LOOSE-LEAF VERSION

ESSENTIALS OF EDUCATIONAL PSYCHOLOGY

BIG IDEAS TO GUIDE EFFECTIVE TEACHING

FIFTH EDITION

JEANNE ELLIS ORMROD
BRETT JONES

Pearson

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To Olivia, Miles, and Jack Fox (from Jeanne)

and

To Mia and Jack Jones (from Brett)

About the Authors

JEANNE ELLIS ORMROD received her A.B. in psychology from Brown University and her M.S. and Ph.D. in educational psychology from The Pennsylvania State University. She earned licensure in school psychology through postdoctoral work at Temple University and the University of Colorado at Boulder and has worked as a middle school geography teacher and school psychologist. She was Professor of Educational Psychology at the University of Northern Colorado (UNC) until 1998 and is currently Professor Emerita in UNC's School of Psychological Sciences. She has published and presented extensively on cognition and memory, cognitive development, instruction, and related topics but is probably best known for this book and four others: *Human Learning* (currently in its 7th edition); *Educational Psychology: Developing Learners* (9th edition coauthored with Eric Anderman and Lynley Anderman); *Child Development and Education* (coauthored with Teresa McDevitt, currently in its 6th edition); and *Practical Research* (coauthored with Paul Leedy, currently in its 11th edition). After raising three children (two of whom have become teachers themselves), she now lives in New Hampshire with her husband, Richard. Within the past few years, she has had the good fortune to visit schools in diverse cultural settings, including Rwanda, Tanzania, Thailand, Malaysia, and Peru's Amazon region.

BRETT D. JONES is Professor of Educational Psychology in the School of Education at Virginia Tech (Virginia Polytechnic Institute and State University). He received his B.A.E. in architectural engineering from The Pennsylvania State University and his M.A. and Ph.D. in educational psychology from the University of North Carolina at Chapel Hill. He has held faculty positions as an educational psychologist at Duke University, the University of South Florida St. Petersburg, and Virginia Tech. He has taught over 20 different types of university courses related to motivation, cognition, and teaching strategies. Dr. Jones has also conducted workshops and invited presentations at several universities and has presented more than 100 research papers at conferences. His research, which includes examining instructional methods that support students' motivation and learning, has led to more than 70 articles, several book chapters, and two other books besides this book (*Motivating Students by Design: Practical Strategies for Professors* and *The Unintended Consequences of High-Stakes Testing*, the latter of which was coauthored with M. Gail Jones and Tracy Hargrove). He and his wife stay busy with their two children, who enjoy school, athletics, and cheering for the Hokies, Nittany Lions, and Tar Heels.

Preface

New to the Fifth Edition

Our knowledge about how children and adolescents learn and develop—and also about how best to *help* them learn and develop—grows by leaps and bounds every year. Throughout this fifth edition, we've made many changes to reflect new research findings and evidence-based classroom strategies. General changes include the following:

- **Reorganization of chapter sequence:** We have switched the order of "Complex Cognitive Processes" (now Chapter 3) and "Learning in Context" (now Chapter 4) to allow a smoother and more logical transition from "Learning, Cognition, and Memory" (Chapter 2). We have also switched the order of "Motivation and Affect" (now Chapter 5) and "Cognitive Development" (now Chapter 6) so that the latter chapter immediately precedes "Personal, Social, and Moral Development" (Chapter 7), and thus the two chapters about child and adolescent development are together in the book.
- **Explicit organization of chapter content to align with the book's Big Ideas:** As was true in the fourth edition, each chapter begins with three to six Big Ideas that summarize the chapter's content. In this edition, each major section of a chapter is explicitly tied to a Big Idea,
- **New graphics to enhance readers' comprehension:** We have added new graphics in several chapters to visually summarize some of the concepts discussed in the text.
-

More specific, chapter-by-chapter changes are the following additions and modifications:

- **Chapter 1:** Reorganization of the chapter content to move some ideas to other sections; minor revisions to the Ormrod's Own Psychological Survey; expanded discussion of educational psychology as a discipline; expanded discussion of principles and theories; reorganization of the principles within Big Idea 1.3; expanded discussion of strategies for learning and studying effectively; several new figures and illustrations related to educational psychology, organizations associated with educational psychology, knowledge needed by teachers, and the cyclical process of action research;

- **Chapter 2:** Reorganization to switch the order of Big Ideas 2.1 and 2.2; new title for Big Idea 2.1;
  expanded discussion of working memory, with a revised figure consistent with the discussion; new discussion and associated figure to summarize the contents of long-term memory; reorganization of some of the meaningful learning strategies, with a new associated figure; new figure related to declarative and procedural knowledge; reorganization of the strategies provided in the *Encouraging Effective Long-Term Memory Storage Processes* section;

- **Chapter 3:** Reorganization to switch the order of the *Self-Regulation* and *Metacognition* sections and to include both sections in Big Idea 3.1; expanded discussion about the components and cycle of self-regulation, with a new associated figure; new See for Yourself exercise titled "Knowledge About Beliefs"; new examples of specific transfer; expanded discussion of well-defined and ill-defined problems; reorganization of subsections in the *Promoting Self-Regulation Skills and Metacognitive Development* section;

- **Chapter 4:** New Big Idea to accompany the *Social Interaction as Context* section; new figure to show contexts that influence learning; four new art figures related to behavior, reinforcement, and punishment; expanded discussion of negative reinforcement; revision of table distinguishing among reinforcements and punishment; reorganization and revision of the *Technology and Media as Contexts* section; updated figures depicting environmental influences on learners; two new classroom strategies to address stereotypes and prejudice, with a new illustrative artifact;

- **Chapter 5:** New entry titled "Interest theories" in the table related to theoretical perspectives; reorganization of the sections related to intrinsic and extrinsic motivation; change of the key term *personal interest* to *individual interest*; new figure related to self-efficacy;

- **Chapter 6:** Addition of *development* as a key term, with a new associated figure; new Think About It question related to growth; new figure showing the interplay among genes, the environment, and behavior; revision of the figure depicting neurons; three new figures related to working memory capacity, the development of knowledge, and intelligence;

- **Chapter 7:** New discussion of peer relationships as an important factor influencing classroom climate; new discussion of how students' social motives influence the kinds of peer relationships they seek; expanded discussion of moral and prosocial development to reflect advancements in research findings; new section on providing support strategies and services for students who are homeless; new discussion of students who are recent refugees from war-torn countries; distinction between autism spectrum disorders and Asperger's syndrome (in line with some experts' current thinking about this issue);

- **Chapter 8:** Revision of opening case study to incorporate the use of technology-based instructional strategies; emphasis on the importance of *evidence-based* strategies in this chapter as well as in Chapter 1; expanded discussion of standards that now includes the Next Generation Science Standards and ISTE standards for technological literacy, rebuttals to several common concerns regarding the Common Core, and the importance of enhancing students' literacy skills in *all* content domains; new section regarding the importance of planning lessons that enhance students' engagement; updated and expanded discussion of computer-based instruction (e.g., in intelligent tutoring programs); expanded discussion of students' independent online research to include webquests and teacher monitoring via a remote desktop feature; new section regarding the use of technology-based simulations and games; new section and Classroom Strategies box regarding modifying and/or supplementing instruction for English language learners; expanded discussion of differentiated instruction to include the importance of scaffolding note taking for students with disabilities and other historically low-achieving students.

- **Chapter 9:** Chapter title changed to "Strategies for Creating Effective Classroom and School Environments" (to more accurately reflect the chapter's content); introduction of *school climate* as a key term; new discussion regarding how poor teacher–student relationships can adversely affect teachers' as well as students' sense of relatedness and overall well-being; addition of "giving low grades" to the list of what *not* to use as a means of punishing students' misbehaviors; terms *positive behavior support* (PBS) and *schoolwide positive behavior support* changed to *positive behavioral interventions and supports* (PBIS) and *schoolwide positive behavioral interventions and supports* (SWPBIS), respectively, in line with current usage;

- **Chapter 10:** Increased emphasis on the use of a backward design; expanded discussion of rubrics, with a new illustrative example; updated and expanded discussions of how teachers might use technology in teacher assessments or student self-assessments; new discussion of how combining criterion-specific scores into a single criterion-referenced score can be problematic; expanded discussion of the downsides of basing final grades on improvement rather than on students' final achievement levels; new discussion of how computer technology can be used in standardized testing (e.g., via adaptive assessment); new discussion of the Every Student Succeeds Act (ESSA), which replaced the No Child Left Behind Act in late 2015; new section on the practice of using standardized achievement test results as possible indicators of teacher effectiveness (e.g., via value-added assessment);

Our Rationale for This Book

The traditional approach to teaching and writing about educational psychology is to cover one theory at a time, explaining its assumptions and principles and then identifying implications for educational practice. But as we authors have gained increasing experience teaching educational psychology to college students, we've started to teach our courses differently, focusing more on commonalities than differences among theories. In fact, although researchers from different traditions have approached human cognition and behavior from many different angles, they sometimes arrive at more or less the same conclusions. The language they use to describe their observations is often different, to be sure, but beneath all the words are certain nuggets of truth that can be remarkably similar.

In this book, we've tried to bring educational psychology to the real world of children, teachers, and classrooms. We've also tried to integrate ideas from many theoretical perspectives into what is, for us, a general set of principles and strategies that psychology *as a whole* can offer beginning teachers. After a short introduction about the importance of research and study strategies (Chapter 1), we proceed to a discussion of the very essence of human experience: cognition (Chapter 2). From that foundation, we go in five different directions—to complex cognitive processes (Chapter 3), learning in various contexts (Chapter 4), motivation (Chapter 5), cognitive development (Chapter 6), and personal and social development (Chapter 7)—but always returning to basic cognitive processes that underlie various universal human phenomena. The last three chapters of the book build on the earlier ones to offer recommendations in instruction (Chapter 8), classroom management (Chapter 9), and assessment (Chapter 10).

Some of our colleagues in the field may be surprised to see our use of footnotes rather than APA style throughout the book. Our decision has been strictly a pedagogical one. Yes, students need to know that the principles and recommendations in this book are research-based. But we've found that APA style can be quite distracting for someone who is reading about psychology for the first time and trying to sort out what things are and are not important to learn and remember. Novice psychologists should be concerned more with the *ideas themselves* than with the people

behind the ideas, and by putting most of the people in small print at the bottom of the page, we can help novices better focus their attention on what things truly are most important to know and understand.

- **Practice for Your Licensure Exam features.** Every chapter ends with an exercise that can give you an opportunity to apply the chapter's content while reading a case study

and then answering multiple-choice and constructed-response questions similar to those that appear on many teacher licensure tests.

PRACTICE FOR YOUR LICENSURE EXAM

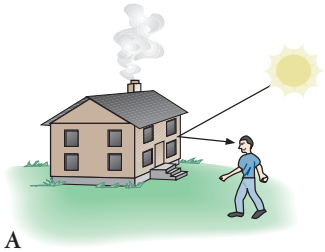
Vision Unit

Ms. Kontos is teaching a unit on human vision to her fifth-grade class. She shows her students a diagram of the various parts of the human eye, such as the lens, cornea, pupil, retina, and optic nerve. She then explains that people can see objects because light from the sun or another light source bounces off those objects and into their eyes. To illustrate this idea, she shows them Picture A.

"Do you all understand how our eyes work?" she asks. Her students nod that they do.

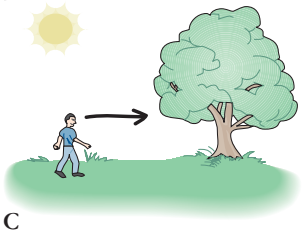
The next day Ms. Kontos gives her students Picture B.

She asks students to draw one or more arrows on the picture to show how light enables the child to see the tree. More than half of the students draw arrows something like the one shown in Picture C.



A

B



C

1. Constructed-response question

Obviously, most of Ms. Kontos's students have not learned what she thought she had taught them about human vision.

A. Explain why many students believe the opposite of what Ms. Kontos has taught them. Base your response on contemporary principles and theories of learning and cognition.

B. Describe two different ways in which you might improve on this lesson to help students gain a more accurate understanding of human vision. Base your strategies on contemporary principles and theories of learning and cognition.

2. Multiple-choice question

Many elementary-age children think of human vision in the way that Ms. Kontos's fifth graders do—that is, as a process that originates in the eye and goes outward toward objects that are seen. When students revise their thinking to be more consistent with commonly accepted scientific explanations, they are said to be

a. acquiring a new script.

b. acquiring procedural knowledge.

c. undergoing conceptual change.

d. revising their worldview.

OTHER BOOK FEATURES

The book's 10 chapters have a variety of features that can help readers better understand, remember, and apply what they're reading. First, each chapter begins with three to six **Big Ideas**—overarching principles that provide a general organizational scheme for the chapter's content, and end-of-chapter summary. Then, boldfaced **Guiding Principles** and **Key Strategies** throughout the chapter highlight key principles and concrete recommendations that can guide teachers in their decision making and classroom practices.

Immediately following the list of Big Ideas presented at the beginning of each chapter is a **case study** that introduces some of the ideas and issues we address in the chapter. Throughout each chapter, we periodically revisit the case to offer new insights and interpretations.

We often put readers themselves in the position of "learner" and ask them to engage in a short learning or thinking activity. Many of these **See for Yourself** exercises are similar to ones we've used in our own educational psychology classes. Our students have found them to be quite helpful in making concepts and principles more "real" for them—and hence more vivid, understandable, and memorable. An example of such an exercise follows.

SEE FOR YOURSELF

MARTIN'S PLIGHT

Imagine that you're in the ninth grade. You're walking quickly down the school corridor on your way to your math class when you see three boys from the so-called "popular" crowd cornering a small, socially awkward boy named Martin. The boys first make fun of Martin's thick glasses and unfashionable clothing, then they start taunting him with offensive names such as "fag" and "retard." What do you do?

a. You look the other way, pretending you haven't heard anything, and hurry on to class. If you were to stop to help, the boys might taunt you as well, and that will only make the situation worse.
b. You shoot Martin a sympathetic look and then head to class so that you won't be late. Afterward, you anonymously report the incident to the principal's office, because you know that the boys' behaviors have violated your school's antibullying policy.
c. You stop and say, "Hey, you jerks, cut it out! Martin's a really nice guy and doesn't deserve your insulting labels. Come on, Martin—let's go. We might be late for math class, so we need to hurry."

An additional feature comes in the form of **Think About It** questions in the margin that encourage readers to connect chapter content to their past experiences or current beliefs and in some cases also encourage readers to take concepts and principles in new directions.

think about it
Using what you've just learned about attention, explain why texting on a phone while driving is illegal in many places. (For an explanation, click **here**.)

If you quickly flip through the book, you'll see many classroom artifacts—that is, **examples of work created by actual students and teachers**. We use artifacts throughout the book to help readers connect concepts, principles, and strategies to students' behavior and to classroom practices.

To a considerable degree, we talk about concepts and principles that apply to children and adolescents at all grade levels. Yet 1st graders often think and act very differently than 6th graders, and 6th graders can, in turn, be quite different from 11th graders. Chapters 2 through 10 each have one or more **Developmental Trends** tables that highlight and illustrate developmental differences that teachers are apt to see in grades K–2, 3–5, 6–8, and 9–12.

Chapters 2 through 10 also each have two or more **Classroom Strategies** boxes that offer concrete suggestions and examples of how teachers might apply a particular concept or principle. These features should provide yet another mechanism to help our readers apply educational psychology to actual classroom practices. And beginning in Chapter 3, each chapter has a **Cultural Considerations** feature that describes cultural differences in specific areas—for instance, in behavior, reasoning, or motivation.

Although our approach in this book is to integrate the concepts, principles, and educational strategies that diverse theoretical perspectives offer, it's also important for future teachers to have some familiarity with specific psychological theories and with a few prominent theorists who have had a significant influence on psychological thinking (e.g., Jean Piaget, Lev Vygotsky, B. F. Skinner). We occasionally mention these theories and theorists in the text discussion, but we also highlight them in **Theoretical Perspectives** tables in Chapters 2, 5, and 6.

Supplementary Materials

Many supplements to the textbook are available to enhance readers' learning and development as teachers.

Online Instructor's Manual. Available to instructors for download at www.pearsonhighered.com/educator is an *Instructor's Manual* with suggestions for learning activities, supplementary lectures, group activities, and additional media resources. These have been carefully selected to provide opportunities to support, enrich, and expand on what students read in the textbook.

Online PowerPoint® Slides. PowerPoint slides are available to instructors for download at www.pearsonhighered.com/educator. These slides include key concept summarizations and other graphic aids to help students understand, organize, and remember core concepts and ideas.

Online Test Bank. The *Test Bank* that accompanies this text contains both multiple-choice and essay questions. Some items (lower-level questions) simply ask students to identify or explain concepts and principles they have learned. But many others (higher-level questions) ask students to apply those same concepts and principles to specific classroom situations—that is, to actual student behaviors and teaching strategies. The lower-level questions assess basic knowledge of educational psychology. But ultimately, it is the higher-level questions that can best assess students' ability to use principles of educational psychology in their own teaching practice.

TestGen. TestGen is a powerful test generator available exclusively from Pearson Education publishers. Instructors install TestGen on a personal computer (Windows or Macintosh) and create their 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—including equations, graphs, and scientific notation—can be created in either paper-and-pencil or online formats.

The tests can be downloaded in the following formats:

TestGen Testbank file—PC
TestGen Testbank file—MAC
TestGen Testbank—Blackboard 9 TIF
TestGen Testbank—Blackboard CE/Vista (WebCT) TIF
Angel Test Bank (zip)
D2L Test Bank (zip)
Moodle Test Bank
Sakai Test Bank (zip)

Artifact Case Studies: Interpreting Children's Work and Teachers' Classroom Strategies. One of us authors, Jeanne Ormrod, has written *Artifact Case Studies* (ISBN 0-13-114671-8) as a supplement to the textbook. It's especially useful for helping students learn to apply psychological concepts and principles related to learning, motivation, development, instruction, and assessment. The case studies, or *artifact cases,* within this text offer work samples and instructional materials that cover a broad range of topics, including literacy, mathematics, science, social studies, and art. Every artifact case includes background information and questions to consider as readers examine and interpret the artifact. Instructors should contact their local Pearson Education sales representative to order a copy of this book and its accompanying Instructor's Manual.

Case Studies: Applying Educational Psychology. With the assistance of Linda Pallock and Brian Harper, Jeanne Ormrod and Dinah Jackson McGuire have coauthored *Case Studies: Applying Educational Psychology* (2nd ed., ISBN 0-13-198046-7) to give students more in-depth practice in applying educational psychology to real children, teachers, and classrooms. The 48 cases in the book address many topics in educational psychology (learning and cognition, child and adolescent development, student diversity, motivation, instruction, classroom management, and assessment) across a variety of grade levels (preschool through high school). This book, too, is accompanied by an Instructor's Manual.

Acknowledgments

Although the title page lists us as the authors of this book, we've hardly written it alone. We're greatly indebted to the countless psychologists, educators, and other scholars whose insights and research findings we have pulled together in these pages. We also owe more thanks than we can possibly express to Kevin Davis, vice president and editor-in-chief at Pearson, who has guided our journey (in Jeanne's case, for more than 25 years) as we've tried to navigate through the myriad new topics, controversies, and technological changes that have encompassed both the field of educational psychology and the publishing world. And we are incredibly appreciative of the collective efforts of Alicia Reilly, Pam Bennett, Norine Strang, Lauren Carlson, and many others who have attended to the gazillion (and sometimes mysterious) details of turning this book into both concrete and virtual realities.

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J. E. O.
B. D. J.

Brief Contents

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ESSENTIALS OF EDUCATIONAL PSYCHOLOGY

BIG IDEAS TO GUIDE EFFECTIVE TEACHING

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1 Introduction to Educational Psychology

Big Ideas to Master in this Chapter

1.1 Effective teachers use research findings and research-based theories to make decisions about instructional strategies, classroom management, and assessment practices.

1.2 Effective teachers continually work to enhance their professional knowledge and skills.

1.3 Learners read, study, and learn more efficiently when they plan appropriately and use effective strategies.

CASE STUDY: THE "NO D" POLICY

Anne Smith is a ninth-grade English teacher with 10 years of teaching experience, and by all accounts she's an excellent teacher. Even so, in previous years many of her students haven't invested much time or energy in their writing assignments and seemingly haven't been bothered by the Cs and Ds they've earned in her classes. In an effort to more fully engage this year's students in their schoolwork, Ms. Smith begins the school year by initiating two new policies. First, to pass her course, students must earn at least a C; she won't give anyone a final grade of D. Second, students will have multiple opportunities to revise and resubmit assignments. She'll give whatever feedback students need on the assignments—and, if necessary, one-on-one instruction—to help them improve their work. She solicits students' questions and concerns about the new policies, gains their agreement to "try something new," and engages them in a discussion of specific, concrete characteristics of A-quality, B-quality, and C-quality work. Then, as the school year progresses, she regularly administers brief surveys to get students' feedback about her innovations, asking such questions as "How is the 'no D' policy working for you?" "Do you think your grade is an accurate reflection of your learning?" and "Any suggestions?"

Students' responses on the surveys are overwhelmingly positive. Students mention noticeable improvements in the quality of their writing and increasingly report that they believe themselves to be in control of both their learning and their grades. Furthermore, they begin to see their teacher in a new light—"as one who will help them achieve their best work, not as one who just gives out grades . . . as a coach encouraging them along the long race of learning." Final course grades also confirm the value of the new policies: A much higher percentage of students earn grades of C or better than has been true in past years.[1]

- Effective teachers don't simply transmit new information and skills to students; they also work hard to help students *master* the information and skills. In the case study just presented, what strategies does Ms. Smith use to foster her students' writing development?

Teaching other people—especially teaching the generation that will follow you into the adult world—can be one of the most rewarding professions on the planet. It can also be a very challenging profession. Certainly effective teaching involves presenting a topic or skill in such a way that students can understand and master it. Yet it involves many other things as well. For instance, teachers must motivate students to *want* to learn the subject matter, must help students recognize what true mastery involves, and—to appropriately individualize instruction—must assess where each student currently is in his or her learning and development. And, in general, effective teachers create an environment in which students believe that if they work hard and have reasonable support, they can achieve at high levels. In the opening case study, Anne Smith does all of these things.

How children and adolescents think and learn, what knowledge and skills they have and haven't mastered, where they are in their developmental journeys, what their interests and

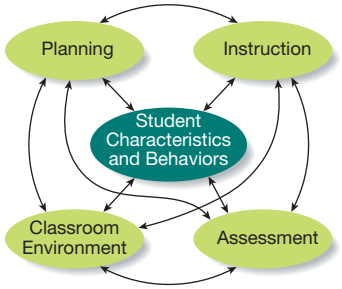
[1] Action research project described in A. K. Smith, 2009.

CHAPTER OUTLINE

priorities are—all of these factors influence the effectiveness of various classroom strategies. Thus, the decisions *teachers* make in the classroom—decisions about what topics and skills to teach (*planning*), how to teach those topics and skills (*instruction*), how to keep students on task and supportive of one another's learning efforts (creating an effective *classroom environment*), and how best to determine what students have learned (*assessment*)—must ultimately depend on students' existing characteristics and behaviors.

Of course, as we saw from Anne Smith in the opening case study, teachers' classroom strategies also change what *students* know, think, and can do. Thus, the relationship between student characteristics and behaviors, on the one hand, and teacher strategies, on the other, is a two-way street. Furthermore, as you'll discover in later chapters, planning, instruction, the classroom environment, and assessment practices influence one another, as depicted in Figure 1.1. Notice how student characteristics and behaviors are at the center of the figure, because these must drive almost everything that teachers do in the classroom. Such an approach to teaching is sometimes known as **learner-centered instruction**.[2]

FIGURE 1.1 A learner-centered model of instruction



The purpose of this book is to help you understand children and adolescents—how they learn and develop, how they're likely to be similar to but also different from one another, what activities and assignments are apt to engage them in the classroom, and so on. It will also give you a toolbox of strategies for planning and carrying out instruction, creating an environment that keeps students motivated and on task, and assessing students' progress and achievement. Such topics are the domain of **educational psychology**, which is an academic discipline that (a) systematically studies the nature of human learning, development, motivation, and related topics and (b) applies its research findings to the identification and development of effective instructional practices. We begin by exploring how teachers can use different types of research findings to make instructional decisions.

1.1 USING RESEARCH FINDINGS TO MAKE INSTRUCTIONAL DECISIONS

Big Idea 1.1 Effective teachers use research findings and research-based theories to make decisions about instructional strategies, classroom management, and assessment practices.

Teachers make instructional decisions based on their prior experiences, advice from others, knowledge and skills they learned in their formal schooling, and so on. Although many of these sources of information are potentially useful to teachers' instructional decisions, effective teachers rely on research findings and research-based theories to inform their practices. In the principles that follow, we discuss why teachers need to understand research, we examine the different types of research conducted by educational psychologists, and we explain how this research can be synthesized and organized to be helpful to teachers.

The effectiveness of various classroom practices can best be determined through systematic research.

You yourself have been a student for many years now, and you've undoubtedly learned a great deal about how individuals learn and develop and about how teachers can foster their learning and development. But exactly how much *do* you know? To help you find out, one of us authors has developed a short pretest titled *Ormrod's Own Psychological Survey (OOPS)*.

[2] For good general discussions of learner-centered instructional practices, see McCombs, 2005; National Research Council, 2000. You may also want to look at the American Psychological Association's (APA's) 14 *Learner-Centered Psychological Principles* on the APA website at www.apa.org; type "learner-centered principles" in the search box on APA's home page.

SEE FOR YOURSELF

ORMROD'S OWN PSYCHOLOGICAL SURVEY (OOPS)

Decide whether each of the following statements is *true* or *false*.

True/False

_____ 1. Some children are predominantly left-brain thinkers, whereas others are predominantly right-brain thinkers.

_____ 2. The best way to learn and remember a new fact is to repeat it over and over.

_____ 3. Students often misjudge how much they know about a topic.

_____ 4. Anxiety sometimes helps students learn and perform more successfully in the classroom.

_____ 5. Instruction is most effective when it is tailored to students' individual learning styles.

_____ 6. Children's personalities are largely the result of their home environments.

_____ 7. Playing video games can enhance children's cognitive development.

_____ 8. The ways in which teachers assess students' learning influence what and how students actually learn.

Now let's see how well you did on the OOPS. The answers, along with an explanation for each one, are as follows:

1. Some children are predominantly left-brain thinkers, whereas others are predominantly right-brain thinkers. FALSE—With the development of new medical technologies in recent years, researchers have learned a great deal about how the human brain works and which parts of it specialize in which aspects of human thinking. As we'll discover in Chapter 2, the two halves, or *hemispheres,* of the brain do seem to have somewhat different specialties, but they continually communicate and collaborate in tackling even the simplest of daily tasks. Practically speaking, there's no such thing as left-brain or right-brain thinking.[3]

2. The best way to learn and remember a new fact is to repeat it over and over. FALSE—Although repeating new information several times is better than doing nothing at all with it, repetition of specific facts is a relatively *in*effective way to learn. Students learn new information more easily and remember it longer when they connect it with things they already know. One especially effective strategy is **elaboration**: using prior knowledge to expand or embellish on a new idea in some way, perhaps by drawing inferences from a historical fact, identifying new examples of a scientific concept, or thinking of situations in which a mathematical procedure might be helpful. Chapter 2 describes several cognitive processes that help students learn and remember school subject matter effectively.

3. Students often misjudge how much they know about a topic. TRUE—Contrary to popular opinion, students are usually *not* the best judges of what they do and don't know. For example, many students think that if they've spent a long time studying a textbook chapter, they must know its contents very well. Yet if they've spent most of their study time inefficiently—perhaps by "reading" while thinking about something else altogether or by mindlessly copying definitions—they may know far less than they think they do. We'll consider this *illusion of knowing* further in Chapter 3.

4. Anxiety sometimes helps students learn and perform more successfully in the classroom. TRUE—Many people think that anxiety is always a bad thing. In fact, a little bit of anxiety can actually *improve* learning and performance, especially when students perceive a task to be something they can accomplish with reasonable effort. For instance, a small, manageable amount of anxiety can spur students to complete their work carefully and to study for tests. We'll explore the effects of anxiety and other emotions in Chapter 5.

5. Instruction is most effective when it is tailored to students' individual learning styles. FALSE—Contrary to a popular belief, most measures of supposed "learning styles" merely reflect students' self-reported *preferences,* and tailoring instruction to such preferences doesn't

[3] Schlegel, Alexander, & Tse, 2016.

noticeably enhance students' learning or academic achievement.[4] It is far more important that teachers base their instructional practices on knowledge of the cognitive processes that underlie how virtually *all* students think and learn. We'll learn more about students' preferences and *cognitive styles* in Chapter 6.

6. Children's personalities are largely the result of their home environments. FALSE—Certainly children's home environments shape their behaviors to some extent. But heredity also has a significant impact. From birth, infants are noticeably different in the extent to which they're calm or fussy, shy or outgoing, fearful or adventurous, and so on. As we'll see in Chapter 7, such differences in *temperament* appear to have their roots in biology and genetics, and they persist throughout the childhood years and into adulthood.

7. Playing video games can enhance children's cognitive development. TRUE or, more accurately, SOMETIMES TRUE—A great deal of time spent playing video games *instead of* reading, doing homework, and engaging in other school-related activities can definitely interfere with children's long-term academic success. But some video games can be powerful tools for promoting important cognitive abilities, such as spatial abilities and the flexible use of attention.[5] And educational technologists have increasingly been designing highly motivating video games that simulate real-world problems and foster complex problem-solving skills.[6] In upcoming chapters (especially Chapter 4 and Chapter 8), we'll examine many ways in which computer technologies can support students' learning and cognitive development.

8. The ways in which teachers assess students' learning influence what and how students actually learn. TRUE—What and how students learn depend, in part, on how they expect their learning to be assessed. For example, in the opening case study, Anne Smith's "No D" and multiple-submission policies encourage students to seek feedback about their work, benefit from their mistakes, and enhance their writing skills. In Chapter 10 we'll look more closely at the potential effects of classroom assessment practices on students' learning.

How many of the OOPS items did you answer correctly? Did some of the false items seem convincing enough that you marked them true? Did some of the true items contradict certain beliefs you had? If either of these was the case, you're hardly alone. College students often agree with statements that seem obvious but are, in fact, partially or completely incorrect.[7] Furthermore, many students in teacher education classes reject research findings when those findings appear to contradict their personal beliefs and experiences.[8]

It's easy to be persuaded by "common sense" and assume that what seems logical must be true. Yet common sense and logic don't always give us the real scoop about how people actually learn and develop, nor do they always give us appropriate guidance about how best to help students succeed in the classroom. Educational psychologists believe that knowledge about teaching and learning should come from a more objective source of information—that is, from systematic research. Increasingly, educators and policy makers alike are calling for **evidence-based practices**—the use of instructional methods and other classroom strategies that research has consistently shown to bring about significant gains in students' development and academic achievement.[9]

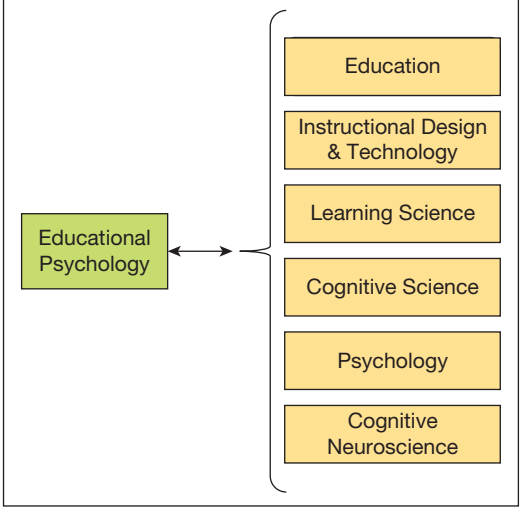
Educational psychologists focus on the scientific study of psychological principles that are relevant to education.

Integrating evidence-based practices into your teaching takes time and practice, of course. But it also takes knowledge of topics within the discipline of educational psychology, including knowledge of human learning and motivation, developmental trends, individual and group differences, classroom assessment and standardized testing, and effective classroom practices. Educational psychologists

[4] Kirschner & van Merriënboer, 2013; Kozhevnikov, Evans, & Kosslyn, 2014; Krätzig & Arbuthnott, 2006; Mayer & Massa, 2003.
[5] Green, 2014; Rothbart, 2011; Tobias & Fletcher, 2011.
[6] Blumberg, 2014; Squire, 2011.
[7] Gage, 1991; L. S. Goldstein & Lake, 2000; Woolfolk Hoy, Davis, & Pape, 2006.
[8] Gregoire, 2003; Holt-Reynolds, 1992; T. M. McDevitt & Ormrod, 2008; Patrick & Pintrich, 2001.
[9] Cook, Smith, & Tankersley, 2012. For example, see Darling-Hammond & Bransford, 2005; Waterhouse, 2006.

develop this knowledge by solving problems in the field of education through the use of rigorous scientific methods.[10] Topics in educational psychology are also studied by researchers in closely related disciplines, such as education, instructional design and technology, learning science, cognitive science, and other overlapping areas of psychology (e.g., behavioral, cognitive, developmental, social, and school psychology). In addition, neurologists, cognitive psychologists, and researchers from other disciplines are working together to discover how the *brain* influences people's behavior and learning and, conversely, how people's behavior and learning experiences can influence brain development. This rapidly expanding field, known as *cognitive neuroscience,* is making many noteworthy contributions to our understanding of human learning. As Figure 1.2 shows, educational psychology informs and is informed by many different disciplines.

FIGURE 1.2 Educational psychology informs and is informed by other disciplines.



One way that individuals contribute to the field of educational psychology is to publish their research findings in academic journals and books. Many educational psychologists also belong to regional, national, and international organizations to share their research and discuss ideas with others (see Figure 1.3 for examples). We authors synthesized much of this research in developing the Big Ideas presented in this book.

When educational psychologists write about and present their research, they identify the particular research articles, books, conference presentations, and other sources on which they base their claims. Most educational psychology publications and conferences require authors to follow **APA style**, guidelines prescribed by the American Psychological Association for identifying sources and preparing references.[11] In APA style, a source is cited by presenting the author(s) and date of publication in the body of the text. For example, this sentence from a prior paragraph would be cited as follows in APA style: College students often agree with statements that seem obvious but are, in fact, partially or completely incorrect (Gage, 1991; Goldstein & Lake, 2000; Woolfolk Hoy, Davis, & Pape, 2006). In this book, we've intentionally deviated from APA style by presenting the references in footnotes. We hope this style will help you focus on the *ideas* instead of on the names and dates provided in the references. But when you find some of the book's ideas especially interesting, exciting, or surprising, we urge you to read the footnoted sources firsthand by finding the detailed citations in the book's References list.

FIGURE 1.3 Examples of organizations that represent educational psychology

Organizations	Website URL
American Educational Research Association (AERA)	http://aera.net/
American Psychological Association (APA)	http://www.apa.org/
Association for Psychological Science (APS)	http://www.psychologicalscience.org/
International Society of the Learning Sciences (ISLS)	https://www.isls.org/

Research can provide quantitative information, qualitative information, or both.

Many research studies involve **quantitative research**: They yield numbers that reflect percentages, frequencies, or averages related to certain characteristics or phenomena. For example, a quantitative study might provide information about students' scores on achievement tests, students' responses to rating-scale questionnaires, or school district records of students' attendance and dropout rates.

Other studies involve **qualitative research**: They yield nonnumeric data—perhaps in the form of verbal reports, written documents, pictures, or maps—that capture many aspects of a complex situation. For example, a qualitative study might involve lengthy interviews in which students describe their hopes for the future, a detailed case study of interpersonal relationships within a tight-knit clique of adolescent girls, or in-depth observations of several teachers who create distinctly different psychological atmospheres in their classrooms.

[10] Harris, Graham, & Urdan, 2012; Reynolds & Miller, 2013.

[11] For more information on APA style, see its *Publication Manual* (APA, 2010) or visit www.apastyle.org

Table 1.1 • Contrasting Various Types of Research

	QUALITATIVE RESEARCH	QUANTITATIVE RESEARCH		
	Descriptive Studies	Descriptive Studies	Correlational Studies	Experimental and Quasi-Experimental Studies
General Nature and Purposes	• Portray the complex, multifaceted nature of human behavior, especially in real-world social settings	• Capture the current state of affairs regarding a real-world issue or problem	• Identify associations among characteristics, behaviors, and/or environmental conditions • Enable predictions about one variable, given knowledge of the degree or quantity of another variable • Provide an alternative when experimental manipulations are unethical or impossible	• Manipulate one (independent) variable in order to observe its possible effect on another (dependent) variable • Eliminate other plausible explanations for observed outcomes (especially in carefully controlled experimental studies) • Enable conclusions about cause-and-effect relationships
Limitations	• Don't enable either predictions or conclusions about cause-and-effect relationships	• Don't enable either (1) predictions about one variable based on another variable or (2) conclusions about cause-and-effect relationships	• Enable only imprecise predictions, with many exceptions to the general relationships observed • Don't enable conclusions about cause-and-effect relationships	• May not completely eliminate alternative explanations for observed outcomes (especially true for quasi-experimental studies) • In some cases, involve artificial laboratory conditions that don't resemble real-life learning environments (true for many tightly controlled experimental studies)
Examples of Questions That Might Be Addressed	• What things do high-achieving students say they do "in their heads" when they read and study their textbooks? • What distinct qualities characterize high schools in which members of various adolescent gangs interact congenially and respectfully? • In what ways do teachers' instructional practices change when their jobs and salaries depend on their students' scores on statewide or national achievement tests?	• How pervasive are gender stereotypes in popular children's literature? • What kinds of aggressive behaviors occur in schools, and with what frequencies? • How well have students performed on a recent national achievement test?	• Are better readers also better spellers? • Are students more likely to be aggressive at school if they often see violence at home or in their neighborhoods? • To what extent are students' class grades correlated with their scores on achievement tests?	• Which of two reading programs produces greater gains in reading comprehension? • Which method is most effective in reducing aggressive behavior—reinforcing appropriate behavior, punishing aggressive behavior, or a combination of both? • Do different kinds of tests (e.g., multiple-choice vs. essay tests) encourage students to study in different ways?

Ultimately educators gain a better understanding of students and effective classroom practices when they consider findings from *both* quantitative and qualitative research. Research that includes both quantitative and qualitative elements is called **mixed methods research**.[12] For example, in the research project described in the opening case study, Anne Smith tabulates students' responses to various survey questions and computes the percentages of various final class grades—all of which are quantitative information. But when she collects students' completed surveys, she also looks closely at their specific comments and suggestions, which provide qualitative information.

Different kinds of research lead to different kinds of conclusions.

In addition to yielding either quantitative or qualitative data (or both), research studies typically fall into one of four general categories: descriptive, correlational, experimental, or quasi-experimental. These various kinds of studies enable different kinds of conclusions and are appropriate for different types of research questions (see Table 1.1).

[12] Creswell, 2014.

A **descriptive study** does exactly what its name implies: It *describes* a situation. Descriptive studies might give us information about the characteristics of students, teachers, or schools. They might also provide information about how frequently certain events or behaviors occur. Descriptive studies allow us to draw conclusions about the way things are—the current state of affairs. Virtually all qualitative studies are primarily descriptive in nature, and some quantitative studies fall into the descriptive category as well.

A **correlational study** explores possible relationships among two or more variables. For example, it might tell us how closely various human characteristics are associated with each other, or it might give us information about the consistency with which certain human behaviors occur in conjunction with certain environmental conditions. In general, correlational studies enable us to draw conclusions about **correlation**: the extent to which two characteristics or phenomena tend to be found together or to change together. Two variables are correlated when one increases as the other increases (a *positive correlation*) or when one *decreases* as the other increases (a *negative correlation*) in a somewhat predictable manner. The bottom row of the fourth column in Table 1.1 presents three examples of possible correlational relationships: those between (1) reading and spelling ability, (2) aggressive behavior at school and violence at home, and (3) class grades and achievement test scores. Correlations are often described numerically with statistics known as *correlation coefficients*, described in Appendix A.

If a correlation exists between two variables, knowing the status of one variable allows us to make *predictions* about the other variable. For example, if we find a positive correlation between reading ability and spelling ability, we can predict that, on average, students who are proficient readers will also be good spellers. Our predictions will be imprecise at best, with exceptions to the general rule; for instance, we may occasionally see very good readers who are poor spellers. A more significant limitation of correlational studies is that although they may demonstrate that a relationship exists, they never tell us for certain *why* it exists. They don't tell us what specific factors—previous experiences, personality, motivation, or perhaps other things we haven't thought of—are the cause of the relationship we see. In other words, *correlation does not necessarily indicate causation.*

Descriptive and correlational studies describe things as they exist naturally in the environment. In contrast, an **experimental study**, or **experiment**, is a study in which the researcher somehow changes, or *manipulates,* one or more aspects of the environment (called *independent variables*) and then measures the effects of such changes on something else (called the *dependent variable*). In educational research the dependent variable is often some aspect of student behavior—perhaps end-of-year grades, skill in executing a complex physical movement, persistence in tackling difficult math problems, or ability to interact appropriately with peers.[13] In a good experiment a researcher *separates and controls variables,* testing the possible effects of one variable while keeping constant all other potentially influential variables. When carefully designed and conducted, experimental studies enable us to draw conclusions about causation—about what variables cause or influence certain other variables.

Often experimental studies involve two or more groups that are treated differently. Consider these examples:

- A researcher uses two different instructional methods to teach reading comprehension skills to two different groups of students. (Instructional method is the independent variable.) The researcher then assesses students' reading ability (the dependent variable) and compares the average reading-ability scores of the two groups.
- A researcher gives three different groups of students varying amounts of practice with woodworking skills. (Amount of practice is the independent variable.) The researcher subsequently scores the quality of each student's woodworking project (the dependent variable) and compares the average scores of the three groups.
- A researcher gives one group of students an intensive instructional program designed to improve their study skills. The researcher gives another group of students no instruction and gives a third group instruction in subject matter unrelated to study skills. (Presence

[13] You might think of the distinction this way: Student behavior (the dependent variable) *depends* on instructional practice or some other aspect of the environment (the independent variable).

or absence of instruction in study skills is the independent variable; the second and third groups did not receive instruction in study skills.) The researcher later (1) assesses the quality of students' study skills and (2) obtains their grade point averages (two dependent variables) to see whether the program had an effect.

Each of these examples includes **treatment groups** that are recipients of a particular intervention. The third example also includes two **control groups**: one that receives no intervention and another that receives a *placebo* intervention that's unlikely to affect the dependent variable(s) in question. In many experimental studies, participants are assigned to groups *randomly*—for instance, by drawing names out of a hat or having computer software randomly pick different participants for different groups. Such random assignment is apt to yield groups that are, on average, roughly equivalent on other variables (preexisting ability levels, personality characteristics, motivation, etc.) that might affect the dependent variable.

Random assignment to groups isn't always possible or practical, however, especially in research studies conducted in actual schools and classrooms. For example, when studying the potential benefits of a new teaching technique or therapeutic intervention, a researcher may not be able to completely control which students receive the experimental treatment and which do not, *or* a particular treatment or intervention may have important benefits for *all* students. In such situations, researchers often conduct a **quasi-experimental study**, in which they take into account, but don't completely control, other influential factors. The following are examples:

- A researcher implements a new after-school homework program at one high school and identifies a comparable high school without such a program to serve as a control group. The researcher obtains achievement test data for students at both schools both before and after the program's implementation. Ideally, to document the homework program's effectiveness, the average test scores for the two high schools should be the same *before* the program begins. Then, if differences exist at the end of the program, they may be attributed to the new homework program.
- A team of researchers wants to study the effects of safety instructions on children's behaviors on the playground. The researchers present the instructional intervention to first graders one week, second graders the following week, and kindergartners and third graders the week after that. The researchers monitor students' playground behavior before, during, and after the intervention to determine whether each grade-level group's risky playground behavior decreases immediately following the intervention.[14]

When researchers conduct such quasi-experimental studies, they don't control for all potentially influential variables and therefore can't completely rule out alternative explanations for the results they obtain. For instance, in the after-school homework program example, possibly the school getting the new homework program—but *only* that school—has simultaneously begun to use more effective instructional methods during the school day, and those methods are the reason for any increase in achievement scores. And in the playground safety example, perhaps certain other things coincidentally happened in the four classrooms during their respective safety-instructions weeks, and those things were the true causes of children's behavior improvements.

When carefully designed and conducted, experimental studies and, to a lesser degree, quasi-experimental studies enable us to draw conclusions about *causation*—about *why* behaviors occur. Yet for practical or ethical reasons, many important questions in education don't easily lend themselves to experimental manipulation and tight control of other potentially influential variables. For example, although we might find a correlation between children's aggression levels at school and the amount of violence in their home environments, it would be highly unethical to conduct an experimental study in which some children are intentionally placed in a violent environment. Consequently, some important educational questions can be addressed only with descriptive or correlational studies, even though such studies don't let us pin down precise cause-and-effect relationships.

[14] Here we're describing a study conducted by Heck, Collins, and Peterson (2001).

Drawing conclusions about cause-and-effect relationships requires that all other possible explanations for an outcome be eliminated.

Whenever we look at the results of a research study—regardless of who has conducted the study and regardless of whether it has been described in a professional journal or other credible media source—we mustn't be too hasty to draw conclusions about cause-and-effect relationships. As an example, imagine that Hometown School District wants to find out which of two new reading programs, *Reading Is Great* (RIG) or *Reading and You* (RAY), leads to better reading in third grade. The district asks each of its third-grade teachers to choose one of these two reading programs and use it throughout the school year. The district then compares the end-of-year achievement test scores of students in the RIG and RAY classrooms and finds that RIG students have gotten substantially higher reading comprehension scores than RAY students. We might quickly jump to the conclusion that RIG promotes better reading comprehension than RAY—in other words, that a cause-and-effect relationship exists between instructional method and reading comprehension. But is this really so?

Not necessarily. If we look at the study more closely, we realize that the school district hasn't eliminated all other possible explanations for the difference in students' reading comprehension scores. Remember, the third-grade teachers personally *chose* the instructional program they used. Why did some teachers choose RIG and others choose RAY? Were these two groups of teachers different in some way? Had RIG teachers taken more advanced courses in reading instruction, were they more open-minded and enthusiastic about using innovative methods, or did they devote more class time to reading instruction? Or, did the RIG teachers have students who were, on average, better readers to begin with? If the RIG and RAY classes were different from each other in any of these ways—or perhaps different in some other way we haven't thought of—then the district hasn't eliminated alternative explanations for why the RIG students have outperformed the RAY students. A better way to study the causal influence of reading program on reading comprehension would be to *randomly assign* third-grade classes to the RIG and RAY programs, thereby making the two groups similar (on average) in terms of student abilities and teacher characteristics.

Be careful that you don't jump to conclusions too quickly about what factors are affecting students' learning, development, and behavior in particular situations. You should scrutinize research reports carefully, always with these questions in mind: *Have the researchers separated and controlled variables that might have an influence on the outcome? Have they ruled out other possible explanations for their results?* Only when the answers to both of these questions are undeniably *yes* should you draw a conclusion about a cause-and-effect relationship.

think about it

What other possible differences between the RIG and RAY teachers might there be? (For one possible answer, click **here**.)

Principles and theories can help synthesize, explain, and apply research findings.

The large body of educational psychology research is more useful to teachers when it's organized into principles and theories. **Principles** describe the specific effects of certain factors on other factors or outcomes, such as those related to learning, development, and behavior. Consider this research-based principle: Students are likely to learn more when they are interested in what they are learning. The influential or "potentially causal" factor in this principle is *interest,* which has an effect on students' *learning*. Teachers at any grade level and subject area can use this principle in a variety of ways. For example, when teaching about a particular war—say, about the American Civil War or the French Revolution—a social studies teacher could select readings with interesting storylines about specific historical figures to pique students' interest as a way of enhancing their learning.

Whereas principles tell us *what* factors are important, theories tell us *why* these factors are important. A **theory** is an integrated set of concepts and principles developed to explain the underlying mechanisms of a phenomenon. Because human functioning is so complex, there is no one "mega-theory" in educational psychology to explain all of our thoughts, behaviors, and feelings. Instead, there are many smaller theories that explain various aspects of human functioning. For example, in Chapter 2 we'll discover that one prominent theory of how people learn—information processing theory—proposes that attention is an essential ingredient in the learning process. If a learner doesn't pay attention, information rapidly disappears from memory; in the words of a

popular expression, the information goes "in one ear and out the other." The importance of attention in information processing theory suggests that strategies that capture and maintain students' attention are apt to enhance students' learning. Therefore, information processing theory could explain why students are likely to learn more when they're interested in what they're learning: they pay attention more closely to what they're supposed to be learning.

Sometimes people use the word *theory* to mean a guess, hunch, or an untested hypothesis. An example would be someone who says, "I have a theory about why he doesn't want to see her anymore." However, educational psychologists build theories over time based on evidence, not purely on speculation. Even so, theories continue to change as new research methods are devised, new research is conducted, and new research findings come to light. In contrast, principles tend to be fairly stable over time.

Although current theories may undergo modifications in the future, they can still be quite useful even in their unfinished forms. They help us integrate thousands of research studies into concise understandings of how children typically learn and develop, and they enable us to make reasonable estimates about how students are likely to perform and achieve in particular classroom contexts. In general, then, theories can help us both *explain* and *predict* human behavior, and so they give us numerous ideas about how best to help students achieve academic and social success at school. In fact, we have organized this book by grouping similar principles and theories together into *Big Ideas* to help you more easily understand the findings from many research studies.

1.2 DEVELOPING AS A TEACHER

Big Idea 1.2 Effective teachers continually work to enhance their professional knowledge and skills.

If you are currently enrolled in a teacher education program, you should think of your program as a good start on the road to becoming a skillful teacher.[15] It's *only* a start, however. True expertise in any profession, including teaching, takes many years of experience to acquire, although even a single year of teaching experience can make a significant difference.[16] So be patient with yourself, and recognize that occasionally feeling a bit unsure and making mistakes is not unusual. As you gain experience, you'll gradually become able to make decisions about routine situations and problems more quickly and efficiently, giving you time and energy to think creatively and flexibly about how best to teach classroom subject matter.[17] Here we offer several strategies to develop your knowledge and skills as a teacher—all of them based on research on teacher effectiveness.

[15] Bransford, Darling-Hammond, & LePage, 2005; Brouwer & Korthagen, 2005.
[16] P. A. Alexander, 2003; Berliner, 2001; Clotfelter, Ladd, & Vigdor, 2007; Henry, Bastian, & Fortner, 2011.
[17] Borko & Putnam, 1996; Bransford, Derry, Berliner, & Hammerness, 2005; Feldon, 2007.

Keep up to date on research findings and innovative evidence-based practices in education.

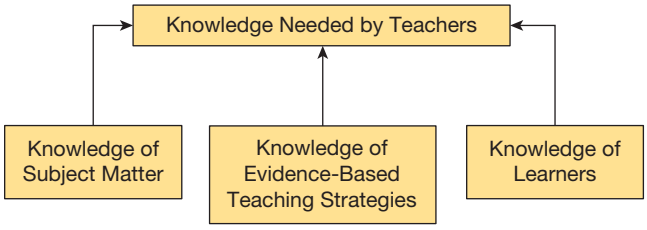
Occasional university coursework and in-service training sessions are two good ways to enhance teaching effectiveness.[18] Also, effective teachers typically subscribe to one or more professional journals, and as time allows, they attend professional conferences in their region. Many websites provide teachers with information and ideas about effective classroom practices, including the websites of professional organizations, such as the National Council of Teachers of Mathematics (www.nctm.org), the National Council for the Social Studies (www.socialstudies.org), the National Association for Music Education (www.nafme.org), the National Science Teachers Association (www.nsta.org), and the International Literacy Association (www.literacyworldwide.org).

Learn as much as you can about the subject matter you teach, about teaching strategies, and about learners and their development.

Effective teachers typically know their subject matter extremely well and can usually anticipate—and thus can also address—the difficulties students will have and the kinds of errors students will make in the process of mastering a certain skill or body of knowledge.[19] Effective teachers also know a variety of teaching strategies, including strategies for teaching particular topics and skills—strategies collectively known as **pedagogical content knowledge**.[20] In addition, effective teachers have knowledge of learners and their development in social contexts, which is why it's important for teachers to understand concepts related to educational psychology.[21]

With subject-matter knowledge, knowledge of teaching strategies, and knowledge of learners, teachers have the knowledge required to design and implement instruction that meets students' needs (see Figure 1.4). To meet the needs of *all* their students, teachers must be prepared to teach students with a wide variety of special needs in their classrooms. These **students with special needs** are different enough from their peers that they require specially adapted instructional materials or practices to help them maximize their learning and development. Many of these students are included in general education classrooms, a practice called **inclusion**. At several points in the book we'll consider students with particular kinds of special needs and identify strategies that may be especially useful in working with them.

FIGURE 1.4 Effective teachers draw on many types of knowledge when making decisions in the classroom.



Learn as much as you can about the culture(s) of the community in which you are working.

In Cultural Considerations boxes throughout the book, you'll see numerous ways in which children from diverse cultural groups may think and behave differently than *you* did as a child. But a textbook can offer only a sampling of the many cultural differences you might encounter. You can become more informed about students' cultural beliefs and practices if you participate in local community activities and converse frequently with parents and other community members.[22]

Continually reflect on and critically examine your assumptions, inferences, and teaching practices.

In the opening case study, Anne Smith reflects on her students' performance in previous years and then institutes new assessment policies that might be more motivating and productive. Like Ms. Smith, effective teachers engage in **reflective teaching**: They continually examine and critique

[18] Desimone, 2009; Guskey & Sparks, 2002; Hamre et al., 2012; Hattie, 2009.
[19] Borko & Putnam, 1996; Cochran & Jones, 1998; H. C. Hill et al., 2008; D. C. Smith & Neale, 1991; Windschitl, 2002.
[20] Baumert et al., 2010; Cochran & Jones, 1998; Krauss et al., 2008; Shulman, 1986.
[21] Bransford, Darling-Hammond, & LePage, 2005.
[22] Castagno & Brayboy, 2008; McIntyre, 2010; Rogoff, 2003.

their assumptions, inferences, and instructional practices, and they regularly adjust their beliefs and strategies in light of new evidence.[23]

Communicate and collaborate with colleagues.

Good teachers rarely work in isolation. Instead they frequently communicate with colleagues in their own school district and across the nation—perhaps with colleagues in other countries as well—through face-to-face meetings, e-mail, regional or national conferences, and professional websites (e.g., www.oercommons.org). Ideally, teachers and administrators at a single school create a **professional learning community**, in which they share a common vision for students' learning and achievement, work collaboratively to achieve desired outcomes for all students, and regularly communicate with one another about their strategies and progress.[24] Most experienced teachers are happy to offer beginning teachers advice and support during challenging times. In fact, they're apt to be flattered to be asked!

Believe that you can make a difference in students' lives.

In Chapter 5 you'll discover the importance of having high **self-efficacy**—that is, of believing that you're capable of executing certain behaviors or reaching certain goals. Students are more likely to try to learn something if they believe they *can* learn it—in other words, if they have high self-efficacy. But teachers, too, must have high self-efficacy about what they can accomplish. Students who achieve at high levels are apt to be those whose teachers have confidence in what they, *as teachers,* can do—both individually and collectively—for their students.[25] Ultimately, what teachers do in the classroom *matters* for students, not only in the short term but for years to come.[26]

Integrate action research into your ongoing classroom practices.

Like Anne Smith in the opening case study, practicing teachers sometimes have questions that existing research findings don't fully answer. In **action research**, teachers conduct systematic studies of issues and problems in their own schools, with the goal of seeking more effective strategies for working with students. For example, an action research project might involve examining the effectiveness of a new teaching technique, seeking students' opinions on a new classroom policy (as Ms. Smith does), or ascertaining reasons why many students rarely complete homework assignments.

Action research studies typically involve the following steps:[27]

1. *Identify an area of focus.* The teacher-researcher begins with a problem and gathers preliminary information that might shed light on the problem, perhaps by reading relevant books or journal articles, searching the Internet, or discussing the issue with colleagues or students. The teacher-researcher then identifies one or more specific questions to address and develops a research plan for answering those questions (data-collection techniques, necessary resources, schedule, etc.). At this point, the teacher also seeks permission to conduct the study from school administrators and any other appropriate authorities. Depending on the nature of the study, parents' permission may be necessary.
2. *Collect data.* The teacher-researcher collects data relevant to the research questions. Such data might, for example, be obtained from questionnaires, interviews, achievement tests, students' journals or portfolios, existing school records (e.g., attendance patterns, school suspension rates), observations, or any combination of these.
3. *Analyze and interpret the data.* The teacher-researcher looks for patterns in the data. Sometimes the analysis involves computing particular statistics (e.g., percentages, averages, correlation coefficients), which would make it a quantitative study. At other times the analysis involves

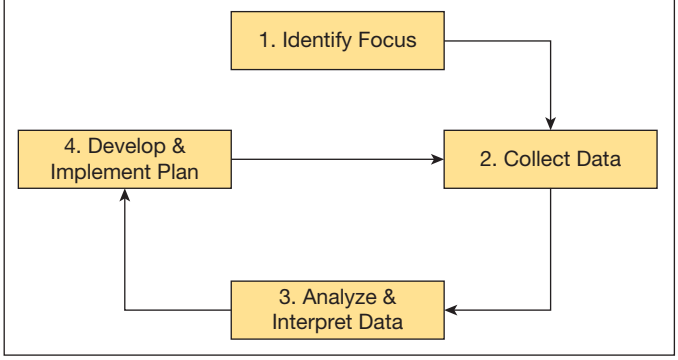
[23] Hammerness, Darling-Hammond, & Bransford, 2005; T. Hogan, Rabinowitz, & Craven, 2003; Larrivee, 2006.
[24] DuFour, DuFour, & Eaker, 2008; P. Graham & Ferriter, 2009; Raudenbush, 2009.
[25] Holzberger, Philipp, & Kunter, 2013; J. A. Langer, 2000; Skaalvik & Skaalvik, 2008.
[26] Hattie, 2009; Konstantopoulos & Chung, 2011.
[27] Steps based on those recommended by Mills (2014).

an in-depth, nonnumeric inspection of the data, which would make it a qualitative study. Or, it could be a combination of both quantitative and qualitative data, which would make it a mixed methods study. The teacher-researcher then relates the findings to the original research questions.

4. *Develop and implement an action plan.* The final step distinguishes action research from the more traditional research studies described earlier. In particular, the teacher-researcher uses the information collected to *take action*—for instance, to change instructional strategies, school policies, or the classroom environment.

After the final step, a teacher-researcher may have all the information that he or she needs to work more effectively with students. Or, he or she may want to go through the process again by collecting more data, analyzing and interpreting the data, and developing and implementing another action plan. This cyclical process is shown in Figure 1.5 and could continue over and over.

FIGURE 1.5 The steps involved in an action research project



1.3 STRATEGIES FOR LEARNING AND STUDYING EFFECTIVELY

Big Idea 1.3 Learners read, study, and learn more efficiently when they plan appropriately and use effective strategies.

This book includes many features that will, we hope, help you read about, study, and apply what researchers and experienced educators have learned about learning, development, motivation, and effective classroom practices. For example, each chapter begins with a few Big Ideas that capture the chapter's underlying themes. Each chapter also presents its major premises (guiding principles) and recommendations (key strategies) as boldfaced headings. In addition, the opening case studies and the figures, tables, exercises, concrete examples, margin questions, and application exercises interspersed throughout the book are all designed to enhance your understanding and memory of what you're reading.

Yet ultimately, how much you learn from the book is up to you. In upcoming chapters you'll learn a great deal about how human beings—including *you*—typically think about, learn, and remember new ideas. We're optimistic that you'll become a better student after reading those chapters, but in the meantime, here are some general strategies you can use as you read and study.[28]

[28] Ormrod, 2011.

Before you study, prepare for your study session.

When you're busy, it's tempting to rush into a study session without much planning. But you will find that you can make more effective use of your time if you plan your study sessions using these strategies:

- *Study at times when you're mentally alert.* Are you a "morning person"? A "night owl"? Identify the times you can most effectively study and then use these times for studying. You probably don't need to be as alert when you're running errands, checking social media, or doing your laundry, so save those tasks for when you're feeling less alert.
- *Select an appropriate environment for studying.* Don't underestimate the importance of selecting a place to study where you can concentrate. Find somewhere that's free of distractions. For example, you might need to leave your iPad in another room, turn off your phone, tell others not to disturb you, or go to a coffee shop if you can concentrate better there. Things that distract you might not distract others, so figure out what's best for you.
- *Be realistic about how much you can effectively learn and remember at any one time.* As you'll discover in Chapter 2, our brains only allow us to think about and learn a limited amount of information in a short amount of time. Plan ahead and divide lengthy learning activities into smaller chunks you can spread out over several days. And certainly don't leave an entire book chapter until the last minute!
- *Set goals for each study session.* Decide what you want to accomplish during a study session, and structure the session in a way that allows you to meet your goals. In Chapter 3, you will learn that setting goals can help you to monitor your learning and stay focused on what's important. Sometimes you won't meet all your goals for a study session because something you need to do takes longer than planned—that's not unusual. But with time and experience, you should become better able to set and accomplish realistic goals for each of your courses, which will allow you to plan your days, weeks, and even months more effectively.

During your study session, use effective study strategies.

Of course what you do *during* your study sessions significantly affects how much you will learn and remember. Here are some study strategies that can help you study more effectively:

- *Pay attention to what you're studying.* You need to be mentally active when you study if you want to remember what you're studying. If your mind starts to drift or you get sleepy, very little of what you are "studying" is likely to stay with you. If you're too tired, maybe you need to take a 5-minute break to do something that requires less attention. Or quit and come back again when you're more rested and less distracted.
- *Relate new information to your existing knowledge and prior experiences.* Think about how new ideas are consistent with your personal experiences, knowledge, and beliefs, as well as with things you've learned in other courses. You can even actively consider how some new information might contradict your existing experiences, knowledge, or beliefs. As the earlier OOPS test may have shown you, some of what you currently "know" and believe may be sort-of-but-not-quite accurate or even downright *in*accurate. People's existing beliefs can occasionally wreak havoc with new learning. For example, many students in teacher education classes adamantly reject research findings that appear to be inconsistent with their personal beliefs and experiences.[29] When you encounter puzzling or seemingly "wrong" ideas and findings, try to keep an open mind and consider how and why they might have some merit. Truly effective learners occasionally undergo *conceptual change,* revising their current understandings and beliefs in light of new and trustworthy evidence.

[29] Fives & Gill, 2015; Gregoire, 2003; Richardson, 2003.

- *Organize the new information.* Organizing information requires you to actively consider how various pieces of information are related. You can categorize related information together using outlines or diagrams. If the information includes cause-and-effect relationships, you can show these relationships, either through explanations or graphically using symbols and/or arrows.
- *Use visual imagery.* A picture may be worth 1,000 words. Form mental pictures of objects and ideas to aid in your memory of the information. You can also create pictures, diagrams, or other graphics to help you capture the meaning of the information.
- *Elaborate on what you read, going beyond it and adding to it.* As you learned earlier in this chapter, elaboration involves embellishing on new information in some way. So try to think *beyond* the things you read. Draw inferences from the ideas presented. Generate new examples of concepts. Identify your own educational applications of various principles of learning, development, and motivation. You will be more likely to understand and remember abstract information when you tie it to concrete objects and events. In this book, we try to help you do this by providing case studies and short examples that involve real children and teachers. We also include links to videos that depict classrooms in action and *See for Yourself* exercises such as the OOPS test—all of which can enhance your understanding and memory of new concepts and help you recognize them when you see them in your own work with children and adolescents.
- *Periodically check yourself to make sure you remember and understand what you have read.* To check your comprehension, try to summarize the material and ask yourself questions about it to ensure everything makes sense to you. Try to explain difficult concepts to someone who doesn't understand them.

think about it

How often do you elaborate while reading your textbooks? Do you learn and remember information more effectively when you elaborate on what you're reading?

After your study session, review what you studied.

What you do before and during your study sessions is important, but what you do *after* your study sessions can also help you to learn and remember information over the long term. Here are a couple suggestions:

- *Schedule time to review what you studied previously.* Research is clear on this point: Periodic review of previously learned material definitely helps students remember it more effectively and accurately. So make time in your schedule for review sessions in the days and weeks after your study sessions.
- *Quickly review what you learned previously.* The point of the review sessions is to review, not to redo what you did in your last study session; therefore, these sessions can be short. Simply remind yourself of the important points and clarify any misunderstandings. Review sessions can even occur immediately prior to a new study session and may help you better assimilate the new information with what you've already learned.

1 SUMMARY

Each chapter in this book includes a summary organized around the Big Ideas listed at the beginning of the chapter. Following are the Big Ideas for Chapter 1.

- **1.1: Effective teachers use research findings and research-based theories to make decisions about instructional strategies, classroom management, and assessment practices.** Effective teachers use practices that are *evidence-based*—that is, they encompass strategies that research has consistently shown to bring about significant gains in students' development, academic achievement, and personal well-being. Evidence-based practices are developed based on research conducted, in part, by educational psychologists who study the nature of human learning, development, motivation, and related topics. As researchers learn more and more about what various phenomena and events are like (descriptive studies), what variables are associated with one another (correlational studies), and what events cause what outcomes (experimental studies), they gradually develop and continually modify theories that integrate and explain their findings. Teachers can—and *should*—draw on research findings and well-supported theories about children's learning and development in their day-to-day and long-term instructional decision making.
- **1.2: Effective teachers continually work to enhance their professional knowledge and skills.** As a teacher, you must think of yourself as a life-long learner who always has new things to discover about effective educational practices, the subject matter you teach, and the out-of-school environments and cultural groups in which your students live. Some of these things you can learn about through books, professional journals, advanced coursework, the Internet, and collaboration with professional colleagues, but others may require immersing yourself in the local community or conducting action research. You must also be willing to reflect on and critically analyze your current assumptions, inferences, and instructional practices—good teachers acknowledge that they can sometimes be wrong, and they adjust their beliefs and strategies accordingly. One way you can analyze your instructional practices is to conduct your *own* action research to address specific questions you have about your students and classroom practices. Most importantly, you must remember that, as a teacher, the many little things you do every day can have a huge impact—either positive or negative—on students' academic and personal successes.
- **1.3: Learners read, study, and learn more efficiently when they plan appropriately and use effective strategies.** You can use what you learn about thinking and learning not only to help children and adolescents be successful in the classroom but also to help *you* learn successfully. You should study at times when you're mentally alert and in places where you can concentrate fully. While you're studying, you should (1) pay close attention to what you're studying, (2) relate new information to your existing knowledge and prior experiences, (3) organize the information, (4) use visual imagery to form mental pictures of objects and ideas, (5) elaborate on what you're learning—for instance, by generating new examples and applications—and (5) occasionally stop to monitor your understandings of what you've read and studied. And after your study session, you should schedule some time in the future to briefly review what you've learned.

PRACTICE FOR YOUR LICENSURE EXAM

New Software

High school math teacher Mr. Gualtieri begins his class on Monday with an important announcement: "Our school has just purchased a new instructional software program that we can use on our classroom tablet computers. This program, called Problem-Excel, will give you practice in applying the mathematical concepts and procedures we'll be studying this year. I strongly encourage you to use it whenever you have free time so that you can get extra instruction and practice with things you might be having trouble with."

Mr. Gualtieri is firmly convinced that the new software will help his students better understand and apply certain concepts in his math curriculum this year. To test his hypothesis, he keeps a record of which students use the software and which students do not. He then looks at how well the two groups of students perform on his next classroom test. Much to his surprise, he discovers that, on average, the students who have used the software have earned *lower* scores than those who have not used it. "How can this be?" he puzzles. "Is the software actually doing more harm than good?"

1. **Constructed-response question**

   Mr. Gualtieri wonders whether the instructional software is actually hurting, rather than helping, his students. Assume that the software has been carefully designed by an experienced educator. Assume, too, that Mr. Gualtieri's classroom test is a good measure of how well his students have learned the material they've been studying.

   A. Explain why Mr. Gualtieri cannot draw a conclusion about a cause-and-effect relationship from the evidence he has. Base your response on principles of educational research.

   B. Identify another plausible explanation for the results Mr. Gualtieri has obtained.

2. Multiple-choice question

Which one of the following results would provide the most convincing evidence that the Problem-Excel software enhances students' mathematics achievement?

a. Students at a high school are randomly assigned to two groups. One group works with Problem-Excel, and the other group works with a software program called Write-Away, designed to teach better writing skills. The Problem-Excel group scores higher than the Write-Away group on a subsequent mathematics achievement test.

b. Ten high schools in New York City purchase Problem-Excel and make it available to their students. Students at these high schools get higher mathematics achievement test scores than students at 10 other high schools that have *not* purchased the software.

c. A high school purchases Problem-Excel, but only four of the eight math teachers at the school decide to have their students use it. The students of these four teachers score at higher levels on a mathematics achievement test than the students of the other four teachers.

d. All 10th graders at a large high school take a mathematics achievement test in September. At some point during the next 2 months, each student spends 20 hours working with Problem-Excel. The students all take the same math achievement test again in December and, on average, get substantially higher scores than they did in September.

michaeljung/Fotolia

2 Learning, Cognition, and Memory

Big Ideas to Master in this Chapter

2.1 The brain continues to change and learn over the course of a lifetime.

2.2 Much of human learning involves a process of actively constructing knowledge, rather than passively absorbing it.

2.3 Human memory is a complex, multifaceted information processing system that is, to a considerable degree, under a learner's control.

2.4 Human memory is fallible: Learners don't remember everything they learn, and sometimes they *mis*remember what they've learned.

2.5 Effective teachers help students mentally process new information and skills in ways that facilitate long-term memory storage and retrieval.

CASE STUDY: MAKING MOUNTAINS

Where do mountains come from? Seven-year-old Rob has an interesting take on the matter, as he reveals in the following conversation with an adult:

Adult: How were the mountains made?

Rob: Some dirt was taken from outside and it was put on the mountain and then mountains were made with it.

Adult: Who did that?

Rob: It takes a lot of men to make mountains—there must have been at least four. They gave them the dirt and then they made themselves all alone.

Adult: But if they wanted to make another mountain?

Rob: They pull one mountain down and then they could make a prettier one.[1]

- Rob's basic premise—that human beings are actively involved in mountain formation—is clearly incorrect. Nevertheless, his "knowledge" about mountains does have a few elements of truth. What things does Rob *correctly* know about mountains?
- What general principles about human learning might Rob's conception of mountain formation reveal?

Based on this conversation between Rob and the adult, it's hard to know exactly what Rob believes about mountains. He first talks about dirt being "put" on a mountain and about men "making" mountains. However, when he says, "they made themselves all alone," perhaps he's talking about the mountains *making themselves,* albeit with the assistance of a few men who "give" them dirt. Despite Rob's obviously naive notions, he has learned a few correct facts about mountains. In particular, he knows that (1) mountains are fairly big (requiring the work of "a lot of men"), (2) they're comprised of dirt (which is true, at least in part), and (3) they can be quite pretty to look at. To understand how children and adolescents acquire understandings about their physical and social worlds, about academic subject matter, and about themselves as human beings, we must first understand the nature of learning.

A good general definition of **learning** is: *a long-term change in mental representations or associations due to experience.* Let's divide this definition into its three parts. First, learning is a *long-term change,* in that it isn't just a brief, transitory use of information—such as remembering a phone number only long enough to make a phone call—but it doesn't necessarily last forever. Second, learning involves *mental representations or associations* and so presumably has its basis in the brain. Third, learning is a change *due to experience,* rather than the result of physiological maturation, fatigue, alcohol or drugs, or onset of mental illness.

Because the brain is the place where humans think about, make sense of, and learn from their environment, we begin this chapter by looking at the brain and some of its key characteristics. But much of what is known about the nature of learning and how to help students learn more effectively has been discovered by psychologists, not neuroscientists who study the brain. Therefore, the remainder of the chapter focuses on what psychologists have discovered about what goes on *inside* the learner during the learning process.

[1] Piaget, 1929, p. 348.

CHAPTER OUTLINE

FIGURE 2.1 Two neurons, an astrocyte, and their interconnections

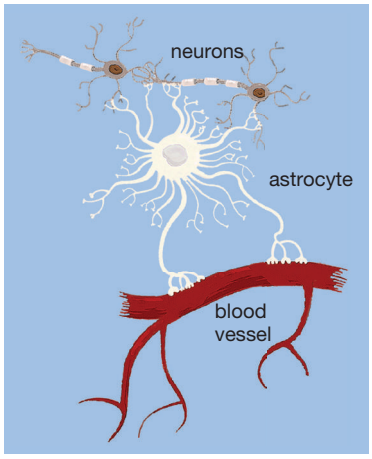
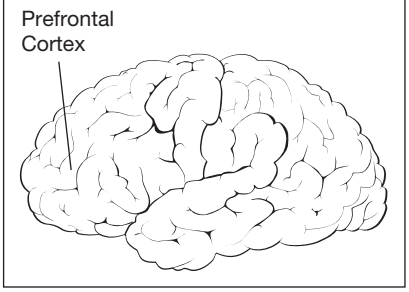


FIGURE 2.2 Cortex of the human brain



2.1 THINKING AND LEARNING IN THE BRAIN

Big Idea 2.1 The brain continues to change and learn over the course of a lifetime.

The brain is an incredibly complicated mechanism that includes several *trillion* cells. About 100 billion of them are nerve cells—**neurons**—that are microscopic in size and interconnected in countless ways. Some neurons receive information from the rest of the body, others synthesize and interpret the information, and still others send messages that tell the body how to respond to its present circumstances. Curiously, neurons don't actually touch one another. Instead, they use a variety of chemical substances to send messages across the tiny spaces—**synapses**—between them. Any single neuron may have synaptic connections with hundreds or even thousands of other neurons.[2]

Accompanying neurons are perhaps 1 to 5 trillion *glial cells,* which serve a variety of specialized functions. Some act as clean-up crew for unwanted garbage, others are "nutritionists" that control blood flow to neurons or "doctors" that tend to infections and injuries, and still others provide a substance known as *myelin* that enhances the efficiency of many neurons. And certain glial cells—star-shaped ones known as **astrocytes**—seem to be intimately involved in learning and memory (more about this point shortly).[3] Figure 2.1 can give you a sense of what neurons and astrocytes look like.

As you'll discover about cognitive development in Chapter 6, the brain changes in important ways over the course of childhood and adolescence. Yet four basic points about the brain are important to keep in mind as we explore cognition and learning in this chapter:

The various parts of the brain work closely with one another.

Groups of neurons and glial cells in different parts of the brain seem to specialize in different things. Structures in the lower and middle parts of the brain specialize in essential physiological processes (e.g., breathing, heart rate), body movements (e.g., walking, riding a bicycle), and basic perceptual skills (e.g., coordinating eye movements, diverting attention to potentially life-threatening stimuli). Complex thinking, learning, and knowledge are located primarily in the upper and outer parts of the brain collectively known as the **cortex**, which rests on the top and sides of the brain like a thick, bumpy toupee (see Figure 2.2). The portion of the cortex located near the forehead, known as the *prefrontal cortex*, is largely responsible for a wide variety of distinctly human activities, including sustained attention, reasoning, planning, decision making, coordinating complex activities, and preventing nonproductive thoughts and behaviors.[4] Other parts of the cortex are important as well, being actively involved in interpreting visual and auditory information, identifying the spatial characteristics of objects and events, and keeping track of general knowledge about the world.

To some degree, the left and right halves of the cortex—its two *hemispheres*—have different specialties.[5] For most people, the left hemisphere takes primary responsibility for language and logical thinking, whereas the right hemisphere is more dominant in visual and spatial tasks. Yet contrary to popular belief, people rarely, if ever, think exclusively in one hemisphere. There's no such thing as "left-brain" or "right-brain" thinking: The two hemispheres constantly collaborate in day-to-day tasks. In fact, learning or thinking about virtually anything tends to be *distributed* across many parts of the brain. A task as seemingly simple as identifying a particular word in speech or print involves numerous areas of the cortex.[6]

Most learning probably involves changes in neurons, astrocytes, and their interconnections.

From a physiological standpoint, how and where does learning occur? Until recently, the great majority of learning theorists believed that the physiological basis for most learning lies primarily in changes in the interconnections among neurons. In particular, learning may involve

[2] C. S. Goodman & Tessier-Lavigne, 1997; Lichtman, 2001; Mareschal et al., 2007.
[3] Koob, 2009; Oberheim et al., 2009; Verkhratsky & Butt, 2007.
[4] Otero & Barker, 2014; Verghese, Garner, Mattingley, & Dux, 2016.
[5] Byrnes, 2001; R. Ornstein, 1997; Siegel, 2012; M. S. C. Thomas & Johnson, 2008.
[6] Gonsalves & Cohen, 2010; Huey, Krueger, & Grafman, 2006; Jung & Haier, 2007; Pereira, Detre, & Botvinick, 2011; Posner & Rothbart, 2007; Schlegel, Alexander, & Tse, 2016.

strengthening existing synapses, forming new ones, or, in some cases, *eliminating* synapses. Eliminating synapses is important because effective learning requires not only that people think and do certain things, but also that they *not* think or do other things—in other words, that they inhibit tendencies to think or behave in particular ways.[7]

Within the past few years, some researchers have begun to speculate that astrocytes are just as important as neurons in learning and memory—possibly even more important. In humans, astrocytes outnumber neurons by at least 10 to 1—a ratio much larger than that for, say, mice and rats—and they have many chemically mediated connections with one another and with neurons. Astrocytes appear to have some control over what neurons do and don't do and how much neurons communicate with one another.[8]

Many new astrocytes form throughout our lifetimes.[9] Some new neurons form throughout life as well, especially in the *hippocampus* (a small, seahorse-shaped structure in the middle of the brain) and possibly also in certain areas of the cortex.[10] Learning experiences seem to stimulate the formation of new brain cells, although researchers don't yet know exactly how these new cells are related to learning and memory.

As for *where* learning occurs, the answer is: many places. The prefrontal cortex is active when people must pay attention to and think about new information and events, and all of the cortex may be active to a greater or lesser extent in interpreting new input in light of previously acquired knowledge. The hippocampus also seems to be a central figure in learning, in that it pulls together the information it simultaneously receives from various parts of the brain.[11]

The brain functions in close collaboration with—rather than in relative isolation from—the rest of the body.

Obviously the brain can't function without the nutrition and health of the rest of the body, and it gets new information from the eyes, ears, and other sensory organs. But in addition, thinking and learning are often intimately intertwined with people's physical actions and reactions.[12] For example, when people think about throwing a baseball—even if they aren't actually throwing one—they activate parts of the brain that control arm and hand muscles involved in throwing.[13] And when people are pondering complex situations—perhaps math problems or perhaps the shapes and locations of various objects in space—gestures with their hands or arms can sometimes help them think and talk about the situations more effectively.[14]

Knowing how the brain functions and develops tells us only so much about learning and instruction.

As you'll see in upcoming sections of this chapter, recent research on the human brain has yielded helpful insights regarding human memory and effective instructional practices. It has also enhanced our knowledge about the typical course of cognitive development (see Chapter 6) and the neurological bases of certain disabilities (e.g., dyslexia, dyscalculia, autism spectrum disorders).[15]

Yet even as researchers determine how and where learning occurs, current knowledge of brain physiology doesn't begin to tell us everything we need to know about learning or how to foster it. For example, brain research can't tell us much about what information and skills are most important for people to have in a particular community and culture.[16] Nor does it provide

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[7] Bruer & Greenough, 2001; Byrnes, 2001; Dempster, 1992; Haier, 2001; Merzenich, 2001; C. A. Nelson, Thomas, & de Haan, 2006.

[8] Koob, 2009; Oberheim et al., 2009; Scharfman & Binder, 2013; Szu & Binder, 2016; Verkhratsky & Butt, 2007.

[9] Han et al., 2013; Koob, 2009.

[10] Deng, Aimone, & Gage, 2010; Gould, Beylin, Tanapat, Reeves, & Shors, 1999; C. A. Nelson et al., 2006; Sapolsky, 1999.

[11] Bauer, 2002; Byrnes, 2001; Davachi & Dobbins, 2008; Huey et al., 2006.

[12] Abrahamson & Lindgren, 2014. The brain's reliance on other parts of the body to help it in its thinking processes is sometimes called *embodiment*.

[13] Spunt, Falk, & Lieberman, 2010.

[14] Alibali, Spencer, Knox, & Kita, 2011; Goldin-Meadow & Beilock, 2010.

[15] Butterworth & Varma, 2014; Tager-Flusberg, 2007; Varma, McCandliss, & Schwartz, 2008.

[16] L. Bloom & Tinker, 2001; Chalmers, 1996; Gardner, 2000b.

much specific guidance about how teachers can best help their students *acquire* such information and skills.[17] In fact, educators who speak of "using brain research" or "brain-based learning" are, in most instances, actually talking about what psychologists have learned from studies of human *behavior* rather than from studies of brain anatomy and physiology.

By and large, if we want to understand the nature of human learning and identify effective ways of helping children and adolescents learn more effectively, we must look primarily at what psychologists, rather than neurologists, have discovered. Hence, we continue our exploration of learning and cognitive processes by looking at what psychologists have discovered about human memory.

2.2 LEARNING AS ACTIVE CONSTRUCTION

Big Idea 2.2 Much of human learning involves a process of actively constructing knowledge, rather than passively absorbing it.

Psychologists have been studying the nature of learning for more than a century, and in the process they've taken a variety of theoretical perspectives. Table 2.1 summarizes four general viewpoints, listed largely in the order in which they've gained prominence in educational psychology. For the most part, these diverse perspectives complement rather than contradict one another, and together they can give us a rich, multifaceted picture of human learning. Accordingly, as you can see in the rightmost column of the table, they'll all contribute considerably to upcoming discussions of what learning involves and how teachers can better enhance students' classroom performance and long-term success.

Cognitive psychology is a theoretical perspective that focuses on the mental processes underlying learning and behavior, including perception, memory, and reasoning. Several basic principles, described in the following sections, are fundamental to what cognitive psychologists have discovered about learning.

By the time they reach school age, young learners are actively involved in much of their own learning.

Sometimes children learn from an experience without really giving the situation much thought. For example, as infants and toddlers acquire the basic vocabulary and syntax of their first language, they seem to do so without consciously trying to acquire these things or thinking about what they're learning. Much of this unconscious learning that occurs during infancy and toddlerhood is called *implicit learning,* and even older children and adults continue to learn some things about their environments in a nonintentional, "thoughtless" way.[18] But as children grow, they

[17] D. M. Beck, 2010; Byrnes, 2007; G. A. Miller, 2010; Schenck, 2011.

[18] P. A. Alexander, Schallert, & Reynolds, 2009; S. W. Kelly, Burton, Kato, & Akamatsu, 2001; Kihlstrom, 2013; Siegel, 2012.

THEORETICAL PERSPECTIVES

Table 2.1 • General Theoretical Approaches to the Study of Learning

THEORETICAL PERSPECTIVE	GENERAL DESCRIPTION	EXAMPLES OF PROMINENT THEORISTS	WHERE YOU WILL SEE THIS PERSPECTIVE IN THE BOOK
Behaviorism	Early behaviorists argued that thought processes cannot be directly observed and thus cannot be studied objectively and scientifically. Accordingly, most behaviorists downplay the role of cognitive processes in learning and instead focus on two things researchers *can* observe and measure: people's behaviors *(responses)* and the environmental events *(stimuli)* that precede and follow those behaviors. Learning is viewed as a process of acquiring and modifying associations among stimuli and responses, largely through learners' direct interactions with the environment.	B. F. Skinner Edward Thorndike Ivan Pavlov MyEdLab: **Content Extension 2.2.** This supplementary reading provides more details about B. F. Skinner's foundational work in behaviorism.	We'll examine learning from a stimulus–response perspective early in Chapter 4 (see the first four principles in the section "Immediate Stimuli as Context"). We'll also draw from behaviorist ideas when we address classroom management in Chapter 9 (see the discussions of cueing, punishment, applied behavior analysis, functional analysis, and positive behavioral interventions and supports in the section "Reducing Unproductive Behaviors").
Social Cognitive Theory	Historically, social cognitive theorists have focused largely on the ways in which people learn from observing one another. Environmental stimuli affect behavior, but cognitive processes (e.g., *awareness* of stimulus–response relationships, *expectations* about future events) play a significant role as well. Often people learn through *modeling:* They watch and imitate what others do. Whether people learn and perform effectively is also a function of their *self-efficacy*, the extent to which they believe they can successfully accomplish a particular task or activity. As social cognitive theory has evolved over time, it has increasingly incorporated the concept of *self-regulation,* in which people take charge of and direct their own actions.	Albert Bandura Dale Schunk Barry Zimmerman	The social cognitive perspective will come into play in our discussion of self-regulation in Chapter 3, as well as in our discussions of modeling, vicarious consequences, incentives, and reciprocal causation in Chapter 4. Later, we'll sometimes draw from social cognitive theory as we examine motivation (and especially as we focus on self-efficacy and goals) in Chapter 5.
Cognitive Psychology	Although not denying that the environment plays a critical role in learning, information processing theorists concern themselves with what goes on *inside* learners, focusing on the cognitive processes involved in learning, memory, and performance. From observations of people's responses to various situations and tasks, these theorists draw inferences about how people may perceive, interpret, and mentally manipulate information they encounter in the environment. Many cognitive psychologists speculate about what internal mechanisms underlie human cognition (e.g., *working memory* and *long-term memory*) and about how people mentally process new information (e.g., through *elaboration* and *visual imagery*); this approach is called **information processing theory**. Other cognitive theorists focus on how individual learners create knowledge through their interactions with the environment; this approach is known as **individual constructivism**.	Richard Atkinson Richard Shiffrin Jean Piaget Jerome Bruner John Anderson John Bransford MyEdLab: **Content Extension 2.3.** This supplementary reading provides some key ideas about Jean Piaget's theory of cognitive development.	Cognitive psychology provides the basis for most of the discussion of learning and memory in this chapter. It will also be central to our discussion of complex cognitive processes in Chapter 3. It will be influential, too, in our discussions of cognitive factors influencing motivation in Chapter 5, cognitive development and intelligence in Chapter 6, social cognition in Chapter 7, and instructional strategies in Chapter 8.
Contextual Theories	Contextual theorists place considerable emphasis on the influence of learners' physical and social environments on cognition and learning. But rather than talk about specific stimuli (as behaviorists do), they focus on more general factors—physical, social, and cultural—that support "thoughtful" (i.e., cognition-based) learning. Some contextual theorists suggest that young learners initially use sophisticated thinking strategies in social interactions and gradually *internalize* these strategies for their own, personal use; this approach is known as **sociocultural theory**. Other contextual theorists emphasize that by working together, two or more people can often gain better understandings than anyone could gain alone; this approach is sometimes called **social constructivism**. Still other theorists propose that various ways of thinking are inextricably tied to particular physical or social circumstances; this approach goes by a variety of labels, including **situated learning** and **distributed cognition**.	Lev Vygotsky Jean Lave Barbara Rogoff Roy Pea Gavriel Salomon James Greeno MyEdLab: **Content Extension 2.4.** This supplementary reading provides more information about Lev Vygotsky's theory of cognitive development.	In Chapter 4, contextual theories will underlie our discussions of cultural and societal factors and technological advancements that significantly influence people's learning and thinking. Sociocultural theory will play a prominent role in our discussion of cognitive development in Chapter 6. We'll also bring contextual perspectives into play as we discuss complex cognitive process in Chapter 3, motivation in Chapter 5, instructional strategies in Chapter 8, and classroom management in Chapter 9. Furthermore, the "Cultural Considerations" boxes in Chapters 3 through 10 will continually remind us how students' cultural backgrounds are likely to influence their thoughts, perceptions, and behaviors.

increasingly engage in intentional, *explicit learning:* They consciously think about, interpret, and reconfigure what they see and hear in their environment. As a simple example, try the following exercise.

SEE FOR YOURSELF
TWELVE WORDS

Spend 30 seconds to memorize the following 12 words. Then look away and write down the words in the exact order in which they come to mind.

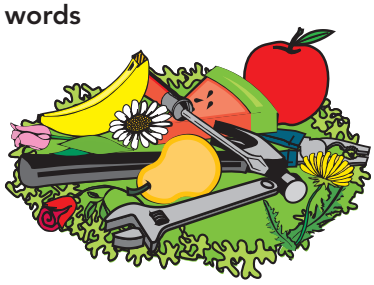
daisy	apple	dandelion
hammer	pear	wrench
tulip	pliers	watermelon
banana	rose	screwdriver

In what order did you remember the words? Did you recall them in their original order, or did you rearrange them somehow? If you're like most people, you grouped the words into three categories—flowers, fruit, and tools—and remembered one category at a time. In other words, you *organized* the words. As children get older, they're more likely to organize what they learn, and learners of all ages learn more effectively when they organize the subject matter at hand.

Cognitive processes influence what is learned.

You may have heard teachers, parents, employers, or others say that they want students to become better thinkers. But have you ever considered what's involved in *thinking?* Thinking is a broad term that can include many different **cognitive processes**—that is, the specific things individuals do mentally as they try to interpret and remember what they see, hear, and study. Cognitive processes are important because they have a profound effect on what people learn and remember. An example of a cognitive process is **encoding**, in which a learner changes or adds to incoming information in some way in order to remember it more easily. In the preceding "Twelve Words" exercise, sorting the words into categories was one possible encoding strategy. But perhaps, instead, you encoded the word list by creating a story or poem (e.g., "As *Daisy* and *Tulip* were walking, they ran across *Dandy* and *Rose* . . ."), or perhaps you formed a mental image of the 12 items in an elaborate, if not entirely edible, fruit salad (see Figure 2.3).

FIGURE 2.3 A visual image for encoding a list of 12 words



Cognitive psychologists have offered numerous explanations of how people mentally process and remember new information and events—explanations that fall into the general category of **information processing theory**. Many of their early explanations portrayed human thinking and learning as being similar to the ways computers operate. It has since become clear, however, that the computer analogy is too simple: People often think about and interpret information in ways that are difficult to explain in the one-thing-always-leads-to-another ways that characterize computers.[19]

Learners must be selective about what they focus on and learn.

People are constantly bombarded with information. Consider the many stimuli you're encountering at this very moment—the many letters in this text, the other objects you can see while you're reading, the various sounds reaching your ears, and the articles of clothing touching your skin, to name a few. You've probably been ignoring most of these stimuli until just now, when we specifically asked you to think about them. People can handle only so much information at any one time, and so they must be selective. Effective learners focus on what they think is important and ignore almost everything else.

[19] For example, see Hacker, Dunlosky, & Graesser, 2009a; G. Marcus, 2008; Minsky, 2006.

As an analogy, consider the hundreds of items you receive in the mail each year, not only in paper form via the post office but also in electronic form through e-mail. Do you open, examine, and respond to every piece of mail? Probably not. You may look closely at a few key items, inspect other items long enough to know that you don't need them, and discard others without even opening them.

Of course, people don't always make good choices about what to attend to. Just as they might overlook a small, inconspicuous rebate check while opening a colorful "You May Already Have Won . . ." sweepstakes announcement, so, too, might students fail to catch an important idea in a classroom lesson because they're focusing on trivial details in the lesson or on a classmate's attention-getting behavior across the room. An important job for teachers, then, is to help students understand what's most important to learn and what can reasonably be cast aside as "junk mail" or "e-mail spam."

Learners actively create—rather than passively absorb—much of what they know and believe about the world.

People learn some things simply by mindlessly "soaking up" certain regularities in their environment.[20] However, a good deal of human learning involves a process of **construction**: In an effort to make sense of their experiences, learners use many separate tidbits of information to create a general understanding, interpretation, or recollection of some aspect of their world.[21] As the conversation with 7-year-old Rob in the opening case study illustrates, learners are apt to construct their own, unique understandings of any given topic or situation, and these understandings may be accurate—or *not*—to varying degrees. Theories that focus primarily on the nature of constructive processes in learning are collectively known as **constructivism**, and a subset of these theories that addresses how learners idiosyncratically construct knowledge on their own (rather than in collaboration with other people) is known as **individual constructivism**.

In the following exercise, you'll almost certainly be able to see the process of construction in your own learning.

SEE FOR YOURSELF

ROCKY

Read the following passage *one time only:*

> Rocky slowly got up from the mat, planning his escape. He hesitated a moment and thought. Things were not going well. What bothered him most was being held, especially since the charge against him had been weak. He considered his present situation. The lock that held him was strong, but he thought he could break it. He knew, however, that his timing would have to be perfect. Rocky was aware that it was because of his early roughness that he had been penalized so severely—much too severely from his point of view.[22]

Now summarize what you've just read in two or three sentences.

Were you able to make sense of the passage? What did you think it was about? A prison escape? A wrestling match? Or something else altogether? The passage leaves a lot unsaid; for instance, it tells us nothing about where Rocky was, what kind of "lock" was holding him, or why timing was important. Yet you were probably able to use the information you were given to construct an overall understanding of Rocky's situation. Most people find meaning of one sort or another in the passage.

Active, constructive processes in learning—what theorists sometimes refer to as *meaning making*—are hardly limited to verbal material. For another example, try the following exercise.

[20] For example, see Aslin & Newport, 2012.

[21] For two classic works on constructive processes in learning, see Bransford & Franks, 1971; Neisser, 1967.

[22] R. C. Anderson, Reynolds, Schallert, & Goetz, 1977, p. 372.

SEE FOR YOURSELF

THREE PICTURES

Look at the three pictures in Figure 2.4. What do you see in each one?

FIGURE 2.4 What do you see in these pictures?

Figures from "Age in the Development of Closure Ability in Children" by C. M. Mooney, 1957, *Canadian Journal of Psychology, 11*, p. 220. Copyright 1957 by Canadian Psychological Association. Reprinted with permission.

Most people perceive the picture on the left as being that of a woman, even though many of her features are missing. Enough features are visible—an eye and parts of her nose, mouth, chin, and hair—that you can construct a meaningful perception from them. Do the other two pictures provide enough information to enable you to construct two more faces? Constructing a face from the figure on the right may take you a while, but it can be done.

Objectively speaking, the three configurations of black splotches, and especially the two rightmost ones, leave a lot to the imagination. The woman in the middle is missing half of her face, and the man on the right is missing the top of his head. Yet knowing what human faces typically look like may have been enough to enable you to mentally add the missing pieces and perceive complete pictures. Curiously, once you've constructed faces from the figures, they then seem obvious. If you were to close this book now and not pick it up again for a week or more, you would probably see the faces almost immediately, even if you had had considerable trouble perceiving them originally.

Learners use what they already know and believe to help them make sense of new experiences.

In the "Rocky" and "Three Pictures" exercises you just completed, you were able to make sense of situations even though a lot of information was missing. Your prior knowledge—perhaps about typical prison escapes or wrestling matches and certainly about how human facial features are arranged—allowed you to fill in many missing details. Prior knowledge and beliefs usually play a major role in the meanings people construct.

think about it

Skillful readers typically skip some of the words on the page and yet accurately understand what they read. How is this possible? (For an explanation, click **here**.)

When different learners construct different meanings from the same situation, it's often because they each bring unique prior experiences and knowledge to the situation. For instance, when the "Rocky" passage was used in an experiment with college students, physical education majors frequently interpreted it as a wrestling match, but music education majors (most of whom had little or no knowledge of wrestling) were more likely to think it was about a prison break.[23] Not only do learners bring different areas of expertise to a learning task, but they also bring different childhood experiences, cultural backgrounds, and general knowledge and assumptions about the world, and such differences are apt to have a significant impact on their meaning-making efforts. For example, we might reasonably guess that 7-year-old Rob had seen people moving large

[23] R. C. Anderson et al., 1977.

mounds of dirt around—perhaps at construction sites—but he probably had no knowledge of the geological processes (e.g., erosion, plate tectonics) that underlie mountain formation.

2.3 HOW HUMAN MEMORY OPERATES

Big Idea 2.3 Human memory is a complex, multifaceted information processing system that is, to a considerable degree, under a learner's control.

The term **memory** refers to a learner's ability to mentally "save" newly acquired information and behaviors. In some cases we'll use the term to refer to the actual process of saving knowledge or skills for a period of time. In other instances we'll use it to talk about particular "locations" where knowledge is held—for instance, in *working memory* or *long-term memory*.

The process of "putting" something into memory is called **storage**. In contrast, the process of remembering previously stored information—that is, "finding" it in memory—is **retrieval**. The following exercise illustrates the retrieval process.

SEE FOR YOURSELF
RETRIEVAL PRACTICE

How quickly can you answer each of the following questions?

1. What is your name?
2. What is the capital of France?
3. In what year did Christopher Columbus first sail across the Atlantic Ocean to reach the New World?
4. What did you have for dinner 3 years ago today?
5. When talking about serving appetizers at a party, people sometimes use a French term instead of the word *appetizer*. What is that French term, and how is it spelled?

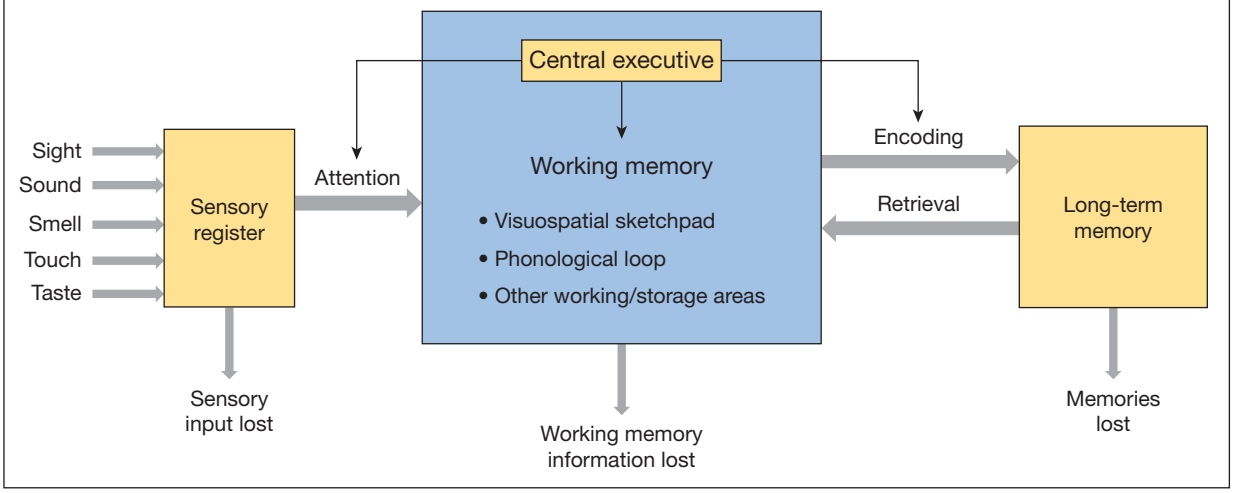
As you probably noticed when you tried to answer these questions, retrieving some information from memory (e.g., your name) is an easy, effortless process. But other things can be retrieved only after some thought and effort. For example, it may have taken you a few seconds to recall that the capital of France is Paris and that Columbus first sailed across the Atlantic in 1492. Still other pieces of information—even though you certainly stored them in memory at one time—may be almost impossible to retrieve. Perhaps a dinner menu 3 years ago and the correct spelling of *hors d'oeuvre* fall into this category.

Human memory is a complex, multifaceted phenomenon that is still somewhat of a mystery. But many psychologists have found it helpful to think of the human memory system as having three general components that hold information for different lengths of time: sensory memory, working memory, and long-term memory (see Figure 2.5).[24] Oversimplified as this model undoubtedly is, we can use it in combination with countless research studies to derive some general principles about how human memory operates.[25]

[24] For example, see R. C. Atkinson & Shiffrin, 1968; Reisberg, 1997; Willingham, 2004.

[25] Findings from recent brain research reveal that the various components of memory depicted in Figure 2.5 aren't completely separate entities; for example, see Baddeley, 2001; Nee, Berman, Moore, & Jonides, 2008; Öztekin, Davachi, & McElree, 2010.

FIGURE 2.5 A model of human memory



Sensory input stays in a raw form only briefly.

If you've ever played at night with a sparkler—one of those metal sticks that, when lit, emits fiery sparks for a few minutes—you've seen the bright tail of light that follows it as it's waved around. If you've ever daydreamed in class, you may have noticed that when you tune back in to a lecture, you can still "hear" the three or four words that were spoken just *before* you started paying attention to your instructor again. The sparkler's tail and the words that linger aren't actually "out there" in the environment. Instead, they're recorded in your sensory register.

The **sensory register** is the component of memory that holds the information you receive from your senses—*input*—in more or less its original, *un*encoded form. Much of what your body sees, hears, smells, touches, or tastes is stored in the sensory register. In other words, the sensory register has a *large capacity:* It can hold a great deal of information at any one time.

That's the good news. The bad news is that information stored in the sensory register doesn't last very long.[26] Visual information (what you see) probably lasts for less than a second. For example, as a child, one of us authors, Jeanne, could never spell out her entire first name with a sparkler; the *J* had always faded before she got to the first *n,* no matter how quickly she wrote. Auditory information (what you hear) lasts slightly longer, perhaps for 2 or 3 seconds. To keep information for any time at all, then, learners need to move it to *working memory.*

Attention is essential for most learning and memory.

Recently received sensory information—such as a sparkler's glittery light—doesn't last very long no matter what we do. But we can preserve a memory of it in some minimal way—for instance, by perceiving alphabet letters or other familiar shapes in a sparkler's curlicue tail. In the model of memory presented in Figure 2.5, the first step in this process is **attention**: *Whatever a learner mentally pays attention to continues on to working memory.* If information in the sensory register doesn't get a learner's attention, it presumably disappears from the memory system, although it might be learned implicitly.[27]

Paying attention involves directing not only the appropriate sensory receptors (in the eyes, ears, fingertips, etc.) but also the *mind* toward whatever needs to be learned and remembered. Imagine yourself reading a textbook for one of your classes. Your eyes are moving down each page, but meanwhile you're thinking about something altogether different—a recent argument with a friend, a high-paying job advertised online, or your growling stomach. What will you remember from the textbook? Absolutely nothing. Even though your eyes were focused on the words in your book, you weren't *mentally* attending to the words.

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[26] Cowan, 1995; Dahan, 2010; Darwin, Turvey, & Crowder, 1972; Sperling, 1960.

[27] Some nonattended-to information may remain, but without the learner's conscious awareness of it, it can be extremely difficult to recall, especially over the long run; for example, see Cowan, 2007.