Psychological Science

MODELING SCIENTIFIC LITERACY

Second Edition

Mark Krause • Daniel Corts

Psychological Science

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Modeling Scientific Literacy

SECOND EDITION

Mark Krause
Southern Oregon University

Daniel Corts
Augustana College

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PEARSON

For Andrea and Finn. Both of you fuel
my passion and motivation for this endeavor.
I cannot thank you enough.

Mark Krause

To Kim, Sophie, and Jonah, for your patience,
understanding, and forgiveness during all
the hours this project has occupied me.

Dan Corts

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Brief Contents

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About the Authors

Dr. Mark Krause received his Bachelor's and Master's degrees at Central Washington University, and his PhD at the University of Tennessee in 2000. He completed a post-doctoral appointment at the University of Texas at Austin where he studied classical conditioning of sexual behavior in birds. Following this, Krause accepted a research fellowship through the National Institute of Aging to conduct research on cognitive neuroscience at Oregon Health and Sciences University. He has conducted research and published on pointing and communication in chimpanzees, predatory behavior in snakes, the behavioral and evolutionary basis of conditioned sexual behavior, and the influence of testosterone on cognition and brain function. Krause began his teaching career as a doctoral candidate and continued to pursue this passion even during research appointments. His teaching includes courses in general psychology, learning and memory, and behavioral neuroscience. Krause is currently a professor of psychology at Southern Oregon University, where his focus is on teaching, writing, and supervising student research. His spare time is spent with his family, cycling, reading, and enjoying Oregon's outdoors.

Dr. Daniel Corts discovered psychology at Belmont University where he received his B.S. He completed a PhD in Experimental Psychology at the University of Tennessee in 1999 and then a post-doctoral position at Furman University for one year where he focused on the teaching of psychology. He is now professor of psychology at Augustana College in Rock Island, IL where he has taught for over 15 years. His research interests in cognition have lead to publications on language, gesture, and memory, and he has also published in the area of college student development. Corts is increasingly involved in applied work, developing programming and assessments related to K-12 educational programming and teacher preparation. Corts is enthusiastic about getting students involved in research and has supervised or coauthored over 100 conference presentations with undergraduates. Corts has served as the local Psi Chi advisor for a dozen years and has served on the Board of Directors for several years, including his current term as President. In his spare time, he enjoys spending time with his two children, traveling, camping, and cooking.

From the Authors

Welcome to the second edition of *Psychological Science: Modeling Scientific Literacy!* It is a great privilege for us to offer an updated and revised version of our textbook. Much has happened in psychology since the first edition and we are excited to present the latest and greatest that our field has to offer. Of course, equally if not more important to keeping up with the science is ensuring that our readers find our book accessible, interesting, and hopefully inspiring. To this end we have, as authors should, put ourselves in the mindset of a college student first encountering this material and re-read the entire book. There is no better way to begin the process of revising and improving a textbook. In the second edition we have continued our emphasis on helping the reader organize and assess their thinking and learning about the material. Each module includes learning objectives of increasing depth (knowing, understanding, analyzing and applying) and end of module quiz and chapter items assessing learning at each level. Also new to this edition are journal prompts in each module which prime students to think deeply about specific topics, take a stance on an issue, or apply a concept to oneself.

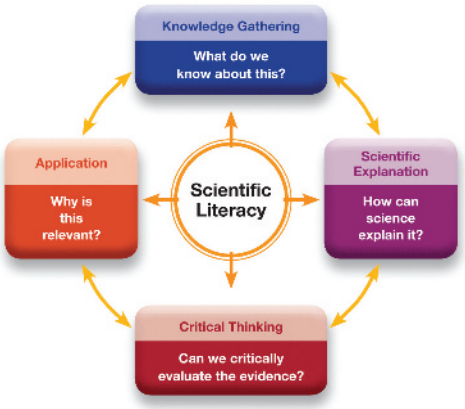
We firmly believe that a well-rounded college education requires a healthy dose of science. This is true regardless of an individual's personal and career goals. To this end, *Psychological Science* is written from the perspective of scientific literacy—the ability not only to define scientific

terminology, but also to understand how it functions, to critically evaluate it, and to apply it to personal and societal matters. Scientific literacy comprises four interrelated components:

1. **knowledge:** what do we know about a phenomenon?
2. **scientific explanation:** how does science explain the psychological process we are examining?
3. **critical thinking:** how do we interpret and evaluate all types of information, including scientific reporting?
4. **application:** how does research apply to your own life and to society?

Psychological Science presents students with a model for scientific literacy; this model forms the core of how this book is written and organized. We believe a scientific literacy perspective and model will prove useful in addressing two course needs we often hear from instructors—to provide students with a systematic way to categorize the overwhelming amount of information they are confronted with, and to cultivate their curiosity and help them understand the relevance, practicality, and immense appeal of psychological science.

Psychological Science models the processes of scientific thinking. As was the case in the first edition, the elements of scientific literacy are explicitly demonstrated once per module, and implicitly throughout. We are very excited to introduce a new feature for the second edition: the Scientific Literacy Challenge. At the end of each chapter students can practice applying scientific and critical thinking to an important, contemporary issue. We tackle such topics as free-range parenting, cognitive enhancement drugs, college admissions testing, and brain training websites. Students are asked to read author created blog entries, editorials, or advertisements about these topics and evaluate them from a scientific literacy perspective through journal prompts, and multiple-choice, matching and true/false questions.



We thank the many instructors and students who have helped us craft this model and apply it to our discipline, and we look forward to your feedback. Please feel free to contact us and share your experiences with the 2nd edition of *Psychological Science.*

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What's New?

The Scientific Literacy Challenge described above is an exciting new feature of the second edition. We also updated module openers to include contemporary and relevant examples, and updated research, and in some cases replaced, topics covered in the Working the Scientific Literacy Model features within each module. Naturally, the topics we cover involve ongoing and exciting research. Therefore, each chapter has been updated accordingly, and, in many places, we have added new topics we felt deserve inclusion in our book. For example:

- Chapter 1, "Introducing Psychological Science" includes additional instruction on critically thinking about sources. Students learn to evaluate a message by considering the author or speaker, the purpose of the article, the publisher or presenter, and other factors that affect the reliability and quality of the message. Interactive exercises help students understand the ways in which psychology may be expanded into other fields, such as sports psychology.
- Chapter 2, "Reading and Evaluating Scientific Research" provides additional tools to think about and understand the outcomes of research. The coverage of correlational methods is supplemented by instruction on how to think about what it means to be a small, medium, or large correlation. Similar improvements have been made to the discussion on how to understand group differences in experimental and quasi-experimental research.
- Chapter 3, "Biological Psychology" now begins by asking students to think about Paleo diets as a way to introduce evolutionary psychology. There is a new section introducing epigenetics. Citations and coverage have been expanded on topics of genomics, neurogenesis and brain plasticity, and brain imaging technology.

- Chapter 4, "Sensation and Perception" includes new interactive features for applying signal detection theory and monocular depth cues, and updated research and coverage of subliminal perception, multi-tasking, phantom limb therapies, and object recognition.
- Chapter 5, "Consciousness" includes a new Working the Scientific Literacy Model feature on the neurocognitive theory of dreaming, updated coverage on how marijuana and other drugs affect cognition, new research on dream sleep and memory, and the therapeutic effects of hypnosis and meditation.
- Chapter 6, "Learning" includes updated coverage on applications of classical conditioning; including taste aversions, advertisement, drug tolerance, in-text activities for practicing concepts of classical and operant conditioning, updated research and expanded personal application opportunities on topics of cognitive and long-term learning, a revised Working the Scientific Literacy Model feature to balance coverage of research on video game playing and violent behavior.
- Chapter 7, "Memory" has more coverage of applications including strengthening memories and the reliability of eyewitness testimony.
- Chapter 8, "Thought and Language" makes more connections between the often very abstract theories of reasoning and daily experience. For example, students can learn about individual differences in the reliance on representativeness, and how these differences relate to interest in superstition, the paranormal, and conspiracy theories.
- Chapter 9, "Intelligence and Aptitude, and Cognitive Abilities" includes updated citations and research, especially when covering intelligence and the brain. Also, students can engage in a debate on whether colleges and universities should consider personality tests as a supplement to or even a replacement for traditional college aptitude tests.
- Chapter 10, "Life Span Development" includes updated coverage of preterm infant development, child cognitive development, expanded and updated coverage of adolescent sexuality, brain development, and identity.
- Chapter 11, "Motivation and Emotion" includes updated research on sex and the brain, and sexual orientation, neural and psychological bases of hunger and eating, effects of loneliness and mental and physical health, and an in-text activity on achievement motivation.
- Chapter 12, "Personality" includes updated coverage of cultural and evolutionary influences on personality, practice application activities for the Big 5, cultural variation, and psychodynamic views on personality, updated discussion on scientific research on suppression and critical analysis of Freud's views on personality.
- Chapter 13, "Psychological Disorders" has been updated throughout to reflect *DSM 5* revisions and recent prevalence statistics when available.
- Chapter 14, "Therapies" includes a new Working the Scientific Literacy Model feature about the use of mobile apps designed to improve mental health, updated coverage of topics such as empirically supported treatments, precision medicine and cultural factors related to drug treatments, effects of nutrients such as Omega-3 fatty acids on health, and reduced emphasis on outdated anti-depressant drugs and expanded coverage of potential new treatments (e.g., low-dose ketamine).
- Chapter 15, "Social Psychology" has updated and modified coverage of stereotypes and person perception. This reflects increased national awareness of the use of force by law enforcement, an extremely important topic that is also very engaging for students.
- Chapter 16, "Health, Stress, and Coping" has updated coverage on the effects of media exposure on health related behaviors (smoking), social contagion effects occurring via social media (Facebook), effects of stress on cognitive processes, posttraumatic growth, effects of exercise and nutrition on cognitive functioning.
- Chapter 17, "Industrial and Organizational Psychology" includes substantial updates to sections on selection and assessment. There is increased linkage between the sections on employee affect and leadership through an interactive investigation of how money may or may not be a useful motivator for employees.

Content and Features

Students in the general psychology course are inundated with many disparate pieces of information at a time when they are still developing the skills and strategies for organizing and making sense of that information. How do Working the Scientific Literacy Model and supporting features in *Psychological Science* address this issue?

Knowledge Gathering

What do we know about this?

Introductory psychology courses cover a vast amount of content drawn from diverse specialty areas. The organization of the material is central to helping students absorb this content.

Modules

Chapters are divided into modules to make it easier for students to organize content as well as to self-test and review their learning at regular intervals. For instructors, the modular content makes it easy to customize their delivery based on their preferred syllabus.

Module 2.1 Principles of Scientific Research

Learning Objectives

2.1a Know . . . the key terminology related to the principles of scientific research.

2.1b Understand . . . the five characteristics of quality scientific research.

2.1c Understand . . . how biases might influence the outcome of a study.

2.1d Apply . . . the concepts of reliability and validity to examples.

2.1e Analyze . . . whether anecdotes, authority figures, and common sense are reliably truthful sources of information.

Several years ago, the Society for Neuroscience invited the Dalai Lama, the spiritual leader of Tibetan Buddhism, to their annual emerging science meeting to discuss the practice of meditation. For most people, meditation is understood to be a mystical, subjective, nonscientific practice embraced by individuals outside the scientific community. It is likely that no more than a hundred—if not fewer—of the Society's 30,000 plus members had a professional, scientific interest in the subject. Why, then, would the Society invite the Dalai Lama to speak about a topic that was clearly not based in science? Several hundred Society members were so opposed to the Dalai Lama's talk that they signed a petition to cancel his scheduled appearance. But according to the Dalai Lama, the members' opposing opinions about the value of meditation are rooted in the same thing: an almost complete lack of understanding of the practice. Without the benefit of careful observations and measurement, there really is no scientific way of saying whether meditation is worthwhile. Therefore, it is precisely this lack of understanding why scientists should be interested in meditation. In recent years, neuroscientists such as Richard Davidson and Antoine Lutz of the University of Wisconsin have confirmed that meditation does have numerous benefits. They have also developed models for how specific brain functions translate the practice of meditation into physical and psychological well-being. In Chapter 1, we argued that critical thinkers should be skeptical, as many Society members demonstrated. However, we also argued that critical thinkers should be curious and that their opinions should be modified to fit the evidence—something that Davidson, Lutz, and colleagues are working toward. In this chapter we turn to the process of gathering and evaluating evidence.

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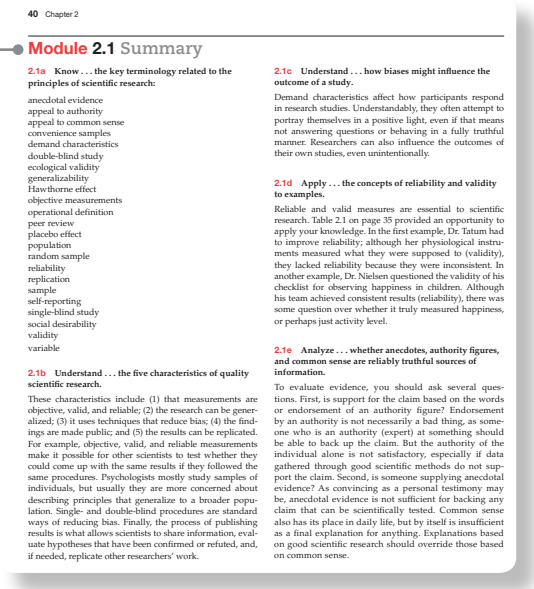
Learning Objectives

Learning Objectives are organized around an updated Bloom's taxonomy that aims to guide students to higher-level understanding. Summaries of the key points related to these objectives are provided at the end of each module. Objectives are listed at four levels of increasing complexity: know, understand, apply, and analyze.

Module Summaries

The major terms, concepts, and applications of the modules are reviewed in the Module Summaries. The summaries also return to and address the original Learning Objectives from the beginning of the module and include application questions. **Answers to end-of-module and end-of-chapter assessment can be found in the Instructor's Manual.**



40 Chapter 2

Module 2.1 Summary

2.1a Know . . . the key terminology related to the principles of scientific research:

anecdotal evidence
appeal to authority
appeal to common sense
convenience samples
demand characteristics
double-blind study
ecological validity
generalizability
Hawthorne effect
objective measurements
operational definition
peer review
placebo effect
population
random sample
reliability
replication
sample
self-reporting
single-blind study
social desirability
validity
variable

2.1b Understand . . . the five characteristics of quality scientific research.

These characteristics include (1) that measurements are objective, valid, and reliable; (2) the research can be generalized; (3) it uses techniques that reduce bias; (4) the findings are made public; and (5) the results can be replicated. For example, objective, valid, and reliable measurements make it possible for other scientists to test whether they could come up with the same results if they followed the same procedures. Psychologists mostly study samples of individuals, but usually they are more concerned about describing principles that generalize to a broader population. Single- and double-blind procedures are standard ways of reducing bias. Finally, the process of publishing results is what allows scientists to share information, evaluate hypotheses that have been confirmed or refuted, and, if needed, replicate other researchers' work.

2.1c Understand . . . how biases might influence the outcome of a study.

Demand characteristics affect how participants respond in research studies. Understandably, they often attempt to portray themselves in a positive light, even if that means not answering questions or behaving in a fully truthful manner. Researchers can also influence the outcomes of their own studies, even unintentionally.

2.1d Apply . . . the concepts of reliability and validity to examples.

Reliable and valid measures are essential to scientific research. Table 2.1 on page 35 provided an opportunity to apply your knowledge. In the first example, Dr. Tatum had to improve reliability; although her physiological instruments measured what they were supposed to (validity), they lacked reliability because they were inconsistent. In another example, Dr. Nielsen questioned the validity of his checklist for observing happiness in children. Although his team achieved consistent results (reliability), there was some question over whether it truly measured happiness, or perhaps just activity level.

2.1e Analyze . . . whether anecdotes, authority figures, and common sense are reliably truthful sources of information.

To evaluate evidence, you should ask several questions. First, is support for the claim based on the words or endorsement of an authority figure? Endorsement by an authority is not necessarily a bad thing, as someone who is an authority (expert) at something should be able to back up the claim. But the authority of the individual alone is not satisfactory, especially if data gathered through good scientific methods do not support the claim. Second, is someone supplying anecdotal evidence? As convincing as a personal testimony may be, anecdotal evidence is not sufficient for backing any claim that can be scientifically tested. Common sense also has its place in daily life, but by itself is insufficient as a final explanation for anything. Explanations based on good scientific research should override those based on common sense.

jects. By examining and reporting an average effect for that group, psychologists can get a much better sense of how individuals are likely to behave. But how large of a group is it possible to study? Ideally, it would be best to study an entire **population**—*the group that researchers want to generalize about.* In reality, the task of finding all population members, persuading them to participate, and measuring their behavior is impossible in most cases. Instead, psychologists typically study a **sample**—*a select*

Key Terms

Key Terms are defined within the narrative, helping students place them in context, and are then listed again within the Module Summaries. A complete glossary is also included at the end of the text.

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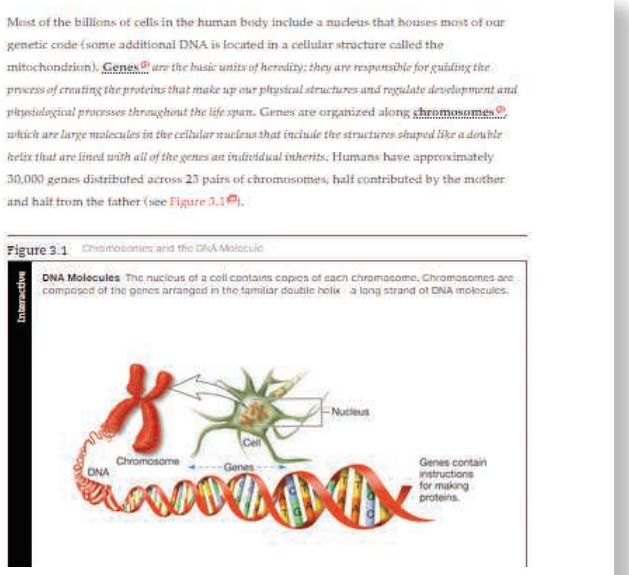
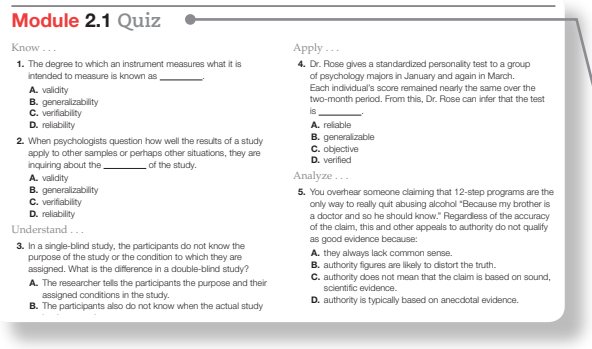


Most of the billions of cells in the human body include a nucleus that houses most of our genetic code (some additional DNA is located in a cellular structure called the mitochondrion). **Genes** are the basic units of heredity; they are responsible for guiding the process of creating the proteins that make up our physical structures and regulate development and physiological processes throughout the life span. Genes are organized along **chromosomes**, which are large molecules in the cellular nucleus that include the structures shaped like a double helix that are lined with all of the genes an individual inherits. Humans have approximately 30,000 genes distributed across 23 pairs of chromosomes, half contributed by the mother and half from the father (see Figure 3.1).

Figure 3.1 Chromosomes and the DNA Molecule

Interactive

DNA Molecules The nucleus of a cell contains copies of each chromosome. Chromosomes are composed of the genes arranged in the familiar double helix—a long strand of DNA molecules.



Module 2.1 Quiz

Know . . .

1. The degree to which an instrument measures what it is intended to measure is known as _____.
   A. validity
   B. generalizability
   C. verifiability
   D. reliability
2. When psychologists question how well the results of a study apply to other samples or perhaps other situations, they are inquiring about the _____ of the study.
   A. validity
   B. generalizability
   C. verifiability
   D. reliability

Understand . . .

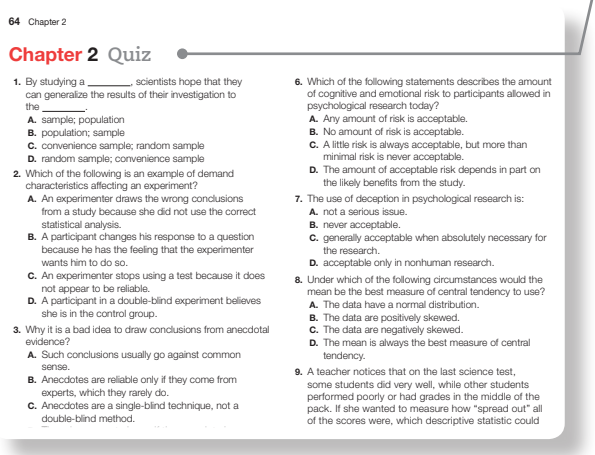
3. In a single-blind study, the participants do not know the purpose of the study or the condition to which they are assigned. What is the difference in a double-blind study?
   A. The researcher tells the participants the purpose and their assigned conditions in the study.
   B. The participants also do not know when the actual study

Apply . . .

4. Dr. Rose gives a standardized personality test to a group of psychology majors in January and again in March. Each individual's score remained nearly the same over the two-month period. From this, Dr. Rose can infer that the test is _____.
   A. reliable
   B. generalizable
   C. objective
   D. verified

Analyze . . .

5. You overhear someone claiming that 12-step programs are the only way to really quit abusing alcohol "Because my brother is a doctor and so he should know." Regardless of the accuracy of the claim, this and other appeals to authority do not qualify as good evidence because:
   A. they always lack common sense.
   B. authority figures are likely to distort the truth.
   C. authority does not mean that the claim is based on sound, scientific evidence.
   D. authority is typically based on anecdotal evidence.



64 Chapter 2

Chapter 2 Quiz

1. By studying a _____, scientists hope that they can generalize the results of their investigation to the _____.
   A. sample; population
   B. population; sample
   C. convenience sample; random sample
   D. random sample; convenience sample
2. Which of the following is an example of demand characteristics affecting an experiment?
   A. An experimenter draws the wrong conclusions from a study because she did not use the correct statistical analysis.
   B. A participant changes his response to a question because he has the feeling that the experimenter wants him to do so.
   C. An experimenter stops using a test because it does not appear to be reliable.
   D. A participant in a double-blind experiment believes she is in the control group.
3. Why it is a bad idea to draw conclusions from anecdotal evidence?
   A. Such conclusions usually go against common sense.
   B. Anecdotes are reliable only if they come from experts, which they rarely do.
   C. Anecdotes are a single-blind technique, not a double-blind method.
6. Which of the following statements describes the amount of cognitive and emotional risk to participants allowed in psychological research today?
   A. Any amount of risk is acceptable.
   B. No amount of risk is acceptable.
   C. A little risk is always acceptable, but more than minimal risk is never acceptable.
   D. The amount of acceptable risk depends in part on the likely benefits from the study.
7. The use of deception in psychological research is:
   A. not a serious issue.
   B. never acceptable.
   C. generally acceptable when absolutely necessary for the research.
   D. acceptable only in nonhuman research.
8. Under which of the following circumstances would the mean be the best measure of central tendency to use?
   A. The data have a normal distribution.
   B. The data are positively skewed.
   C. The data are negatively skewed.
   D. The mean is always the best measure of central tendency.
9. A teacher notices that on the last science test, some students did very well, while other students performed poorly or had grades in the middle of the pack. If she wanted to measure how "spread out" all of the scores were, which descriptive statistic could

Module Quizzes
End-of-Chapter Quizzes

Quizzes appear at the conclusion of modules and chapters. These quizzes contain multiple-choice questions that enable students to assess their comprehension and better prepare for exams. Like the Learning Objectives, the Module Quizzes assess understanding at the four levels of Bloom's taxonomy and are marked accordingly. **Answers to quizzes can be found in the Instructor's Manual.**

Scientific Explanation

How can science explain it?

This element of scientific literacy encompasses a basic understanding of research methodology and thinking about problems within a scientific framework. *Psychological Science* integrates and reinforces key research methodology concepts throughout the book. This interweaving of methodology encourages students to continue practicing their scientific thinking skills. As noted in the *National Science Education Standards*, learning science is more than accumulating facts; that is, students learn to ask questions, construct explanations, test those explanations, and communicate their ideas to others.

Module Opening Vignettes

Each module opens with a short vignette emphasizing the personal and societal relevance of certain topics to be covered.

Module 2.1 Principles of Scientific Research

Learning Objectives

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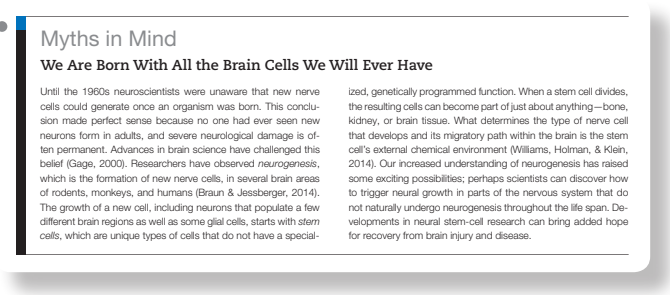
Myths in Mind

Many commonly held beliefs people have about behavior before taking a psychology course are half-truths or outright falsehoods. This feature sets the record straight in a concise and informative way. The selected examples are likely to have personal relevance to many readers and deal with important scientific issues.



Myths in Mind

We Are Born With All the Brain Cells We Will Ever Have

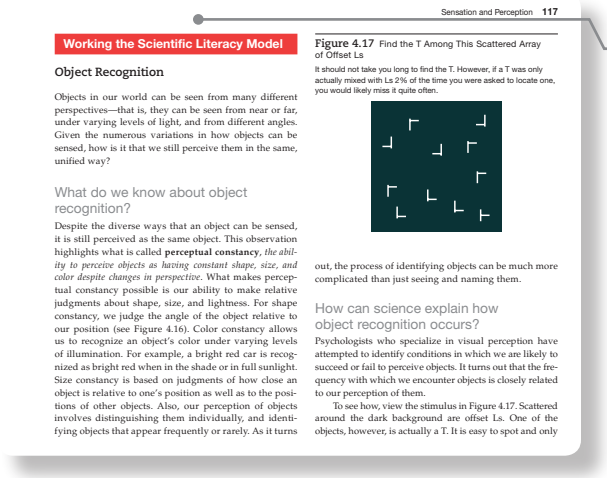
Until the 1960s neuroscientists were unaware that new nerve cells could generate once an organism was born. This conclusion made perfect sense because no one had ever seen new neurons form in adults, and severe neurological damage is often permanent. Advances in brain science have challenged this belief (Gage, 2000). Researchers have observed *neurogenesis*, which is the formation of new nerve cells, in several brain areas of rodents, monkeys, and humans (Braun & Jessberger, 2014). The growth of a new cell, including neurons that populate a few different brain regions as well as some glial cells, starts with *stem cells*, which are unique types of cells that do not have a specialized, genetically programmed function. When a stem cell divides, the resulting cells can become part of just about anything—bone, kidney, or brain tissue. What determines the type of nerve cell that develops and its migratory path within the brain is the stem cell's external chemical environment (Williams, Holman, & Klein, 2014). Our increased understanding of neurogenesis has raised some exciting possibilities; perhaps scientists can discover how to trigger neural growth in parts of the nervous system that do not naturally undergo neurogenesis throughout the life span. Developments in neural stem-cell research can bring added hope for recovery from brain injury and disease.

In recent years, an increasing number of instructors have begun to focus on telling students how psychological science fits within the scientific community. Psychology serves, in essence, as a hub science. Through this emphasis on scientific literacy in psychology, students begin to see the practicality and relevance of psychology and become more literate in the fields that our hub science supports.

Critical Thinking

Can we critically evaluate the evidence?

Many departments are focusing to an increasing extent on the development of critical thinking, as these skills are highly sought after in society and the workforce. Critical thinking is generally defined as the ability to apply knowledge, use information in new ways, analyze situations and concepts, and evaluate decisions. To develop critical thinking, the module objectives and quizzes are built around an updated Bloom's taxonomy. Objectives are listed at four levels of increasing complexity: know, understand, apply, and analyze. The following features also help students organize, analyze, and synthesize information. Collectively, these features encourage students to connect different levels of understanding with specific objectives and quiz questions.



Sensation and Perception 117

Working the Scientific Literacy Model

Object Recognition

Objects in our world can be seen from many different perspectives—that is, they can be seen from near or far, under varying levels of light, and from different angles. Given the numerous variations in how objects can be sensed, how is it that we still perceive them in the same, unified way?

What do we know about object recognition?

Despite the diverse ways that an object can be sensed, it is still perceived as the same object. This observation highlights what is called **perceptual constancy**, *the ability to perceive objects as having constant shape, size, and color despite changes in perspective.* What makes perceptual constancy possible is our ability to make relative judgments about shape, size, and lightness. For shape constancy, we judge the angle of the object relative to our position (see Figure 4.16). Color constancy allows us to recognize an object's color under varying levels of illumination. For example, a bright red car is recognized as bright red when in the shade or in full sunlight. Size constancy is based on judgments of how close an object is relative to one's position as well as to the positions of other objects. Also, our perception of objects involves distinguishing them individually, and identifying objects that appear frequently or rarely. As it turns out, the process of identifying objects can be much more complicated than just seeing and naming them.

Figure 4.17 Find the T Among This Scattered Array of Offset Ls

It should not take you long to find the T. However, if a T was only actually mixed with Ls 2% of the time you were asked to locate one, you would likely miss it quite often.

How can science explain how object recognition occurs?

Psychologists who specialize in visual perception have attempted to identify conditions in which we are likely to succeed or fail to perceive objects. It turns out that the frequency with which we encounter objects is closely related to our perception of them.

To see how, view the stimulus in Figure 4.17. Scattered around the dark background are offset Ls. One of the objects, however, is actually a T. It is easy to spot and only

Working the Scientific Literacy Model

Working the Scientific Literacy Model, introduced in Chapters 1 and 2, and then featured in each module in the remaining chapters, fully integrates the model of scientific literacy. Core concepts are highlighted and students are walked through the steps of knowledge gathering, approaching the problem from a scientific standpoint, using critical thinking, and revealing applications.

Module 4.5 Scientific Literacy Challenge: Distracted Drivers

Cell phones made their first appearance in the retail market as car phones. Units had to be mounted in the interior of a vehicle and wired into its electrical system; they were literally part of the car. Ironically, there is now evidence suggesting that a car is the *last* place a cell phone should be. You have probably heard arguments in favor of banning drivers from using cell phones, and most states have enacted laws to curb their usage—especially for texting.

Before you start this activity, take a minute to write your thoughts about using a cell phone while driving.

JOURNAL PROMPT

Do you think cell phone use while driving should be legal, banned outright, or only permitted as hands-free devices for drivers? What experiences, assumptions, or statistics have influenced your opinion?

What do we know about distracted driving?

Read the following letter from a consumer advocacy group. Make sure you understand the boldfaced terms and concepts from Chapter 4 and that you have a clear sense of what the writer is claiming.

An Open Letter to Congress

By Vanessa Fowler, President, Federation of American Drivers

Dear Representative,

I am writing on behalf of the 320,000 members of the Federation of American Drivers (FAD) who, as a group, are concerned about a major threat to public safety: "Distracted drivers," who are responsible for more than 3,000 traffic deaths annually, and more than 420,000 significant injuries. Drivers face a barrage of sights and sounds that **divide attention**. Only a portion of these are relevant to driving; the rest are distractions, and few are as powerful and ubiquitous as the cell phone. FAD's position is that cell phone use should be completely banned for drivers of any age, any vehicle, on any public roadway. While several US states and territories have taken steps in that direction, far too few have enacted a complete ban.

Many people assume that the problem with cell phone use is limited to texting or conversations that require at least one hand off the wheel. However, data show that preoccupied hands are not the problem. The real issue is that cell phone use—including texting, talking, or using apps—demands that the user **selectively attends** to the task, which can block out virtually everything else. For drivers, that means blocking out the traffic, instruments on the dashboard, and pedestrians or cyclists. Scientists have shown that people are so good at selecting what to attend to that they can experience **inattentional blindness**. In other words, a driver can be unaware of something they are looking directly at, simply because their attention is on their phone.

The FAD is advocating a very strict position on cell phones, one that they know will meet a lot of resistance. Read on to see what kinds of evidence they cite to support their argument.

Scientific Literacy Challenge

At the end of each chapter, students can practice applying scientific and critical thinking to an important, contemporary issue such as free-range parenting, cognitive enhancement drugs, college admissions testing, and brain training websites. Students are asked to read author created blog entries, editorials, or advertisements about these topics and evaluate them from a scientific literacy perspective through journal prompts and multiple-choice, matching, and true/false questions.

Application

Why is this relevant?

Psychology is a highly relevant, modern science. To be scientifically literate, students should relate psychological concepts to their own lives, making decisions based on knowledge, sound methodology, and skilled interpretation of information.

For Instructors

SCIENTIFIC LITERACY is a key course goal for many introductory psychology instructors.

Learning science is an active process. How do we help instructors model scientific literacy in the classroom and online in a way that meets the needs of today's students?

Organization

Instructors consistently tell us one of the main challenges they face when teaching the introductory psychology course is organizing engaging, current, and relevant materials to span the breadth of content covered. How do we help organize and access valuable course materials?

Revel

Reading has been the cornerstone of education since the advent of the printing press. Yet despite our world becoming ever more technologically interconnected, the ways in which learners and educators interact with the written word have remained largely static. With REVEL from Pearson, a new learning experience can begin. Through our interactions with customers around etexts, videos, and powerful reporting tools, we arrived at REVEL—an immersive learning experience that enlivens familiar and respected course content with media interactives and assessments. Designed for the way today's students read, think, and learn, REVEL empowers educators to increase engagement in the course, to better connect with students, and to break through to learning reimagined.

Writing Space

Better writers make great learners—who perform better in their courses. To help you develop and assess concept mastery and critical thinking through writing, we created Writing Space.

It's a single place to create, track, and grade writing assignments, provide writing resources, and exchange meaningful, personalized feedback with students, quickly and easily, including auto-scoring for practice writing prompts. Plus, Writing Space has integrated access to Turnitin, the global leader in plagiarism prevention.

Learning Catalytics

Learning Catalytics is a "bring your own device" student engagement, assessment, and classroom intelligence system. It allows instructors to engage students in class with real-time diagnostics. Students can use any modern, web-enabled device (smartphone, tablet, or laptop) to access it.

Instructor's Manual

The Instructor's Manual (ISBN 0134403045) includes suggestions for preparing for the course, sample syllabi, and current trends and strategies for successful teaching. Each chapter offers integrated teaching outlines, lists the key terms for each chapter for quick reference, and provides an extensive bank of lecture launchers, handouts, and activities, as well as suggestions for integrating third-party videos and web resources. The electronic format features click-and-view hotlinks that allow instructors to quickly review or print any resource from a particular chapter. This resource saves prep work and helps maximize classroom time. Chapter and module quiz answers can also be found in the Instructor's Manual.

Standard Lecture PowerPoint Slides (ISBN 0134377850) are available online at http://www.pearsonhighered.com/irc, with a more traditional format with excerpts of the text material, photos, and artwork.

Create a Custom Text

For courses with enrollments of at least 25 students, instructors can create their own textbook by combining chapters from best-selling Pearson textbooks or reading selections in a customized sequence. To begin building a custom text, visit www.pearsoncustomlibrary.com.

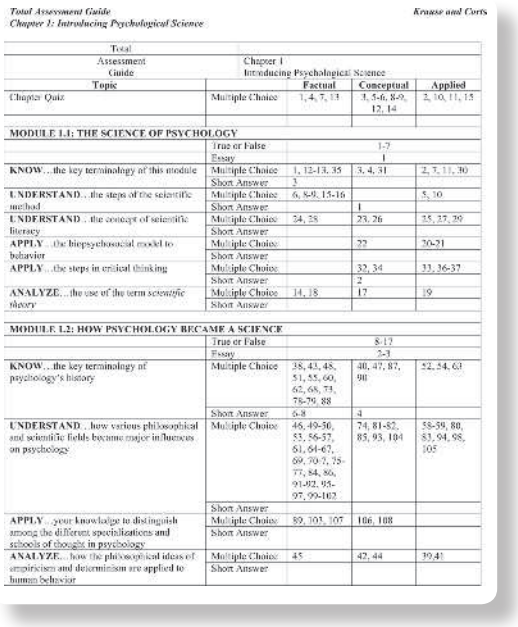
Instructors can also work with a dedicated Pearson Custom editor to create the ideal text—publishing original content or mixing and matching Pearson content. Contact a Pearson publisher's representative to get started.

ASSESSMENT

Instructors consistently tell us that assessing student progress is a critical component to their course and one of the most time-consuming tasks. Vetted, good-quality, easy-to-use assessment tools are essential. We have been listening and we have responded by creating the absolutely best assessment content available on the market today.

Test Bank

The Test Bank (ISBN 0134377842) contains more than 3,000 questions, many of which were class-tested in multiple classes at both 2-year and 4-year institutions across the country prior to publication. Item analysis is provided for all class-tested items. All questions have been thoroughly reviewed and analyzed line-by-line by a development editor and a copy editor to ensure clarity, accuracy, and delivery of the highest-quality assessment tool. All conceptual and applied multiple-choice questions include rationales for each correct answer and the key distracter. The item analysis helps instructors create balanced tests, while the rationales serve both as an added guarantee of quality and as a time-saver when students challenge the keyed answer for a specific item. The Test Bank includes a two-page Total Assessment Guide, an easy-to-reference grid that organizes all test items by learning objective and question type.



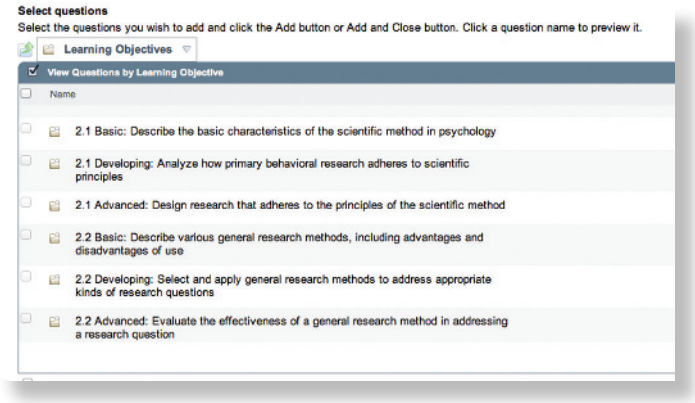
Total Assessment Guide — *Krause and Corts*
Chapter 1: Introducing Psychological Science

Total Assessment Guide	Chapter 1 Introducing Psychological Science			
Topic		**Factual**	**Conceptual**	**Applied**
Chapter Quiz	Multiple Choice	1, 4, 7, 13	3, 5-6, 8-9, 12, 14	2, 10, 11, 15
MODULE 1.1: THE SCIENCE OF PSYCHOLOGY				
	True or False	1-7		
	Essay	1		
KNOW…the key terminology of this module	Multiple Choice	1, 12-13, 35	3, 4, 31	2, 7, 11, 30
	Short Answer	3		
UNDERSTAND…the steps of the scientific method	Multiple Choice	6, 8-9, 15-16		5, 10
	Short Answer		1	
UNDERSTAND…the concept of scientific literacy	Multiple Choice	24, 28	23, 26	25, 27, 29
	Short Answer			
APPLY…the biopsychosocial model to behavior	Multiple Choice		22	20-21
	Short Answer			
APPLY…the steps in critical thinking	Multiple Choice		32, 34	33, 36-37
	Short Answer		2	
ANALYZE…the use of the term *scientific theory*	Multiple Choice	14, 18	17	19
	Short Answer			
MODULE 1.2: HOW PSYCHOLOGY BECAME A SCIENCE				
	True or False		8-12	
	Essay		2-3	
KNOW…the key terminology of psychology's history	Multiple Choice	38, 43, 48, 51, 55, 60, 62, 68, 74, 75-79, 88	40, 47, 87, 90	52, 54, 63
	Short Answer	6-8	4	
UNDERSTAND…how various philosophical and scientific fields became major influences on psychology	Multiple Choice	46, 49-50, 53, 56-57, 61, 64-67, 69, 70-7, 75-77, 84, 86, 91-92, 95-97, 99-102	74, 81-82, 85, 93, 104	58-59, 80, 83, 94, 98, 105
	Short Answer			
APPLY…your knowledge to distinguish among the different specializations and schools of thought in psychology	Multiple Choice	89, 103, 107	106, 108	
	Short Answer			
ANALYZE…how the philosophical ideas of empiricism and determinism are applied to human behavior	Multiple Choice	45	42, 44	39,41
	Short Answer			

In addition to this high-quality Test Bank, a second bank containing more than 2,000 questions is available for instructors looking for more variation. It has also been class-tested, with item analysis available for each question.

The Test Bank also comes with Pearson MyTest, a powerful assessment generation program that helps instructors easily create and print quizzes and exams. Questions and tests can be authored online, providing instructors with the ultimate in flexibility and the ability to efficiently manage assessments wherever and whenever they want. Instructors can easily access existing questions and then edit, create, and store them using simple drag-and-drop and Word-like controls. The data for each question identifies its difficulty level and the text page number where the relevant content appears. In addition, each question maps to the text's major section and Learning Objective. For more information, go to www.PearsonMyTest.com.

BlackBoard Test Item File and WebCT Test Item File: For instructors who need only the test item file for their learning management system, we offer the complete test item file in BlackBoard and WebCT format. Go to the Instructor's Resource Center at **http://www.pearsonhighered.com/irc.**



APA Assessments

A unique bank of assessment items allows instructors to assess student progress against the American Psychological Association's Learning Goals and Outcomes. These assessments have been keyed to the APA's latest progressive Learning Outcomes (basic, developing, advanced).

For access to all instructor supplements for *Psychological Science: Modeling Scientific Literacy,* go to www.pearsonhighered.com/irc and follow the directions to register (or log in if you already have a Pearson user name and password). Once you have registered and your status as an instructor is verified, you will be emailed a log-in name and password. Use your log-in name and password to access the catalog. Click on the "online catalog" link, click on "psychology" and then "introductory psychology," and finally select the Krause/Corts, *Psychological Science* text. Under the description of each supplement is a link that allows you to download and save the supplement to your desktop.

You can also request hard copies of the supplements through your Pearson sales representative. If you do not know your sales representative, go to www.pearsonhighered.com/replocator and follow the directions to identify him or her.

For technical support for any of your Pearson products, you and your students can contact http://247.pearsoned.com.

Development Story

Psychological Science reflects the countless hours and extraordinary efforts of a team of authors, editors, and reviewers that shared a vision for not only a unique introductory psychology textbook, but also the most comprehensive and integrated supplements program on the market. Over 300 manuscript reviewers provided invaluable feedback for making the text as accessible and relevant to students as possible. Each chapter was also reviewed by a panel of subject matter experts to ensure accuracy and currency. Over 200 focus group participants helped guide every aspect of the program, from content coverage to the art style and design, to the configuration of the supplements. Over 200 students class tested the full manuscript and Test Bank to ensure the best content possible and over 500 students compared the manuscript to their current textbooks and provided suggestions for improving the prose and design. We thank everyone who participated in ways great and small, and hope that you are as pleased with the finished product as we are!

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Chapter 1
Introducing Psychological Science

1.1 The Science of Psychology

- The Scientific Method
- Building Scientific Literacy

  Working the Scientific Literacy Model: How We Learn and Remember
- Critical Thinking, Curiosity, and a Dose of Healthy Skepticism
- Module 1.1 Summary
- Module 1.1 Quiz

1.2 How Psychology Became a Science

- Psychology's Philosophical and Scientific Origins
- The Beginnings of Contemporary Psychology
- Module 1.2 Summary
- Module 1.2 Quiz

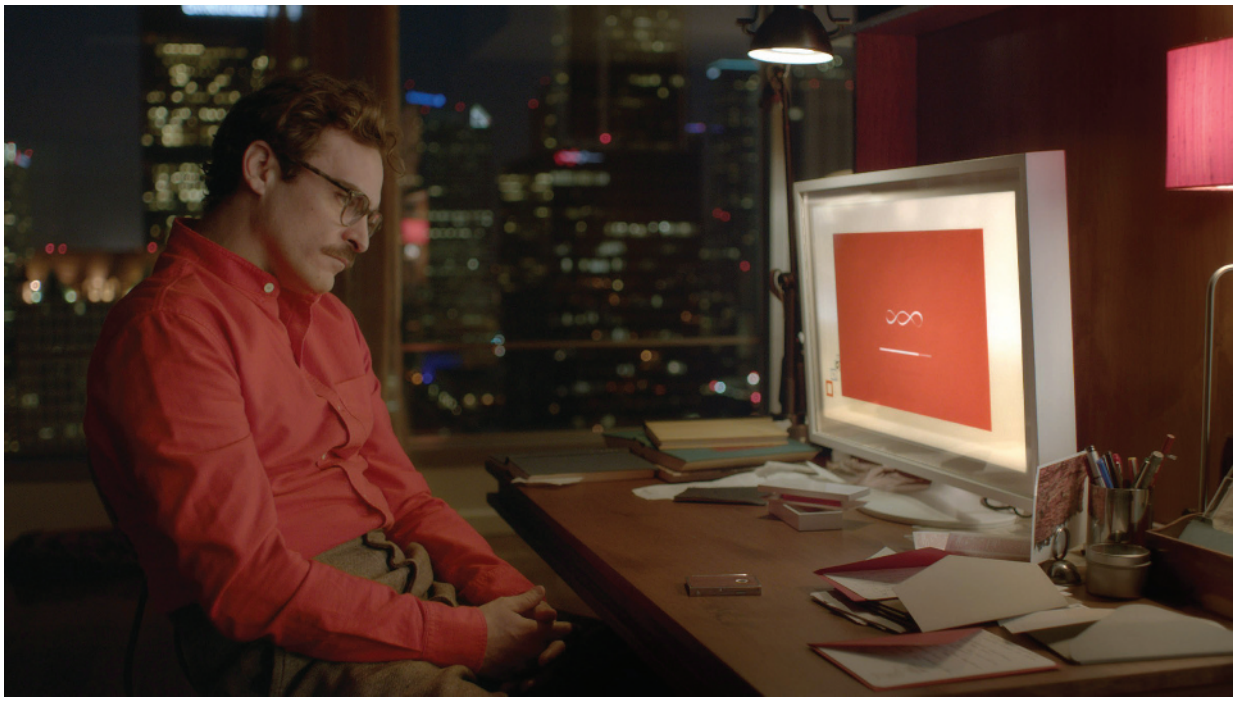
1.3 Putting Psychology to Work: Careers in Psychology and Related Fields

- Professions in Psychology
- Module 1.3 Summary
- Module 1.3 Quiz

1.4 Scientific Literacy Challenge: Imagery in Sports

Chapter 1 Quiz

Module 1.1 The Science of Psychology



Learning Objectives

1.1a Know . . . the key terminology of the scientific method.

1.1b Understand . . . the steps of the scientific method.

1.1c Understand . . . the concept of scientific literacy.

1.1d Apply . . . the biopsychosocial model to behavior.

1.1e Apply . . . the steps in critical thinking.

1.1f Analyze . . . the use of the term *scientific theory*.

Her *(2013) is not your typical love story. Theodore (played by Joaquin Phoenix) falls in love with Samantha (Scarlett Johansson). They are perfect for each other, it would seem. But here is the conflict: Samantha is not a person; she is an artificial intelligence software designed to behave less like a machine and more like a living, breathing human being. Although the plot of* Her *is based on science fiction, encountering a "being" like Samantha may be closer to reality than you think. Ellie, for instance, is a computer-generated avatar developed by scientists at the University of Southern California. Ellie is designed to carry on conversations with you—sometimes seemingly meaningful ones. By detecting subtle changes in your facial expressions, speech patterns, and posture, Ellie is able to respond with vocal changes and gestures as a caring human would. If you feel a bit down, you will find that Ellie's expression may change as she listens; her voice may soften and she may even mention that you seem a bit upset. Many who have spoken with Ellie have been surprised that a technology comprising a series of algorithms can seem so empathetic.*

So what do these virtual women have to do with your psychology course? The nonfictional Ellie demonstrates how scientific inquiry can reveal some pretty reliable facts about how people think, feel, and behave. Her fictional counterpart Samantha entertains by showing us how fascinating these thoughts and feelings can be. We hope you will learn both in this chapter.

Psychology is a vast discipline; in fact, we might do better to consider it to be a collection of disciplines, composed of many overlapping fields of study. Two unifying qualities allow us to group all these fields into the single category of *psychological science*. First, psychology involves the study of behavior that, broadly defined, can include perceptions, thoughts, and emotions. Second, psychologists employ the *scientific method* in their work. On these grounds, we can define **psychology** *as the scientific study of behavior, thought, and experience*.

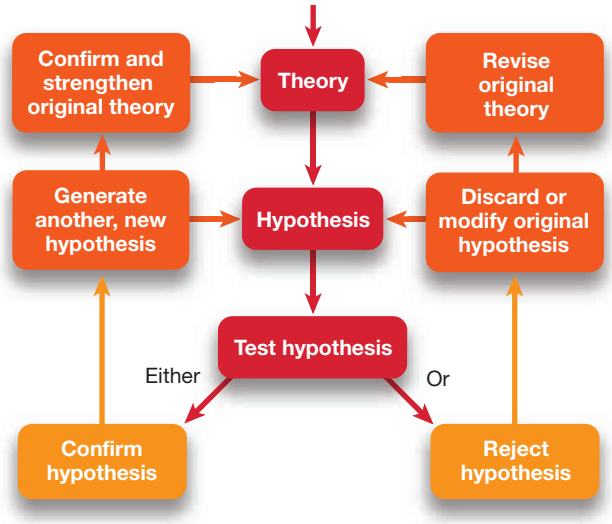
The Scientific Method

What exactly does it mean to be a scientist? A person who haphazardly combines chemicals in test tubes may look like a chemist; a person who dissects a frog just to see its organs may appear to be a biologist—but neither is engaged in science. For a specific type of activity to be considered *scientific* or a field of study to be considered a *science*, application of the scientific method is a must. The **scientific method** *is a way of learning about the world through collecting observations, proposing explanations for the observations, developing theories to explain them, and using the theories to make predictions about future occurrences or behaviors*. It revolves around the concepts of hypothesis and theory and how they interact to produce a discipline-based body of knowledge (see Figure 1.1).

HYPOTHESES: MAKING PREDICTIONS A **hypothesis** (plural: hypotheses) *is a testable prediction about processes that can be observed and measured*. By *testable*, we mean that observations and measurements can be shown whether the prediction was correct or, equally important, whether it

Figure 1.1 The Scientific Method

Scientists use theories to generate hypotheses. Once tested, hypotheses are either confirmed or rejected. Confirmed hypotheses lead to new ones and strengthen theories. Rejected hypotheses are revised and tested again, and can potentially alter an existing theory.



"All swans are white" is a falsifiable statement. A swan that is not colored white will falsify it. Falsification is a critical component of scientific hypotheses and theories.

was false—a quality known as *falsifiability*. People claiming to be scientific regularly ignore falsifiability. Imagine a horoscope reads, "It's time for you to keep quiet and postpone important calls or e-mails." That is not really a testable prediction for a number of reasons, including the fact that it does not describe a specific consequence or a time frame in which a problem might arise. Therefore, if you did make that important call, it would be impossible to show the prediction was false. In contrast, a good scientific hypothesis is stated in more precise, and publicly relevant, terms, such as the following:

> People become less likely to help a stranger if there are others around.
>
> Cigarette smoking causes cancer.
>
> Exercise relieves depression.

Unlike the astrologer's prediction, each of these hypotheses can be supported or rejected through scientific testing. Astrology is an easy target for criticism. We bring it up only because it provides an opportunity to clarify what a scientific hypothesis is and also to highlight a key difference between science and **pseudoscience**, *which refers to ideas that are presented as science but do not actually use basic principles of scientific thinking or procedure*. Alarmingly, approximately one in four Americans believes astrology has at least some scientific basis despite a total lack of evidence or support from trained scientists (National Science Foundation, 2010).

EXPLAINING PHENOMENA Hypotheses are essential to creating and refining scientific theories. A **theory** *is a well-tested explanation that combines a range of observations into a coherent whole*. Figure 1.1 shows how hypothesis testing eventually leads back to the theory from which it was based. Theories are built from hypotheses that are repeatedly tested and confirmed; in turn, good theories eventually become accepted explanations of behavior

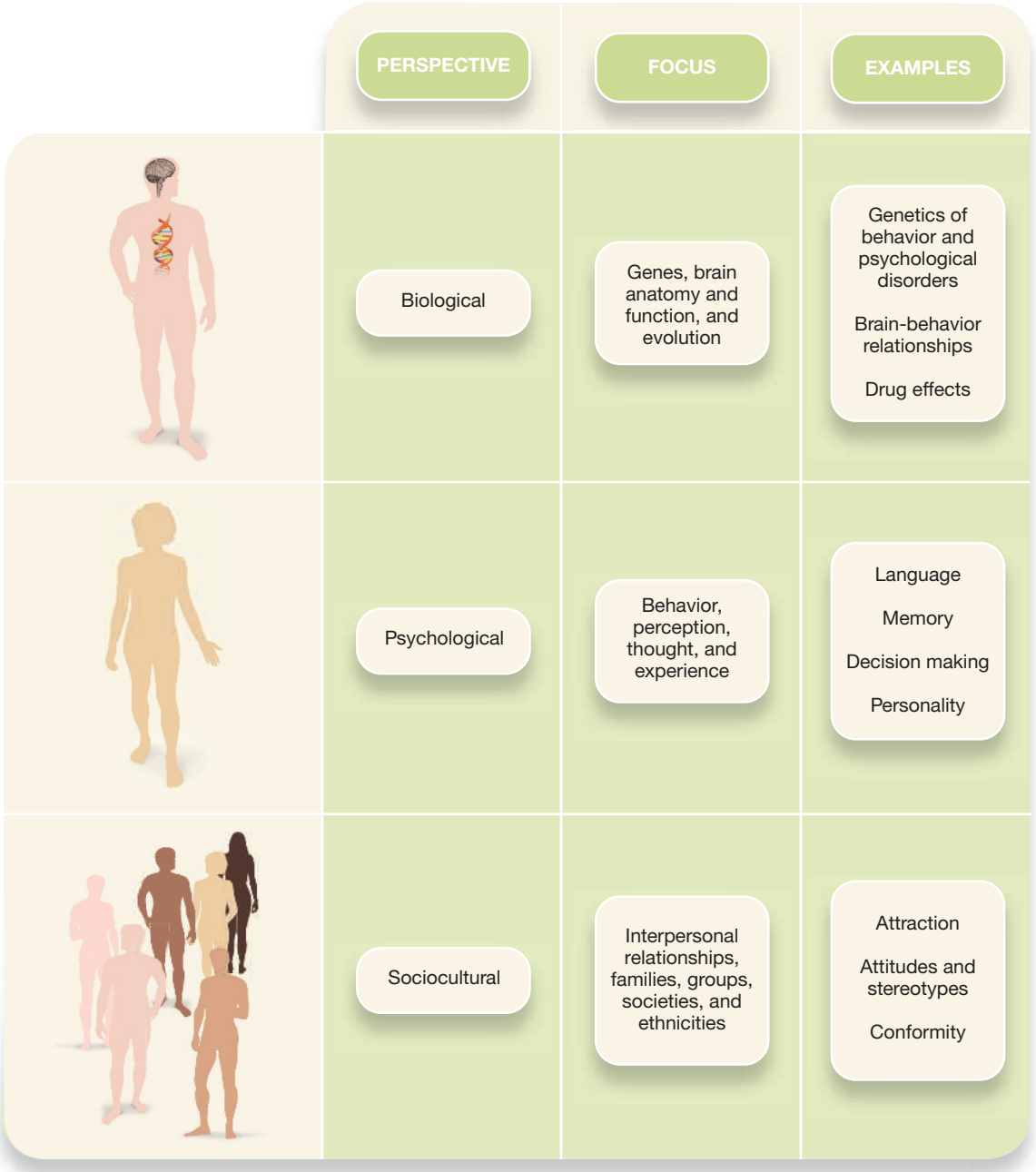
or other natural phenomena. Similar to hypotheses, an essential quality of scientific theories is that they are *falsifiable*; like hypotheses, they can be proved false with new evidence. As Figure 1.1 shows, falsifying a theory means that it either needs to be modified to account for new findings, or in some cases, replaced by an entirely new theory. In this way, science becomes self-correcting; bad ideas typically do not last long before being discovered and replaced.

The scientific term *theory* is specific and essential to understanding how explanations differ from common sense. Make sure that as you read this text you keep in mind *scientific* theory, rather than these common misusages:

- **Theories are not the same thing as opinions or beliefs.** Yes, it is certainly true that everyone is entitled to his or her own opinions. But the phrase "That's just your theory" is neither the scientific meaning of "theory," nor a valid scientific argument.
- **All theories are not equally plausible.** Groups of scientists might adopt different theories for explaining the same phenomenon. For example, several

Figure 1.2 The Biopsychosocial Model

Psychologists view behavior from multiple perspectives. A full understanding of human behavior comes from analyzing biological, psychological, social, and cultural factors.



theories have been proposed to explain why people become depressed. This does not mean that all are equally valid. There are good theories, and there are not-so-good theories; the good ones generate successful hypotheses as shown in Figure 1.1.

- **The quality of a theory is not evaluated by the number of people who believe it to be true.** According to a 2013 Pew Research Center Survey, only one third of Americans believe in the theory of evolution by natural selection, despite the fact that it is the most plausible, rigorously tested theory of biological change and diversity.

Testing hypotheses and constructing theories are both part of all sciences. In addition, each science, including psychology, has its own unique way of approaching its subject matter. As the study of behavior, thought, and experience, psychology examines the individual as a product of multiple influences, including biological, psychological, and social factors.

THE BIOPSYCHOSOCIAL MODEL Defining psychology as the scientific study of behavior, thought, and experience may sound pretty straightforward, but thinking and behaving are complex subjects with complex explanations. One psychologist might study a single type of cell in the nervous system, whereas another might examine the cultural customs and beliefs that shape daily life for millions of people—all this to explain the same overarching question: Why do we behave the way we do?

Because our thoughts and behaviors have multiple influences, psychologists adopt multiple perspectives to understand them. The **biopsychosocial model** *is a means of explaining behavior as a product of biological, psychological, and sociocultural factors* (see Figure 1.2). Biological influences on our behavior include brain structures, hormones, and drug effects. On the other end of the spectrum, your family, peers, and immediate social situation also determine how you think, feel, and behave, as do beliefs about social characterisitcs such as ethnicity, gender, or socioeconomic status. These influences constitute the sociocultural part of the model. In between biology and culture, we can examine how a person's thoughts, experiences, emotions, and personality constitute his or her psychological makeup.

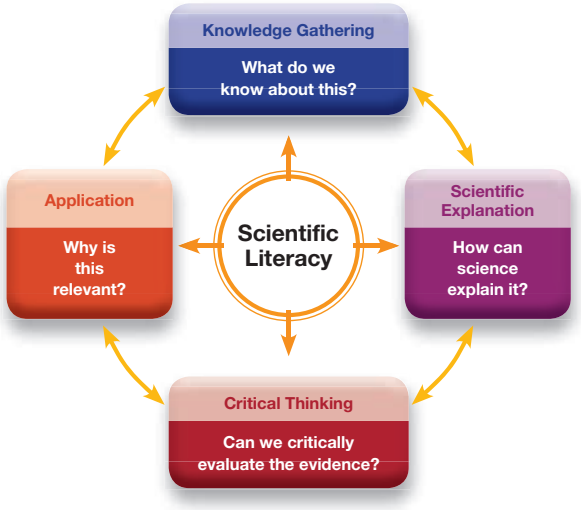
The biopsychosocial model is a reminder that behavior can be fully explained only if multiple perspectives are incorporated.

Building Scientific Literacy

A major aim of this text is to help students develop **scientific literacy**, *which is the ability to understand, analyze, and apply scientific information.* Our focal topic is psychology, but these same skills are applicable to other scientific fields. As shown in Figure 1.3, our model of scientific literacy reveals several key components, starting with the ability to learn new information, new terminology, and concepts. However, knowledge of terminology alone does not make one scientifically literate; one must also be able to provide explanations that incorporate the scientific terms and concepts of the discipline one is studying (in this case, psychology). Being scientifically literate means being able to read and interpret new terminology, and knowing when and where to go to find out more. It also means being able to apply this ability to real-world situations and to use one's critical thinking skills to evaluate information and claims.

Figure 1.3 A Model of Scientific Literacy

Scientific literacy involves four different skills: gathering knowledge about the world, explaining it using scientific terms and concepts, thinking critically, and applying this knowledge to relevant, real-world situations.



Working the Scientific Literacy Model

How We Learn and Remember

To give you a chance to develop scientific literacy skills, we will revisit this model regularly and apply its four components to a specific psychological topic—a process we call *working the model*. We can demonstrate this process with a topic that is familiar to many: using flashcards to study vocabulary terms.

What do we know about studying with flashcards?

Many college courses require that you learn key-term definitions and factual information such as dates, and students often study with flashcards to master this information.

Most students prefer what is called *massing*—they break up a large pile of cards into smaller groups and move through each mass of cards separately. Another approach is *spacing*—leaving the cards in one big stack and moving through them one at a time. In contrast to massing, spacing means more time passes between each card and more new terms are introduced before any specific card repeats itself. The larger the deck, the more spacing there is before returning to the first card. Most students prefer the massing technique because it seems to allow them to master words more quickly. However, science shows that the two are not equally effective, and that spacing is generally the better of the two.

How can science explain this difference?

To find out which study method works best, psychologist Nate Kornell (2009) conducted an experiment in which 20 student volunteers agreed to study according to his instructions. Students studied one list of words with massing (four sets of five cards each) and another list with spacing (one set of 20 words). As shown in Figure 1.4, the volunteers studied each word four times, regardless of study method. At the end of the study period, Kornell administered a memory test and discovered that the volunteers could remember more words from the spaced condition than the massed condition. Interestingly, almost all students still preferred massing.

Can we critically evaluate this conclusion?

There is no such thing as a perfect study; no single experiment will fully answer scientific questions about studying with flashcards or any other topic. Although it is the researcher's job to conduct the best studies possible, it is up to you, the reader, to think critically about them. We provide advice on critical thinking later in this chapter, and once you read Chapter 2, you will be better prepared to assess the quality of the research. For now, start by asking yourself questions about the outcome: Why do students prefer the less effective method? You should think about ways in which this may or may not apply to other situations: Does spacing work better for other types of studying, like learning to solve math problems? You should notice that being critical means asking for limitations and shortcomings without being overly emotional or hostile. This prevents us from wholeheartedly accepting faulty claims, but we should not hastily dismiss any single study either. Instead, we give time for researchers to build evidence with additional studies.

How is this finding relevant?

Ideally, you will be inspired to apply the findings from Kornell's experiment to your own experiences as a student—whether studying for your psychology or other courses. But to really make use of spacing, you might have to convince yourself to trust the data, especially if you are like the students in Kornell's study and find yourself preferring the massing technique, despite the evidence that more strongly supports the efficacy of spacing!

Keep in mind there is still much to learn about "working the model": The next section focuses on critical thinking skills and how to use them; Chapter 2 walks you through the specific methods for conducting and evaluating scientific research. You will get a chance to "work" the scientific literacy model again in Chapter 2, and then again in the remaining chapters.

Critical Thinking, Curiosity, and a Dose of Healthy Skepticism

On page 5, as shown in the scientific literacy model, critical thinking is an important element of scientific literacy. **Critical thinking** *involves intentionally analyzing and evaluating beliefs, claims, or judgments*. Psychologists often do this by assessing research in terms of how it relates to theory and how well it follows scientific principles.

Figure 1.4 Massed Versus Spaced Practice

In both conditions of Kornell's experiment, volunteers studied each vocabulary word four times. In the massed condition, shown at left, the individual cards were studied closer together whereas in the spaced condition, at right, they were studied further apart. Spaced learning results in better memory for vocabulary terms.

You have a total of 20 terms to learn.

Massing: Studying a deck of five cards four times in a row. This masses study for an individual card, such as card A in the drawing above.

You have a total of 20 terms to learn.

Spacing: Leaving all 20 cards in one stack and studying the whole deck four times in a row. This spaces the studying for each card, such as card A in the drawing above. However, in both conditions, card A will be studied the same number of times (four).

As such, critical thinking is something you develop and practice rather than something with which you are born (Halpern, 1996).

In addition to analytical and evaluative skills, critical thinking requires a certain set of attitudes or dispositions, namely curiosity, skepticism, and self-reflection. As psychologists, we are always *curious*. We ask questions about all kinds of behaviors, not just the unusual or problematic, which many of us tend to do, but also about everyday activities and experiences (*How do we remember where we left our car keys?*).

We also approach matters with cautious and healthy *skepticism*. Because we are constantly being told about products that will radically improve our lives or about political positions that are supposedly in everyone's best interests, it is important to raise questions. Being skeptical can be challenging, especially when a product or campaign promise fits our assumptions of the truth or what we hope to be the truth—eventually, though, we have to challenge our own assumptions, even if it risks being proved wrong. Consider again Kornell's research on flashcards: Students overwhelmingly prefer massing, so you may assume massing works best; but if you challenge this assumption, you may actually find a technique that works better. Ultimately, curiosity and skepticism lead us to be *reflective*. In other words, they help us to reconsider what we think we know, to understand what we know, and to explore why we believe what we believe. Sometimes, the best outcome is to understand what we cannot be certain of, and to tolerate ambiguity when the evidence is inconclusive.

KEY PRACTICES TO CRITICAL THINKING Now that you have an idea of what critical thinking entails, it is time to learn the skills and put them to use. Researchers have identified six key practices of a critical thinker:

1. **Be curious.** Look for opportunities to ask questions, even when they are not obvious. Here are two ways to approach curiosity. First, rather than wait until something goes wrong to be curious (*Why did he develop depression?*), ask questions while things are going well (*How did he succeed in the face of all that hardship?*). Second, watch out for narrow-minded questions that already presume to have an answer (*Why are they all criminals?* This question assumes knowledge of "they.") Instead ask open and objective questions (*Is that group more likely to engage in crime*? *If so, why?*). Remember that most aspects of behavior are complex; there is usually no single right answer to a question, but rather a complex set of answers.
2. **Examine the evidence.** Examining the evidence is key to science and critical thinking. Bear in mind that common sense is not evidence, and in fact, it will often lead you astray. Therefore, you should look for evidence that is reliable, objective, and relevant. You will be even better equipped to do this after reading Chapter 2, which focuses on scientific processes.
3. **Examine assumptions and biases.** Assumptions and biases too quickly lead us to accept claims that support our expectations and to discount those that do not. Recall that in Kornell's flashcard experiment, the majority of his volunteers preferred massing. We have found that students in our own classes also prefer massing, and as such, they too quickly discount Kornell's rather strong evidence that spacing is better. Fortunately, this particular example does not have severe consequences. However, at their worst, biases and conflicts of interest can lead people to willfully mislead others, sometimes even with fabricated data and claims that they know are not true.
4. **Avoid overly emotional thinking.** Emotions can tell us what we value, but they do not always help us make critical decisions. By all means, emotions should guide decisions about a relationship, career, and so on. However, emotions can lead to some wrong answers, which, at their worst, can have grave consequences. For example, many young parents have opted not to vaccinate their children out of a fear that vaccines may lead to autism. This emotional decision ignores the fact that there is no credible scientific evidence for this threat, and in fact, the most influential medical study to support a purported vaccine–autism link was eventually exposed as a fraud and retracted by the research journal that published it (Godlee, Smith, & Marcovitch, 2011). Critical thinkers acknowledge their emotions, but they carefully discern the situations when emotional-based decisions may not be appropriate.
5. **Tolerate ambiguity.** Most complex issues do not have clear-cut answers, but they do have lots of *ifs, buts*, and *it depends*. For example, for many years the medical community advised the public to avoid eating fats based on the evidence that fats were associated with weight gain and heart disease. However, the same scientific community now encourages us to include certain fats, such as those that come from olive oil or avocados. Although this change seems contradictory, ongoing research will sometimes lead to changes in prior beliefs. This case is just one among many where the apparent contradiction includes an "if." In other words, fats are viewed more favorably, but only *if* they are rich in substances such as omega-3 acids.
6. **Consider alternative viewpoints.** Finally, make sure you are open to alternative viewpoints. This does not mean that everyone's opinion is equally correct, but you can often learn from the perspective of others. You may even discover that emotions, assumptions, and biases have been affecting your own thinking without your awareness, or that others have better evidence than you do!

Table 1.1 Critical Thinking

Practice applying critical thinking skills to the scenario:
Magic Mileage is a high-tech fuel additive that actually increases the distance you can drive for every gallon by 20%, although costing only a fraction of the gasoline itself!! Wouldn't you like to cut your fuel expenses by one-fifth? Magic Mileage is a blend of complex engine-cleaning agents and patented "octane-booster" that not only packs in extra miles per gallon but also leaves your engine cleaner and running smooth while reducing emissions!
1. How might this appeal lead to overly emotional thinking? 2. Can you identify assumptions or biases the manufacturer might have? 3. Do you have enough evidence to make a judgment about this product?

These six practices will help you to develop critical thinking habits and skills. To further hone these habits and skills, also consider what does *not* constitute critical thinking. Critical thinking is neither a belief nor a faith, nor is it meant to make everyone arrive at the same answer. In fact, complex issues often remain ambiguous, and a plausible answer may not always be possible. Although critical thinking means respecting others' viewpoints, the nature of the scientific method may lead you to discover that some of those ideas are incorrect. Critical thinking does not mean being negatively or arbitrarily critical; it means intentionally examining knowledge and beliefs, as well as how conclusions about them are obtained. It also means carefully examining the sources of information. You can practice applying critical thinking to the scenario in Table 1.1.

JOURNAL PROMPT

Critical Thinking: What is a common belief people tend to have in which critical thinking is especially lacking? Describe the belief and explain why you think people hold it.

CRITICAL THINKING ABOUT SOURCES Not all sources of information are equal and trustworthy. Therefore, it is important that you pay especial attention to the sources' purpose, openness, accuracy, and comprehensiveness *before*, *during*, and *after* you read or research information.

- **Purpose:** Make sure you can identify the purpose of the article you are reading. Obviously, this will help you establish whether it is relevant to your needs, but it will also help with other elements of critical thinking, such as determining bias. For example, imagine you are interested in dining out at a new restaurant. If you are counting your calories (*purpose*), you will likely examine fact-based data about the calorie value of each entree (*source*), but if you are wondering whether you will enjoy the food (*purpose*), you will more likely rely on opinion-based reviews (*source*). You would not read a rave review to find out the calorie value of the entrees because, chances are, the information you find will be biased, inaccurate, or irrelevant. There are parallels to this example in all sorts of domains, from buying a new car to deciding how to be a better parent. When considering the relationship between purpose and source, ask yourself:
  - Is this an opinion piece (e.g., an editorial or a campaign statement)?
  - Is this a straightforward report of facts (news) or description (e.g., encyclopedia entry)?
  - Is this an advertisement?
- **Bias and Openness:** Determine whether the source has a social or political agenda, or perhaps financial motives for presenting information in a certain way. For example, if you have encountered a YouTube video highlighting the terrible conditions endured by factory-raised pigs. You watch pigs being kicked, shoved into tiny pens, or denied fresh water. You would not be surprised to discover that an animal rights group produced it, but you would probably be shocked if it were created by an association of hog farmers. It is no surprise that groups with specific agendas and interests will produce media that suit their needs rather than present and assess all sides to the story. Knowing this, you should always ask yourself:
  - Who are the publishers, advertisers, and other supporters of this source? What do these groups stand to gain when the source presents the information?
  - Are multiple opinions or options represented, or should they be?
  - What is being left out?
  - Does the source appear thoughtful, or is there extensive use of exaggeration, sweeping generalizations, or emotional language?
- **Accuracy and credibility:** Responsibly written articles present accurate and precise information that can be traced back to credible sources. Imagine you encounter an article warning people of the dangers of marijuana on memory and reasoning skills, but you notice that the author has no background in drug research and only cites anecdotes rather than scientific evidence. You would be wise to disregard that article and instead look for a source written by someone with an appropriate background and provides verifiable data to support the opinions. When considering the accuracy and credibility of a source, ask yourself:
  - Are the authors listed?
  - Are claims supported with citations, footnotes, or references?
  - Is it up to date?
  - Do multiple sources agree? (Make sure they are not citing the same original source or sponsored by the same ads or organizations.)
  - If someone is cited as an authority, are they still providing sound evidence? Are they speaking within their realm of expertise?

Myths in Mind

Abducted by Aliens!

Independent reports of alien abductions often resemble events and characters depicted in science fiction movies.

Occasionally we hear claims of alien abductions, ghost sightings, and other paranormal activity. Countless television shows and movies, both fictional and documentary, reinforce the idea that these events can and do occur. Alien abductions are often the most complicated and far-fetched stories, yet many people can provide extremely detailed accounts of being kidnapped and examined. So what should we believe about alien abductions?

Scientific and critical thinking involves the use of the *principle of parsimony*, which means that the simplest of all competing explanations (the most "parsimonious") of a phenomenon should be the one we accept. Is there a simpler explanation for alien abductions? Probably so. First, historical reports of abductions typically spike just after the release of science fiction movies featuring space aliens. Details of the reports often follow specific details seen in these movies (Clancy, 2005). Second, people who claim to have been abducted are likely to experience *sleep paralysis* (waking up and becoming aware of being unable to move—a temporary state that is not unusual) and hallucinations while in the paralyzed state (McNally et al., 2004). Finally, people who report being abducted tend to fantasize more than the average person and they also have more *false memories* (vivid and convincing memories about events that did not happen; Lynn & Kirsch, 1996). Taken together, these lines of research lead to a plausible explanation: abductions could be false memories incorporating elements of media with the experience of sleep paralysis; all of these events are easily observable. In contrast, finding physical evidence of aliens is not. Following the principle of parsimony typically leads to real, though sometimes less spectacular, answers.

Module 1.1 Summary

1.1a Know . . . the key terminology of the scientific method:

biopsychosocial model
critical thinking
hypothesis
pseudoscience
psychology
scientific literacy
scientific method
theory

1.1b Understand . . . the steps of the scientific method.

The basic model in Figure 1.1 guides us through the steps of the scientific method. Scientific theories generate hypotheses, which are specific and testable predictions. If a hypothesis is confirmed, new hypotheses may stem from it, and the original theory receives added support. If a hypothesis is rejected, the original hypothesis may be modified and retested, or the original theory may be modified or rejected.

1.1c Understand . . . the concept of scientific literacy.

Scientific literacy refers to the process of how we think about and understand scientific information. The model for scientific literacy was summarized in Figure 1.2. Working the model involves answering a set of questions:

- What do we know about a phenomenon?
- How can science explain it?
- Can we critically evaluate the evidence?
- Why is this relevant?

You will see this model applied to concepts in each chapter and module of this text. This includes gathering knowledge, explaining phenomena in scientific terms, engaging in critical thinking, and knowing how to apply and use your knowledge.

1.1d Apply . . . the biopsychosocial model to behavior.

This is a model we will use throughout the text. As you consider each topic, think about how biological factors (e.g., the brain and genetics) are influential. Also consider how