, autonomy, and relatedness. Design challenging learning tasks that, when completed, can provide evidence for increasing competence, and emphasize these accomplishments when students succeed.
   - **Elementary:** A fifth-grade teacher drops an ice cube into a cup of water and a second cube into a cup of alcohol and asks them why it floats in one and sinks in the other. He guides students' efforts until they solve the problem and then praises them for their thinking.
   - **Middle School:** A math teacher has students bring in a challenging "problem of the week." He helps them solve each problem and comments on how much their problem solving is improving.
   - **High School:** A biology teacher guides a discussion of our skeletal system until students understand the function of the skull, rib cage, and other bones, and then comments on how good the students are getting at analyzing our body systems.
3. Learners' perceptions of autonomy increase when teachers ask them for input into classroom procedures, involve them in learning activities, and give them feedback on assessments. Create a classroom environment that helps meet learners' needs for autonomy.
   - **Elementary:** A fourth-grade teacher holds periodic class meetings in which she encourages students to offer suggestions for improving the classroom environment.
   - **Middle School:** A prealgebra teacher returns all tests and quizzes the following day and discusses frequently missed problems in detail. He comments frequently on students' continually improving skills.
   - **High School:** In a simulation, a world history teacher asks students to identify specific archeological evidence for sites that represent different civilizations. She comments that the students' ability to link evidence to conclusions has improved significantly.
4. Learners' needs for relatedness are met when teachers communicate a commitment to students both as people and as learners.
   - **Elementary:** A first-grade teacher greets her students each morning at the door with a hug, "high five," or handshake. She tells them what a good day they're going to have.
   - **Middle School:** A seventh-grade teacher calls a parent to express concern about a student whose behavior and attitude seems to have changed.
   - **High School:** A geometry teacher in an urban school conducts help sessions after school on Mondays through Thursdays. When they come in for extra help, she also encourages students to talk about their personal lives and their hopes for the future.

Learners' Needs to Preserve Self-Worth

5. Self-worth theory suggests that people link self-worth to high ability. Emphasize that ability can be increased with effort.
   - **Elementary:** When her second graders succeed with word problems during their seatwork, a teacher comments, "You're really understanding what we're doing. The harder we work, the smarter we get."
   - **Middle School:** A life-science teacher comments, "You're really seeing the connections between animals' body structures and their ability to adapt. This is not an easy idea to grasp and you should feel good about figuring this out.
   - **High School:** As students' understanding of balancing equations increases, a chemistry teacher comments, "Balancing equations is important in chemistry and I know it isn't easy, but you people are really getting good at this stuff."

Developmentally Appropriate Practice. These features in each chapter describe developmental differences in our students and help teachers ensure that their instruction will best meet the needs of learners at all developmental levels. The example you see here appears on page 146 of Chapter 3 in the text.

Developmentally Appropriate Practice

Personal, Social, and Moral Development with Learners at Different Ages

Important differences exist in the personal, emotional social, and moral development of elementary, middle, and high school students. The following paragraphs outline suggestions that will help you respond to these differences.

Working with Students in Preschool Programs and Elementary Schools

As children enter preschool, they are developing autonomy and taking the initiative to seek out experiences and challenges. "Let me help!" and "I want to do it" are signs of this initiative. Criticism or overly restrictive directions detract from a sense of independence and, in extreme cases, lead to feelings of guilt and dependency. At the same time, children need the structure that helps them learn to take responsibility for their own behavior.

As children move through the elementary years, teachers attempt to help them succeed in learning activities challenging enough to promote feelings of competence and industry. This is demanding. Activities that are so challenging that students frequently fail can leave them with a sense of inferiority, but success on trivial tasks does little to make students feel competent (Brophy, 2010).

During the elementary years, students need opportunities to practice perspective taking and social problem solving. Discussions and small-group work where students can interact with others and practice these skills are effective learning experiences.

The elementary grades also lay the foundation for students' moral growth and the development of social responsibility and self-control. Teachers who encourage students to understand the impact of their actions on others help them make the transition from preconventional morality, with its egocentric orientation, to conventional morality, at which stage students understand why rules are important for both classrooms and the world outside of school.

Working with Students in Middle Schools

Adolescence is a time of considerable physical, emotional, and intellectual changes, and adolescents are often uncertain about how to respond to new sexual feelings. They are concerned with what others think of them and are preoccupied with their looks. They want to assert their independence, yet long for the stability of structure and discipline. They want to rebel to assert their independence but need something solid to rebel against.

Most adolescents successfully negotiate this period, however, exploring different roles and maintaining positive relationships with their parents, teachers, and other adults. Students in middle and junior high schools need firm, caring teachers who empathize with them and their sometimes capricious actions while simultaneously providing the security of clear limits for acceptable behavior (Emmer & Evertson, 2013). Classroom management provides opportunities to advance moral reasoning from preconventional to conventional thinking. Effective teachers create clear classroom rules, discuss the reasons for them, and enforce them consistently.

Instruction in middle school classrooms should promote deep understanding of the topics being studied, while simultaneously providing students with opportunities to practice prosocial behaviors, such as tolerance for others' opinions, listening politely, and avoiding hurtful comments. Effective instruction in middle schools is highly interactive, and lecture is held to a minimum.

Working with Students in High Schools

High school students are continuing to wrestle with who they are and what they want to become. Peers become increasingly important to students and have an important influence on social, emotional, and moral development.

Linking content to students' lives is particularly valuable at this age. For example, examining ideas about gender and occupational trends in social studies and showing how math and science can influence their futures are important for these students.

Like younger learners, high school students need opportunities to try out new ideas and link them to their developing sense of self. Discussions, small-group work, and focused writing assignments provide valuable opportunities for students to integrate new ideas into their developing self-identities.

Supplementary Materials

This edition of *Educational Psychology: Windows on Classrooms* provides a comprehensive and integrated collection of supplements to assist students and professors in maximizing learning and instruction. The following resources are available for instructors to download from **www.pearsonhighered.com/educator.** Enter the author, title of the text, or the ISBN number, then select this text, and click on the "Resources" tab. Download the supplement you need. If you require assistance in downloading any resources, contact your Pearson representative.

Instructor's Resource Manual

The Instructor's Resource Manual includes chapter overviews and outcomes, lists of available PowerPoint® slides, presentation outlines, teaching suggestions for each chapter, and questions for discussion and analysis along with feedback.

Powerpoint® Slides

The PowerPoint® slides highlight key concepts and summarize text content. The slides also include questions and problems designed to stimulate discussion, encourage students to elaborate and deepen their understanding of the topics in each chapter, and apply the content of the chapter to both the real world of teaching and their daily lives. The slides are further designed to help instructors structure the content of each chapter to make it as meaningful as possible for students.

Test Bank

The Test Bank provides a comprehensive and flexible assessment package. The Test Bank for this edition has been revised and expanded to make it more applicable to students. To provide complete coverage of the content in each chapter, all multiple-choice and essay items are grouped under the chapters' main headings and are balanced between knowledge/recall items and those that require analysis and application.

TestGen®

TestGen is a powerful test generator available exclusively from Pearson Education publishers. You install TestGen on your personal computer (Windows or Macintosh) and create your own tests for classroom testing and for other specialized delivery options, such as over a local area network or on the web. A test bank, which is also called a Test Item File (TIF), typically contains a large set of test items, organized by chapter and ready for your use in creating a test, based on the associated textbook material. Assessments may be created for both print and testing online. The tests can be downloaded in the following formats:

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TestGen Testbank—Blackboard CE/Vista (WebCT) TIF
Angel Test Bank (zip)
D2L Test Bank (zip)
Moodle Test Bank
Sakai Test Bank (zip)

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Our appreciation goes to all of these fine people who have taken our words and given them shape. We hope that all of our efforts will result in increased learning for students and more rewarding teaching for instructors.

Finally, we would sincerely appreciate any comments or questions about anything that appears in the book or any of its supplements. Please feel free to contact either of us at any time. Our e-mail addresses are: peggen@unf.edu and don.kauchak@gmail.com.

Good luck and best wishes.

Paul Eggen

Don Kauchak

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Brief Contents

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Contents

chapter 1

Educational Psychology: Understanding Learning and Teaching

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OUTLINE	LEARNING OUTCOMES
	After you've completed your study of this chapter, you should be able to:
The Preeminence of Teachers	**1.** Describe expert teaching and explain how expert teaching influences student learning.
Educational Psychology, Professional Knowledge, and Expert Teaching Professional Knowledge Professional Knowledge and Reflective Practice ▶ Developmentally Appropriate Practice: Using Knowledge of Learners and Learning to Promote Achievement in Students at Different Ages	**2.** Describe the different kinds of professional knowledge that expert teachers possess.
The Role of Research in Acquiring Professional Knowledge Quantitative Research Qualitative Research Action Research Design-Based Research Research and the Development of Theory	**3.** Describe different types of research, and explain how research and theory contribute to teachers' professional knowledge.
Teaching in Today's Classrooms Standards and Accountability Teacher Licensure and Evaluation Learner Diversity Technology The Influence of Neuroscience Educational Psychology and Teaching: Applying Your Professional Knowledge in Today's Classrooms	**4.** Identify factors that influence teaching in today's classrooms.

You've just opened your textbook, and you're probably wondering what this class will be like and how it will make you a better teacher. So, let's start right off with a couple questions. First, why do children go to school? To learn and develop is the obvious answer. Easy question, right?

Second, which of the following factors contributes the most to students learning and development?

- *Curriculum and materials available to them*—the content students study and the quality of their textbooks.
- *Facilities and extracurricular activities*—access to a good library, the Internet, and athletics, clubs, and after-school music and drama.
- *Class size*—the number of students in a class.
- *Leadership*—such as the school principal and district superintendent.
- *You*—their teacher.

The unequivocal answer is *you, their teacher*! Unlike our first question, however, this answer hasn't always been obvious to educational leaders. We'll explore the importance of excellent teachers in more detail as the chapter unfolds, but before we do, let's turn to a conversation between Keith Jackson, a struggling, first-year, middle school math

teacher, and Jan Davis, a four-year "veteran" who has become his confidant. As you read this case study, think about Jan's teaching and how it might influence her students' learning.

As Keith walks into the work room at Lakeside Middle School, Jan looks up and asks, "Hi, Keith. How's it going?"

"My last period class is getting to me," Keith replies."The students are okay when we just stick to mechanics, but they simply can't do word problems. . . . And they hate them. . . . They just try to memorize formulas and enough to get by.

"I have a good math background, and I was going to be so great when I got here. . . . I'm not so sure any more. . . . I explain the stuff so carefully, but some of the kids just sit with blank looks on their faces. Then, I explain it even more carefully, and . . . nothing.

"And, there's Kelly. She disrupts everything I do. I gave her a referral, and I even called her mother. . . . The only thing that seemed to work was taking her aside and asking her straight out why she was giving me such a hard time."

"Sounds like you're becoming a *teacher*," Jan smiles. "There are few easy answers for what we do. . . . But then, that's what makes it both the toughest and the most rewarding work in the world.

"Like working with Kelly. She might not have another adult she can talk to, and she may simply need someone to care about her.

"As for the blank looks, I'm taking a class at the university. The instructor emphasizes involving the kids, and he keeps talking about research that says how important it is to call on all the kids as equally as possible.

"So, here's an example of how I'm approaching word problems now. We're working on decimals and percents, ultimately to help the kids reach this standard," she says as she shows Keith a lesson plan:

> **CCSS.Math.Content.6.RP.A.3c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. (Common Core State Standards Initiative, 2014v).**

"So, here's what I'm doing. I brought in a 12-ounce soft drink can from a machine, a 20-ounce bottle, and a 6-pack with price tags on them.

"I put the kids into pairs and told them to figure out a way to determine which one was the best buy. To figure it out, they needed to apply their understanding of decimals and percents, which helps us reach the standard. I helped them along, and we created a table, so we could compare the groups' answers. They're beginning to see how math relates to their lives. . . . Some of them even said they think it's important. And, now that they're used to being called on, they really like it. It's one of the most important things I do.

"When I think about it, I realize that I sometimes jump in too soon when they can figure it out themselves, and at other times I let them stumble around too long, and they waste time. So, then I adapt for the next lesson."

"I hate to admit this," Keith says, "but some of my university courses suggested just what you did. It was fun, but I didn't think it was real teaching."

"You couldn't relate to it at the time. You didn't have a class with live students who 'didn't get it.'

"Hang in there," Jan smiles. "You're becoming what teaching needs—a real pro."

Now, as you study this chapter, keep the following questions in mind:

1. How was Jan's approach to teaching word problems different from Keith's?
2. Why were their approaches so different, and how will these differences affect their students' learning?

We answer these and other questions about teaching and learning as the chapter unfolds. We begin by revisiting the idea we introduced at the beginning of the chapter.

The Preeminence of Teachers

In our introduction we asked, "Which of the following factors contributes the most to student's learning and development?" and we said that the answer hasn't always been obvious to educational leaders. In an effort to improve schooling, a great deal has been written about this question, and reformers have offered a variety of answers, including different organizational structures, such as open classrooms, and a variety of curricular and instructional approaches, such as Whole Language, or what was commonly described as "New Math." However, none of them were as successful as hoped (Thomas & Wingert, 2010).

The solution, however, is simple (but admittedly not easy). No organization, system, institution, or enterprise is any better than the people in it, and the same applies to schools. The quality of a school is determined by the quality of its teachers. *You* are the most important factor influencing your students' learning! Surprisingly, in spite of many years of research documenting the importance of teachers, only within approximately the last two decades have educational leaders begun to understand and appreciate this fact (Thomas & Wingert, 2010).

Let's look at some of this research. One widely publicized study conducted 20 years ago found that students who had expert teachers in third, fourth, and fifth grades scored more than 50 percentile points higher on standardized math tests than those in the same three grades who were taught by teachers less skilled (Sanders & Rivers, 1996). Another study revealed that five years in a row of expert teaching was nearly enough to close the achievement gap between disadvantaged and advantaged students (Hanushek, Rivkin, & Kain, 2005). Additional research has found that expert teaching in later grades could substantially, though not completely, make up for poor teaching in earlier grades (Rivkin, Hanushek, & Kain, 2001). More recent research corroborates the assertion that the expertise of teachers is the key to increased student achievement (Konstantopoulos, 2011; Kraus et al., 2008; Kunter et al., 2013).

The importance of teachers even caught the attention of the popular press. "The Key to Saving American Education" appeared on the cover of the March 15, 2010, issue of *Newsweek*, identifying teachers as the "key," and the *New York Times* included a lengthy article, "Building a Better Teacher," in its March 7, 2010, issue (Green, 2010). "Teacher quality is now a national priority" (Margolis, 2010, Introduction, para. 1). The American people agree. According to an annual poll of the public's attitudes toward public education, "Americans singled out improving the quality of teachers as the most important action for improving education" (Bushaw & Lopez, 2010, p. 15). Also, the quality of teachers is linked to the widely publicized success of students in other countries (Friedman, 2013). And, some good news: public opinion polls indicate that "More than 70% of Americans have trust and confidence in the men and women who teach in public schools" (Bushaw & Lopez, 2013, p. 12).

Some, including many educational leaders, once believed that expert teaching is essentially instinctive, a kind of magic performed by born superstars. And, just as is the case with other domains, such as athletics, music, or art, some teachers do indeed have more natural ability than others. However, research dating back to the 1960s and 1970s indicates

that expert teachers possess knowledge and skills that are not purely instinctive. They are acquired through study and practice (Fisher et al., 1980), and more recent work corroborates these earlier findings (Kunter et al., 2013; Lemov, 2010). This is true in all domains. For example, many athletes, through awareness and hard work, perform better than their counterparts with more natural ability.

We referred to "expert" teachers in the preceding paragraphs. **Experts** are people who are highly knowledgeable and skilled in a particular domain, such as music, architecture, medicine, or teaching. Expert teachers' professional knowledge and skills are what set them apart from their less effective colleagues. This knowledge and these skills make them capable of producing learning in students that less able teachers cannot produce.

This leads us to the reason we wrote this book and the reason you're taking this course. Your goal is to begin acquiring the knowledge and skills that will ultimately lead to expertise, and our goal is to help you in this process. We turn to this topic next.

Educational Psychology, Professional Knowledge, and Expert Teaching

If expertise is so important to effective teaching, how do teachers gain the knowledge and skills needed to become experts? This leads us to the study of **educational psychology (ed psych)**, the academic discipline that examines human teaching and learning (Berliner, 2006). The content of educational psychology contributes to the professional knowledge base you will need to become an expert teacher. We discuss this professional knowledge in the following sections.

Ed Psych and You

How much do you know about teaching and learning? To test your knowledge, complete the following Learning and Teaching Inventory. It will introduce you to the kinds of knowledge you'll need to become an expert teacher.

Professional Knowledge

Professional knowledge refers to the body of information and skills that are unique to an area of study, such as law, medicine, architecture, or engineering. The same applies to teaching. In this section we focus on how educational psychology can increase your professional knowledge, and with it, your expertise.

To introduce you to the idea of professional knowledge in teaching, respond to each of the items in the *Learning and Teaching Inventory* below.

Learning and Teaching Inventory

Look at each of the 12 items, and decide if the statement is true or false.

1. The thinking of children in elementary schools tends to be limited to the concrete and tangible, whereas the thinking of middle and high school students tends to be abstract.
2. Students generally understand how much they know about a topic.

3. Experts in the area of intelligence view knowledge of facts, such as "On what continent is Brazil?," as one indicator of intelligence.
4. Expert teaching is essentially a process of presenting information to students in succinct and organized ways.
5. Preservice teachers who major in a content area, such as math, are much more successful than nonmajors in providing clear examples of the ideas they teach.
6. To increase students' motivation to learn, teachers should praise as much as possible.
7. The key to successful classroom management is to stop disruptions quickly.
8. Preservice teachers generally believe they will be more effective than teachers who are already in the field.
9. Teachers learn by teaching; in general, experience is the primary factor involved in learning to teach.
10. Testing detracts from learning, because students who are tested frequently develop negative attitudes and consequently learn less than those who are tested less often.
11. Criticizing students damages their self-esteem and should be avoided.
12. Because some students are left-brained thinkers and others are right-brained thinkers, teachers should make an effort to accommodate these differences in their students.

Let's see how you did. The correct answers for each item are outlined in the following paragraphs. As you read the answers, remember that they describe students or other people in general, and exceptions will exist.

1. *The thinking of children in elementary schools tends to be limited to the concrete and tangible, whereas the thinking of middle and high school students tends to be abstract.*
   False: Research indicates that middle school, high school, and even university students can effectively think in the abstract only when they have considerable prior knowledge and experience related to the topic they're studying (Berk, 2013; Cole, Cole, & Lightfoot, 2009). When you study the development of students' thinking in Chapter 2, you'll see how understanding this research can improve your teaching.
2. *Students generally understand how much they know about a topic.*
   False: Learners, in general, and young children in particular, often cannot accurately assess their own understanding (Hacker, Bol, Horgan, & Rakow, 2000). Students' awareness of what they know and how they learn strongly influences understanding, and cognitive learning theory helps us understand why. (You will study cognitive learning theory in Chapters 7, 8, and 9.)
3. *Experts in the area of intelligence view knowledge of facts, such as "On what continent is Brazil?," as one indicator of intelligence.*
   True: The Wechsler Intelligence Scale for Children—Fourth Edition (Wechsler, 2003), the most popular intelligence test in use today, includes several items similar to this example. We examine theories of intelligence, including controversies involved in these theories, in Chapter 5.
4. *Expert teaching is essentially a process of presenting information to students in succinct and organized ways.*
   False: The better we understand learning, the more we realize that simply explaining information to students is often ineffective for promoting learning (Kunter et al., 2013; Mayer, 2008). Learners construct their own knowledge based on what they already know, and their emotions, beliefs, and expectations all influence the process (Bruning, Schraw, & Norby, 2011; Schunk, Meece, & Pintrich, 2014). You will study the process of knowledge construction in Chapter 9.
5. *Preservice teachers who major in a content area, such as math, are much more successful than nonmajors in providing clear examples of the ideas they teach.*
   False: One of the most pervasive misconceptions about teaching is the idea that knowledge of subject matter is all that is necessary to teach effectively. In a study of

teacher candidates, researchers found that math majors were no more capable than nonmajors of effectively illustrating math concepts in ways that learners could understand (U.S. Department of Education, 2008). Knowledge of content is essential for expert teaching, but understanding how to make that content meaningful to students requires additional knowledge (Darling-Hammond & Baratz-Snowden, 2005; Kunter et al., 2013). You will study ways of making knowledge accessible to learners in Chapters 2, 6–9, and 13.

6. *To increase students' motivation to learn, teachers should praise as much as possible.*
   False: Although appropriate use of praise is effective, overuse detracts from its credibility. This is particularly true for older students, who discount praise if they believe it is invalid or insincere. Older students may also interpret praise given for easy tasks as indicating that the teacher thinks they have low ability (Schunk et al., 2014). Your study of motivation in Chapters 10 and 11 will help you understand this and other factors influencing students' motivation to learn.
7. *The key to successful classroom management is to stop disruptions quickly.*
   False: Research indicates that classroom management, a primary concern of beginning teachers, is most effective when teachers prevent management problems from occurring in the first place, instead of responding to problems after they occur (Brophy, 2006; Emmer & Evertson, 2013; Evertson & Emmer, 2013). You will study classroom management in Chapter 12.
8. *Preservice teachers generally believe they will be more effective than teachers who are already in the field.*
   True: Preservice teachers (like you) are often optimistic and idealistic. They believe they'll be effective with young people, and they generally believe they'll be better than teachers now in the field (Feiman-Nemser, 2001; Ingersoll & Smith, 2004). They are also sometimes "shocked" when they begin work and face the challenge of teaching on their own for the first time (Grant, 2006; Johnson & Birkeland, 2003). Keith's comments in the opening case study are typical of many beginning teachers: "I was going to be so great when I got here. . . . I'm not so sure anymore." Teaching is complex and challenging, and the more knowledge you have about learners, learning, and the teaching process, the better prepared you'll be to cope with the realities of your first job.
9. *Teachers learn by teaching; in general, experience is the primary factor involved in learning to teach.*
   False: Experience is essential in learning to teach, but it isn't sufficient by itself (Darling-Hammond & Bransford, 2005; Song & Felch, 2009; Kunter et al., 2013). In some cases, experience results in repeating the same actions year after year, regardless of their effectiveness. Knowledge of learners and learning, combined with experience, however, can lead to high levels of teaching expertise.
10. *Testing detracts from learning, because students who are tested frequently develop negative attitudes and consequently learn less than those who are tested less often.*
    False: In comprehensive reviews of the literature on assessment, experts have found that frequent, thorough assessment is one of the most powerful and positive influences on learning that exist (Rohrer & Pashler, 2010; Stiggins & Chappuis, 2012). This emphasis focuses on assessment *for* learning, however, and not the emphasis—and many argue *overemphasis*—on high-stakes standardized testing (Stiggins & Chappuis, 2012).
11. *Criticizing students damages their self-esteem and should be avoided.*
    False. Under certain circumstances, criticism can increase motivation and learning. For instance, criticism, such as a teacher saying, "Come on, you can do better work than this," communicates high expectations to students and the belief that they are capable learners. We're not suggesting that you make criticizing students

a habit, but periodic and well-timed criticism can enhance motivation (Deci & Ryan, 2008).

12. *Because some students are left-brained thinkers and others are right-brained thinkers, teachers should make an effort to accommodate these differences in their students.* **False.** The idea that we tend to be right-brained or left-brained is a myth (Boehm, 2012; Jarrett, 2012; Nielsen, Zielinski, Ferguson, Lainhart, & Anderson, 2013). "This popular myth, which conjures up an image of one side of our brains crackling with activity while the other lies dormant, has its roots in outdated findings from the 1970s . . ." (Boehm, 2012, para. 1).

The items you've just examined briefly introduce you to the professional knowledge base that will help you acquire teaching expertise. In the next section we examine this knowledge in more detail. Research indicates that four related types of knowledge are essential for expert teaching (Darling-Hammond & Baratz-Snowden, 2005; Kunter et al., 2013; Shulman, 1987). They are outlined in Figure 1.1 and discussed in the sections that follow.

KNOWLEDGE OF CONTENT

We obviously can't teach what we don't understand. To effectively teach about the American Revolutionary War, for example, a social studies teacher needs to know not only basic facts about the war but also how the war relates to other aspects of history, such as the French and Indian War, the colonies' relationship with England before the Revolution, and the unique characteristics of the colonies. The same is true for any topic in any other content area, and research confirms the relationship between what teachers know and how they teach (Bransford, Brown, & Cocking, 2000).

PEDAGOGICAL CONTENT KNOWLEDGE

Knowledge of content is essential, but, alone, not sufficient for expert teaching. We must also possess **pedagogical content knowledge**, an understanding of how to represent topics in ways that make the content understandable to learners, as well as an understanding of what makes specific topics easy or difficult to learn (Darling-Hammond & Bransford, 2005; Kunter et al., 2013; Shulman, 1986). It also includes teachers' abilities to identify students' most common misconceptions and to help students resolve their misunderstandings (Sadler, Sonnert, Coyle, Smith, & Miller, 2013).

The following quote supports the idea that pedagogical content knowledge (PCK) is essential for teaching expertise. "Yet as a new insight, our study also showed that teachers' PCK affects not only students' achievement but also their motivation, specifically their enjoyment of the subject . . ." (Kunter et al., 2013, p. 815). Expert teachers understand the

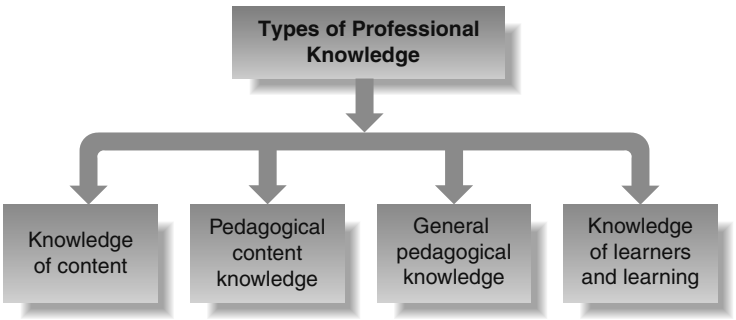


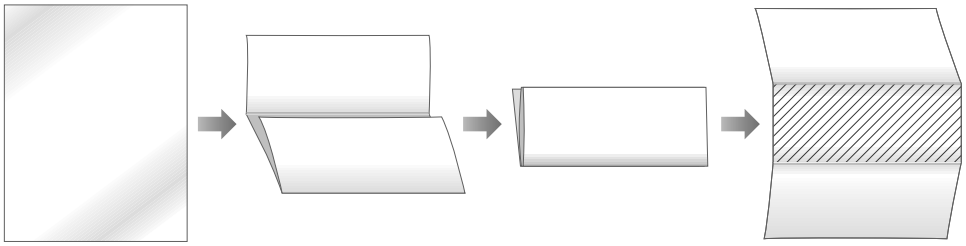
Figure 1.1
Types of professional knowledge

content they teach, and they also know how to make it understandable and interesting to students.

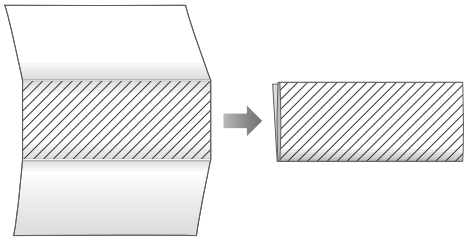
Knowledge of content and pedagogical content knowledge are related but not identical. For example, understanding the factors that led to the American Revolution reflects knowledge of content; knowing how to illustrate this content so students can understand it reflects pedagogical content knowledge. Expert teachers possess both (Kunter et al., 2013; Loughran, Mulhall, & Berry, 2004; Segall, 2004). So, as you study specific topics in your content area, such as math, social studies, science, or any other, ask yourself, "How can I illustrate this topic so students can understand it?" The ability to do so will reflect your pedagogical content knowledge, and it is one of the most important aspects of teaching expertise.

Demonstrating Pedagogical Content Knowledge. To further illustrate what we mean by pedagogical content knowledge in expert teaching, let's look at several examples. First, think about how you might help students understand the process of multiplying fractions, such as $1/4 \times 1/3 = 1/12$. This is neither easy to understand nor easy to teach. Our experience tells us that the product of two numbers is larger than either (e.g., $6 \times 5 = 30$), but with fractions the product is smaller, so the results are counterintuitive. As a result, students often simply memorize the process with little understanding.

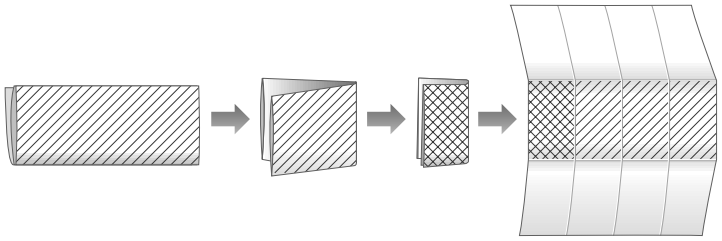
Now, try the following activity. Fold a sheet of plain paper into thirds, and shade the center one-third of the paper, as shown:



Now, refold your paper so that the shaded third is exposed:



Now fold the paper in half, and in half again, so that one-fourth of the shaded one-third is visible. Put additional shading on that portion, and then unfold the paper, as shown:



You've just prepared a concrete example demonstrating that $1/4 \times 1/3 = 1/12$ (the cross-hatched portion of the paper). This example helps students see that the product of multiplying two fractions results in a smaller number and also helps them apply their understanding in real-world settings (Mayer, 2008). This also demonstrates why pedagogical content knowledge is so important. Without examples, such as this one, students grasp what they can, memorize as much as possible, and little understanding develops (Donovan & Bransford, 2005; Kunter et al., 2013).

Now, let's look at an example in science. Consider the concept *density,* which represents the amount of mass (material) in a certain volume—and a concept with which many students, including those who are older, struggle. You can simply illustrate this concept for your students with cotton balls in a transparent drink cup as you see here.

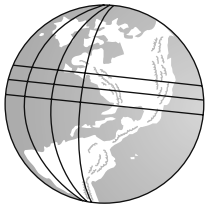
Then, when you compress the cotton in the cup, your students can see that the same amount of cotton (mass) takes up less space (occupies less volume), so the cotton is more dense.

Illustrating the concept this way is much more meaningful for students than using the formula D = m/v, which is the way *density* is usually represented, and which students memorize with little understanding.

As a third example, suppose you are a language arts teacher and you want to teach your students about *gerunds*, verb forms that behave as nouns, and *participles*, verb forms that behave as adjectives. To illustrate these concepts you might display the following short paragraph for your students.

> Running is a very good form of exercise, and athletes, such as running backs in football, have to be in very good physical shape. I'm running a three miler this afternoon.

Here students can see that "running" is first used as a noun (*Running* is a very good form of exercise); then as an adjective (. . . such as *running* backs in football); and finally as a verb (I'm *running* a three miler this afternoon). An important point here is that students *can see* how the verb forms are used. They don't have to understand the concepts based on your explanation. The ability to represent topics in this way again illustrates pedagogical content knowledge.



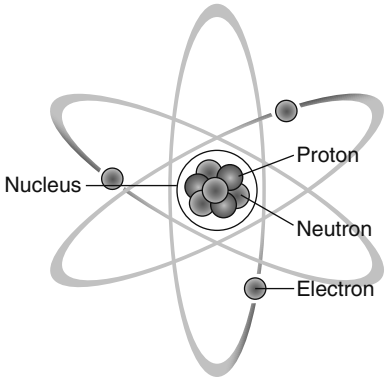
Finally, suppose you're a geography teacher and you want to illustrate the concepts *longitude* and *latitude* for your students. You might draw lines on a beach ball as you see here.

As with the language arts example, your students *can see* that the latitude lines are parallel to each other, and the longitude lines meet at the poles. Then, during your discussion, you can guide your students to recognize that lines of longitude are farthest apart at the equator, but lines of latitude are the same distance apart everywhere, and that longitude measures distance east and west, whereas latitude measures distance north and south.

These are merely examples, and you will find many others when you teach. Depending on the content area, you can represent the topics you teach in several ways:

- *Examples.* Examples are useful when you're teaching a well-defined topic (Renkl, 2011). The illustrations we outlined above to help students understand multiplication of fractions and the concepts *density, gerund, participle, longitude,* and *latitude* are all examples Demonstrations, such as using the cotton balls in the drink cup, are also forms of examples.
- *Case studies.* We use case studies throughout this text to illustrate the topics you're studying. Together with vignettes (short case studies), they effectively illustrate complex topics that are hard to represent with simple examples. For instance, an English teacher might illustrate the concept *internal conflict* with this brief vignette:

Andrea didn't know what to do. She was looking forward to the class trip, but if she went, she wouldn't be able to take the scholarship-qualifying test.



- *Metaphors.* A world history teacher uses her students' loyalty to their school, their ways of talking, and their weekend activities as a metaphor for the concept *nationalism*. Another history teacher uses her class's "crusade" for extracurricular activities as a metaphor for the actual Crusades.
- *Simulations.* Simulations can be effective because they provide concrete models that illustrate complex systems and processes (de Jong, 2011). For instance, an American government teacher creates a mock trial to simulate the workings of our country's judicial system, and a history teacher has students role-play delegates in a simulated Continental Congress to help students understand forces that shaped our country.
- *Models.* Models allow students to visualize what they can't observe directly. For instance, a science teacher uses a model of an atom to help students visualize the organization of the nucleus and electrons, as you see here.

This list further illustrates why knowledge of content and pedagogical content knowledge are related but not identical, and it also helps us understand why item 5 in our Learning and Teaching Inventory ("Preservice teachers who major in a content area, such as math, are much more successful than nonmajors in providing clear examples of the ideas they teach") is false. Earning a degree in a content area, such as math, doesn't ensure that someone will be able to create examples like the one involving the multiplication of fractions, nor does majoring in history ensure that we would be able to think of using a campaign to save a school's extracurricular activities as a metaphor for the Crusades. The ability to represent topics in ways that are understandable to learners requires a special form of knowledge—pedagogical content knowledge—in addition to understanding content (Kunter et al., 2013). If we lack either, we commonly paraphrase information in learners' textbooks or provide abstract explanations that aren't meaningful to our students. We need both to become expert teachers.

GENERAL PEDAGOGICAL KNOWLEDGE

Knowledge of content and pedagogical content knowledge are domain specific, that is, they're related to knowledge of a particular content area, such as the Crusades, multiplying fractions, or the concepts *density, gerund, participle, internal conflict*, and many others. In comparison, **general pedagogical knowledge** involves an understanding of instructional strategies and classroom management that apply to all subject matter areas and topics (Borko & Putnam, 1996; Darling-Hammond & Bransford, 2005).

Instructional Strategies. Instructional strategies, such as knowing how to structure effective lessons that involve students in learning and check for understanding, are important regardless of the grade level, content area, or topic. For example, involving all students in a lesson by calling on them as equally as possible is important whether you're teaching first graders, middle school learners, or advanced high school students (Good & Brophy, 2008; Lemov, 2010). These strategies are essential aspects of general pedagogical knowledge, and you will study them in detail in Chapter 13.

Classroom Management. Classroom management is a second major component of general pedagogical knowledge. To be effective we need to create classroom environments that are safe, orderly, and focused on learning (Emmer & Evertson, 2013; Evertson & Emmer, 2013). Meeting this goal requires that we know how to plan, implement, and monitor rules and procedures; organize groups; and intervene when misbehavior occurs. The complexities of these processes help us see why item 7 in the Learning and Teaching Inventory ("The key to successful classroom management is to stop disruptions quickly") is false. It's impossible to maintain an orderly classroom if we wait for misbehavior to occur. Ideally,

classroom environments are designed to prevent, rather than stop, disruptions. Chapter 12 describes how to do this in your classroom.

KNOWLEDGE OF LEARNERS AND LEARNING

Knowledge of learners and learning, the fourth type of professional knowledge, is also essential, "arguably the most important knowledge a teacher can have" (Borko & Putnam, 1996, p. 675). Let's see how this knowledge can influence the way we teach.

Knowledge of Learners. The following items from the Learning and Teaching Inventory all involve knowledge of learners.

Item 1: The thinking of children in elementary schools tends to be limited to the concrete and tangible, whereas the thinking of middle and high school students tends to be abstract.

Item 2: Students generally understand how much they know about a topic.

Item 6: To increase students' motivation to learn, teachers should praise as much as possible.

For instance, with respect to item 1, we know that students need to have abstract ideas illustrated with concrete examples, and this is true for older as well as younger students. Chapter 2 helps us understand how students' thinking develops, and helps us understand how to represent topics in developmentally appropriate ways.

Item 2 suggests that learners often aren't good judges of either how much they know or the way they learn. Chapters 7 and 8 help us understand how to make our students more aware of the way they think and how to become more strategic in their approaches to learning (Bruning et al., 2011; Veenman, 2011).

Item 6 has implications for the ways we interact with our students. Intuitively, it seems that providing as much praise as possible is desirable and effective. However, motivation research, which you will study in Chapters 10 and 11, helps us understand why this isn't always the case.

Knowledge of Learning. As we better understand the different ways people learn, we can understand why item 4 ("Expert teaching is essentially a process of presenting information to students in succinct and organized ways") on the Learning and Teaching Inventory is false. For example, evidence consistently indicates that we don't behave like video recorders; we don't simply remember what we hear or read. Rather, in our attempts to make sense of the information, we interpret it in personal and sometimes idiosyncratic ways (Dubinsky, Roehrig, & Varma, 2013; Edwards, Esmonde, & Wagner, 2011; Hattie & Gan, 2011). In the process, meaning can be distorted, sometimes profoundly. For instance, the following statements were actually made by students:

"The phases of the moon are caused by clouds blocking out the unseen parts."
"Coats keep us warm by generating heat, like a stove or radiator."
"A triangle which has an angle of 135 degrees is called an obscene triangle."

Obviously, students didn't acquire these ideas from their teachers' explanations. Rather, they interpreted what they heard, experienced, or read; related it to what they already knew; and attempted to make sense of it.

These examples help us understand Keith's comments in the case study at the beginning of the chapter: "I explain the stuff so carefully, but some of the kids just sit with blank looks on their faces. Then, I explain it even more carefully, and . . . nothing." Expert teaching is much more than simply explaining, and expert teachers have a thorough understanding of how learning occurs and what they can do to promote it. (We examine learning in detail in Chapters 6 through 9.)

Developmentally Appropriate **Practice**

Using Knowledge of Learners and Learning to Promote Achievement in Students at Different Ages

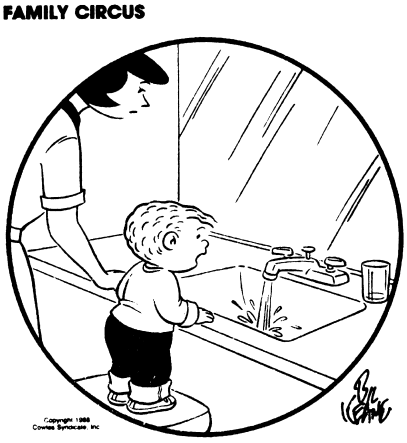
While much of what we know about learners and learning applies to students of all ages, **developmental differences**, age-related changes in students' thinking, personalities, and social skills, exist.

Because the developmental level of your students affects their learning and your teaching, a feature titled "Developmentally Appropriate Practice" appears in each chapter. **Developmentally appropriate practice** refers to instruction that matches teacher actions to the capabilities and needs of learners at different developmental levels. The feature describes ways to adapt each chapter's content to the different learning needs of early childhood and elementary, middle school, and high school students.

Here's how the feature will appear in subsequent chapters:

Working with Students in Early Childhood Programs and Elementary Schools

Young children's thinking differs from the thinking of older students. As an example, look at the accompanying cartoon. Wondering how all the water could fit in the spigot is characteristic of the thinking of young children. Older students would of course realize that a vast reservoir of water exists that we can't see. Young children's personal and social characteristics also differ from those of older students and influence how they interact and learn in classrooms. We examine these differences in each of the chapters in the book.



"How do they fit so much water in that little spigot?"

Working with Students in Middle Schools

As a result of maturation and experience, the thinking and social skills of middle school students differ from those of young children. For example, older students are more likely to realize that they don't understand an idea being discussed in class and raise their hands to ask for an explanation. In addition, middle schoolers are increasingly social and find the opposite sex more interesting. These developmental differences have important implications for how we teach and interact with these students.

Working with Students in High Schools

As with differences between elementary and middle school students, additional differences exist between high school learners and their younger counterparts. For example, many high school students are quite mature, and discussing personal and social issues with them on an adult-to-adult level can be effective. They are capable of more abstract thinking than their younger counterparts, although they still need concrete examples to understand new or difficult topics.

We now understand why item 9 ("Teachers learn by teaching; in general, experience is the primary factor involved in learning to teach") on the Learning and Teaching Inventory is false. Experience is important, but we can't acquire all the knowledge we need to be effective from experience alone. Acquiring this knowledge is the primary reason you're studying educational psychology.

Professional Knowledge and Reflective Practice

You will make a staggering number of decisions in your teaching; some historical research suggests as many as 800 per day (Jackson, 1968). For example, the following are only a few of the aspects of her teaching about which Jan made decisions in her lesson earlier in the chapter:

- The learning objectives for her lesson
- The examples she would use to help students reach the objectives
- Which students she would call on and the order in which she would call on them
- The specific questions she would ask and how she would respond to students if they answered incorrectly

No one is there to help you make these decisions; you're essentially on your own. Learning how to make them leads us to the idea of **reflective practice**, the process of conducting a critical self-examination of one's teaching (Clarke, 2006; McGregor, 2011). Every professional decision we make is designed to promote student learning, and research suggests that reflective practice can help us become more sensitive to student differences (Berrill & Whalen, 2007). And it can make us more aware of the impact of our instruction on learning (Gimbel, 2008). For example, Jan's comment, "When I think about it, I realize that I sometimes jump in too soon . . . and at other times I let them stumble around too long. . . . So, then I adapt for the next lesson," illustrates the process of reflective practice and its influence on her instruction.

The Role of Research in Acquiring Professional Knowledge

To this point in the chapter, we've found that professional knowledge is essential for expert teaching, and we've examined the different types of professional knowledge we need to become experts. But, where does this knowledge originate, how does it accumulate, and how can we acquire it?

One answer is experience, sometimes called "the wisdom of practice" (Berliner, 2000). Well-designed teacher education programs help people like you acquire the beginnings of "the wisdom of practice" by integrating clinical experiences in schools with the topics you study in your classes.

Research, the process of systematically gathering information in an attempt to answer professional questions, is a second important source of the knowledge needed for expert teaching. All professions use research to guide their practice (Gall, Gall, & Borg, 2010; Van Horn, 2008). For example, in an effort to answer the question "How does teacher questioning influence student learning?" researchers have conducted large numbers of studies examining the numbers and types of questions teachers ask and the ways they are asked and distributed among students (Good & Brophy, 2008). The influence of teacher questioning on student learning is part of the professional literature of educational psychology. Jan drew from it when she talked about the changes she made in her teaching based on the class she is taking and her instructor who "keeps talking about research that says how important it is to call on all the kids as equally as possible." Jan is a veteran teacher but continues to grow professionally by staying up to date on current research.

Research in education exists in several forms, each of which answers different kinds of questions. The different types include:

- Quantitative research, which includes descriptive research, correlational research, and experimental research
- Qualitative research
- Action research
- Design-based research

Quantitative Research

Quantitative research refers to the systematic, empirical investigation of phenomena using numerical data and often involving statistical and mathematical techniques. Quantitative research can exist in descriptive, correlational, or experimental forms. We discuss them next.

DESCRIPTIVE RESEARCH

Descriptive research uses tools such as tests, surveys, and observations to describe the status or characteristics of a situation or phenomenon (Gall et al., 2010). For example, "How much are our students learning?" is an important question facing all educators. To answer this question, the National Assessment of Educational Progress (NAEP), often called "The Nation's Report Card," assesses our country's students in a variety of areas, including math, science, reading and writing, the arts, economics, geography and U.S. history, and beginning in 2014, in technology and engineering literacy (TEL) (National Center for Education Statistics, 2012). This is a form of descriptive research, and educators use it to measure the effectiveness of different programs and to make comparisons with other countries.

Surveys, such as the annual Phi Delta Kappan/Gallup Poll of the Public's Attitude Toward the Public Schools (Bushaw & Lopez, 2013), are also forms of descriptive research, as are firsthand observations. Jean Piaget (1959), a pioneer in the study of cognitive development, used systematic observations of children as his primary research technique. (You will study Piaget's work in Chapter 2.)

Descriptive research provides valuable information about a variety of topics related to education, but it doesn't allow us to predict future events, and it doesn't identify relationships. Finding relationships between variables leads us to correlational research.

CORRELATIONAL RESEARCH

Consider the following questions: Does a relationship exist between

- Students' grade-point averages (GPAs) and their scores on the SAT?
- Students' absences and their grades in school?
- Students' heights and high school GPAs?

Correlational research is the process of looking for relationships between variables that enables researchers to predict changes in one variable on the basis of changes in another. A **correlation** is a relationship, either positive or negative, between two or more variables. In our first example, the variables are *grade-point averages* and *SAT scores*; in the second, *absences* and *grades;* and in the third, *height* and *high school GPAs*. The variables are positively correlated in the first example; in general, the higher students' GPAs, the higher their SAT scores. In the second example, the variables are negatively correlated; the more school students miss, the lower their grades. No correlation exists in the third; height and high school GPAs are not related.

It's important to remember that a correlation doesn't imply that one variable *causes* the other. For example, a high GPA—by itself—obviously doesn't cause a high SAT score. Rather, time spent studying, effective study strategies, and general intelligence are likely to be causes of both. Similarly, being absent, per se, doesn't cause low grades. Instead, missing

opportunities to learn, not completing homework assignments, and losing chances to interact with peers are likely causes.

Much of what we know about the relationships between teaching and learning is based on correlational research (Springer, 2010).

EXPERIMENTAL RESEARCH

Whereas correlational research looks for relationships in existing situations, such as the relationship between teacher questioning and student achievement, **experimental research** systematically manipulates variables in attempts to determine cause and effect (Springer, 2010). To illustrate this process, imagine that researchers randomly assign teachers to two groups (random assignment is important to ensure, as much as possible, that the groups are comparable). The researchers then train teachers in one group to call on their students equally, as Jan did with hers, but the other group receives no training. If the students taught by the trained teachers exhibit higher levels of achievement than the students taught by teachers who receive no training, researchers can then conclude that training in equitable distribution of questions causes an increase in achievement (Springer, 2010).

Qualitative Research

Quantitative research, and particularly experimental studies, can be costly, and conducting this research can be a challenge. For example, training interventions are often time consuming, and access to classrooms and teachers may be difficult. **Qualitative research**, which attempts to describe a complex educational phenomenon in a holistic fashion using nonnumerical data, such as words and pictures, is an alternative (Johnson & Christensen, 2011). It relies on interviews, field notes, and other descriptive techniques, and then looks for patterns, as does quantitative research. The results of qualitative studies, however, are published in narrative reports with detailed descriptions of settings and participants, whereas quantitative studies typically result in reports with correlations and other statistical techniques (Gay, Mills, & Airasian, 2012).

A classic qualitative study of teaching, *First-Year Teacher* (Bullough, 1989), illustrates these characteristics. The researcher's goal was to describe, from the teacher's perspective, what it's like to be a first-year teacher. He spent a year observing a first-year, middle school language arts teacher, interviewing her, and collecting artifacts such as lesson plans and assignments. A realistic account of the triumphs and difficulties encountered by one teacher emerged from the study. As in other qualitative studies, the researcher did not claim that this teacher's experience generalized to the experiences of all first-year teachers. Instead, he simply attempted to describe one teacher's experience in as much detail as possible and then allow readers to draw their own conclusions about that teacher's experiences.

Each of these forms of research contributes to professional knowledge, the knowledge expert teachers understand and apply in their work with students.

Action Research

When you teach, and as you gain experience, you'll have questions about the effects your actions have on your students' learning. Some might include:

- How much homework should I give?
- Should I systematically grade homework, or merely check to see if students have completed it?
- How often should I give quizzes?
- Should I ever give my students free time to socialize with their classmates?

Many other examples exist, and to answer these questions, you might conduct your own studies, which are forms of **action research**, applied research designed to answer a specific

school- or classroom-related question. It can use either quantitative or qualitative methods (Gay et al., 2012). For example, you might want to compare your students' achievement when you give a quiz every week during one grading period to a previous grading period when you gave only three quizzes for the 9 weeks. In doing so, you are conducting action research.

If carefully organized and systematically conducted, action research can be published in professional journals or presented at conferences just as is done by professional researchers (Bransford et al., 2000). If you do so, you will also be contributing to the body of professional knowledge that expert teachers possess.

Design-Based Research

Research in education has received a considerable amount of criticism over the years, with its lack of impact on classroom practice being one of the most important. "It is both surprising and depressing that many educators cannot think of a single research output or can think of only trivial outputs that meet this most practical and important outcome of research" (Anderson & Shattuck, 2012, p. 18).

In response to these criticisms, **design-based research** has evolved. In addition to the goal of impacting classroom practice, it has the following characteristics (Anderson & Shattuck, 2012; McKenney & Reeves, 2013):

- It is conducted in a real-world context, such as a classroom.
- It focuses on the design and testing of educational interventions, which could be a specific learning activity, type of assessment, administrative innovation (such as starting school later in the morning), or application of some form of technology, among many others.
- It uses mixed methods, such as combining experimental and qualitative methods.
- It involves multiple iterations, that is, it repeats the process with the aim of approaching a desired goal. The result of one iteration is used as a starting point for the next one.
- It involves a partnership between researchers and practitioners.
- It is intended to contribute to theory.

Design-based research is not the same as action research. When action research is conducted, the educator, such as a teacher or administrator, is both researcher and teacher, whereas a design-based study involves a partnership between researchers and practitioners. "The partnership in a design-based study recognizes that teachers are usually too busy and often ill trained to conduct rigorous research" (Anderson & Shattuck, 2012, p. 17). It also recognizes that teachers working in the real world of classrooms are essential for a study's validity. Further, design-based research doesn't focus exclusively on a local need, as would be the case with action research; as we saw above, it also attempts to contribute to theories that are applicable to a variety of settings.

From your perspective as someone involved in a teacher preparation program, design-based research's attempt to have a practical impact on classroom practice is probably its most important characteristic. When successful, design-based research provides us with concrete and practical suggestions for improving our teaching.

Research and the Development of Theory

As we saw in the discussion of design-based research, contributing to theory is one of its goals. Arguably, this is the goal of all research. As research results accumulate, patterns emerge. For instance, after many studies researchers have concluded that the thinking of young children tends to be dominated by their perceptions (Piaget, 1970, 1977; Wadsworth, 2004). For example, when first graders see an inverted cup of water with a card beneath it, as we see in the accompanying picture, they commonly explain that the card doesn't fall because the water somehow holds it against the cup. They focus on the most perceptually

obvious aspect of the object—the water—and ignore atmospheric pressure, the actual reason the card stays on the cup.

The statement "The thinking of young children tends to be dominated by their perceptions" is a pattern found in large numbers of research studies. Some additional examples of research-based patterns include:

- Behaviors rewarded some of the time, but not all of the time, persist longer than behaviors rewarded every time they occur.
- People tend to imitate behaviors they observe in others.
- People strive for a state of order, balance, and predictability in the world.

As additional research is conducted, related patterns are found, which in turn generate further studies. As knowledge accumulates, **theories**, sets of related patterns that researchers use to explain and predict events in the world, are gradually constructed (Cooper, 2006). In our everyday world, the term is used more loosely. For instance, one person makes a point in a conversation, and a second responds, "I have a theory about that." In this case, the person is merely offering an explanation for the point. In educational psychology, theory is reserved for the more systematic collection of data and the forming of patterns over time.

Theories help organize research findings and can provide valuable guidance for our teaching. Let's look at a brief example. One research-based pattern states, "Reinforced behaviors increase in frequency," and a related pattern we mentioned earlier indicates that intermittently reinforced behaviors persist longer than those that are continuously reinforced (Baldwin & Baldwin, 2001; Schunk, 2012; Skinner, 1957). Further, too much reinforcement can actually decrease its effectiveness. So, for example, if you reinforce your students for their attempts to answer questions by praising them, they are likely to increase their efforts, but they will persist longer if they are praised for some, but not all, of their attempts (intermittently reinforced). If you praise them too much, they may actually reduce their efforts (Deci & Ryan, 2008).

These related patterns are part of behaviorism, a theory that studies the effects of external influences on behavior. Our illustration, of course, is only a minor portion of the complete theory. (We examine behaviorism in depth in Chapter 6.) The key feature of any theory is the large number of research-based patterns that are integrated into a coherent body of knowledge.

Theories are useful in two important ways. First, they allow us to *explain* events in our classrooms and the world at large. For instance, look again at the cartoon on page 35. Piaget's theory of cognitive development (1970, 1977), which includes the pattern we mentioned earlier ("The thinking of young children tends to be dominated by their perceptions"), helps us explain why the child in the cartoon thinks the way he does. We can explain this behavior by saying that the child can see only the water and the faucet, and because his thinking is dominated by his perception—what he can see—he concludes that all the water is in the faucet. Similarly, using behaviorist theory, we can explain why casino patrons persist in playing slot machines, though coins infrequently fall into the trays, by observing that they are being intermittently reinforced.

Theories also allow us to *predict* behavior and events. For instance, based on behaviorism, we would predict that students who periodically receive positive comments on essays will try harder than either students who receive no comments at all, or students who receive effusive positive comments.

In both instances, theories—cognitive development theory and behaviorist theory—help us understand learning and teaching by allowing us to explain and predict our students' behavior and how our actions will influence their learning. Throughout this book, you will study a number of theories, and we will discuss and illustrate ways that you can apply them in your teaching. These theories, together with a large body of research, make up the professional knowledge you need to become an expert teacher.

Teaching in Today's Classrooms

The world of teaching is rapidly changing, and in many ways it's more challenging than it was only a few years ago. But at the same time more potential rewards also exist. To start you on the path toward meeting these challenges and reaping these rewards, we want to provide you with an overview of what you will encounter when you begin your teaching career. In it we'll discuss the following:

- Standards and accountability
- Teacher licensure and evaluation
- Learner diversity
- Technology
- The influence of neuroscience

Standards and Accountability

In 1983 a very influential report, called *A Nation at Risk: The Imperative for Educational Reform,* was published (National Commission on Excellence in Education, 1983). This widely read document, considered to be a landmark in American educational history, argued that our country's schools were failing to meet the national need for a competitive workforce, and since its publication, a great deal has been written about American students' lack of knowledge and skills. For instance, one survey found more than half of high school students identified Germany, Japan, or Italy, instead of the Soviet Union, as America's World War II ally (Bauerlein, 2008). And in 2010 the National Assessment of Educational Progress (NAEP) found that only 12% of American 12th graders scored well enough to be considered "proficient" in American history (National Center for Education Statistics, 2010). Further, NAEP results for 2013 showed that student performance in math and reading remains well below where government and education leaders want it to be (National Center for Education Statistics, 2013a).

American adults also fare poorly. For example, a report from the Organization for Economic Cooperation and Development (OECD), which focused on people aged 16–64 in 24 countries, found that, compared with their international counterparts, American adults are weak in both literacy and math (OECD, 2013).

In response to these concerns, educational leaders have established academic **standards**, statements that describe what students should know or be able to do at the end of a prescribed period of study. All states and the District of Columbia have established standards. The following are two examples, the first in world history from the state of California and the second in third-grade math from Texas.

> Students analyze the effects of the Industrial Revolution in England, France, Germany, Japan and the United States.
>
> 1. Analyze why England was the first country to industrialize (California State Board of Education, 2008).

> (3) Number and operations. The student applies mathematical process standards to represent and explain fractional units. The student is expected to:
>
> (A) represent fractions greater than zero and less than or equal to one with denominators of 2, 3, 4, 6, and 8 using concrete objects and pictorial models, including strip diagrams and number lines (Texas Education Agency, 2012)

Analysis of standards from different states has identified significant variations in expectations, rigor, and even content. Also, charges have been made suggesting that many states lowered their standards to meet federal mandates (Ginsburg, Leinwand, & Decker, 2009).

Further, American students still remain behind other nations in academic achievement, readiness for college, and the world of work. For instance, according to some measures,

American students rank 25th in math, 17th in science, and 14th in reading compared with students in 27 industrialized countries around the world (Broad Foundation, 2013).

Because of these issues, the Common Core State Standards Initiative (CCSSI) was developed. Let's look at it.

THE COMMON CORE STATE STANDARDS INITIATIVE

The **Common Core State Standards Initiative (CCSSI)** is a state-led effort to establish a single set of clear educational standards for all states (Common Core State Standards Initiative, 2014a). The standards exist in mathematics and English-language arts together with literacy in history/social studies, science, and technical subjects. States can voluntarily adopt and share the standards. The CCSSI is coordinated by the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO). By 2012, 45 states, the District of Columbia, four territories, and the Department of Defense Education Activities had adopted the Common Core standards (Common Core State Standards Initiative, 2014a).

The CCSSI standards are designed to ensure that students graduating from high school are prepared to go to college or enter the workforce and that parents, teachers, and students have a clear understanding of what is expected of them. The standards are also linked to international benchmarks to hopefully ensure that American students are competitive in the emerging global marketplace (Ginsburg et al., 2009; Lee & Spratley, 2010).

The following is an example from first-grade math:

> **CCSS.Math.Content.1.OA.B.3 Apply properties of operations as strategies to add and subtract. Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.) (Common Core State Standards Initiative, 2014p).**

As another example, a literacy standard in History/Social Studies for Grade 9–10 appears as follows.

> **CCSS.ELA-Literacy.RH.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claims. (Common Core State Standards Initiative, 2014d).**

The Common Core State Standards are similar to many of the standards that already exist in the states. The consistency that the standards provide—both among states in our country and internationally—is a primary advantage of the CCSSI.

Controversies with the Common Core. The Common Core enjoyed widespread acceptance until the fall of 2012, but then criticisms began to surface (Bushaw & Lopez, 2013). For example, some critics argued that the uniformity of standards across states represented federal overreach and an attempt to establish a national curriculum (Strauss, 2013).

Public understanding of the CCSSI was also a problem. For instance, one poll found that "almost two of three Americans have never heard of the Common Core State Standards, . . . and most of those who say they know about the Common Core neither understand it nor embrace it" (Bushaw & Lopez, 2013, p. 9).

On the other hand, supporters point out that the CCSSI is not a federal program; it originated in the states, where the standards were developed by governors and state school officials. Also, initial impetus for the standards began at the annual meeting of the Council of Chief State School Officers in 2007 during the George W. Bush presidential administration (Schoof, 2013). And the Common Core isn't a mandate, and it doesn't prescribe curriculum. Individual teachers interpret the standards, set their own objectives, design their own learning activities, and create their own assessments.

Further, the Common Core has variously been described as "The most important educational reform in the country's history" (New York Times Editorial Board, 2013, para. 2),

"[A]rguably one of the most important education initiatives in decades" (Bushaw & Lopez, 2013, p. 9), and "[A]rguably the most serious educational reform of our lifetime" (Keller, 2013, para. 3). The standards have been endorsed by most professional groups, and business leaders have come out in formal support of the Common Core (Molnar, 2014). Also, more than 8 of 10 Americans strongly agree that schools should teach critical thinking skills, which are integral to the Common Core (Bushaw & Lopez, 2013).

Despite controversies, the Common Core appears to be moving forward and will likely be a part of your professional life when you begin teaching. This is the reason we link most of our case studies in this book to Common Core standards—so you will be ready when you begin your career.

ACCOUNTABILITY

Accountability is the process of requiring students to demonstrate that they have met standards as measured by standardized tests. States that have adopted the Common Core standards have collaborated to develop common assessments that are aligned with the standards and replace existing end-of-year state assessments. These assessments linked to the Common Core were intended to be made available for the 2014–2015 school year (Common Core State Standards Initiative, 2014a). So, if your state is one that has adopted the Common Core standards, your students will be held accountable for meeting them.

Prior to the development of tests aligned with the Common Core State Standards, states developed their own end-of-year tests designed to assess the extent to which students have met state standards. If your state has not adopted the Common Core, your students will be held accountable for meeting the standards established by your state.

Either way, standards and accountability will be a part of your teaching life when you begin your career, and the sooner you become comfortable with them, the easier your job will be. Our goal in introducing them in this chapter is to help you hit the ground running.

Teacher Licensure and Evaluation

In addition to standards and accountability, teacher licensure and evaluation are part of the reality of teacher preparation programs and teaching in today's classroom. For you, this process will exist at two levels. The first will occur before you begin teaching and will require you to pass a licensure exam; the second is ongoing evaluation that will be conducted throughout your career. Let's first look at licensure exams.

LICENSURE EXAMS

As you saw earlier in the chapter, teacher quality is now a national priority, and, for many, "teacher quality" is synonymous with teacher knowledge. In an attempt to ensure that teachers possess adequate professional knowledge, all states now require prospective teachers to pass one or more tests before they receive a teaching license. These tests commonly measure general knowledge, as well as the types of professional knowledge that we described earlier in the chapter. It is a virtual certainty that you will be required to pass an exam that measures your professional knowledge before you receive your teaching license.

The Praxis Series™, published by the Educational Testing Service, is the test most widely used for teacher licensure (*praxis* means putting theory into practice). A majority of the states in our country use this series (Educational Testing Service, 2014a). States that don't use the Praxis Series™ have created their own licensure exams, and these exams are quite similar to the Praxis in design and content.

The Praxis Series™ tests include (Educational Testing Service, 2014a):

- Praxis™ Core Academic Skills for Educators (Core). These tests measure academic skills in reading, writing, and mathematics. They're designed to assess the knowledge and skills of candidates entering teacher preparation programs.

- Praxis I® Pre-Professional Skills Tests (PPST®). These tests measure basic skills in reading, writing, and mathematics. In addition to licensure, these tests are often used to qualify candidates for entry into a teacher education program.
- Praxis II® Subject Assessments. These tests measure subject-specific content knowledge, together with general and subject-specific teaching skills that are needed to succeed as a teacher.

The *Principles of Learning and Teaching (PLT)* tests are important parts of the Praxis II® series. The PLT tests are designed for teachers seeking licensure in early childhood or grades K–6, 5–9, and 7–12. Each of the four tests is 2 hours long and consists of 70 questions that are multiple-choice combined with four constructed-response questions that are based on two "case histories" similar to the case study that you read at the beginning of this chapter (Educational Testing Service, 2014b, 2014c, 2014d, 2014e). The content of educational psychology makes up much of what is measured on the tests, and in our "Preparing for Your Licensure Exam" feature, which appears at the end of each chapter, you can practice responding to multiple-choice and short-answer questions similar to those you'll encounter on the PLT tests. In addition, Appendix C provides a matrix that correlates the content covered in this text with the content measured on the Praxis PLT exams.

TEACHER EVALUATION

Teacher evaluation, the process of assessing teachers' classroom performance and providing feedback they can use to increase their expertise, is another aspect of reality that you will encounter when you begin your career. Teacher evaluation has become an increasingly important issue in education, because evidence suggests that, historically, evaluation procedures have done little to reward good teachers and eliminate those that are incompetent. Criticisms of these procedures vary from calling them inefficient and ineffective (Weisberg, Sexton, Mulhern, & Keeling, 2009) to calling them perfunctory and haphazard (Pallas, 2010/2011). Current reforms are attempting to remedy this problem by creating more valid and reliable teacher evaluation systems (Hull, 2013; MET, 2013).

The use of student achievement data is one aspect of these systems. This leads us to the concept of value-added modeling in teacher evaluation.

Value-Added Modeling in Teacher Evaluation. **Value-added modeling** is a method of teacher evaluation that measures a teacher's contribution to student learning in a given year by comparing the current test scores of their students to the scores of those same students in previous school years, and to the scores of other students in the same grade. For example, if a second grader scores at the 50th percentile on a reading test at the beginning of the year and on the 60th percentile at the end of the year, researchers conclude that the gain is a result of the teacher's expertise, and *value* had been added. This approach seeks to isolate the contribution that each teacher provides (the value added) during the year, which can then be compared with the performance of other teachers (Corcoran, 2010; Darling-Hammond, Amrein-Beardsley, Haertel, & Rothstein, 2011).

Value-added models are controversial (Fuhrman, 2013). Students are rarely randomly assigned to teachers, which can impact the validity of test results (Paufler & Amrein-Beardsley, 2014). Critics also question whether tests can accurately capture what teachers are actually accomplishing, such as learning gains that might not show up immediately, and other outcomes, such as social skills, motivation, and self-regulation, that can't be measured on tests (Baker et al., 2010; Corcoran, 2010; Darling-Hammond et al., 2011). "[T]here is broad agreement among statisticians, psychometricians, and economists that student test scores alone are not sufficiently reliable and valid indicators of teacher effectiveness . . . even when the most sophisticated statistical applications such as value-added modeling are employed" (Baker et al., 2010, p. 2). As a result of these criticisms, no state in our country evaluates teachers on the basis of student test scores alone (Hull, 2013).

Trends in Teacher Evaluation. So, how will you be evaluated when you begin your teaching career? A report issued in 2013 by National School Boards Association Center for Public Education outlines the patterns among the states in our country with respect to teacher evaluation (Hull, 2013). The following is a summary of them:

- Forty-seven states require or recommend that stakeholders, including teachers, provide input into the design of evaluation systems. This means that you and/or your colleagues will have input into the way your teaching will be evaluated.
- Forty-one states require or recommend that teachers be evaluated on multiple measures. In addition to student test scores and classroom observations, these evaluations may include measures such as student and parent surveys, examinations of lesson plans, teacher self-assessments, student artifacts, and teacher portfolios.
- Forty-six states require or recommend that evaluations include measures on how teachers impact their students' achievement, and 23 states have mandated that achievement measures comprise half of teachers' evaluations. And some research suggests that high-quality measures of student achievement correlate strongly with other measures of teacher effectiveness (MET, 2013). So, it's highly likely that your students' test scores will make up part of your evaluation.
- Classroom observations are a component of every state's evaluation system, and several evaluations during a school year are recommended. The goal is to use well-trained observers to ensure that teachers being evaluated receive similar scores regardless of who conducts the observations, and observation instruments are supposed to be based on practices most likely to increase student learning.
- Most states are focusing on using evaluation for the purpose of raising teacher performance, but some are also using the results to inform personnel decisions, such as teacher retention and salary increases.

To identify your state's specific practices, go to the website that includes the report conducted by the National School Boards Association Center for Public Education (Hull, 2013).

What are the implications of these changes for you when you begin teaching? First, evaluation will be an important part of your teaching life, so become thoroughly familiar with the criteria that will be used to evaluate you. Study the observation instruments that will be used, so that demonstrating the teaching skills identified in them become essentially automatic. For instance, if the instrument has a category saying, "Learning objectives are displayed for students," make writing your learning objectives on the board one of your routines. If the amount of student involvement is a category, make high levels of student involvement part of your teaching repertoire. (This is a win-win for you. Student involvement promotes learning, and you will earn positive evaluations.)

Since it's likely that your students' performance on standardized tests will make up part of your evaluation, become as familiar as possible with the content measured on the tests, as well as test formats, and do everything you can to ensure that your students have mastered the content and are familiar with test formats and procedures. (This suggestion is different from "teaching to the test," which focuses on specific test items and provides practice with those items.)

The same is true for other measures, such as lesson plans or student artifacts, if they're used as part of your evaluation. You will undoubtedly feel some pressure to perform well when you're evaluated, but teacher evaluation should not be onerous or punitive. Rather, it should be an opportunity for you to demonstrate your expertise and receive feedback that will help you improve in areas where needed. None of us teach perfect lessons, and we can all improve. If this is the spirit in which your district and school conducts evaluations, they can become a positive professional growth experience.

Learner Diversity

The demographic trends in our country are changing rapidly, and increasing diversity is one of the most significant. For example, you probably have friends whose ethnic backgrounds

are different from your own, and they may speak a native language other than English. In fact, English may not be your first language.

The following projections illustrate some of these demographic changes, comparing the status in 2010 to predictions for 2021 (National Center for Education Statistics, 2013b):

- The total population in our country is projected to increase slightly more than 7%.
- The Hispanic population is projected to increase from approximately 23% to 26% of the total.
- The Black population, approximately 16% of the total, is projected to remain stable.
- The percentage of other ethnic groups, such as Asian/Pacific Islander, Native Americans, and multi-ethnic groups, is projected to increase.
- In 2010 the non-Hispanic white population in our country made up 52% of the total, but by 2021 that figure is projected to drop to 47%. This means that by that year, no ethnic group will be a majority in our country.

Prior to 2010, more than 40% of Californians spoke a language at home other than English. In Texas it was more than 33%; in New York nearly 30%; and it was more than 25% in Florida (Center for Public Education, 2012). Those figures are almost certainly higher today. In an event that symbolizes some of the potential issues related to this diversity, 20,000 students sued California educators in the spring of 2013 for failing to teach English to non-native English speakers (Mohajer, 2013).

The diversity in our country is more complex than culture and language. For example, children coming from low-income families are now a major factor in today's schools. Consider the following statistics (Southern Education Foundation, 2013):

- All states in our country experienced rising rates of low-income students between the years 2000 and 2011.
- Forty-eight percent of all students in our country were eligible for free or reduced-price lunch in 2011.
- Urban areas in every part of our country now have majorities of students who come from low-income families, and nationwide, two out of five students in the suburbs also are poor.

In addition, over a million homeless students attended our schools in 2011–2012, with substantial subgroups of learners with disabilities and non-native English speakers among this number. Forty states reported an increase in the number of homeless students, with 10 reporting an increase of 20% or more (National Center for Homeless Education, 2013).

Finally, statistics indicate that approximately 12% of the students who attend our nation's schools have exceptionalities that may require extra services in order for them to reach their full potential (Center for Public Education, 2013; Heward, 2013).

This all means that your students will have very diverse backgrounds, and this diversity will be both enriching and challenging. Different cultural habits, attitudes, and values can make learning experiences more enriching for all your students, while at the same time, for example, working with children from low-income families will be a challenge. Because learner diversity is such an important influence on teaching and learning in today's world, we include one or more sections examining diversity topics in each of the chapters of this book.

Technology

Think about the following questions.

1. When was the last time you went to a print encyclopedia to find some information, or to a print dictionary to find the definition of a word?
2. When was the last time you took a picture with a camera that uses film?

3. How often do you "Google" something?
4. Are you a Facebook user?
5. Do you own a smartphone or tablet computer?
6. Do you prefer to "text" rather than talk on the phone?

The answer to the first two questions might be "Never" or "Can't remember when." "Daily" or even more often might be the answer to the third, and "Yes" is probably the most common answer to the last three. We could ask many more similar questions, but you get the idea. Technology is now so much a part of our world that, until we stop to think about it, we almost don't realize it.

As with the other topics we've discussed in this section, technology will be an integral part of your teaching life, and it will have benefits and present challenges. As a simple example, instead of sending a letter in print form home to parents you will likely email it. You may teach some classes online. You will store lesson plans and a myriad of examples and other resources in your computer, which you will access and display for your students at the touch of your keyboard. Your classroom will likely be equipped with an **interactive whiteboard**, a device that includes a display screen connected to a computer and projector that allows information displayed on the screen to be manipulated with hands or special pens, stored in the computer, and recovered later for further use (Roblyer & Doering, 2013). Technology such as this is being used in classrooms across the country ranging from early elementary (Linder, 2013) to university levels (Greene & Kirpalani, 2013). Also, an increasing number of teachers are using social media, such as blogs, wikis, Twitter, and others, to promote classroom learning (Seo, 2013). And students are becoming increasingly "tech savvy." For example, many kindergarten students are now experienced tablet users—for both entertainment and learning. This technology is merely the tip of an iceberg. The list of potential technological influences is virtually endless, and we can only imagine what the future world has in store (Kaku, 2011).

Challenges will also exist. For instance, one survey found that nearly half of university students text at least once per class session (Johnson, 2013), and another determined that more than 9 of 10 bring their cell phones to class every day and use their phones to send texts during class time (Tindell & Bohlander, 2013). These issues also exist at the P–12 level.

The point here is that technology has permeated students' very existence, and it will also be an integral part of your teaching life. So, the sooner you begin preparing to capitalize on its benefits and meet its challenges the better off you'll be. Because technology is such an integral part of teaching and learning in our nation's schools, we include discussions of it in special features throughout this book.

The Influence of Neuroscience

Ed Psych and You

Is it possible for us to literally "get smarter" if the conditions are right? To what extent do emotions, such as joy and anger, influence our learning? We've all heard the old adage, "Let's sleep on it?" Can this make a difference?

Neuroscience is the study of how the nervous system develops, how it's structured, and what it does. Traditionally seen as a branch of biology, neuroscience is now viewed as an interdisciplinary science that collaborates with other fields such as chemistry, computer science, and medicine, and it's also linked to such disciplines as law, psychology, and education. Neuroscience began its march to prominence in the 1980s, and in the 1990s it gathered momentum that continues today (van Ommen, 2013).

Neuroscience research contributes to our understanding of learning and teaching in two ways. First, it provides evidence that confirms teaching practices that we have long believed are important, such as the need for active learning. "Many research studies suggest that active engagement is a prerequisite for changes in the brain. Not surprisingly, just listening to a presentation or lecture will not lead to learning" (Van Dam, 2013, p. 32). This quote implies that we won't learn from lectures, and while this is probably overstated, we have long known that students learn much more when they are cognitively active—consciously *thinking about* the content they're studying—than they do when they sit passively listening (Edwards et al., 2011; Veenman, 2011).

As a second example, intuitively it makes sense that stress and fatigue will have a negative impact on cognitive functioning, and neuroscience research confirms this sensible idea (Palmer, 2013). This research was done on university students, and it has implications for you as you move through your university experience; simply, understand that stress and fatigue affect learning and make every effort to manage your stress levels and get enough rest.

Second, neuroscience provides us with insights into the brain and the way it works. **Neuroplasticity** (sometimes called *brain plasticity,* or simply *plasticity*), the brain's ability to physically remodel itself in response to experience, is one of the most important of these insights (Dubinsky et al., 2013; Pascual-Leone, Amedi, Fregni, & Merabet, 2005). In other words, as we acquire experiences, the brain can literally rewire itself (Schachter, 2012). "People have different genetic predispositions, but experience continuously shapes our brain structure and modifies behavior" (Van Dam, 2013, p. 32). This is a very different view of the brain; until recently scientists thought the structure of the brain developed during childhood and that once developed there was little room for change (Pascual-Leone et al., 2005).

The concept of neuroplasticity helps answer the first question we asked in *Ed Psych and You*. It suggests that yes, if we have the right kinds of experiences, we can indeed literally get smarter. This is very good news, and it also has enormous implications for teaching and learning. It suggests that providing meaningful experiences—in areas varying from academic to personal, social, and emotional—is arguably our most important task as teachers. When we succeed, we don't just help our students acquire knowledge and skills; we literally change their brains. It has implications for learners as well. "Students who understand that their brains are plastic are more willing to struggle to learn difficult content" (Dubinsky et al., 2013, p. 319).

Neuroscience also helps us answer the second and third questions we asked in *Ed Psych and You.* Emotions do indeed influence both motivation and learning. Positive emotions, such as joy, are generally linked to increased motivation and achievement, whereas the opposite is true for negative emotions (Legault & Inzlicht, 2013; Lövheim, 2012). There's something to the old adage, "Let's sleep on it"; neuroscience research indicates that memories are often consolidated and linked during sleep, resulting in more coherent and usable patterns (Nieuwenhuis, Folia, Forkstam, Jensen, & Petersson, 2013).

Because neuroscience contributes to our understanding of learning and its implications for teaching, we include sections on the topic in several of the chapters of this text.

Educational Psychology and Teaching: Applying Your Professional Knowledge in Today's Classrooms

Much of educational psychology is interesting for its own sake, because it provides insights into how we all learn and develop. It can also make an important contribution to your teaching, but only if you know how to apply its content to your work. As you see in the title of this section, *applying* the content of educational psychology to your teaching is the

focus here, and one or more sections devoted to application will appear in each chapter of this book. This is why you're taking this course and studying this text—so you can use your knowledge of learning and teaching, the content of educational psychology, to increase your students' achievement.

To understand how applications of educational psychology can influence your teaching, let's return to the questions we asked at the beginning of the chapter.

"How was Jan's approach to teaching word problems different from Keith's?"

and

"Why were their approaches so different, and how will these differences affect their students' learning?"

We now want to examine these questions again, using professional knowledge as the lens through which we look. Let's begin by considering the first. Keith's approach to teaching word problems was to ". . . explain the stuff so carefully," and when the kids sat with blank looks on their faces, to ". . . explain it even more carefully." He was conscientious and sincere in his attempts to help his students learn to solve problems, and his approach—to explain—is the one most commonly used in classrooms. The problem he encountered is also common; explaining—alone—is often ineffective in helping students understand difficult ideas, such as problem solving. In contrast, Jan built her lesson around concrete and real-world examples—the costs of the 12-ounce soft drink can, the 20-ounce bottle, and the 6 pack.

To promote student involvement, she had them work in pairs to determine which one was the best buy, and she provided them with enough guidance to ensure that they were making progress toward a solution. In contrast with Keith, she didn't use explaining as her primary approach to helping them learn to solve problems.

Now, let's answer the second question. Their approaches were different because Jan possessed more professional knowledge than did Keith, and, as a result, Jan's students are likely to learn more. They both had ample knowledge of content; they both understood decimals and percents and the processes involved in problem solving. However, the fact that Keith used verbal explanations—an often ineffective teaching strategy—as his only approach indicated that he lacked pedagogical content knowledge, general pedagogical knowledge, and knowledge of learners and learning—the other forms of professional knowledge needed for expert teaching. He explained, and when that didn't work, he was only able to explain some more. In contrast, Jan was able to provide concrete and real-world examples of decimals, percents, and problem solving, which demonstrated her pedagogical content knowledge. The fact that she knew her students needed the concrete examples and needed to be actively involved in the learning activity indicated her knowledge of learners and learning.

The differences between Jan's and Keith's professional knowledge are not surprising. Keith is a first-year teacher, whereas Jan has four years of experience, and she continues to grow professionally by taking classes that focus on this knowledge. Because Keith is a rookie, he is less knowledgeable than Jan, but he is no less committed. With study and practice he will learn and grow, and the same applies to you. You won't be an expert immediately, but with effort you can be, and in doing so, you *will* become more effective and more satisfied with your teaching.

chapter 1

Summary

1. Describe expert teaching and explain how expert teaching influences student learning.
   - Experts are people who are highly knowledgeable and skilled in a particular domain, such as teaching. Students taught by expert teachers learn more than students taught by teachers with less expertise.
   - Expert teachers can produce learning in their students and do so despite challenging circumstances.
2. Describe the different kinds of professional knowledge that expert teachers possess.
   - Expert teachers thoroughly understand the topics they teach, and their knowledge is reflected in their actions when they use their pedagogical content knowledge to illustrate those topics in ways that make sense to learners.
   - Expert teachers apply general pedagogical knowledge to organize learning environments and use basic instructional skills in ways that promote learning for their students.
   - Expert teachers' knowledge of learners and learning allows them to design learning activities that involve students, promote motivation to learn, and use developmentally appropriate practice.
3. Describe different types of research, and explain how research and theory contribute to teachers' professional knowledge.
   - Research is the process of systematically gathering information in an attempt to answer professional questions, and it is an important source of the knowledge needed for expert teaching.
   - Quantitative research is the systematic examination of events using numerical data and statistical and mathematical techniques. Quantitative research exists in descriptive, correlational, and experimental forms.
   - Descriptive research uses tests, surveys, and observations to describe the characteristics of some phenomena; correlational research looks for relationships among variables that allows the prediction of changes in one variable based on changes in another variable; experimental research systematically manipulates variables in attempts to determine cause and effect.
   - Qualitative research attempts to describe complex educational phenomen in a holistic fashion using nonnumerical data.
   - Action research is applied research designed to answer a specific school- or classroom-related question. It can use both quantitative and qualitative methods.
   - Influencing classroom practice is the goal of design-based research, and its characteristics include collaboration between researchers and teachers, a focus on educational interventions, the use of multiple iterations, and mixed methods. Unlike action research, it includes both the solution of local problems and efforts to contribute to theory.
   - Theories are sets of related patterns that help explain and predict events in the world. Theories can provide valuable guidance for teaching.
4. Identify factors that influence teaching in today's classrooms.
   - Standards, statements describing what students should know or be able to do after a given period of study, and accountability, the process of requiring students to demonstrate that they have met standards as measured by standardized tests, are parts of professional reality in today's classrooms.
   - Teachers are required to pass a licensure exam before they're allowed to work full time in today's classrooms, and they will also be regularly evaluated during their teaching careers.
   - Teacher evaluation systems commonly include a combination of measures. Virtually all include classroom observations, but they may also include other items, such as student and parent surveys, lesson plans, and student artifacts. A number of states are now including student scores on standardized tests as well.
   - Today's schools are now attended by students whose backgrounds are the most diverse in our country's history. In addition to differences in cultural and language backgrounds, large numbers of students from low-income backgrounds are now attending our nation's schools.
   - Technology is now an integral part of our lives, and it is becoming an increasingly significant factor in today's classrooms.
   - Neuroscience, the study of how the nervous system develops, how it's structured, and what it does, is contributing to our understanding of teaching and learning, with neuroplasticity, the ability of the brain to physically remodel itself in response to experience, a being one of the most important. It suggests that providing high-quality experiences for students might arguably be teachers' most important role.

Preparing for **Your Licensure Exam**

Understanding Professional Knowledge

You will be required to take a licensure exam before you go into your own classroom. This exam will include information related to the different types of professional knowledge teachers need to become experts, and the following exercises are similar to those that appear on licensure exams. They are designed to help you prepare for the exam in your state. This book and these exercises will be a resource for you later in your program as you prepare for the exam.

The following episodes illustrate four teachers at different classroom levels working with their students. As you read the episodes, think about the different types of professional knowledge that the teachers demonstrate in their lessons.

The segments you study here are based on the video episode you saw in "Practice Using What You Have Learned" Exercise 1.1. To make the written segments more meaningful, you may want to review the video episode again.

Rebecca Atkins, a kindergarten teacher, is talking with her children about planting a garden. She sits on a small chair at the front of the room and has the children seated on the floor in a semicircle in front of her.

She begins, "We had a story about gardening the other day. Who remembers the name of the story? . . . Shereta?"

"'Together,'" Shereta softly responds.

"Yes, 'Together,'" Rebecca repeats. "What happened in 'Together'? . . . Andrea?"

"They had a garden."

"They planted a garden together, didn't they?" Rebecca smiles. "The boy's father helped them plant the garden."

She continues by referring the children to previous science lessons during which they had talked about plants and soil. She then asks them about their own experiences helping their parents plant a garden.

"I helped put the seeds in the ground and put the dirt on top of it," Robert offers.

"What kinds of vegetables did you plant? . . . Kim?"

"I planted lots of vegetables . . . tomatoes, carrots."

"Travis?"

"I planted okra."

"Raphael?"

"I planted beans."

She continues, "Tell about the story 'Together.' What did they have to do to take care of the garden? . . . Carlita?"

"Water it."

"Bengemar?"

"Pull the weeds from it."

"Pull the weeds from it," Rebecca smiles. "What would happen if we left those weeds in there? . . . Latangela?"

"It would hurt the soil."

"What's another word for soil?"

"Dirt," several of the children say in unison.

"How many of you like to play in the dirt?"

Most of the children raise their hands.

"So, planting a garden would be fun because you get to play in the dirt," Rebecca says enthusiastically.

"I like to play in the mud," Travis adds.

"You like to play in the mud," Rebecca repeats, attempting to stifle a laugh.

We turn now to Richard Nelms, a middle school science teacher, as he illustrates the concept of symmetry for his seventh graders.

Richard begins his discussion of symmetry by holding up a sponge as an example of an asymmetrical animal; he demonstrates radial symmetry using a starfish; and he then turns to bilateral symmetry.

"We have one more type of symmetry," he says. "Jason, come up here. . . . Stand up here."

Jason comes to the front of the room and stands on a stool.

"Would you say," Richard begins, "that Jason is asymmetrical—that there is not uniformity in his shape?"

The students shake their heads.

He has Jason extend his arms out from his sides as you see here and then asks, "Would you consider this radial, because he has extensions that go out in all directions? . . . Jarrett?"

"No."

"Why not? Explain that for us."

"There's nothing there," Jarrett says, pointing to Jason's sides.

"There's nothing coming from here, is there, and the arms, legs and head are all different?" Richard adds.

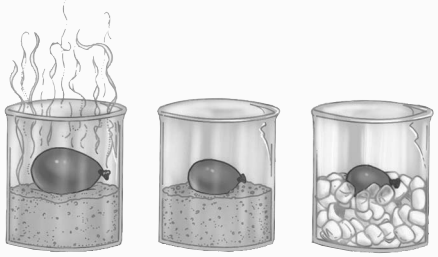
"So, we move to the third type of symmetry," he continues, as Jason continues to stand with his arms extended. "It's called *bilateral*. . . . Bilateral means that the form or

shape of the organism is divided into two halves, and the two halves are consistent. . . . If I took a tree saw and started at the top," he says, pointing at Jason's head as the class laughs, "the two halves would be essentially the same."

"Now, tomorrow," he continues, "we're going to see how symmetry influences the ways organisms function in their environments."

Let's look in now at Didi Johnson, a 10th-grade chemistry teacher, as she attempts to help her students understand Charles's law of gases, the law stating that an increase in the temperature of a gas causes an increase in its volume if the pressure on the gas doesn't change.

To illustrate that heat causes gases to expand, Didi prepares a demonstration in which she places three identical balloons filled with the same amount of air into three beakers of water. She puts the first into a beaker of hot water, the second into a beaker of water at room temperature, and the third into a beaker of ice water, as you see here.



"This water is near boiling," Didi explains as she places the first balloon in the beaker. "This is room temperature, and this has had ice in it, so it is near the freezing point," she continues as she puts the other two balloons into the beakers.

"Today," she continues as she begins writing on the board, "we're going to discuss Charles's law, but before we put it on the board and discuss it, we're going to see what happened to the balloons. . . . Look up here. . . . How is the size of the balloon related to the temperature of the water we placed it in?"

"The balloon in the hot water looks bigger," Chris responds.

"Can you see any difference in these two?" Didi continues, pointing to the other two balloons.

"The one in the cold water looks smaller than the one in the room-temperature water," Shannon adds.

"So, from what we see, if you increase temperature, what happens to the volume of the gas?"

"It increases," several students volunteer.

Didi writes, "Increase in temperature increases volume" on the board, emphasizes that the amount of air and the pressure in the balloons were kept essentially constant, and then asks, "Who can state Charles's law based on what we've seen here?"

"Increased temperature will increase volume if you have constant pressure and mass," Jeremy offers.

Didi briefly reviews Charles's law, writes an equation for it on the board, and has the students solve a series of problems using the law.

Finally, let's look at Bob Duchaine's work with his students. An American history teacher, he is discussing the Vietnam War with his 11th graders.

Bob begins by saying, "To understand the Vietnam War, we need to go back to the beginning. Vietnam had been set up as a French colony in the 1880s, but by the mid-1900s, the military situation had gotten so bad for the French that they only controlled certain enclaves like the little city of Dien Bien Phu."

He explains that the French surrendered this city in the summer of 1954, and peace talks followed. The talks resulted in Vietnam being split, and provisions for free elections were set up.

"These elections were never held," Bob continues. "Ngo Dinh Diem, in 1956, said there will be no free elections: 'I am in charge of the South. You can have elections in the North if you want, but there will be no elections in the South."'

He continues by introducing the "domino theory," which suggested that countries such as South Vietnam, Cambodia, Laos, Thailand, Burma, and even India would fall into communist hands much as dominos tip over and knock each other down. The way to prevent the loss of the countries, he explains, was to confront North Vietnam.

"And that's what we're going to be talking about throughout this unit," he says. "The war that we took over from the French to stop the fall of the dominos soon was eating up American lives at the rate of 12 to 15 thousand a year. . . . This situation went from a little simple plan—to stop the dominos from falling—to a loss of over 53,000 American lives that we know of.

"We'll pick up with this topic day after tomorrow. . . . Tomorrow, you have a fun day in the library."

Questions for **Case Analysis**

In answering these questions, use information from the chapter, and link your responses to specific information in the case.

Multiple-Choice Questions

1. The two teachers who most nearly demonstrated pedagogical content knowledge were:
   - **a.** Rebecca and Richard.
   - **b.** Richard and Didi.
   - **c.** Richard and Bob.
   - **d.** Didi and Bob.
2. The teacher who *least* demonstrated general pedagogical knowledge was:
   - **a.** Rebecca.
   - **b.** Richard.
   - **c.** Didi.
   - **d.** Bob.

Constructed-Response Question

3. What type or types of professional knowledge did Bob most nearly demonstrate?

Important **Concepts**

accountability
action research
Common Core State Standards Initiative (CCSSI)
correlation
correlational research
descriptive research
design-based research
developmental differences
developmentally appropriate practice
educational psychology (ed psych)
experimental research
experts
general pedagogical knowledge
interactive whiteboard
neuroplasticity
neuroscience
pedagogical content knowledge
professional knowledge
qualitative research
quantitative research
reflective practice
research
standards
teacher evaluation
theories
value-added modeling

chapter 2

Cognitive and Language Development

fstop123/Getty Images

OUTLINE	LEARNING OUTCOMES
	After you've completed your study of this chapter, you should be able to:
What Is Development? Principles of Development Bronfenbrenner's Bioecological Model of Development ▸ Analyzing Theories: Assessing Bronfenbrenner's Bioecological Model of Development The Neuroscience of Development	**1.** Describe development, and explain how Bronfenbrenner's theory and neuroscience research contribute to our understanding of development.
Piaget's Theory of Cognitive Development The Drive for Equilibrium The Development of Schemes Responding to Experiences: Assimilation and Accommodation Stages of Development Neo-Piagetian Views of Cognitive Development Educational Psychology and Teaching: Applying Piaget's Theory with Your Students	**2.** Use concepts from Piaget's theory of intellectual development to explain both classroom and everyday events.
Vygotsky's Sociocultural Theory of Cognitive Development Learning and Development in a Cultural Context Zone of Proximal Development Scaffolding: Interactive Instructional Support Diversity: Culture and Development Educational Psychology and Teaching: Applying Vygotsky's Theory with Your Students ▸ Analyzing Theories: Piaget's and Vygotsky's Views of Cognitive Development ▸ Developmentally Appropriate Practice: Promoting Cognitive Development with Learners at Different Ages	**3.** Use Vygotsky's sociocultural theory to explain how language, culture, and instructional support influence development.
Language Development Theories of Language Development Early Language Development Language Development in the School Years Using Language to Learn ▸ Technology, Learning, and Development: Is Technology Interfering with Cognitive and Language Development? Educational Psychology and Teaching: Helping Your Students Develop Language Abilities" ▸ Developmentally Appropriate Practice: Promoting Language Development with Learners at Different Ages	**4.** Use theories of language development to explain language patterns in children.

The way we conduct our lives depends, to a large extent, on the experiences we have. Rich experiences can lead to healthy personalities, advanced social skills, and sophisticated thinking, whereas lack of quality experiences can leave people disadvantaged.

Our focus in this chapter is on cognitive development—the development of thinking. As you read the following case study, think about the influence of experience on students'

thinking as you witness a teacher's frustration with her students' seeming inability to understand basic science concepts.

On Friday morning Karen Johnson, an eighth-grade science teacher, walks into the teachers' workroom with a discouraged look on her face.

"What's happening?" Ken, one of her colleagues, asks.

"I just had the most frustrating class. . . . I was working on the Common Core Standard that addresses key concepts and terms in science:

> CCSS.ELA-Literacy.RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. (Common Core State Standards Initiative, 2014k).

"The standard says that all students should understand basic science terms, and this is basic information everyone should know. Concepts like *mass, weight, volume,* and *density* certainly are key terms in science, and they're commonly used in our everyday world. We hear about dense fog, "massive" changes, high-volume business, and on and on. But my third-period students are really struggling. For example, today we were working on the concept *density*. They memorize the formula for finding the density of some material and try to solve problems, but they don't actually understand it. And they're confused about related concepts, such as *mass, weight, volume*—everything. To them, *mass*, *weight*, and *density* are all the same. If it's bigger, it's more dense. The class was a disaster."

"You know how these kids are; they're not used to thinking on their own," Ken responds.

"I guess so, but there's more," Karen nods. "They've never really done anything other than memorize definitions and formulas. So, I guess, what do we expect?

We'll return to the conversation between Karen and Ken later in the chapter, but for now, think about these questions:

1. Why did Karen's students struggle with a concept as basic as *density?*
2. What, specifically, can she do in response to her students' struggles?
3. How will an understanding of the way students think increase your expertise as a teacher?

Theories of cognitive development help answer these questions, and in this chapter you'll see how these theories can be applied to your teaching.

Ed Psych and You

Think back to when you were in elementary and middle school. What kinds of abilities do you have now that you didn't have then? How about your high school years? How has your thinking changed since you graduated from high school?

What Is Development?

The questions in *Ed Psych and You* relate to the concept of **development**, the changes that occur in all of us as we go through our lives. We recognize these changes in ourselves, and we observe them in our sisters, brothers, and friends. Development exists in several forms.

Physical development describes changes in the size, shape, and functioning of our bodies and explains why we could, for example, run faster as a high school student than as a fifth grader. **Personal, social, and emotional development** refer to changes in our personalities, the ways we interact with others, and the ability to manage our feelings.

As we said in our introduction, in this chapter we focus on **cognitive development**, changes in our thinking that occur as a result of maturation and experience. The question, "How has your thinking changed?" in *Ed Psych and You* relates to cognitive development, and it was an important factor in Karen's students' inability to understand the concept *density.*

Understanding development is valuable for two important reasons. First, because we've all gone through the process, and will continue to go through it our entire lives, it gives us insights into ourselves and the people around us. Second, understanding development can make us better teachers because it helps us understand why our students think and act the way they do. This understanding can help reduce frustrations, such as those Karen is experiencing, and amplify the rewards we feel when we observe advances in our students' thinking and know we've contributed to these advances.

Principles of Development

Three general principles apply to all forms of development (Berk, 2013; Boyd & Bee, 2012; Feldman, 2014).

- *Development depends on both heredity and the environment.* **Maturation**, genetically driven, age-related changes in individuals, plays an important role in development. For instance, high school students are more cognitively mature than elementary or middle school students, which helps us understand why we don't teach calculus or physics to younger learners. Heredity interacts with the environment, through the experiences we provide, to maximize development.
- *Development proceeds in orderly and predictable patterns.* Development is relatively systematic and predictable. For example, we babble before we talk, crawl before we walk, and learn concrete concepts like *mammal* and *car* before abstract ones like *density* and *democracy*. These patterns exist in virtually all human beings.
- *People develop at different rates.* While development is generally systematic and orderly, the rate at which individuals progress varies. We've all heard phrases such as "He's a late bloomer" or "She never quite grew up," which describe individual differences in people's rates of development. These differences influence the effectiveness of our instruction and our interactions with our students.

With these principles in mind, we turn now to Bronfenbrenner's theory of development, which helps explain how the environment interacts with our genes to produce the unique individuals we each become.

Bronfenbrenner's Bioecological Model of Development

Bronfenbrenner's bioecological model offers a comprehensive description of the environmental factors influencing all forms of development (Bronfenbrenner, 1979, 2005; Bronfenbrenner & Morris, 2006). Figure 2.1 outlines this comprehensive view.

Ed Psych and You

Do you have brothers or sisters? In what ways are you and they similar or different? Why do you think these similarities and differences exist?

Figure 2.1
Bronfenbrenner's bioecological model of human development

As you see in Figure 2.1, individuals are at the center of his model, and the *bio* in the title reflects the influence of genetics on development. For instance, height and some aspects of body build, health, and intelligence are determined by genetics.

The *ecological* component in Bronfenbrenner's model suggests that our development is influenced by a complex set of systems in the environment, including family, peers, social institutions, such as churches and schools, and individuals' communities and cultures (Bronfenbrenner & Morris, 2006). As you see in the figure, each system is nested in a larger system, and each layer is viewed as impacting development (Dodge, 2011; Lee, 2010). Let's look at these systems.

The **microsystem**, the innermost level, is composed of the people and activities in our immediate surroundings, such as family, peers, neighborhood, and school. For instance, your parents probably expected you to do your homework, accept responsibility, and follow through on your commitments. These expectations were all part of the environmental influence on your development. Similarly, some neighborhoods are safe and nurturant, whereas others are dangerous and toxic (Dunn, Schaefer-McDaniel, & Ramsey, 2010; Bornstein, Hahn, & Haynes, 2011; Gauvain & Parke, 2010). Also, schools can be caring and

supportive or sterile and impersonal (Fauth, Roth, & Brooks-Gunn, 2007; Kozol, 2005). These elements of Bronfenbrenner's microsystem provide different levels of support for healthy development.

The **mesosystem** consists of interactions among the elements of the microsystem, and healthy development depends on how effectively the elements work together (Lee, 2010; Lerner, Lewin-Bizan, & Warren, 2011). For instance, schools that promote high levels of parental involvement provide a more effective environment for development than those that don't (Lezotte & Snyder, 2011; O'Connor, Dearing, & Collins, 2011).

The **exosystem** includes societal influences, such as parents' jobs, school systems, and workplace conditions, such as health care, that influence both the microsystem and mesosystem. For example, parents' jobs affect the amount of time they have to spend with their children, and wealthier school systems are more likely to provide nurses, counselors, psychologists, and smaller class sizes.

The **macrosystem** is the culture in which a child develops, and it influences all the other systems (Cole & Packer, 2011; Goodnow, 2010). For example, some cultures, such as ours, focus on the individual and emphasize autonomy, whereas others, such as those in parts of Asia, focus more strongly on social influences and conformity (Goodnow, 2010).

Finally, environments change over time. For example, your home environment was similar, but not identical, to that of your siblings. If you're the oldest child in your family, your parents were younger and less experienced in the process of parenting, and they might have been less secure economically. As a result, they probably treated you differently than your younger brothers and sisters. Also, other changes in our broader environments occur over time. For instance, the "Great Recession" that began in the first decade of the 21st century had a major impact on our country and particularly our country's middle class. As an example, more than one of five American public school students are in families living in poverty, and all states in our country experienced rising rates of poverty among public schoolchildren between the years 2000 and 2011 (Southern Education Foundation, 2013). When people live in poverty, they can't provide the kind of environments that promote healthy development.

Many other examples exist, including the influence of technology, changes in domestic and world politics, and societal changes. Bronfenbrenner calls this time-dependent element of our environments the **chronosystem**.

So now we can understand why similarities and differences exist between us and our siblings, and they help answer the questions we asked earlier in *Ed Psych and You.* We have a common genetic background, although we're all genetically unique. And the environments we grew up in were different enough to produce different, and sometimes *very different*, individuals.

Analyzing **Theories**

Bronfenbrenner's Bioecological Theory of Development

Bronfenbrenner's theory helps us better understand differences in our students and why children the same age and even from the same families often think and act very differently. It also helps us understand why home–school partnerships are so important and why involving the larger community in our children's education is valuable. For example, research tells us that the children of involved parents are more likely to do their homework, attend school more regularly, achieve more, and graduate from high school (Kersey & Masterson, 2009; Weinstein, Romano, & Mignano, 2011). You and your classroom will be embedded within larger contexts, all of which influence the development of the children you teach.

The model has weaknesses, however, and its tendency to ignore the role that cognition plays in development is an important one. The ways children think about themselves, their abilities, and their relationships with others also influence development. Further, Bronfenbrenner's assertions are difficult to examine with research, so his theory is difficult to assess empirically. Bronfenbrenner's theory, including its contributions and criticisms, is summarized in Table 2.1.

Table 2.1 Analyzing theories: Bronfenbrenner's bioecological theory of development

Key question	How do genetics and different levels of environmental influence interact to impact all forms of development?
Key concepts	Microsystem—family, peers, neighborhood, schools Mesosystem—interactions among the elements of the microsystem Exosystem—societal influences, such as parents' jobs and access to health care Macrosystem—culture in which the child develops Chronosystem—changes in a child's environment that occur over time
Description of development	Development occurs as different levels of environmental influence interact in dynamic systems with each other and with a child's genetic makeup to produce growth.
Catalyst for development	• Genetics • Multiple levels of environmental factors
Contributions	• Provides a detailed description of how genetics and different levels of environmental factors interact to influence children's development • Reminds educators that many factors outside of classrooms have important influences on children's learning and development
Criticisms	• Descriptions of how different levels of the environment interact with each other and with a child's genetics to influence development are somewhat vague. • Theory is difficult to empirically test with research and refine because the components of the theory lack specificity.

Sources: Berk, 2013; Bronfenbrenner, 1979, 2005; Bronfenbrenner & Morris, 2006; Feldman, 2014.

Ed Psych and You

Imagine you have a new experience, which might be as simple as learning a new word. Then, sometime later you use the word in your speech and writing. Expanding your vocabulary is a form of cognitive development. What, if anything, happens in your brain when this occurs? Neuroscience provides some answers.

The Neuroscience of Development

A great deal of research on the brain has occurred in the last 20 years, and it has contributed to the growing interest in healthy brain functioning in both children and adults (Gogtay & Thompson, 2010; Marx, 2013). Also, the fact that we now live in an information age has contributed to this interest. In recognition of the increasing importance of intellectual skills as central to our country's economic success, President Obama, during his second term, announced a broad, interdisciplinary research initiative to examine the human brain (Markoff & Gorman, 2013). This initiative, which was intended to receive 100 million dollars in 2014, involves scientists from a range of fields in an effort to better understand the brain and what can be done to promote its healthy development.

Before we examine the physiology of the brain and cognitive development, let's look briefly at what research has uncovered about our brains (Anguera et al., 2013; Dubinsky, Roehrig, & Varma, 2013; Kurzweil, 2012; Quiroga, Fried, & Koch, 2013):

- The brain is our body's most complex organ. The complexity of an organism's nervous system determines the range of behaviors it's able to produce. Humans have the most complex nervous systems of any animal.

- Genetically determined electrical circuits are the foundation of the nervous system. The basic wiring of the brain is similar for individuals within a species; variations at the brain-cell level account for differences.
- Intelligence grows as the brain reasons and solves problems. The brain is the foundation of the mind and thinking.
- The brain makes it possible to communicate through language. Language allows information exchange and creative thought.
- The brain instinctively looks for patterns in the way the world works. The brain tries to make sense of incoming sensory information, recognizes conflicts, and creates predictions and expectations that guide behavior.
- The brain is plastic. The concept of **neuroplasticity** describes the brain's ability to physically remodel itself in response to experience. In other words, experience can literally rewire our brains. "People have different genetic predispositions, but experience continuously shapes our brain structure and modifies behavior" (Van Dam, 2013, p. 32). This is a very different view of the brain; until around the 1980s scientists thought that the structure of the brain developed during childhood and that once developed, there was little room for change (Pascual-Leone et al., 2005).

Now, with these basic characteristics of our brains in mind, let's look at the physiology of the brain and how it relates to cognitive development.

THE PHYSIOLOGY OF THE BRAIN AND COGNITIVE DEVELOPMENT

The human brain is incredibly complex. Estimates suggest that it is composed of between 100 and 200 billion nerve cells, called **neurons** (Carlson, 2011; Seung, 2012). The neuron is the learning unit of the brain and is central to cognitive development. As you see in Figure 2.2, a neuron is composed of a cell body; **dendrites**, relatively short, branchlike structures that extend from the cell body and receive messages from other neurons; and **axons**, longer branches that also extend from the cell body and transmit messages.

Neurons communicate with each other, but don't actually touch; instead, signals are sent across **synapses**, tiny spaces between neurons that allow messages to be transmitted from one neuron to another. When an electrical impulse is sent down an axon, it produces a chemical that crosses the synapse and stimulates the dendrites of neighboring neurons. Frequent transmission of information between neurons can establish a permanent physical relationship between them, and evidence from animal studies indicates that learning experiences increase the number of synaptic connections per neuron (Johnson, 2011). For example, laboratory rats provided with mazes, and objects to manipulate, develop and retain 25% more synaptic connections than rats developed in sterile environments (Nelson, Thomas, & de Haan, 2006).

In other words, "What gets fired, gets wired," and this is why experiences are so important for development; they influence the connections between neurons that can remain throughout our lives. So, as a simple example, once a child learns to ride a bicycle, for all intents and purposes, that child will always be able to ride. Similarly, as young athletes practice shooting jump shots in basketball over and over, the experience gradually produces neurological connections that result in the development of a smooth and accurate shot. Without these experiences, the aspiring athlete will never develop into a skilled jump shooter, and the same is true for all forms of development.

These examples involve motor skills, but the same applies to cognitive tasks. And as we saw earlier in our discussion, the brain instinctively looks for patterns in experiences and tries to make sense of those experiences (Dubinsky et al., 2013; Quiroga, Fried, & Koch, 2013). So, for example, when young children correctly answer $2 + 4 = ?$, they not only know that the answer is 6 but identify a number of other patterns, such as 2 and 4 can each represent a variety of objects, both are even numbers, and many others. Identifying patterns is important for learning. Knowledge organized in this way is retained longer and is more

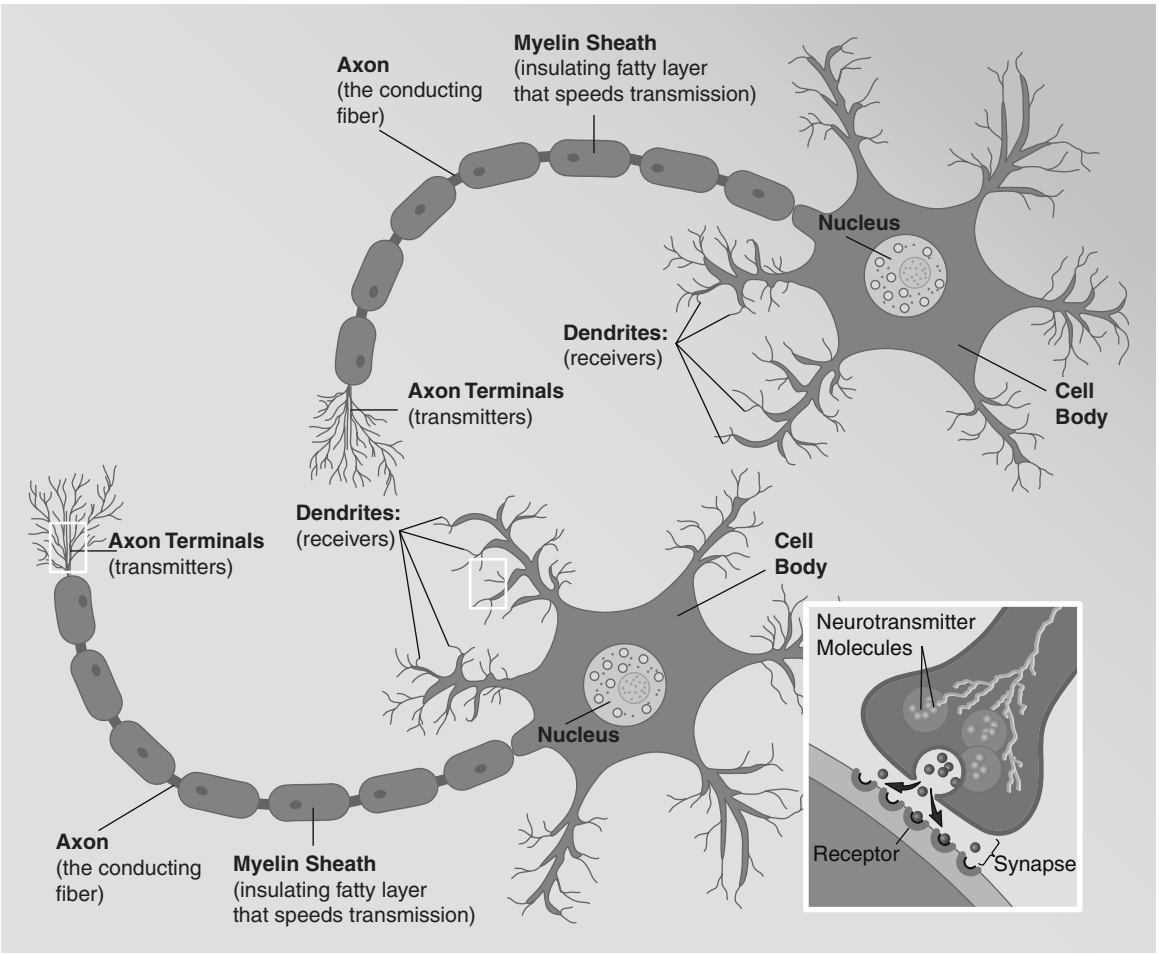


Figure 2.2
The structure of neurons

likely to connect to other information (Bruning, Schraw, & Norby, 2011; Schunk, 2012). This has important implications for instruction, which we'll discuss later in this section.

During the first 3 years of our lives, so many new synapses are created that they far exceed adult levels. Psychologists believe that generating more synapses than they will ever need allows children to adapt to the wide variety of circumstances they'll encounter throughout their lives (Davidson, 2011; Johnson, 2011).

Two important processes occur in the brain during development. The first is **myelination**, which occurs when cells grow around neurons to give them structural support, and a fatty coating of myelin, called the *myelin sheath*, develops to insulate axons and enable them to conduct electrical charges quickly and efficiently (see Figure 2.2). The second, **synaptic pruning**, eliminates synapses that are infrequently used. As the brain recognizes patterns in our environments, it physically reorganizes, keeping the synaptic connections that are used and useful, and discarding those that aren't. Cognitive development involves both creating and eliminating these synaptic connections (Siegel, 2012), and it is somewhat analogous to what we do when we clean and update our computer files; it makes the brain more efficient and effective.

This process is related to the concept of *neuroplasticity,* which we described earlier (Dubinsky et al., 2013; Pascual-Leone, Amedi, Fregni, & Merabet, 2005). This is a very powerful developmental idea. It suggests that, as we acquire experiences, we can change our brains' "wiring," that is, we can literally change the physiology of our brains (Schachter,

2012). It also debunks the old maxim, "You can't teach an old dog new tricks." Our brains retain the capacity to change and grow throughout our lives (Anguera et al., 2013).

Neuroplasticity is arguably the brain's most important characteristic and one that has enormous implications for teaching. It suggests that with the right kinds of experiences, we can literally "get smarter," which is indeed very good news. It is also cause for optimism as we work with students who have learning problems related to causes ranging from genetic issues to the lack of a stimulating home environment to environmental toxins such as lead, drugs, or alcohol. With effective experiences, these problems can, at least to a certain extent, be overcome (Auyeung & Baron-Cohen, 2012).

THE CEREBRAL CORTEX

The cerebral cortex is the part of the brain that rests on its top and sides, and much of human thinking occurs in this area (Anderson, 2010; Carlson, 2011). Not surprisingly, it is proportionately much larger in humans than in other animals, comprising 85% of the brain's total weight and containing the greatest number of neurons and synaptic connections (Berk, 2013).

The left and right hemispheres of the cortex specialize in different functions (Carlson, 2011). The right controls the left side of our bodies and vice versa. Also, in most people the left hemisphere controls language and logical thinking, and the right deals with synthesizing information—especially visual images—into meaningful patterns. This hemispheric specialization is sometimes misinterpreted, resulting in the misconception that some people are "right brained" and others "left brained." People are neither, and efforts to teach to the left or right brain are both overly simplistic and misguided (Siegel, 2012; Sprenger, 2010). The two hemispheres function as an integrated whole, especially with respect to the cognitive tasks found in schools (Carlson, 2011).

The Prefrontal Cortex. The **prefrontal cortex** (see Figure 2.3), a portion of the cortex located near the forehead, is the area of the brain largely responsible for a range of complex human activities. As development occurs, the prefrontal cortex monitors and guides other parts of the brain's activities including planning, maintaining attention, reasoning, decision making, emotional control, and the inhibition of unhealthy thoughts and behaviors (Cartwright, 2012; Casey, Jones, & Somerville, 2011; Kurzweil, 2012; Yang & Raine, 2009). Some authors also suggest that an integral link exists between a person's personality and the functions of the prefrontal cortex (DeYoung et al., 2010).

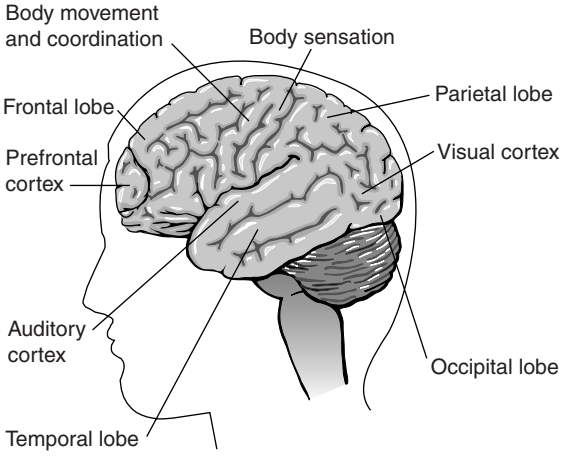


Figure 2.3
The prefrontal cortex

When we identified principles of development at the beginning of the chapter, we said that people develop at different rates, and this is true for brain development as well (Berk, 2013). The part controlling physical movement develops first, followed by vision and hearing, and ending with the prefrontal cortex. This area may not be fully developed until we are in our twenties.

The lag in development of the prefrontal cortex helps us understand a variety of behaviors, such as the temper tantrums of 2-year-olds and the sometimes undisciplined and dangerous behaviors of teenagers, such as drinking and driving, drug use, and unprotected sex. While equipped with the bodies of adults, teenagers' abilities to assess risk and make sound decisions are still developing. This helps explain why it's against the law to sell liquor and cigarettes to minors, and it also helps us understand why firm and consistent home and school environments that support learning and development are so important, particularly for adolescents. Rules and limits that simplify decisions help teenagers through this often confusing period.

CONTROVERSIES IN NEUROSCIENCE

As with most areas, some controversies with neuroscience exist. Critics argue, for instance, that people get caught up in the breakthroughs that neuroscience researchers have made, overreact, and try to use neuroscience to explain everything (Brooks, 2013).

Other authors go farther. Sally Satel and Scott Lilienfeld (2013) in their book *Brainwashed: The Seductive Appeal of Mindless Neuroscience* offer a biting criticism of attempts to use neuroscience to explain certain behaviors, such as how people will vote in elections or what products they will buy, attempts they argue are dramatic overreach and well beyond what neuroscience is capable of predicting. Their criticism is reinforced by other authors, such as Shulman (2013), who criticizes conclusions based on brain imaging studies that he believes are too broad.

These criticisms suggest that we need to view claims based on neuroscience research with caution, and we should be particularly cautious about prescriptions for teaching based on this field of study.

For example, a number of "brain-based learning" prescriptions exist. They're controversial, with proponents (e.g., Murphy & Benton, 2010; Wolfe, 2010) lining up on one side and critics (e.g., Miller, 2010; Varma, McCandliss, & Schwartz, 2008; Satel & Lilienfeld, 2013; Steinberg, 2009) on the other.

One of the controversies centers on the role of early stimulation for cognitive development. Research on synaptic connections and evidence supporting early stimulation in animals have resulted in some brain-based advocates recommending specialized instruction during children's early years. Other experts disagree. Early stimulus deprivation can indeed impede cognitive development, but evidence doesn't support the application of added stimulation, such as expensive toys or computers. In fact, one widely publicized study found that extensive media viewing in young children is associated with reduced language development (Zimmerman, Christakis, & Meltzoff, 2007), and others have criticized the sale of videos and other products designed to promote early stimulation as blatant commercialization (Linn, 2009).

The existence of critical periods for maximum development is a second controversy. For instance, young children who grow up in bilingual homes learn to speak both languages flawlessly, but adults who learn a language later in life struggle to produce certain sounds that are effortless for native speakers (Gluszek & Dovidio, 2010; Kuhn, 2009). Extrapolating from these findings, some educators suggest designing schools around these critical periods, such as introducing foreign languages to preschoolers to take advantage of a critical period in language development.

Critics counter that our brains retain the capacity to benefit from stimulation throughout our lives, and they caution against intensive training for young children. "No evidence exists for a sensitive period in the first few years of life for mastering skills that depend on extensive

training, such as reading, musical performance, or gymnastics" (Berk, 2013, p. 192). Further, Berk (2013) argues that rushing early learning may harm the brain by overwhelming its neural circuits, making it less sensitive to the routine experiences it needs for a healthy start in life.

Instruction is a third area of controversy. Brain-based-instruction advocates emphasize the importance of deliberate practice and active learning strategies such as guided discovery, problem solving, and hands-on learning. Critics counter that these are strategies that have been widely accepted for years, and describing them as "brain based" adds nothing new (Byrnes, 2007). To this point, brain research is unable to provide specific guidance to teachers facing the myriad of decisions they make every day (Murphy & Benton, 2010).

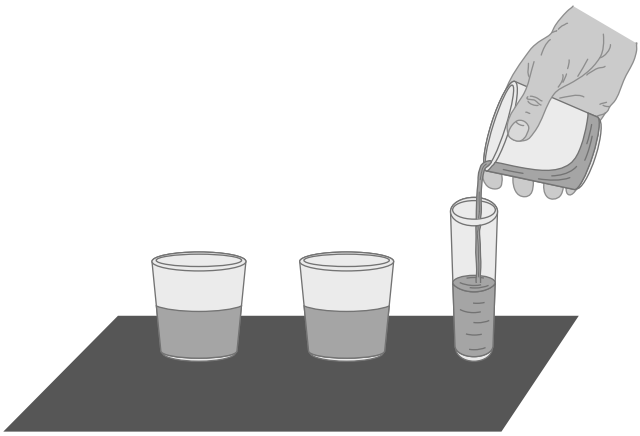
Research and theory consistently indicate, however, that the stimulation that occurs in a healthy environment is essential for normal cognitive development, and, as teachers, we play major roles in the process. Understanding this research and theory is part of your professional knowledge. Piaget's and Vygotsky's theories of cognitive development are two of the most important contributions to this knowledge base. We begin with Piaget's work.

Piaget's Theory of Cognitive Development

Jean Piaget (1896–1980) was a Swiss developmental psychologist whose career took a major turn when he became fascinated by the changes in thinking that he observed in his own children. This shift led him to a life of research examining the thinking of children as they matured, acquired experiences, and attempted to make sense of the world around them. He is one of the most famous and influential psychologists in history.

As an introduction to Piaget's theory, consider the following problem.

You have two identical glasses of water. You then pour the contents of one into a third glass as shown here. Now, are the amounts of water in the first and third glasses the same or different?

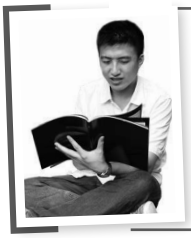


The question may seem silly; the amounts are obviously the same. However, when Piaget posed this problem to young children (such as 4- and 5-year-olds), he found that they believed more water was in the taller glass. These intriguing differences in children's

thinking proved fascinating to Piaget and resulted in one of the most widely studied theories of cognitive development (Inhelder & Piaget, 1958; Piaget, 1952, 1959, 1980). We examine his theory in this section.

Overview of Piaget's Theory

Piaget believed that—consistent with what we know about the way our brains work—people in general, and children in particular, construct mental structures and ideas in attempts to make sense of their experiences. This helps them achieve a state of cognitive balance and predictability and the view that the world is an orderly place. When they have new experiences that don't make sense to them, this cognitive order is disrupted, and they make an effort to reestablish it. In doing so, their thinking becomes more sophisticated and development advances. These developmental advances occur in general patterns that fit within approximate age ranges.



Ed Psych and You

Are you bothered when something doesn't make sense? Do you want, and even expect, the world to be predictable? Are you more comfortable in classes where the instructor specifies the requirements, outlines the grading practices, and consistently follows through? For most people, the answer to these questions is "Yes." Why do you think this is the case?

The Drive for Equilibrium

As we go through life, we all have enormous numbers of experiences, and in our discussion of neuroscience we saw that our brains instinctively search for patterns in attempts to make sense of these experiences. It also helps answer the questions we asked in *Ed Psych and You.* When our experiences make sense to us and our world is predictable, we arrive at a condition Piaget (1952, 1959, 1980) described as **equilibrium**, which is the state of cognitive order, balance, and predictability that we described in our overview.

When we're able to explain our experiences using our existing understanding, we're at equilibrium. When we can't, our equilibrium is disrupted, and we're motivated to reestablish it (Berk, 2013; Boyd & Bee, 2012; Feldman, 2014). Development advances when our knowledge and skills increase as a result of equilibrium being disrupted and restored.

The concept of equilibrium helps explain many events common in our lives. Think about some of your own experiences. For instance, do you sit in essentially the same seat every time you come to class? Most students do. Do you fall into familiar patterns of interaction when you're out with your friends? And people are described as "creatures of habit." Following familiar habits and patterns is the result of our need for equilibrium. Teachers are urged to establish classroom routines as early as possible in the school year (Emmer & Evertson, 2013; Evertson & Emmer, 2013). Doing so helps students establish equilibrium by making their school experiences predictable.

The drive for equilibrium can be a double-edged sword. Karen's students, for example, were at equilibrium when they thought that *mass* and *density* were the same. This helps us understand why people retain misconceptions (Vosniadou, 2009) and why critical thinking is so difficult for many (Willingham, 2009).

The drive for equilibrium is the cornerstone of Piaget's theory. It provides the foundation for the rest of his ideas. Let's look at them now.

The Development of Schemes

To make sense of our experiences and reach equilibrium, people construct **schemes**, mental operations that represent our understanding of the world (the mental structures we described in our overview). Piaget believed that schemes are the building blocks of thinking. For instance, when you learned to drive a car, you had a series of experiences with attempting to start the engine, maneuver in traffic, and make routine driving decisions. As you (cognitively) organized these experiences, they became your "driving" scheme.

As suggested by our example with the containers of water, the schemes we construct vary with age, and they also vary with respect to accuracy and comprehensiveness. Infants develop psychomotor schemes, such as grasping objects and looking for them when they disappear; school-age children develop more abstract schemes like classification and proportional reasoning. Piaget used the idea of schemes to refer to a narrow range of operations, such as children's conservation-of-volume scheme (the idea that the amount of liquid doesn't change when poured into a different-shaped container, as you saw in our example) (Piaget, 1952). However, teachers and some researchers (e.g., Wadsworth, 2004) find it useful to extend Piaget's idea to include content-related schemes, such as *adding-fractions-with-unlike-denominators, creating-a-persuasive-essay,* or *reptile* schemes. As with our driving scheme, each represents our developing understanding based on our experiences, and they are commonly described as *schemas* rather than schemes. We use this expanded view in our description of Piaget's work.

Responding to Experiences: Assimilation and Accommodation

As we go through life and have new experiences, we either interpret them with our existing schemes, if doing so makes sense to us, or we modify our schemes (change our thinking) if we're not able to make sense of our new experiences with our existing schemes. For instance, suppose you first learned to drive your parents' car with an automatic transmission, and later you bought a Toyota Camry, also with an automatic. You were easily able to drive the Camry, because your thinking about driving didn't change. You *assimilated* the experience with the Camry into your original driving scheme. **Assimilation** is the process of using existing schemes to interpret new experiences.

Then you buy a Honda hybrid, but it has a stick shift. You must change your thinking about driving, or, in other words, you must *accommodate* your driving scheme. **Accommodation** is the process of changing our thinking to create new schemes or adjust old ones when they can no longer explain new experiences.

HOW EXPERIENCES ADVANCE DEVELOPMENT

Now, let's see how experiences advance development. Because you had the experience with your Honda hybrid, you are now able to drive cars with either automatic transmissions or stick shifts. This capability marks an advance in development with respect to your driving. If you hadn't had the experience with your Honda, you would only have been able to drive cars with automatics and your driving would not have developed. This developmental process is potentially never ending. For instance, if you acquired experiences with driving 18-wheelers or heavy equipment, such as bulldozers, your driving expertise would be even more fully developed.

The same processes apply in schools. For instance, if young children are given the problem

$$\begin{array}{r} 47 \\ -\ 23 \\ \hline \end{array}$$

and they get 24 as an answer, their *subtracting-whole-numbers* scheme suggests that they subtract smaller numbers from larger ones. However, if they are then given this problem,

$$\begin{array}{r} 43 \\ -\ 27 \\ \hline \end{array}$$

and they also get 24 as an answer, they have—mistakenly—assimilated the new experience into their existing scheme. Their thinking didn't change, and they still subtracted the smaller numbers from the larger ones, ignoring the positioning of the numbers. Now, suppose their teacher models and explains the process for subtracting numbers where regrouping is required, such as with the problem

$$\begin{array}{r} 43 \\ -\ 27 \\ \hline \end{array}$$

so they get a correct answer of 16. Then, with guidance and practice they learn to solve a variety of problems. The problems, and their teacher's modeling, explaining, guidance, and practice, are experiences that lead to this capability. Because they've had this experience, they can now subtract numbers both when regrouping is and is not required. This increased capability represents an advance in development with respect to subtraction.

The essential role experience plays in cognitive development helps us answer our first question at the beginning of the chapter: "Why did Karen's students struggle with a concept as basic as *density*?" Lack of the direct, concrete experiences they needed to understand the concept is the answer. For example, many of us have used the formula Density = Mass/Volume (d = m/v), inserted numbers, and got answers that meant little to us. We lacked meaningful experiences with these concepts. We will see how Karen responds to this issue with her students in the section "Educational Psychology and Teaching: Applying Piaget's Theory with Your Students" later in our discussion.

SOCIAL EXPERIENCE

To this point we've emphasized the role of direct experiences with the physical world as a major factor influencing development. However, **social experience**, the process of interacting with other people, also contributes (Piaget, 1952, 1959, 1970, 1980). Social experiences allow us to test our schemes against those of others. When our schemes match, we remain at equilibrium; when they don't, our equilibrium is disrupted, we are motivated to reestablish it, we adjust our thinking, and our development advances (Howe, 2009, 2010; Siegler & Lin, 2010). As an example, let's look at a conversation between two students.

Devon: (Holding a beetle between his fingers and pointing at a spider) Look at the bugs.
Gino: Yech. . . . Put that thing down. (gesturing to the spider) Besides, that's not a bug. It's a spider.
Devon: What do you mean? A bug is a bug.
Gino: Nope. Bugs . . . actually, insects . . . have six legs. See (touching the legs of the beetle). This one has eight. . . . Look (pointing to the spider).
Devon: So, . . . bugs . . . insects . . . have six legs, and spiders have eight . . . I didn't know that.
Gino: Yeah . . . so, what do you think this is (holding up a grasshopper)?

Piaget would interpret this episode in the following way: As a result of the social interaction, Devon's equilibrium was disrupted. And, because it was disrupted, he was motivated to reestablish it, which he did by changing his thinking—the process of accommodation—about "bugs" and "spiders." The accommodation led to an advance in his development.

EXPERIENCE AND PIAGET'S INFLUENCE ON EDUCATION

Piaget's emphasis on experience has strongly influenced education in general, and preschool and kindergarten programs in particular (Berk, 2013; Trawick-Smith, 2014). For instance, in many early childhood classrooms, you'll see water and sand tables, building blocks, and other concrete materials that provide young children with the concrete experiences they need to form new schemes.

Maria Montessori, an Italian educator who stressed the importance of exploration and discovery, developed what is probably the best-known early childhood program (Feldman, 2014). In her work with children of poverty, Montessori concluded that learning environments, in which children simultaneously "worked" on both academic and social activities, were needed for development. It wasn't really *work*, however, because children could freely explore learning centers that provided hands-on activities and opportunities for social interaction with other students. Make-believe was encouraged with dress-up costumes and other accessories like play telephones.

Today, however, many early childhood programs, influenced by standards and accountability, emphasize early reading skills, such as knowing the letters of the alphabet, understanding basic concepts such as *left* and *right,* and math skills—counting, number recognition, and even adding to and taking away, for instance. As a result, child-centered programs have decreased in favor of those more academically oriented. "Yet despite grave concerns about its appropriateness, even preschool and kindergarten teachers have felt increased pressure to stress teacher-directed, academic training" (Berk, 2013, p. 639). Despite the influence and popularity of Piaget's emphasis on experience with the physical and social worlds, academically oriented early childhood programs are likely to grow.

Stages of Development

Stages of development—general patterns of thinking for children at different ages or with different amounts of experience—are among the most widely known elements of Piaget's theory. As you examine these stages, keep the following ideas in mind (Green & Piel, 2010; Meece & Daniels, 2011; Miller, 2011):

- Movement from one stage to another represents a qualitative change in thinking—a difference in the *way* children think, not the *amount* they know. As an analogy, a qualitative change occurs when a caterpillar metamorphoses into a butterfly, and a quantitative change occurs as the butterfly grows larger.
- Children's development is steady and gradual, and experiences in one stage form the foundation for movement to the next.
- All people pass through each stage in the same order but at different rates. Students at the same age may be at different stages, and the thinking of older children and even adults may be similar to that of younger children if they lack experience in that area (Kuhn, Pease, & Wirkala, 2009; Siegler, 2012).

Piaget's stages are summarized in Table 2.2 and described in the sections that follow.

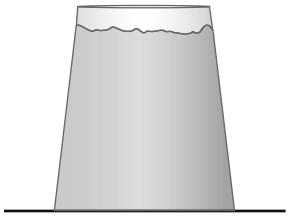
THE SENSORIMOTOR STAGE (0 TO 2 YEARS)

In the sensorimotor stage, children use their motor capacities, such as grasping objects, to understand the world, and they don't initially represent the objects in memory; the

Table 2.2 Piaget's stages and characteristics

Stage	Characteristics	Example
Sensorimotor (0–2)	Goal-directed behavior	Makes jack-in-the-box pop up
	Object permanence (represents objects in memory)	Searches for object behind parent's back
Preoperational (2–7)	Rapid increase in language ability with overgeneralized language	"We goed to the store."
	Symbolic thought	Points out car window and says, "Truck!"
	Dominated by perception	Concludes that all the water in a sink came out of the faucet (the cartoon in Chapter 1)
Concrete Operational (7–11)	Operates logically with concrete materials	Concludes that two objects on a "balanced" balance have the same mass even though one is larger than the other
	Classifies and serial orders	Orders containers according to decreasing volume
Formal Operational (11–Adult)	Solves abstract and hypothetical problems	Considers outcome of WWII if the Battle of Britain had been lost
	Thinks combinatorially	Systematically determines how many different sandwiches can be made from three different kinds of meat, cheese, and bread

objects are literally "out of sight, out of mind" early in this stage. Later, they acquire **object permanence**, the understanding that objects exist even when out of sight. As any parent will attest, young children at this stage of development learn many concrete concepts (e.g., Mom, Dad, doggie) and they form a conceptual foundation for later learning (Rakison, 2010). Children at this stage also develop the ability to imitate, which allows them to learn by observing others.



THE PREOPERATIONAL STAGE (2 TO 7 YEARS)

The term *preoperational* derives from the idea of "operation," or mental activity. A child who identifies different animals as dogs, cats, and bears, for example, is performing a mental operation.

Perception dominates children's thinking in this stage. For instance, look at the drawing here, which represents an inverted glass filled with water, and a card on the bottom. (Go ahead and try this.) Since they can see the glass, water, and card, preoperational thinkers conclude that the water is holding the card on the glass (atmospheric pressure is what actually holds the card next to the glass).

Many cognitive changes occur in children as they pass through this stage. For example, they make enormous progress in language development, reflecting their growth in the ability to use symbols, and they also learn huge numbers of concepts. For example, a child on a car trip will point excitedly and say, "truck," "horse," and "tree," delighting in exercising these newly formed schemes. These concepts are concrete, however, and children in this stage have limited notions of abstract ideas such as *fairness*, *democracy*, and *energy*.

The influence of perceptual dominance is also seen in another prominent idea from Piaget's theory: preoperational thinkers' inability to conserve.

Conservation. **Conservation** refers to the idea that the "amount" of some substance stays the same regardless of its shape or the number of pieces into which it is divided. A number of conservation tasks exist. The example with the glasses of water that we used to introduce our discussion of Piaget's work is one, and two others are outlined in Figure 2.4.

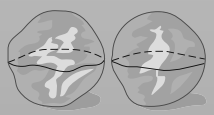
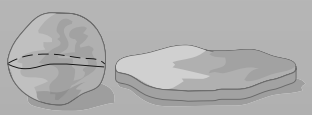
Conservation Task	Initial Presentation by Observer	Change in Presentation by Observer	Typical Answer from Preoperational Thinker
Number	The observer shows the child two identical rows of objects. The child agrees that the number in each row is the same. 	The observer spreads the bottom row apart while the child watches. The observer then asks the child if the two rows have the same number of objects or if there are more in one row. 	The preoperational child typically responds that the row that has been spread apart has more objects. The child centers on the length, ignoring the number.
Mass	The observer shows the child two balls of clay. The child agrees that the amount of clay is the same in each. (If the child doesn't agree that they have the same amount, the observer then asks the child to move some clay from one to the other until the amount is the same.) 	The observer flattens and lengthens one of the balls while the child watches. The observer then asks the child if the two have the same amount of clay or if one has more. 	The preoperational child typically responds that the longer, flattened piece has more clay. The child centers on the length.

Figure 2.4
Conservation tasks for number and mass

In Figure 2.4 we see that preoperational children don't "conserve," that is, it makes sense to them that the amount of water, the number of coins, or the amount of clay can somehow change without adding or subtracting anything from them. Let's see how this occurs using the example with the water.

First, they tend to *center* on the height of the water in the glass. **Centration** (or centering) is the tendency to focus on the most perceptually obvious aspect of an object or event and ignore other features. The height is most perceptually obvious, so preoperational children conclude that the tall, narrow glass has more water. Second, young children lack **transformation**, the ability to mentally record the process of moving from one state to another, such as pouring the water from the first to the third glass. To them it's a new and different container of liquid. Third, they also lack **reversibility**, the ability to mentally trace the process of moving from an existing state back to a previous state, such as being able to mentally reverse the process of pouring the water from one glass to another. When lack of transformation and reversibility are combined with their tendency to center, we can see why they conclude that the tall, narrow glass has more water in it, even though no water was added or removed.

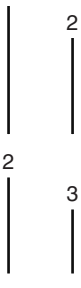
Egocentrism. Preoperational thinkers also demonstrate **egocentrism**, the inability to see objects and events from others' perspectives. In a famous experiment, Piaget and Inhelder (1956) showed young children a three-dimensional model of several mountains and asked them to describe how the mountains would look to a doll seated on the opposite side. Preoperational children described the doll's view as identical to their own. Preoperational thinkers tend to believe that everyone sees the world as they do, and they ignore the possibility that other perspectives exist. As another example, we can see this tendency in preoperational children's gift giving; they'll typically give gifts that *they* would enjoy, such as a stuffed animal, ignoring the fact that they are giving these to an adult. To them, others view the world as they do.

THE CONCRETE OPERATIONAL STAGE (7 TO 11 YEARS)

The concrete operational stage, which is characterized by the ability to think logically when using concrete materials, marks another advance in children's thinking (Flavell, Miller, & Miller, 2002). For instance, when facing the conservation-of-number task, learners in this stage simply say, "You just made the row longer" or "You just spread the coins apart" (so, the number must remain the same).

Concrete operational learners also overcome some of the egocentrism of preoperational thinkers. They are able to understand the perspectives of storybook characters and better understand the views of others, which makes them better able to work effectively in groups.

Classification and Seriation. **Classification**, the process of grouping objects on the basis of common characteristics, and **seriation**, the ability to order objects according to increasing or decreasing length, weight, or volume, are two logical operations that develop during this stage, and both are essential for understanding number concepts (Piaget, 1977). For example, before age 5, children can form simple groups, such as separating black and white circles into two sets based on color. When a black square is added, however, they typically include it with the black circles, instead of forming subclasses of black circles and black squares. By age 7 they can form subclasses, but they still have problems with more complex classification systems.



When children are able to order objects according to some dimension, such as length (seriation), they can master **transitivity**, the ability to infer a relationship between two objects based on their relationship with a third. For example, suppose we have three sticks, you're shown sticks 1 and 2, and you see that 1 is longer than 2.

Now, stick 1 is removed, you're shown 2 and 3, and you see that 2 is longer than 3. You demonstrate transitivity when you conclude that 1 is longer than 3, reasoning that since 1 is longer than 2, and 2 is longer than 3, 1 must be longer than 3.

Though concrete operational thinkers have made dramatic progress, their thinking is still limited. For instance, they interpret sayings such as "Make hay while the sun shines" literally, such as concluding, "You should gather your crop before it gets dark."

Let's see how this compares to formal thinkers.

THE FORMAL OPERATIONAL STAGE (AGE 11 TO ADULT)

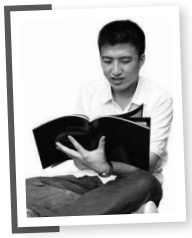
Although concrete operational learners are capable of logical thought, their thinking is tied to the real and tangible. Formal thinkers, in contrast, can think *abstractly, systematically,* and *hypothetically*. For example, formal thinkers would suggest that "Make hay while the sun shines" means something abstract, such as "Seize an opportunity when it exists." Their ability to think in the abstract allows the study of topics such as algebra in math, or allegory in literature, to be meaningful. Formal thinkers also reason systematically and recognize the need to control variables in forming conclusions. For example, consider the following problem:

You're making sandwiches for a picnic. You have rye and whole wheat bread, turkey, ham, and beef for meat, and Swiss and cheddar cheese. How many different kinds of sandwiches can you make?

Formal thinkers attack the problem systematically such as rye, turkey, and Swiss; rye, turkey, and cheddar; rye, ham, and Swiss; and so on. A concrete thinker attacks the problem haphazardly, forming ad hoc solutions such as rye, turkey, and Swiss; whole wheat, beef, and cheddar; and so on.

Formal operational learners can also think hypothetically. For instance, considering what our country might be like today if the British had won the Revolutionary War requires hypothetical thinking for American history students, as does considering the influence of dominant and recessive genes for biology students.

When students can't think abstractly, systematically, or hypothetically, they revert to memorizing what they can, or, in frustration, give up completely.

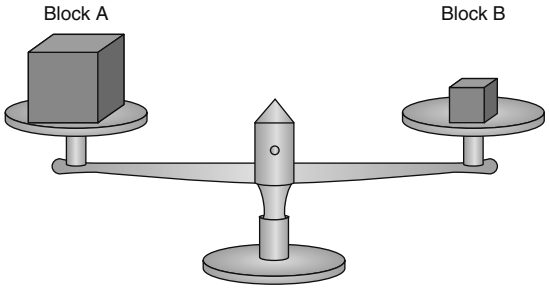


Ed Psych and You

Look at the figure below. The blocks on the balance are solid cubes that aren't compressible. Which of the following statements is true of the relationships between block A and block B?

1. A is bigger than B.
2. The mass of A is greater than the mass of B.
3. A is more dense than B.
4. A is made out of a different material than B.

What stage of development is required to respond correctly to each question?



PIAGET'S STAGES AND RESEARCH ON STUDENT THINKING

Let's see how you did. Statement 1 is true, and, because we *can see* that A is bigger (greater volume), it is a preoperational task. A first grader, for example, would be likely to respond successfully.

Responding correctly to statement 2 requires logical thought. The beam is balanced; therefore, the masses of the two objects are the same, so the statement is false. It requires logical thought with concrete materials, so it is a concrete operational task.

Statement 3 is also false. A is larger than B, but the masses are the same, so the density of A is less than B, not greater. Finally, statement 4 is true; if the blocks are solids and have different densities, they must be made of different materials. Statements 3 and 4 require abstract thinking, so they are formal operational tasks.

Don't feel badly if you struggled with one or more of these problems. Here's why. Even as adults, *virtually all of us are formal operational thinkers only in areas where we have*

considerable experience (Berk, 2013; Miller, 2011). Research indicates that the thinking of nearly half of all college students isn't formal operational with respect to topics outside their majors (Wigfield, Eccles, & Pintrich, 1996). Many individuals, including adults, never reach the stage of formal operations in a number of content areas.

This creates a dilemma, particularly for those of you who are planning to teach in middle, junior high, or high schools, because understanding many topics—and particularly those in high schools—requires formal operational thinking. It was clear that Karen's students' thinking was not formal operational with respect to the concept *density.* Further, while *centering* is viewed as characteristic of young children's thinking, we see it in older students and even adults.

Neo-Piagetian Views of Cognitive Development

Piaget did his work many years ago, and more recent research has built on and refined his theory. For instance, **neo-Piagetian theories of development** retain Piaget's basic insights into children's construction of knowledge but focus more on the ways people process information to explain movement from one stage to the next than on Piaget's global stages (Siegler, 2000, 2006).

To illustrate this perspective, look at the following list for 15 seconds, cover it up, and see how many items you can remember.

apple	bear	cat	grape
hammer	pear	orange	cow
chair	sofa	chisel	lamp
saw	table	elephant	pliers

Most adults organize the list into categories such as *furniture, fruit, tools,* and *animals*, and use the categories to remember specific items (Bruning, Schraw, & Norby, 2011; Radvansky & Ashcraft, 2014). Young children tend to use less efficient strategies such as repeating the items verbatim. Their ability to gradually begin using more efficient strategies marks an advance in development.

Neo-Piagetian theory also emphasizes the important role that *working memory*, the part of our memory system that is capable of holding only small amounts of information for short periods of time while we process and attempt to make sense of it, plays in development (Jack, Simcock, & Hayne, 2012; Morra & Camba, 2009). As children develop, their working memory capacity increases, which allows them to think about more items of information simultaneously as they solve problems (Case, 1992, 1998; Marchand, 2012). These theorists also suggest that advancing *executive functioning,* such as the ability to maintain attention and suppress intuitive conclusions in favor of more logical processing, marks an advance in development. For instance, some researchers suggest that this increase in executive functioning helps explain why concrete operational thinkers succeed on the conservation-of-number task that was illustrated in Figure 2.4, whereas younger children do not (Houdé et al., 2011).

Neo-Piagetian theory suggests that teachers should consciously focus on helping children acquire learning strategies and develop their executive functioning, which will facilitate both immediate learning and long-term development (Davidse, de Jong, Bus, Huijbregts, & Swaab, 2011).

Educational Psychology and Teaching: Applying Piaget's Theory with Your Students

Now, let's see what Piaget's theory suggests for our work with our students. The following guidelines can help us in our efforts to apply this understanding.

1. Provide concrete experiences that represent abstract ideas.
2. Help students link the concrete representations to the abstract idea.

3. Use social interaction to help students advance and refine their understanding.
4. Design learning experiences as developmental bridges to more advanced stages of development.

Let's examine these guidelines now.

Provide Concrete Experiences That Represent Abstract Ideas. As we saw earlier, most students, including those in middle and high schools—and even those in colleges and universities—are not formal operational in their thinking with respect to many of the topics they study. This means that they will benefit from concrete experiences that help them make the transition to formal operational thinking. To illustrate this process, let's sit in on another conversation between Karen and Ken the Tuesday following their Friday discussion.

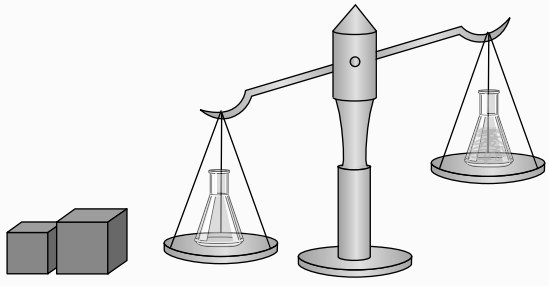
"What's that for?" Ken asks, seeing Karen walking into the teachers' lounge with a plastic cup filled with cotton balls.

"I just had the greatest class," Karen replies. "You remember how frustrated I was on Friday when the kids didn't understand basic concepts like *mass* and *density*. . . . I thought about it over the weekend, and decided to try something different, even if it seemed sort of elementary.

"See," she goes on, compressing the cotton in the cup. "Now the cotton is more dense. And now it's less dense," she points out, releasing the cotton.

"Then, I made some different-sized blocks out of the same type of wood. Some of the kids first thought the density of the big block was greater. But then we weighed the blocks, measured their volumes, and computed their densities, and the kids saw they were the same. They gradually began to get it.

"This morning," she continues, "I had them put equal volumes of water and vegetable oil on our balances, and when the balance tipped down on the water side, they saw that the mass of the water was greater, so water is more dense than oil. I had asked them to predict which was more dense before we did the activity, and most of them said oil. We talked about that, and they concluded the reason they predicted oil is the fact that it's thicker.



"Now, here's the good part. . . . Ethan, he hates science, remembered that oil floats on water, so it made sense to him that oil is less dense. He actually got excited about what we were doing and came up with the idea that less dense materials float on more dense materials. . . . You could almost see the wheels turning. We even got into population density and compared a door screen with the wires close together to one with the wires farther apart, and how that related to what we were studying. The kids were really into it. A day like that now and then keeps you going."