PARTNERSHIP BETWEEN

INSIDE
CHAPTER 4
CONSCIOUSNESS

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PSYCHOLOGY

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A PARTNERSHIP BETWEEN

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In this breakthrough introduction to psychology, two committed, tech-savvy professors, Deborah Licht and Misty Hull, combine years of research and teaching insights with the journalistic skill of a *Scientific American* writer, Coco Ballantyne. Together, they have created a text and ancillary program that draws on written profiles and video interviews of 27 real people to help students better understand, remember, and relate to psychology’s basic ideas.

Beautifully designed, the printed text is filled with high-interest examples and features, including full-page infographics that help students understand and retain key concepts. Online, additional author-created resources, including scaffolded activities and adaptive quizzes, provide a seamless learning experience for students and a reliable assessment mechanism for instructors and programs.

This innovative collaboration between Worth Publishers and *Scientific American* reflects a commitment to engaging all students, including those who sometimes seem difficult to engage—via the contemporary style of the world’s most respected science magazine.
ACROSS THE WORLD highlights fascinating research on behavior variation across cultures.

NATURE AND NURTURE looks at twin studies, genetic research, and heritability studies to give students a sense of how heredity and environment shape human behavior.

DIDN’T SEE THAT COMING details unexpected, high-interest, and newsworthy developments related to the chapter’s theme.

CONTROVERSIES examines debates over contemporary research and issues in the psychology community.

THINK AGAIN helps students improve their critical thinking by digging deeper into key concepts or deconstructing popular psychological myths.
## CONTENTS

### CHAPTER 1
**INTRODUCTION AND RESEARCH METHODS**
Demonstrates how psychology was intensely relevant to the 33 Chilean miners who spent over two months trapped underground.

### CHAPTER 2
**BIOLOGY AND BEHAVIOR**
Interweaves psychological concepts with the stories of Iraq War veteran Brandon Burns, who experienced a miraculous recovery from a brain injury, and Christina Santhouse, a young woman who has thrived in school, work, and life in general—after having an operation to remove nearly half her brain.

### CHAPTER 3
**SENSATION AND PERCEPTION**
Tells the story of Elizabeth Allen, a mother raising deaf and blind triplets.

### CHAPTER 4
**CONSCIOUSNESS**
Offers a peek into the life of anesthesiologist Dr. Robert Julien, and explores the experiences of Matt Utesch, a young man with narcolepsy.

### CHAPTER 5
**LEARNING**
Illustrates learning principles using basketball pro Jeremy Lin and blind marathon runner/triathlete Ivonne Mosquera.

### CHAPTER 6
**MEMORY**
Tells the poignant tale of the amnesiac Clive Wearing and follows Dorothea Seitz, a memory expert, to the World Memory Championships.

### CHAPTER 7
**COGNITION, LANGUAGE, AND INTELLIGENCE**
Explores the cognitive breakdown of stroke survivor Jill Bolte Taylor and the reading difficulties of actor Orlando Bloom, who has dyslexia.

### CHAPTER 8
**HUMAN DEVELOPMENT**
Details the lives of two community college students—Jasmine Mitchell, a single mother juggling education and career responsibilities with childrearing, and Chloe Ojeah, a young woman who cares for her aging grandparents in between classes and homework.

### CHAPTER 9
**MOTIVATION AND EMOTION**
Relates the life experiences of Mohamed Dirie, a young man who immigrated to the United States from Somalia, and Lucy Magnum, a child who survived a shark attack.

### CHAPTER 10
**GENDER AND SEXUALITY**
Presents insights on gender and sexuality from the perspectives of Stephen Patten, a male nurse, and Dr. Stephanie Bueller, a female sex therapist.

### CHAPTER 11
**PERSONALITY**
Introduces the digital personality Tank, a robot receptionist at Carnegie Mellon University.

### CHAPTER 12
**STRESS, HEALTH, AND COPING**
Details the experiences of Eric Flansburg, a police officer, and Kehlen Kirby, an emergency medical services (EMS) provider.

### CHAPTER 13
**PSYCHOLOGICAL DISORDERS**
Tells the story of Ross Szabo, a young man with bipolar disorder, and Melissa Hopely, young woman with obsessive—compulsive disorder.

### CHAPTER 14
**PSYCHOLOGICAL THERAPIES**
Focuses on Dr. Daniel Foster, a therapist working on a Native American reservation, and Laura Lichti, a licensed therapist just beginning her career.

### CHAPTER 15
**SOCIAL PSYCHOLOGY**
Explores the life of Olympic runner Julius Achon, who adopted 11 orphans from his homeland of Uganda, and relates the story of Joe and Susanne Maggio, a married couple who found each other via the Internet.
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An Introduction to Consciousness

Mind-Altering Medicine

Sleep

Asleep at the Wheel

NATURE AND NURTURE
What Kind of Sleeper Are You?

Problem Identified

FROM THE PAGES OF SCIENTIFIC AMERICAN
More Than Just a Bad Dream

THINK AGAIN
7 Sleep Myths

Dreams

Sleep, Sleep Go Away

Altered States of Consciousness

Drugs, Drugs, Everywhere

SOCIAL MEDIA AND PSYCHOLOGY
Can’t Get Enough

CONTROVERSIES
False Claims About Hypnosis
An Introduction to Consciousness

**MIND-ALTERING MEDICINE**  Robert Julien, M.D., did not choose a typical 9-to-5 job. His profession involves paralyzing people, interfering with their memory formation, and numbing their senses—but only temporarily. Dr. Julien is an anesthesiologist, a medical doctor whose primary responsibility is to monitor a patient’s vital functions (for example, respiration and pulse) and manage pain before, during, and after surgery. With the help of powerful drugs that manipulate the nervous system, Dr. Julien has eased the pain and anxiety of over 30,000 patients undergoing procedures that otherwise would likely have been very unpleasant.

In ancient times, people may have sought pain relief by dipping their wounds in cold rivers and streams. They concocted mixtures of crushed roots, barks, herbs, fruits, and flowers to ease pain and induce sleep in surgical patients (Keys, 1945). Many of the plant chemicals discovered by these early peoples are still given to patients today, although in slightly different forms. Opium was used by the ancient Egyptians (El Ansary, Steigerwald, & Esser, 2003), and its chemical relatives are used by modern-day physicians and hospitals all over the world (for example, morphine for pain relief and codeine for cough suppression).

Credits: African American Male Nurse, Curt Pickens/Getty Images; Silhouette of people in different poses, iStock Vectors/Getty Images; Pillow without pillowcase, ©D. Hurst/Alamy; Pillow with white pillowcase, ©D. Hurst /Alamy; Drip bag on stand, against white background, ©moodboard/Alamy; Close up of eye mask, Exactostock/superstock
Nevertheless, anesthesia’s routine use during surgery did not occur for centuries. Before the mid-1800s, surgery was so painful, patients writhed and screamed on operating tables, sometimes held down by four or five people (Bynum, 2007). During the Mexican-American War, a band would play when Mexican soldiers had their limbs amputated so the men’s cries would not be heard by others (Aldrete, Marron, & Wright, 1984). The only anesthetic available may have been whiskey, wine, or a firm blow to the head, that is, patients were literally knocked out. Fortunately, the science of anesthesia has come a long way. It is now possible to have a tooth extracted or a mole removed without a twinge of discomfort. A patient undergoing open heart surgery can lie peacefully as surgeons pry open his chest and poke around with their instruments, then leave the hospital with no memory of the actual surgery. But anesthesia is a curious thing. Drugs used to ease pain and anxiety also influence sensations, perceptions, and one’s awareness of self and the environment: They can dramatically alter “conscious” experiences.
WHAT IS CONSCIOUSNESS? People usually think of consciousness as the state of being awake and unconsciousness as what happens when you are asleep, but as you will learn in this chapter, consciousness is a concept that can be difficult to pinpoint. Although some psychologists disagree about its precise definition, G. William Farthing offers a good starting point: Consciousness is “the subjective state of being currently aware of something either within oneself or outside of oneself” (1992, p. 6). Consciousness is best defined as the state of being aware of oneself, one’s thoughts, and/or the environment. According to this definition of subjective awareness, one can be asleep and still be aware (Farthing, 1992). Once a person has gone to sleep, does she lose awareness of what is occurring within and outside of herself? Not necessarily. As an example, imagine you are dreaming about a siren blaring and you wake up to discover it is your alarm clock; you were clearly asleep but aware at the same time, as the sound registered within your brain. This ability to register a sound while asleep is very important in the production of not only alarm clocks but also smoke detectors and fire alarms. Human factors researchers have conducted numerous studies to determine the types of sounds most likely to

CONNECTIONS
In Chapter 3, we considered the subfield of human factors engineering. Just as we can study sensation and perception as they relate to machines and equipment, human factors engineers must be aware of issues related to consciousness and the design of machines.
arouse a sleeping person, as well as individual differences (for example, age, gender, sleep deprivation, hearing ability, and sleep stage) that affect whether a person will register and/or wake up to a sound (Bruck & Ball, 2007). This ability to remain aware of our environment even while sleeping has served us well, allowing our ancestors to be vigilant about dangers day and night.

Consider this story: Several years ago, Dr. Julien had a patient who didn’t want to have general anesthesia during her hysterectomy, an operation to remove the uterus. Anesthesiologists typically put patients “to sleep” for hysterectomies, but Dr. Julien agreed to honor the patient’s unusual request. He gave her a drug called Versed (midazolam) to help her relax, but not enough to knock her out. (Versed belongs to a class of calming drugs called depressants, which you will learn about later.) The woman seemed to be wide awake throughout the two-and-a-half hour procedure, chatting with doctors and nurses and even requesting that certain music be played in the operating room (much to the dismay of the surgical team).

At 11:00 p.m. that night, Dr. Julien received a phone call from a nurse indicating that the patient was furious because he had used general anesthesia during the operation. Apparently, she could not remember any of the experience. The drug Dr. Julien had used to help the patient relax can also cause memory loss for events experienced while under its influence. Unable to remember the surgery, the patient logically assumed she had been given general anesthesia. “I went to the hospital at midnight to explain to the patient that I had honored her request and that she had been wide awake during the procedure but was unable to form memory proteins because the Versed had blocked their formation,” Dr. Julien explained. In other words, the Versed had interfered with the production of a protein needed for memory creation. “To this day, I’m not sure she ever accepted my explanation or forgave me for taking away any memory of the procedure” (Julien & DiCecco, 2010, p. 11).

CONSCIOUSNESS AND MEMORY Would you say Dr. Julien’s patient was conscious during the operation? If consciousness is a “subjective state of being currently aware” (Farthing, 1992, p. 6), then it would appear she was conscious during the surgery. She was alert and talking, yet her awareness of the event vanished within hours, so was she conscious after all? Let’s not confuse consciousness with memory. It appears she was conscious at the time but later had no memory of the event. As Dr. Julien explained to her, a failure occurred in the process involved in memory formation, for example, in the encoding or storage of the event (Chapter 6).

Millions of Americans suffer from memory problems similar to that experienced by Dr. Julien’s patient. They are aware, alert, and able to have meaningful conversations, yet they cannot form new memories (they may suffer from Alzheimer’s or another form of dementia; Chapter 6). What about those accused of crimes while under the influence of consciousness-altering prescription drugs? In very rare cases, people taking certain types of sleeping pills have been known to “sleep-drive” or get behind the wheel in a trance-like state of sleep (Dolder & Nelson, 2008; Southworth, Kortepeter, & Hughes, 2008; Zammit, 2009). If such a person causes a fatal accident while in this sort of state, is she to blame? Keep this question in mind as we delve the depths of consciousness in the pages to come.
Studying Consciousness

The field of psychology began with the study of consciousness. Wilhelm Wundt and his disciple Edward Titchener founded psychology as a science based on research that examined consciousness and its contents. Another early psychologist, William James, was also interested in studying consciousness. According to James, consciousness can be thought of as a “stream” that provides a sense of day-to-day continuity (James, 1890/1983). Think about how this “river” of thoughts is constantly rushing through your head. An e-mail from an old friend appears in your inbox, jogging your memory of the birthday party she threw last month, and that reminds you that tomorrow is your mother’s birthday (better not forget that one), and you need to swing by the mall after class to pick up a gift for her. You notice your shoe is untied. You think about dinner last night, school starting tomorrow, your utility bill sitting on the counter; all of these thoughts might cross your mind within a matter of seconds. Thoughts interweave and overtake each other like currents of flowing water; sometimes they are connected by topic, emotion, events, but at other times they seem to not be connected by anything other than your stream of consciousness.

Although psychology started with the very introspective study of consciousness, American psychologists John Watson, B. F. Skinner, and other behaviorists insisted that psychology as a science should only study observable behavior. This attitude persisted until the 1950s and 1960s, when psychology underwent a revolution of sorts. Researchers began to direct their focus back on the unseen mechanisms of the mind. Cognitive psychology, the scientific study of conscious experiences such as thinking, problem solving, and language, emerged as a major subfield. Today, understanding consciousness is an important goal of psychology, and many believe science can be used to further investigate the mysteries of consciousness.

Although advanced technology for studying brain processes and functions has added to our growing knowledge, there are several barriers to studying consciousness. One is that consciousness is subjective, pertaining only to the individual who experiences it. Because of this, it is impossible to objectively study another’s conscious experience (Blackmore, 2005; Farthing, 1992). To make matters more complicated, consciousness is constantly changing; there is great variety in the conscious experiences within a person from moment-to-moment. Right now you are concentrating on these words, but in a few seconds you might be thinking of something else or slip into light sleep. In spite of these challenges, researchers around the world are inching closer to understanding consciousness by studying it from many perspectives.

Wrap Your Mind Around This

How exactly do psychologists understand this concept we call “consciousness”? We must first agree on what topics are relevant to the study of consciousness. There are many elements of conscious experience, including desire, thought, language,
sensation, perception, and knowledge of self—simply stated, any cognitive process is potentially a part of your conscious experience. And memory is definitely a key player, as conscious experiences usually involve the retrieval of memories. Let’s look at what this means, for example, when you go shopping on the Internet. Your ability to navigate from page to page hinges on your ability to recognize visual images (is that the PayPal home page or my e-mail log-in?), language aptitude (for reading), and motor skills (for typing and clicking). As you scroll through a page, or click on a hyperlink, your mind might wander from what you are looking at onscreen to a variety of memories (such as which link you just clicked, the shoes you saw last week while shopping, and the homework you were supposed to be doing)—all of this is part of your consciousness, your stream of thought.

**LO 2** Explain how automatic processing relates to consciousness.

**AUTOMATIC PROCESSING** One of the important distinctions often made regarding consciousness is between cognitive activity that happens automatically (without effort, control, or awareness on our part) and cognitive processes that require us to focus our attention on sensory input (with effort, we choose what to attend to and we are aware of this focus). Our sensory systems absorb an enormous amount of information, and one of the major functions of the brain is to sift through that information, determining what is important and needs immediate attention, what can be ignored, and what can be processed and stored for later use if necessary. This automatic processing allows information to be collected and saved (at least temporarily) with little or no conscious effort (McCarthy & Skowronski, 2011; Schmidt-Daffy, 2011). If it weren’t for automatic processing, we would be overwhelmed with data. Just imagine assuming some of your brain’s behind-the-scenes responsibilities (for example, keeping track of your heart rate or filtering unimportant noises) while taking a psychology midterm exam.

Automatic processing can also refer to the involuntary cognitive activity guiding some of our behaviors. We are seemingly able to behave and act without focusing our attention on particular behaviors. These behaviors seem to occur without intentional awareness, and without getting in the way of our other behaviors (Hassin, Bargh, & Zimerman, 2009). A few examples are in order here. Do you remember the last time you drove a car on a familiar route, daydreaming the entire time? Somehow you arrived at your destination without noticing much about your driving, the traffic, and so forth. Or have you ever found yourself listening to music while cleaning the kitchen, and then realizing you are almost finished cleaning up without once being aware that you had scrubbed the countertop or mopped the floor? You managed to be conscious enough to complete complex tasks, but not conscious enough to truly realize that you were doing so.

Although unconscious processes guide a great number of our behaviors, we are also able to focus our attention, making conscious decisions about what to attend to.
When driving, you might focus intently on a conversation you just had with your friend or an exam you will take in an hour. With this type of conscious activity, we deliberately channel or direct our attention.

**LO 3** Describe how we narrow our focus on specific stimuli to attend to them.

**Selective Attention**

This brings us to an important concept in understanding consciousness; although we have access to a great deal of information in our internal and external environments, we can only focus our attention on a small portion of that information at one time. This narrow focus on specific stimuli is known as **selective attention**. Researchers have found selective attention can be influenced by negative emotions. Anger, for example, increases our ability to selectively attend to something or someone (Finucane, 2011). In addition, repeated exposure to stimuli (our attention is better with repetition; Brascamp, Blake, & Kristjánsson, 2011) and age (we get better at ignoring distractions as we age; Couperus, 2011) affect selective attention.

This doesn’t mean other information isn’t being processed. We generally adapt to continuous input, ignoring the millions of unimportant sensory stimuli constantly bombarding us. Yet, we are designed to pay attention to abrupt, unexpected changes in the environment, and to stimuli that are unfamiliar or especially strong (Bahrick & Newell, 2008; Daffner et al., 2007; Parmentier & André, 2010). Think about how you approach reading this chapter, for example. Your sensory systems are hard at work, but your focus remains on your reading.

Imagine you are studying in a busy courtyard. You are aware the environment is bustling with activity, but you fail to pay attention to every person. If something changes, though, your attention might be directed to that novelty. The same thing occurs when you are in a crowded room talking to someone. You are able to pay attention to your conversation despite all the noise from the many other conversations. This is known as the **cocktail-party effect**; you can block out the chatter and noise of the party and get lost in a deep conversation, a very efficient use of selective attention (Koch, Lawo, Fels, & Vorländer, 2011).

**Inattentional Blindness**

Selective attention is great if you need to study for a psychology test while others are watching TV, but it can also be dangerous. Suppose a friend sends you a hilarious text message while you are walking into a busy intersection. Thinking about the text can momentarily steal your attention away from signs of danger, like a car turning right on red without stopping. While distracted by the text message, it is completely possible you step into the intersection—without seeing the car turning in your path. This “looking without seeing” is referred to as inattentional blindness, and it can have serious consequences (Mack, 2003).

Ulric Neisser was the first to illustrate just how blind we can be to objects directly in our line of vision. In one of his studies, participants were instructed to watch a video of men passing a basketball from one person to another (Neisser, 1979; Neisser & Becklen, 1975). As they diligently followed the basketball with their eyes, counting each pass, a partially transparent woman holding an umbrella was superimposed walking across the basketball court. Only 21% of the participants even noticed the woman (Most et al., 2001; Simons, 2010), because they had been too fixated on the basketball to see her (Mack, 2003).
LEVELS OF CONSCIOUSNESS  People often equate consciousness with being awake and alert, and unconsciousness as being passed out or comatose. But the distinction is not so clear, because there are different levels of conscious awareness including wakefulness, sleepiness, drug induced states, dreaming, hypnotic states, and meditative states, to name but a few. One way to define these levels of consciousness is to determine how much control you have over your awareness at the time. A high level of awareness might occur when focusing a lot of attention on a task (using a sharp knife); a lower level might occur when daydreaming, although you are able to snap out of it as needed. Sometimes we can identify an agent that causes a change in the level or state of consciousness. Psychologists typically delineate between waking consciousness and altered states of consciousness that are the result of drugs, alcohol, or hypnosis, for example, topics covered later in the chapter.

Consciousness is like a swirling plume of smoke, always changing, seemingly impossible to grasp. But wherever your attention is focused at this moment, that is your conscious experience. There are times when attention essentially shuts down, however. What’s going on when we lie in bed motionless, lost in a peaceful slumber? Sleep, fascinating sleep, is the subject of our next section. Welcome to the world of consciousness and its many shades of gray.

**show what you know**

1. When researchers try to study participants’ conscious experiences, one barrier they face is that consciousness is ___________, pertaining only to the individual who experiences it.

2. While studying for an exam, your sensory systems absorb an inordinate amount of information from your surroundings, most of which you are not aware of. Because of ___________, generally you do not get overwhelmed with incoming sensory data.

   a. consciousness  
   b. automatic processing  
   c. depressants  
   d. encoding

3. Inattentional blindness is the tendency to “look without seeing.” Researchers have determined that most people do not notice a variety of events. Given what you know about selective attention, what advice would you give someone about defending against “looking without seeing”?

   ✓ CHECK YOUR ANSWERS IN APPENDIX A.
When Matt Utesch reminisces about childhood, he remembers having a lot of energy. “I was the kid that would wake up at 6:00 a.m. and watch cartoons,” Matt recalls. As a teenager, Matt channeled his energy through sports—playing basketball, running cross-country, and competing in one of the nation’s top-ranking private soccer leagues. But everything changed during Matt’s sophomore year of high school. That was the year the sleepiness hit.

At first it seemed like nothing serious. Matt just dozed off in class from time to time. But his mini-naps gradually became more frequent. Eventually, the sleepiness would take hold of him in every class except physical education. “Matt, you just fell asleep,” his friends would say. “No I didn’t,” he would shoot back, unaware he had been sleeping. Most of Matt’s teachers assumed he was just another teenager exhausted from late-night partying. Some even slammed their hands on his desk to rouse him. Nobody, not even Matt’s doctor, suspected he had a serious medical condition—until the accident happened.

It was the summer before junior year, and Matt was driving his truck home from work at his father’s appliance repair shop. One moment he was rolling along the street at a safe distance from other cars, and the next he was ramming into a brown Saturn that had slowed to make a left turn. What had transpired in the interim? Matt had fallen asleep. He slammed on the brake pedal, but it was too late; the two vehicles collided. Unharmed, Matt leaped out of his truck and ran to check on the other driver—a woman who, as he remembers, “was totally out of it.” Her backrest had broken, and her back had nearly broken along with it. This woman already had a serious back problem, and a fresh injury was the last thing she needed. Matt was dismayed. A few weeks after the accident, he went to the woman’s home to bring her flowers. She invited him inside, and they sat down and began to chat. Right in the midst of their conversation, Matt fell asleep. More on Matt’s story in a bit.

An Introduction to Sleep

All animals sleep or engage in some rest activity that resembles sleep (Horne, 2006). Dolphins snooze while swimming, keeping one eye cracked open at all times; horses usually sleep standing up; and some birds appear to doze mid-flight (U.S. Fish & Wildlife Service, 2006). There are animals that require loads of sleep—bats and opossums sleep 18 to 20 hours a day—and those that need barely any—elephants and giraffes get by on 3 or 4 hours (Siegel, 2005). Sleep needs vary greatly among people, ranging from as little as 4 hours a night to as long as 11 or more (Horne, 2006). But most of us require between 7 and 8 hours to stay mentally and physically healthy (Banks & Dinges, 2007). Do the math and that translates to more or less a third of the day. And that translates to a third of your life. Clearly, sleep must serve some important function, but what is it? And how does it relate to consciousness? How can sleep go so wrong, as happened for Matt? We will address these questions and many more in the pages to come, but first let’s cover the basics.

LO 4 Identify how circadian rhythm relates to sleep.

CIRCADIAN RHYTHM Have you ever noticed that you often get sleepy in the middle of the afternoon? Even if you had a good sleep the night before, an afternoon daze invariably sets in at 2:00 or 3:00 p.m.; it’s like clockwork. That’s because it is...
The daily patterns of consciousness are regulated by biological clocks. These clocks, known as the suprachiasmatic nucleus (SCN), are found in cells throughout the body, with a master clock nestled deep within the hypothalamus. The SCN helps regulate daily patterns of sleep-wake cycles, sexual arousal, and appetite.

In the circadian rhythm for sleep and wakefulness, there are two times when the desire for sleep hits hardest. The first is between 2:00 and 6:00 a.m., the same window of time when most car accidents caused by sleepiness occur (Horne, 2006). The second, less intense desire for sleep strikes mid-afternoon, around 2:30 p.m., when many college students have trouble keeping their eyes open in class (Mitler & Miller, 1996).

Not all biological rhythms are circadian. Some occur over longer time intervals (monthly menstruation), and others cycle much faster (the 90-minute sleep cycles, to be discussed shortly). Many animals migrate or hibernate during certain seasons and mate according to a yearly pattern. Even when deprived of cues like changing levels of sunlight, some animals continue to follow these cycles. Birds caged indoors, for example, exhibit mood and behavioral changes at the times of year when they would normally be migrating (Wright, 2002). Biological clocks are everywhere in nature, acting as day planners for organisms as basic as bacteria and slime mold.

**SUPRACHIASMATIC NUCLEUS** Where in the body do these inner clocks and calendars dwell? Miniclocks are found in cells all over your body, but a master clock is nestled deep within the hypothalamus, a brain structure whose activities revolve around maintaining homeostasis, or balance, in the body’s systems. This king of clocks, known as the suprachiasmatic nucleus (SCN), actually consists of two clusters, each no bigger than an ant, totaling around 20,000 neurons (Forger & Peskin, 2003; Wright, 2002). The SCN plays a role in our circadian rhythm by communicating with other areas of the hypothalamus, which regulates daily patterns of hunger and temperature, and the reticular formation, which regulates alertness and sleepiness (INFOGRAPHIC 4.1).

Although tucked away in the recesses of the brain, the SCN knows the difference between day and night. That’s because it receives signals from a special type of light-sensing cells in the eye, called retinal ganglion cells. With the help of these informants, the clock resets to the light and dark cycling of the planet. When light beams upon the earth, your clock tells you to rise and shine, and when darkness hits, it urges you to bed. One way the SCN keeps you on schedule is by indirectly communicating with the pineal gland, a part of the endocrine system, to regulate the release of melatonin, a hormone that promotes sleep. In dark conditions, the clock commands the pineal gland to produce melatonin, making it easier to sleep. When light hits the eye, melatonin secretion slows down. So if you want to sleep, turn down the lights, and let your brain turn up the melatonin.

What would happen if you lived in a dark cave with no watches or computers to help you keep track of time? Would your body stay on a 24-hour cycle or get confused? Studies of people living in conditions with no indication of the time of day show that the internal clock continues to hum along at a slightly slower pace, eventually settling on a cycle that runs a little over 24 hours (Carskadon, Labayak, Acebo, & Seifer, 1999; Czeisler et al., 1999). But depriving the clock of its external light cues is generally not a good idea. Sleep-wake cycles can be disrupted, leading to exhaustion, irritability, impairment of memory, and other negative outcomes (Infographic 4.1).
The Suprachiasmatic Nucleus

The suprachiasmatic nucleus (SCN) of the hypothalamus is the body’s internal master clock, playing a role in regulating our circadian rhythms. These rhythms roughly follow the 24-hour cycle of daylight and darkness. But one doesn’t have to consciously perceive light for the SCN to function properly; there is a dedicated, nonvisual pathway that carries light information from the eyes to the SCN.

The SCN is located deep in the brain, far away from visual processing areas. So how does it get information about light? Our eyes contain a separate nonvisual pathway made of retinal ganglion cells. This pathway goes directly to the SCN.

For the 20% of the U.S. workforce doing shift work, normal sleep schedules are disrupted. This can lead to health problems and increased accidents (Harrington, 2001). Using what we know about how the SCN works, researchers are helping industries ease these effects. Bright lights, such as those installed in this power station control room, contain a high proportion of the blue light found in morning sun, fooling the SCN into thinking it is daytime. That makes it easier for workers to synchronize sleep patterns with work activities.
LARKS AND OWLS  Everyone has their own unique clock, which helps explain why some of us are “morning people” or so-called larks, and others are “night owls.” If you are a lark, likely you roll out of bed feeling energized and alert, get more accomplished early in the day, yet grow weary as the day drags on. One study characterized larks as preferring to go to bed before 11:00 P.M. and rising before 8:00 A.M. (Gale & Martyn, 1998). Owls, on the other hand, get up late and hit the sack late. If you slam the “snooze” button on your alarm clock five times every morning, shower with your eyes closed, and act like a grouch at breakfast, you’re probably an owl. But being an owl often means your energy level builds throughout the day, making it easy to stay up late watching movies or reading your text book. About 20% of us are true owls, 20% are genuine larks, and the rest fall somewhere in between (Horne, 2006).

JET LAG AND SHIFT WORK  Whether you are a lark or an owl, your clock is likely to become confused when you travel between time zones. If you take an airplane halfway around the globe, your biological clock does not automatically reset to match the new time. The physical and mental consequences of this delayed adjustment are known as “jet lag,” and it is not an ideal way to start a business trip or honeymoon, as typical symptoms include difficulty concentrating, headaches, and gastrointestinal distress. Fortunately, the biological clock can readjust by about 1 or 2 hours each day, eventually falling into step with the new environmental schedule (Cunha & Stöppler, 2011). Jet lag is frustrating, but at least it’s only temporary.

Now imagine plodding through life with a case of jet lag you just can’t shake. This is the tough reality for some of the world’s shift workers—firefighters, nurses, miners, power plant operators, and other professionals who work while the rest of the world is snuggled under the covers. Shift workers represent about 20% of the workforce in the United States and other developed countries, or 1 in 5 people who are employed (Di Lorenzo et al., 2003). Some work rotating shifts, which means they are constantly going to bed and waking up at different times; others consistently work the overnight shift, so their sleep–wake cycles are permanently out-of-step with the light and dark cycles of the earth. Constantly fighting the clock takes a heavy toll on the mind and body. An irregular sleep schedule may lead to symptoms of insomnia, or difficulty falling asleep and sleeping soundly. It’s not hard to imagine why. Picture yourself coming off the nightshift and arriving home at 7:00 A.M.: The sun is shining brightly, the birds are chirping, and the rest of the family is chatting over their cornflakes. This is not an ideal environment for sleep. Insomnia resulting from shift work can lead to decreased job productivity, depression, anxiety, diabetes, and other chronic diseases (Morin et al., 2006; Vgontzas et
Studies also show that shift workers face an elevated risk of becoming overweight, and developing stomach ulcers and heart disease (Di Lorenzo et al., 2003; Knutsson, 2003). In addition, 5% to 10% of shift workers are estimated to have a diagnosis of circadian rhythm sleep–wake disorders, which are characterized by excessive sleepiness at work and insomnia at home (American Psychiatric Association, 2013).

However, in our world of 24-hour pharmacies and round-the-clock customer service, shift work is a necessary evil. Dr. Lawrence J. Epstein, the director of Harvard’s Sleep HealthCenters, suggests ways in which night workers can minimize circadian disturbances and increase their productivity. Remember that light is the clock’s most important external cue. Dr. Epstein suggests maximizing light exposure during work time and steering clear of it close to bedtime. Some night shifters don sunglasses on their way home, to block the morning sun, and head straight to bed in a quiet, dark room (Epstein & Mardon, 2007). Taking 20- to 30-minute power naps in the middle of a night shift can also help shift workers stay awake and alert (Harvard Medical School, 2007).

The Stages of Sleep

Have you ever watched someone sleeping? The person looks blissfully tranquil: body still, face relaxed, chest rising and falling like a lazy ocean wave. Don’t be fooled. Underneath the body’s quiet front is a very active brain, as determined by an electroencephalogram (EEG), a device that picks up electrical signals from the brain and displays this information on a screen. If you could look at an EEG trace of your brain right this moment, you would probably see a series of tiny, short spikes in rapid-fire succession. These high-frequency brainwaves are called beta waves, and they appear when you are solving a math problem, reading a book, or whenever you are alert. Now let’s say you climb into bed, close your eyes, and relax. As you become more and more drowsy, the electrical activity measured by an EEG would likely begin showing alpha waves, which are lower in frequency than beta waves (Cantero, Atienza, Salas, & Gomez, 1999). At some point, you drift into a different level of consciousness known as sleep.

NON-REM SLEEP A normal sleeper begins the night in non-rapid eye movement (non-REM), or nondreaming, sleep, which has four stages (INFOGRAPHIC 4.2 on p. 4-15). The first and lightest is Stage 1 sleep, also known as “light sleep.” During Stage 1, muscles go limp and body temperature starts to fall. The eyeballs may move gently beneath the lids. If you looked at an EEG of a person in Stage 1, you would likely see theta waves, which are lower in frequency than both alpha and beta waves. This is the type of sleep many people deny having. Example: Your friend begins to snore while watching TV, so you poke her in the ribs and say, “Wake up!” but she swears she wasn’t asleep. It is also during this initial phase of sleep that hallucinations, or imaginary sensations, can occur. Do you ever see blotches of color or bizarre images floating past while you drift off to sleep? Or perhaps you have felt a sensation of falling or swinging and then jerked your arms or legs in response? False perceptions

beta waves Brain waves that indicate an alert, awake state.
alpha waves Brain waves that indicate a relaxed, drowsy state.
non-rapid eye movement (non-REM) The nondreaming sleep that occurs during sleep Stages 1 to 4.
theta waves Brain waves that indicate the early stage of sleep.
that occur during the limbo between wakefulness and sleep are called hypnagogic hallucinations, and they are no cause for concern, in most cases. More on this when we return to Matt’s story.

After a few minutes in Stage 1, you move on to the next phase of non-REM sleep, called Stage 2 sleep, which is slightly deeper than Stage 1, so it is harder to awaken the sleeper. Theta waves continue showing up on the EEG, along with little bursts of electrical activity called sleep spindles and large waves called K-complexes appearing every 2 minutes or so. Researchers suspect sleep spindles are associated with memory consolidation and intelligence (Fogel & Smith, 2011). The exact function of K-complexes is up for debate: Some suggest they are the brain’s way of being ready to awaken when the need arises, others believe they are the mechanism for remaining asleep in spite of disturbing stimuli (Colrain, 2005).

After passing through Stages 1 and 2, the sleeper descends into Stage 3, and then into an even deeper Stage 4, when it is most difficult to rouse someone. Both Stages 3 and 4 are known as slow-wave sleep, because they are characterized by tall, low-frequency delta waves. Stages 3 and 4 are really very similar, but Stage 4 contains a higher proportion of delta waves (delta waves are evident more than 50% of the time). Waking a person from slow-wave sleep is not easy and, if you succeed, be prepared. Most of us will feel groggy, disoriented, and downright irritated when jarred from a slow-wave slumber. This is also the time of greatest secretion of growth hormone, which helps children to grow taller and stronger, and to build tissue (Awikunprasert & Sittiprapaporn, 2012).

**REM SLEEP** You will only remain in Stage 4 for around 40 minutes. You don’t stay in deep sleep for the remainder of the night; your sleep becomes less deep as you work your way from Stage 4 back to Stage 1. And instead of waking up, you enter the fifth stage, known as **rapid eye movement (REM)** sleep, so called because during this stage, a person’s eyes often dart around, even though they are closed. How else can you tell someone is in REM sleep? Brain activity changes from those slower brain waves to faster and smaller brain waves; an EEG reading of someone in REM sleep shows brain activity similar to that of a person who is wide awake. Meanwhile, the eyes make quick, sharp movements beneath the eyelids, pulse and breathing rate fluctuate, and blood flow to the genitals increases, which explains why people frequently wake up in a state of sexual arousal. Another name for REM sleep is paradoxical sleep, because the sleeper appears to be quiet and resting, but the brain is full of electrical activity. People roused from REM sleep often report having vivid, illogical dreams. Thankfully, the brain has a way of preventing us from acting out our dreams. During REM sleep, certain neurons in the brainstem control the voluntary muscles, keeping most of the body still.

What would happen if the neurons responsible for disabling the muscles during REM sleep were destroyed or damaged? Researchers led by Michel Jouvet in France and Adrian Morrison in the United States found the answer to that question in the 1960s and 1970s. Both teams showed that severing these neurons in the brains of cats caused them to act out their kitty dreams. Not only did the sleeping felines stand up; they arched their backs in fury, groomed and licked themselves, and hunted imaginary mice (Jouvet, 1979; Sastre & Jouvet, 1979).
Sleep

Looking in on a sleep study, you’ll see that the brain is actually very active during sleep, cycling through non-REM (NREM) stages and ending in REM sleep approximately five times during the night. Transitions between stages are clearly visible as shifts in EEG patterns.

Graphs illustrating the human sleep cycle typically present an 8-hour time span, as shown here. But this doesn’t tell the whole story of sleep. The amount of time spent sleeping and the content of our sleep changes across the life span. And while a normal night’s sleep lasts approximately 7 hours for a healthy young adult, 30% of working adults get 6 hours or fewer of sleep per night (Centers for Disease Control and Prevention, 2012).

A typical night’s sleep has 4 or 5 multistage sleep cycles, each lasting approximately 90 minutes. Each cycle includes at least 1 NREM and 1 REM stage. Pattern and duration of stages differ over the course of the night.

As we age, we need fewer hours of sleep, and the proportion of time spent in REM diminishes.

Looking at brain waves allows us to trace a person’s stage of sleep. Here we can see a clear shift from waking to sleeping patterns. (AFTER DEMENT, 2000)

Credits: Photo of woman wearing EEG, AJ PHOTO/HOP AMERICAIN/SCIENCE PHOTO LIBRARY; EEG waves on iPad, Science Source; IPAD Photo, Thinkstock
SLEEP ARCHITECTURE  Congratulations. You have just completed one sleep cycle, working your way up and down Stages 1, 2, 3, and 4 of non-REM sleep and ending with a dream-packed episode of REM. Each of these cycles lasts about 90 minutes, and the average adult sleeper loops through five of them per night. These cycles are not identical because they change in composition throughout the night. During the first two cycles, a considerable amount of time is devoted to the deep Stages 3 and 4. Halfway through the night, however, Stages 3 and 4 vanish. Meanwhile, the REM periods become progressively longer, and an adult will average approximately four to five REM cycles. The first REM episode may last a mere 5 to 10 minutes, whereas the final one may drag on for nearly a half-hour (Siegel, 2005). When all is said and done, the sleep stage where we spend the most time—nearly half the night—is Stage 2 (Epstein & Mardon, 2007). Therefore, we pack in most of our restorative sleep early in the night and most dreaming toward the end.

As we age, the makeup of our sleep cycles, or sleep architecture, changes. Older people spend less time in REM sleep and the deeply refreshing stages of non-REM sleep (3 and 4). Instead, their periods of light sleep (Stages 1 and 2, which can be interrupted easily by noises and movements) are longer (Ohayon, Carskadon, Guilleminault, & Vitiello, 2004). This may be why many older people complain of sleeping poorly, waking up often, and feeling drowsy during the day. Not all elderly people have trouble sleeping, of course. Like most everything in life, sleep patterns vary considerably from one individual to the next.

nature AND nurture

On a typical weeknight, the average American sleeps 6 hours and 40 minutes, but there is significant deviation from this “average.” A large number of people—about 20% of the population—get fewer than 6 hours, and another 28% snooze longer than 8 hours (National Sleep Foundation, 2009). How do you account for so much variation in the duration of sleep?

When it comes to understanding sleep patterns, we cannot ignore what is in our nature, or biology. Some studies suggest sleep needs are inherited from parents, and there are probably many genes involved (He et al., 2009; Hor & Tafti, 2009). Evidence also suggests that “short sleepers” (people who average fewer than 6 hours per night) and “long sleepers” (those who sleep more than 9 hours) are running on different circadian rhythms. Nighttime increases in the “sleep hormone” melatonin, for example, tend to be shorter for those who get fewer zzz’s (Aeschbach et al., 2003; Rivkees, 2003).

But it is also possible that some short sleepers are really just average sleepers getting by on less than an optimal amount of sleep. Given the opportunity to catch up for a few days, would they sleep for hours upon hours? This is just what happened in a small study of healthy young adults. On Day 1 of sleep catch-up, all the participants slept more than usual. But by Day 3, the longer sleepers were engaged in less catch-up than the shorter sleepers, who seemed to be chipping away at a “sleep debt” they had accumulated (Klerman & Dijk, 2004). We do not have access to the genetic codes of these participants, so it is impossible to know what heritable factors might have influenced the results. But the findings do suggest sleep patterns are, to some degree, shaped by the circumstances of our lives. If the short sleepers in the study were getting sufficient sleep, then we wouldn’t expect them to show signs of sleep debt. Sleep patterns, like virtually every psychological phenomenon, appear to be dictated by both nature and nurture.
PROBLEM IDENTIFIED Shortly after the car accident, Matt was diagnosed with narcolepsy, a neurological disorder characterized by excessive daytime sleepiness and other sleep-related disturbances. The most striking symptoms of narcolepsy include the “irrepressible need to sleep, lapsing into sleep, or napping occurring within the same day” (APA, 2013, p. 372). Sleepiness can strike anytime, anywhere—during a job interview, while riding a bicycle, or in the midst of a passionate kiss. One time Matt fell asleep while making a sandwich. When he woke up, he was still holding a slice of meat in his hand. Some people with narcolepsy report a waking alert level and then falling asleep, while others report an overwhelming feeling of sleepiness all the time. “Sleep attacks” can occur several times a day. Most are measured in seconds or minutes, but episodes of an hour or longer have been reported (National Institute of Neurological Disorders and Stroke, 2011). By the time Matt was a junior in high school, his uncontrollable naps were striking upward of 20 to 30 times a day.

CATAPLEXY And that wasn’t all. Matt developed another debilitating symptom of narcolepsy: cataplexy, or sudden episodes of total loss of muscle tone or strength that occur when a person is awake. During a severe cataplectic attack, some muscles go limp, and the body may collapse slowly to the floor like a rag doll. One moment Matt would be standing in the hallway laughing with friends; the next he was splayed on the floor unable to move a muscle. “It was like a tree being cut down [and] tipping over,” he recalls. Usually, cataplexy wears off after several seconds, but severe attacks can render a person immobilized for minutes at a time.

Cataplexy may completely disable the body, but it produces no loss in consciousness. Even during the worst attack, Matt remained completely aware of himself and his surroundings. He could hear people talking about him; sometimes they snickered in amusement. “Kids can be cruel,” Matt says. Cataplexy attacks come on suddenly, usually during periods of emotional excitement (APA, 2013). By junior year, Matt’s cataplexy had spun out of control. He was having 60 to 100 attacks a day.

SLEEP PARALYSIS AND HYPNAGOGIC HALLUCINATIONS Matt also developed two other common narcolepsy symptoms: sleep paralysis and hypnagogic hallucinations. Sleep paralysis is a temporary paralysis that strikes just before falling asleep or upon waking up (APA, 2013). Recall that the body becomes paralyzed during REM sleep, but sometimes this paralysis sets in prematurely or fails to turn off on time. Picture yourself lying in bed, awake and fully aware yet unable to roll over, climb out of bed, or even wiggle a toe. You want to scream for help, but your lips won’t budge. Sleep paralysis is a common symptom of narcolepsy, but it can also strike ordinary sleepers. One study found that nearly a third of college students had experienced sleep paralysis at least once in their lives (Cheyne, Newby-Clark, & Rueffer, 1999). Episodes usually last a few seconds, but some go on for several minutes—a terrifying experience for most people.

Sleep paralysis may seem scary, but now imagine seeing bloodthirsty vampires standing at the foot of your bed just as you are about to fall asleep. Earlier we discussed the hypnagogic hallucinations people can experience during Stage 1 sleep (seeing strange images, for example). But not all hypnagogic hallucinations involve harmless blobs. They can also be realistic visions of axe murderers or space aliens trying to abduct you (McNally & Clancy, 2005). Matt had a recurring hallucination of a man with a butcher knife racing through his doorway, jumping onto his bed, and

**narcolepsy** A neurological disorder characterized by excessive daytime sleepiness, which includes lapses into sleep and napping.
stabbing him in the chest. Upon awakening, he would often quiz his mother with questions like, “When is my birthday?” or “What is your license plate number?” He wanted to verify she was real, not just another character in his dream. Like sleep paralysis, vivid hypnagogic hallucinations can occur in people without narcolepsy, too. Shift work, insomnia, and sleeping face-up are all factors that appear to heighten one’s risk (Cheyne, 2002; McNally & Clancy, 2005).

Throughout junior year, Matt took various medications to control his narcolepsy, but his symptoms persisted. Narcolepsy was beginning to interfere with virtually every aspect of his life. At the beginning of high school, Matt had a 4.0 grade point average; now he was working twice as hard and earning lower grades. Playing sports had become a major health hazard because his cataplexy struck wherever and whenever, without notice. If he collapsed while sprinting down the soccer field or diving for a basketball, he might twist an ankle, break an arm, or worse. Narcolepsy also began to undermine Matt’s social life. Some of his classmates viewed him as a source of entertainment. “Hey, you’re like that guy out of Rat Race or Deuce Bigalow,” they would say, drawing on Hollywood’s inaccurate stereotypes. It was during those years that Matt realized who his true friends were. “The people that stuck with me [then] are still my close friends now,” he says. Matt’s loyal buddies learned to read the warning signs of cataplexy (for example, when he suddenly stands still and closes his eyes) and did everything possible to keep him safe, grabbing hold of his body and slowly lowering him to the ground. His buddies had his back—literally.

Sleep Disturbances

LO 6 Recognize various sleep disorders and their symptoms.

Approximately 1 in 2,500 people suffer from narcolepsy (Ohayon, 2011). It is believed to result from a failure of the brain to properly regulate sleep patterns. Normally, the boundaries separating sleep and wakefulness are relatively clear—you are awake, in REM sleep, or in non-REM sleep. With narcolepsy, the lines separating these different realms of consciousness fade, allowing sleep to spill into periods of wakefulness. The loss of muscle tone during cataplexy, sleep paralysis, and dreamlike hypnagogic hallucinations experienced while falling asleep may be explained by occurrences of REM sleep in the midst of wakefulness (Attarian, Schenck, & Mahowald, 2000). In other words, REM sleep occurs in the wrong place, at the wrong time (see the summary of sleep disturbances in Table 4.1).

REM SLEEP BEHAVIOR DISORDER Problems with REM regulation can also lead to other sleep disturbances, including REM sleep behavior disorder. The defining characteristics of this disorder include “repeated episodes of arousal often associated with vocalizations and/or complex motor behaviors arising from REM sleep” (APA, 2013, p. 408). People with REM sleep behavior disorder are much like the cats in Morrison and Jouvet’s experiments; something has gone awry with the brainstem mechanism responsible for paralyzing their bodies during REM sleep, so they are able to move around and act out their dreams (Schenck & Mahowald, 2002). This is not a good thing, since the dreams of REM sleep behavior disorder sufferers tend to be unusually violent and action-packed, involving fights with wild animals and other attackers (Fantini, Corona, Clerici, & Ferini-Strambi, 2005). The sleeping partners of individuals with REM sleep behavior disorder often get kicked, punched, and screamed at. According to some research, up to 65% of REM sleep behavior disorder sufferers have injured either themselves or their bedmates at one point or another. Scrapes, cuts, and bruises are common, and traumatic brain injuries have also been
Does Shaq Snore?

Basketball icon Shaquille O’Neal suffers from a breathing-related sleep disorder. At the request of Harvard researchers who studied his sleep behaviors, Shaq began wearing a special mask to keep his airway open at night. He now reports sleeping better and feeling more energized during the day (American Academy of Sleep Medicine, 2011; National Heart, Lung, and Blood Institute, 2011).

BREATHING-RELATED SLEEP DISORDERS

There are several breathing related sleep disorders, but the most common is obstructive sleep apnea hypopnea (hahy-pop-nee-uh). This is a serious disturbance characterized by a complete absence of air flow (apnea) or reduced air flow (hypopnea). During normal sleep, the airway remains open, allowing air to flow in and out of the lungs. With obstructive sleep apnea hypopnea, the upper throat muscles go limp, allowing the upper airway to close shut (APA, 2013). Breathing stops for 10 seconds or more, causing blood oxygen levels to drop (Chung & Elsaid, 2009). Sensing an emergency, the brain responds by commanding the body to wake up and breathe! The sleeper awakes and gasps for air, sometimes with a noisy nasal sound, and then drifts back to sleep. This process can repeat itself several hundred times per night, preventing a person from experiencing the deep stages of sleep so crucial for a feeling of refreshed or restored energy in the morning. Most people have no memory of the repeated awakenings and wonder why they feel so exhausted during the day, with absolutely no idea they suffer from a serious sleep disturbance.

Table 4.1 SLEEP DISTURBANCES

<table>
<thead>
<tr>
<th>Sleep Disturbance</th>
<th>Definition</th>
<th>Defining Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narcolepsy</td>
<td>Neurological disorder characterized by excessive daytime sleepiness, which includes lapses into sleep and napping.</td>
<td>Irrepressible need to sleep; daytime napping; cataplexy; sleep paralysis; hypnagogic hallucinations.</td>
</tr>
<tr>
<td>REM Sleep Behavior Disorder</td>
<td>The mechanism responsible for paralysis during REM not functioning, resulting in the acting out of dreams.</td>
<td>Dreamers vocalize and act out dreams; violent and active dreams are common; upon awakening the dream is remembered; risk of injury to self and sleeping partners.</td>
</tr>
<tr>
<td>Obstructive Sleep Apnea Hypopnea</td>
<td>Serious disturbance characterized by a complete absence of air flow (apnea) or reduced air flow (hypopnea).</td>
<td>Upper throat muscles go limp; airway closes; breathing stops for 10 seconds or longer; sleeper awakens, gasping for air.</td>
</tr>
<tr>
<td>Insomnia</td>
<td>Inability to fall asleep or stay asleep.</td>
<td>Poor sleep quantity or quality; tendency to wake up too early; can’t fall back asleep; not feeling refreshed after a night’s sleep.</td>
</tr>
<tr>
<td>Sleepwalking</td>
<td>Disturbance of non-REM sleep characterized by complex motor behavior during sleep.</td>
<td>Expressionless face; open eyes; may sit in bed, walk around, or speak gibberish; upon awakening has limited recall.</td>
</tr>
<tr>
<td>Sleep Terrors</td>
<td>Disturbance of non-REM sleep generally occurring in children.</td>
<td>Screaming, inconsolable child; usually no memory of the episode the next day.</td>
</tr>
</tbody>
</table>

Problems can arise during both REM and non-REM sleep. This table outlines some of the most common sleep disturbances and their defining characteristics.
Obstructive sleep apnea hypopnea is more common among men than women and is linked to increased risk of death in the elderly, traffic accidents, and reduced quality of life. This disorder is also associated with a rise in blood pressure, increasing the risk of cardiovascular disease. Research indicates that obstructive sleep apnea hypopnea is more prevalent with obesity and in men, but has an increase in prevalence for women after menopause (APA, 2013).

**INSOMNIA** The most prevalent sleep disorder is **insomnia**, which is characterized by an inability to fall asleep or stay asleep; often people with insomnia will report that the quantity or quality of their sleep is not good. Some may complain they wake up too early and can’t fall back to sleep, or they don’t feel refreshed after a night’s sleep. Sleepiness during the day and difficulties with cognitive tasks and processes are also reported (APA, 2013). About a third of adults experience some symptoms of insomnia, and 6% to 10% suffer from insomnia disorder (APA, 2013; Mai & Buysse, 2008; Roth, 2007). Insomnia symptoms can be related to factors such as the stress of a new job, college studies, depression, anxiety, jet lag, aging, and drug use.

**OTHER SLEEP DISTURBANCES** A common sleep disturbance that can occur during non-REM (typically, Stages 3 and 4) is sleepwalking. A quarter of all children will experience at least one sleepwalking incident, and it seems to run in families (Licis, Desruisseau, Yamada, Duntley, & Gurnett, 2011). Here are some ways to spot a sleepwalker: Her face is expressionless; her eyes are open; and she may sit up in bed, walk around in confusion, or speak gibberish. (The garbled speech of sleepwalking is different from sleep **talking**, which can occur in either REM or non-REM sleep, but is not considered a sleep disturbance.) Sleepwalkers may have “limited recall” of the event upon awakening (APA, 2013). They are capable of accomplishing a variety of tasks such as opening doors, going to the bathroom, and getting dressed, all of which they are likely to forget by morning. Most sleepwalking episodes are not related to dreaming, and contrary to urban myth, awakening a sleepwalker will not cause sudden death or injury. What’s dangerous is leaving the front door unlocked and the car keys in the ignition, as sleepwalkers have been known to wander into the streets and even attempt driving (APA, 2013).

**Sleep terrors** are a non-REM sleep disturbance primarily affecting children. Here’s how a sleep terror typically presents itself: A child sits bolt upright in bed, staring fearfully at nothing, and utters a blood-curdling scream. Parents rush into the room to find the child crying hysterically, hyperventilating, and perhaps struggling frantically. No matter what the parents say or do, the child remains inconsolable. Fortunately, sleep terrors only last a few minutes, and most children outgrow them. Sleep terrors are often worse for parents, who are awakened by a screaming child, than they are for the child, who generally won’t remember the episode the next day (APA, 2013).

**Nightmares** are frightening dreams that occur in REM sleep. They affect people of all ages. And unlike night terrors, nightmares can often be recalled in vivid detail. Because nightmares usually occur during REM sleep, they are generally not acted out (APA, 2013). Phew, that’s a relief. But can nightmares cause any type of emotional harm?
More Than Just a Bad Dream

Nightmares may fuel anxiety rather than serving as an emotional release.

You awake with a pounding heart and clammy hands. Relax, you think to yourself—it was just a bad dream. But are nightmares truly benign? Psychologists aren’t so sure. Although some continue to believe nightmares reduce psychological tensions by letting the brain act out its fears, recent research suggests that nocturnal torments are more likely to increase anxiety in waking life.

In one study Australian researchers asked 624 high school students about their lives and nightmares during the past year and assessed their stress levels. It is well known that stressful experiences cause nightmares, but if nightmares serve to diffuse that tension, troubled sleepers should have an easier time coping with emotional ordeals. The study, published in the journal *Dreaming*, did not bear out that hypothesis: not only did nightmares not stave off anxiety, but people who reported being distressed about their dreams were even more likely to suffer from general anxiety than those who experienced an upsetting event such as the divorce of their parents.

It is possible, however, that something is going wrong in the brains of individuals who experience a lot of anxiety, so that normal emotional processing during dreaming fails, says Tore Nielsen, director of the Dream and Nightmare Laboratory at Sacred Heart Hospital in Montreal. But Nielsen’s most recent results, published in the *Journal of Sleep Research* last June, actually bolster the Australian findings. To tease out how REM sleep—during which most dreaming takes place—affects our emotions, the Canadian researchers showed disturbing images (such as gory scenes or a women being forced into a van at knifepoint) to a group of healthy volunteers just before they went to bed. When the subjects viewed the same pictures in the morning, those who had been deprived of dream-filled REM sleep were less emotionally affected than those deprived of other sleep phases. The same was true for those who experienced fewer negative emotions in their dreams. In other words, having nightmares did not make dreamers more resilient in waking life—just the opposite.

What is not clear from these studies is whether nightmares play a causal role in anxiety or are merely an expression of an underlying problem. Most researchers agree that having an occasional nightmare is normal and not problematic. But if the dreams give rise to persistent anxiety and concern, something more serious could be going on—and it may be a good idea to talk to a mental health professional about it.

Who Needs Sleep?

Matt’s worst struggle with narcolepsy stretched through the last two years of high school. During this time, he was averaging 20 to 30 naps a day. You might think that someone who falls asleep so often would at least benefit from feeling well-rested while awake. This was not the case. Matt had trouble sleeping at night, and it was taking a heavy toll on his ability to think clearly. He remembers nodding off at the wheel a few times but continuing to drive, reassuring himself that everything was fine. (Such a decision was a poor one given that his narcolepsy had already caused at least one serious accident.) He forgot about homework assignments and simple things people told him. Matt was experiencing two of the most common symptoms of sleep deprivation: impaired judgment and lapses in memory (Goel, Rao, Durmer, & Dinges, 2009).

Let’s face it. No one can function optimally without a good night’s sleep. But the expression “good night’s sleep” means something quite different from one person to another.
the next. Newborns sleep anywhere from 10.5 to 18 hours per day, toddlers 12 to 14 hours, school-aged children 10 to 11 hours, and teens about 9 hours (National Sleep Foundation, 2012a, 2012b). The average adult needs between 7 and 8 hours to feel restored, though others (including Madonna and Jay Leno) claim they get by on just 4 (Breus, 2009, May 6). People who average less than 4 or more than 11 hours, otherwise known as “extreme sleepers,” are very rare (Horne, 2006).

**SLEEP DEPRIVATION** What happens to animals when they don’t sleep at all? Laboratory studies show that sleep deprivation kills rats faster than starvation (Rechtschaffen & Bergmann, 1995; Siegel, 2005). Curtailing sleep in humans leads to rapid deterioration of mental and physical well-being. Stay up all night for 48 hours and you can expect your memory, attention, reaction time, and decision making to suffer noticeably (Goel et al., 2009; Lim & Dinges, 2010). Sleepy people find it especially challenging to accomplish tasks that are monotonous and boring; sleep deprivation impairs the ability to focus attention on a single activity, such as keeping your eyes on the road while driving (Lim & Dinges, 2010). Using driving simulators and tests to measure alertness, hand–eye coordination, and other factors, researchers report that getting behind the wheel while sleepy is similar to driving drunk. Staying awake for just 17 to 19 consecutive hours (which many of us with demanding jobs, children, and social lives do regularly) produces the same effect as having a blood alcohol content (BAC) of 0.05%, the legal limit in many countries. Stay up a few hours beyond that, and your driving will begin to look like that of a person whose BAC is 0.10%—enough to get you arrested in the United States (Williamson & Feyer, 2000). Sleep loss also makes you more prone to *microsleeps*, or uncontrollable mini-naps lasting several seconds—enough time to miss a traffic light turning red. When you take sleep deprivation to the extreme, staying awake for several days at a time (11 days is the current world record, based on experimental data; Gillin, 2002, March 25), a host of disabling effects may result, including fragmented speech, cognitive deficits, mood swings, and hallucinations (Gulevich, Dement, & Johnson, 1966).

Just because you don’t pull all-nighters does not mean you are immune to problems of sleep deprivation. A large proportion of people suffer from a more chronic form of sleep loss, resulting from insufficient sleep night-upon-night for weeks, months, or years. These people are less likely than their well-rested peers to exercise, eat healthy foods, have sex, and attend family events (National Sleep Foundation, 2009), and they face a greater risk for heart disease, diabetes, and weight gain (Sigurdson & Ayas, 2007). People who do not get enough sleep have decreased immune system responses and slower reaction times (Besedovsky, Lange, & Born, 2012; Orzel-Gryglewska, 2010). Many researchers suspect the obesity epidemic currently plaguing Western countries is linked to chronic sleep deprivation. Skimping on sleep appears to disrupt appetite-regulating hormones, which may lead to excessive hunger and overeating (Willyard, 2008).

**REM DEPRIVATION** So far we have only covered sleep loss in general, but remember there are two types of sleep: REM and non-REM. What happens if only one of these is compromised? Studies show that depriving people of Stages 3 and 4 sleep leads to increased physical symptoms such as fatigue and more overall pain (Roehrs, Hyde, Blaisdell, Greenwald, & Roth, 2006). Preliminary research suggests depriving people of REM sleep in particular can cause emotional overreactions to threatening situations (Rosales-Lagarde et al., 2012). One other important thing to note is that following REM deprivation, people experience REM *rebound*, an increased amount of time spent in REM sleep when they finally have an opportunity to sleep in peace.
WHY DO WE SLEEP? Although we spend one third of our lives sleeping and we know what goes on while we are asleep, there is disagreement on the function of sleep. Drawing from sleep deprivation studies and other types of experiments, researchers have constructed various theories to explain why we spend so much time sleeping (Table 4.2). Here are three of the major ones:

• The restorative theory of sleep suggests we sleep because it allows for growth and repair of the body and brain. This makes sense, given that growth hormone is secreted during non-REM sleep and protein production ramps up in the brain during REM. Some have suggested that sleep is a time for rest and replenishment of neurotransmitters, especially those important for attention and memory (Hobson, 1989).

• An evolutionary theory of sleep suggests that sleep serves an adaptive function; it evolved because it helped us survive. For much of human history, before people became accustomed to illuminating their homes, nighttime was very dark—and very unsafe—for humans, who have poor night vision compared to animals hunting for prey. Given that our predators were more threatening in the dark, it was adaptive for us to stay out of environments where we couldn’t see. The development of our circadian rhythms driving us to sleep thus served an important evolutionary purpose.

• Another compelling theory suggests that sleep helps with the consolidation of memories and learning. Researchers disagree which stage of sleep might facilitate such a process, but one thing seems clear: Without sleep, our ability to lay down complex memories, and thus learn difficult concepts, is hampered (Farthing, 1992). How do we know this? Studies show that areas of the brain excited during learning tasks are reawakened during non-REM sleep. When researchers monitored the neuronal activity of rats exploring a new environment, they noticed certain neurons firing. These same neurons became active again when the rats fell into non-REM sleep, suggesting that the neurons were involved in remembering the experience (Diekelmann & Born, 2010). Maquet (2000) found evidence of a similar phenomenon in humans. Using PET scans, he observed common patterns of brain activity when the participants were awake and learning and later while asleep.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Description</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restorative</td>
<td>Sleep allows for growth and repair of the body and brain.</td>
<td>Growth hormone secreted during non-REM sleep; protein production increases during REM; replenishment of neurotransmitters.</td>
</tr>
<tr>
<td>Evolutionary</td>
<td>Sleep serves adaptive function; evolved as it helped survival.</td>
<td>Dark environments were unsafe; humans have poor night vision compared to animals hunting at night.</td>
</tr>
<tr>
<td>Consolidation</td>
<td>Sleep aids in the consolidation of memories and learning.</td>
<td>Assists in creation of memories, learning difficult concepts; similar patterns of brain activity when learning and sleeping afterwards.</td>
</tr>
</tbody>
</table>

We spend approximately a third of our lives sleeping, yet the precise purpose of sleep is still to be established. Above are three of the dominant theories.

REM rebound An increased amount of sleep in the REM stage with the first sleep session following sleep deprivation.
The exact purpose of sleep has yet to be identified, but there is no denying its importance. After a couple of sleepless nights, we are grumpy, clumsy, and not able to think straight. Research has confirmed what we all know intuitively: Without good sleep, we don’t feel like ourselves.

THINK again

7 Sleep Myths

Everyone seems to have their own bits of “expert knowledge” about sleep. Read on to learn about claims (in bold) that are false.

• **Drinking alcohol before bed helps you sleep better:** Alcohol helps you fall asleep, but too much interferes with slow-wave sleep and may cause you to wake up during the night (Ballantyne, 2009). So, too, can one or two cups of coffee. Although moderate caffeine consumption heightens alertness (Epstein & Mardon, 2007), be careful not to drink too much or too close to bedtime; either action may lead to further sleep disruption (Landolt, Dijk, Gaus, & Borbély, 1995). And the decreased quantity and quality of sleep may lead to daytime sleepiness.

• **Exercising right before bed sets you up for a good night’s sleep:** Generally speaking, exercise promotes slow-wave sleep, the type that makes you feel bright-eyed and bushy-tailed in the morning (Driver & Taylor, 2000; Youngstedt & Kline, 2006). However, working out too close to bedtime (2 to 3 hours beforehand) may prevent good sleep (National Institutes of Health [NIH], 2012).

• **Everyone needs 8 hours of sleep each night:** Most people require between 7 and 8 hours (Banks & Dinges, 2007), but sleep needs can range greatly from person to person. Some people do fine with 6; others genuinely need 9 or 10 hours.

• **Watching TV or tooling around on your computer just before bed will help get you into the sleep zone:** Screen time is not advised as a transition to sleep time. The stimulation of TV and computers can interfere with your slumber, and the ability to fall and remain asleep (National Sleep Foundation, 2012c).

• **You can catch up on accumulated sleep loss with one night of “super-sleep”:** Settling any sleep debt is not easy. You may feel refreshed upon waking from 10 hours of “recovery” sleep, but the effects of sleep debt will likely creep up later on (Cohen et al., 2010).

• **Insomnia is no big deal. Everyone has trouble sleeping from time to time:** Insomnia is a mentally and physically debilitating condition that can result in mood changes, memory problems, difficulty with concentration and coordination, and other life-altering impairments (Pavlovich-Danis & Patterson, 2006).

• **Sleep aids are totally safe:** When taken according to prescription, sleep aids are relatively safe and effective, although they do not guarantee a normal night of sleep. That being said, research has linked some of these medications to an increased risk of death (Kripke, Langer, & Kline, 2012), as well as an increased risk of sleepwalking, sleep eating, and sleep driving.

Before moving on to the next section, look at TABLE 4.3 for some ideas on how to get better sleep.
Dreams

Sleep is an exciting time for the brain. As we lie in the darkness, eyes closed and bodies limp, our neurons keep firing. REM is a particularly active sleep stage, when the brain waves are fast and irregular. During REM, anything is possible. We can soar through the clouds, kiss superheroes, and ride roller coasters with frogs. Time to explore the weird world of dreaming.

Table 4.3  HOW TO GET A GOOD NIGHT’S SLEEP

<table>
<thead>
<tr>
<th>Getting Good Sleep</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get on a schedule.</td>
<td>The body operates according to daily cycles, or circadian rhythms. Putting your body and brain on a regular schedule—going to bed and waking up at roughly the same time every day—is critical.</td>
</tr>
<tr>
<td>Set the stage for sleep.</td>
<td>Turn down the lights, turn off your phone, and slip into soft pajamas. Do everything possible to create a quiet, dark, and comfortable sleeping environment.</td>
</tr>
<tr>
<td>Watch eating, drinking, and smoking.</td>
<td>Beware of foods that create heartburn, and avoid excessive use of alcohol, caffeine, and nicotine (known enemies of sleep) especially late in the day.</td>
</tr>
<tr>
<td>Move it or lose it.</td>
<td>Exercise is associated with better sleep, but not right before bed. Exercise 2 to 3 hours before bed can actually prevent good sleep.</td>
</tr>
</tbody>
</table>

If you frequently wake up feeling groggy and unrestored, there are several simple measures you can take to improve the quality of your sleep.


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show what you know

1. The suprachiasmatic nucleus obtains its information about day and night from:
   a. circadian rhythm.
   b. beta waves.
   c. K complexes.
   d. retinal ganglion cells.

2. In which of the following stages of sleep do we spend the most time at night?
   a. Stage 1
   b. Stage 2
   c. Stage 3
   d. Stage 4

3. Narcolepsy is a neurological disorder characterized by excessive daytime sleepiness and other sleep-related disturbances such as __________, which refers to the sudden loss of muscle tone that can occur when a person is awake.

4. Make a drawing of the 90-minute sleep cycle. Label each stage with the appropriate brain wave experienced.

CHECK YOUR ANSWERS IN APPENDIX A.

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Dreams

Sleep is an exciting time for the brain. As we lie in the darkness, eyes closed and bodies limp, our neurons keep firing. REM is a particularly active sleep stage, when the brain waves are fast and irregular. During REM, anything is possible. We can soar through the clouds, kiss superheroes, and ride roller coasters with frogs. Time to explore the weird world of dreaming.

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SLEEP, SLEEP GO AWAY  Just 2 months before graduating from high school, Matt began taking a new medication that vastly improved the quality of his nighttime sleep. Taking this drug at set intervals was a key element in the dramatic improvement he experienced over the next few years. He also began strategic power napping, setting aside time in his schedule to go somewhere peaceful and fall asleep for 15 to 30 minutes. “Power naps are probably the greatest thing a person with narcolepsy can do,” Matt insists. The naps helped eliminate the daytime sleepiness, effectively preempting all those unplanned naps that had fragmented his days. Matt also worked diligently to create structure in his life, setting a predictable rhythm of going to bed, taking medication, going to bed again, waking up in the morning, attending class, taking a nap, and so on.

---

You Asked, Matt Answers

http://goo.gl/d4q2o

What sorts of medications help to control narcolepsy?
Four years and a college education later, Matt has worked to control his narcolepsy. All of his major symptoms—the spontaneous naps, cataplexy, sleep paralysis, and hypnagogic hallucinations—have faded. “Now if I fall asleep, it’s because I choose to,” Matt says. “Most people don’t even know I have narcolepsy.”

Not everyone with narcolepsy is so fortunate. The disorder is often mistaken for another ailment, such as depression or insomnia. Most people with narcolepsy don’t even know they have it, and by the time an expert offers them a diagnosis (sometimes years after the symptoms began), they have already suffered major social and professional consequences (Stanford Center for Narcolepsy, 2012). While several medications are available to help control symptoms, there is no known cure for narcolepsy. Scheduling “therapeutic naps,” avoiding monotonous activities, and controlling emotional highs are all behavioral treatments for narcolepsy.

Now when Matt goes to sleep at night, he no longer imagines people coming to murder him. He no longer is awakened by horrible nightmares, and when he recalls his dreams today, he reports soaring through the skies like Superman. Sometimes he cruises at the altitude of an airplane; other times he penetrates the earth’s outer atmosphere and barrels into outer space to visit the planets. “All my dreams are now pleasant,” says Matt, “[and] it’s a lot nicer being able to fly than being stabbed by a butcher knife.” And if you wonder what Matt is doing these days, he works at a credit union (he was just promoted) and is very busy remodeling his new home. Onward and upward, like Superman.

In Your Dreams

What are dreams, and why do we have them? Dreams have been interpreted as messages from God, revelations of the future, and communication from spirits. People have contemplated the significance of dreams for millennia, resulting in many theories to explain why we dream.

PSYCHOANALYSIS AND DREAMS The first comprehensive theory of dreaming was developed by the father of psychoanalysis, Sigmund Freud. In 1900 Freud laid out his theory in the now-classic *The Interpretation of Dreams*, proposing that dreams were a form of “wish fulfillment,” or a playing out of unconscious desires. As Freud saw it, many of the desires expressed in dreams are forbidden ones that would produce great anxiety in a dreamer if she were aware of them. In dreams, these desires are disguised so they can be experienced without danger of discovery. Freud believed dreams have two levels of content: manifest and latent. Manifest content, the apparent meaning of the dream, is the actual story line of the dream itself—what you remember when you wake up. Latent content contains the hidden meaning of the dream, which represents unconscious conflicts and desires. During therapy sessions, psychoanalysts use the latent content of dreams to uncover the unconscious, by looking deeper than the actual story line of the dream. Freud would ask patients to recount the manifest content and then look for symbols and other clues that might expose what is otherwise hidden because of its threatening nature; that is, the latent content.

Here’s an example: A painter arrives at Freud’s office and recounts a dream in which his wife destroys the canvas he has been working on for weeks. Freud might suggest the brush used by the painter’s wife is a symbol of the painter’s fear of his mother controlling his sexual activity. But critics of Freud’s approach to dream analysis would note there are an infinite number of ways to interpret any dream (all impossible to prove wrong). For example, maybe the underlying conflict in the painter is the lack of control he feels about his own work. Either interpretation could be correct, or perhaps his disturbing dream was simply the result of indigestion.
ACTIVATION–SYNTHESIS MODEL  In contrast to Freud’s theory, the activation–synthesis model suggests that dreams have no meaning whatsoever (Hobson & McCarley, 1977). During REM sleep, the motor areas of the brain are inhibited (remember, the body is paralyzed), but sensory areas of the brain hum with the excitement of a great deal of neural activity. According to the activation–synthesis model, we respond to the random neural activity as if it has meaning. The brain tries to interpret this sensory excitement, which really is nothing more than neural chatter. This model suggests that our creative minds make up stories to match the neural activity. The brain is also trying to make sense of activity in the vestibular system, which is active during REM sleep. If the vestibular system is active while we are lying still, then the brain can interpret this as floating or flying—both common experiences reported by dreamers.

NEUROCOGNITIVE THEORY OF DREAMS  The neurocognitive theory of dreams proposes that a network of neurons exists in the brain, including some areas in the limbic system and the forebrain, that is necessary for dreaming to occur (Domhoff, 2001). People with damage to these areas of the brain either do not have dreams, or their dreams are not normal in some way. Another indication of the underlying neurocognitive nature of dreams is that children seem to develop the ability to dream, as their dreams are not like those of adults. For example, until children are around 13 to 15 years old, their reported dreams are less vivid and seem to have less of a story line. The underlying neural network must develop or mature before a child can dream like an adult. And as noted earlier, memory consolidation seems to be facilitated by sleep, with some theorists emphasizing the important role REM sleep plays in this process. The neurocognitive theory of dreams does not suggest, however, that dreams serve a purpose. Instead, they seem to be the result of how sleep and consciousness have evolved in humans (Domhoff, 2001).

Dream a Little Dream  Most dreams feature ordinary, everyday scenarios like driving or sitting in class. The content of dreams is repetitive and in line with what we think about when we are awake, and includes similar ideas about relationships, bad luck, people, and negative feelings. In fact, even over long periods of time and across cultures, the content of dreams is relatively consistent. Unfortunately, dreams are more likely to include sad events than happy ones. Despite popular assumptions, less than 12% of dream time is devoted to sexual activity (Yu & Fu, 2011). If you’re one of those people who believe they don’t dream, you are probably wrong. Most individuals who insist they don’t dream simply fail to remember their dreams. If you’re still skeptical, ask a bedmate to wake you next time it looks like you are in REM sleep (typical signs include eyes flitting side to side beneath the eyelids, and fingers and toes twitching). If awakened during a dream, you are more likely to be able to recall it at that moment than if asked to remember it at lunchtime. The ability to remember dreams is dependent on the length of time since the dream.

Most dreaming takes place during REM sleep and is jam-packed with rich sensory details and narrative. Dreams also occur during non-REM sleep, but they lack the vivid imagery and storylike quality of REM dreams. The average person starts dreaming about 90 minutes into sleep, then goes on to have about four to six dreams during the night. Add up the time and you get a total of about 1 to 2

CONNECTIONS  In Chapter 3 we discussed that the vestibular system is responsible for our balance. Accordingly, if this area of the nervous system is active while we are asleep, the sensations normally associated with this system when we are awake will be interpreted in a congruent manner.
hours of dreaming per night. Dreams happen in real time. In one early study investigating this phenomenon, researchers roused sleepers after they had been in a 5-minute REM cycle and again after a 15-minute REM cycle, asking them how long they had been dreaming (5 or 15 minutes). The majority of the participants—four out of five—gave the right answer (Dement & Kleitman, 1957).

Have you ever experienced the realization that you are in the middle of a dream? A **lucid dream** is a dream in which you are aware you are dreaming, and research suggests that about half of us have had one (Gackenbach & LaBerge, 1988). There are two parts to a lucid dream: the dream itself and the awareness that you are dreaming. Some suggest lucid dreaming is actually a way to direct the content of dreams (Gavie & Revonsuo, 2010), but this is a controversial claim because there is no way to confirm people’s subjective reports; dreams cannot be experienced by an outsider.

**French discourse, funny, frightening dreams can take many forms. Freud suggested that dreams unlock the mysteries of the unconscious mind. Contemporary scholars suspect that dreams are the result of neurocognitive activity. Others posit that dreams mean nothing and are merely the product of the brain’s efforts to make sense of the electrical traffic from sensory networks. What do dreams mean, and why do they happen? These are two of the great puzzles facing today’s psychologists. We know dreams represent a distinct state of consciousness, and consciousness is a fluid, ever-changing entity. But now it’s time to explore how consciousness transforms when chemicals are introduced into our bodies.**

**show what you know**

1. Freud believed dreams have two levels. The ________ refers to the apparent meaning of the dream, whereas the ________ refers to its hidden meaning.

2. According to the ________, dreams have no meaning whatsoever. Instead, the brain is responding to random neural activity as if it has meaning.
   a. psychoanalytic perspective
   b. neurocognitive theory
   c. activation–synthesis model
   d. evolutionary perspective

3. Your 6-year-old cousin does not have dreams with a true story line; her dreams seem to be fleeting images. This supports the neurocognitive theory of dreams, as does the fact that:
   a. until children are around 13 to 15 years old, their reported dreams are less vivid.
   b. dream content is not the same across cultures.
   c. children younger than 13 can report very complicated story lines from their dreams.
   d. dream content is the same for people, regardless of age.

4. What occurs in the brain when you dream?

**CHECK YOUR ANSWERS IN APPENDIX A.**

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**Altered States of Consciousness**

We have so far explored a range of levels of consciousness, from wide-awake to sound asleep. But we have not addressed states of consciousness that result from the influence of agents such as drugs and alcohol, or hypnosis. Let’s take a look now at these altered states.

**psychoactive drugs** Substances that can cause changes in psychological activities such as sensation, perception, attention, judgment, memory, self-control, emotion, thinking, and behavior; substances that cause changes in conscious experiences.

**depressants** A class of psychoactive drugs that depress or slow down activity in the central nervous system.

**DRUGS, DRUGS, EVERYWHERE** You awake in the middle of the night with a dull pain around your belly button. By morning, the pain is sharp and stabbing and has migrated to your lower right abdomen, so you head to the local emergency room where doctors diagnose you with appendicitis, an inflammation of the appendix often caused by infection. You need an emergency operation to remove your appendix, and a strong anesthetic is in order: a combination of drugs to paralyze the abdominal muscles, dull the pain, and wipe out your memory of the procedure. Dr. Julien, introduced at the start of the chapter, is your anesthesiologist.
For paralysis, Dr. Julien would probably give you a drug similar to curare, an arrowhead poison used by South American natives. Curare works by blocking the activity of the neurotransmitter called acetylcholine, which stimulates muscle contractions in the body. But curare does not cross into the brain, and therefore it does not have the power to transport you to another level of consciousness (Czarnowski, Bailey, & Bal, 2007). If curare were the only drug Dr. Julien administered, you would be lying on the operating table paralyzed yet completely awake and aware of your pain—not a pleasant scenario.

**LO 8** Define psychoactive drugs.

**PSYCHOACTIVE DRUGS** To dull the perception of pain, Dr. Julien might administer Fentanyl, which belongs to a class of drugs called opioids that we will soon discuss. And to stamp out your memory of the surgery, he would lull you into a sleep-like stupor with a drug such as Propofol and then maintain that state of sleep with other drugs. One moment you are awake, sensing, perceiving, thinking, and talking. The next moment you see nothing, hear nothing, feel nothing. It’s like you are gone. Fentanyl and Propofol are considered psychoactive drugs because the chemicals in these drugs can cause changes in psychological activities such as sensation, perception, attention, judgment, memory, self-control, emotion, thinking, and behavior—all of which may be associated with our conscious experiences.

You don’t need to visit the hospital to have a psychoactive drug experience. Mind-altering drugs are everywhere—in the coffee shop around the corner, at the liquor store down the street, and probably in your own kitchen. About 90% of people in the United States regularly use caffeine, a psychoactive drug found in coffee, soda, tea, and medicines (Alpert, 2012; Gurpegui, Aguilar, Martínez-Ortega, Díaz, & de Leon, 2004). Trailing close behind caffeine are alcohol (found in beer, wine, and liquor) and nicotine (in cigarettes and other tobacco products), two substances that present serious health risks. Another huge category of psychoactive drugs is prescription medications—drugs for pain relief, depression, insomnia, and just about any ailment you can imagine. Don’t forget the illicit, or illegal, drugs like LSD and Ecstasy. About a third of Americans aged 12 and older have tried an illicit drug at least once in their lifetime, and some 11% have used drugs in the past year, according to reported estimates (Substance Abuse and Mental Health Services Administration [SAMHSA], 2008).

Psychoactive drugs alter consciousness in an untold number of ways. They can rev you up, slow you down, let down your inhibitions, and convince you that the universe is on the verge of collapse. We will discuss the three major categories of psychoactive drugs—stimulants, depressants, and hallucinogens—but keep in mind that some drugs fall into more than one group.

**Depressants**

**LO 9** Identify several depressants and stimulants and their effects.

In his 25 years as an anesthesiologist, Dr. Julien has primarily relied on a group of psychoactive drugs that depress activity in the central nervous system, or slow things down. For this reason, we call them depressants. Dr. Julien sometimes premedicates patients, administering drugs to calm them while they wait to be wheeled into the operating room. For this purpose, he might use a benzodiazepine, which would act as a tranquilizer—a type of depressant that has a calming, sleep-inducing effect. Other
Once a patient is in the operating room and ready for surgery, consciousness is regained. Recall from the beginning of the chapter that the brain continues to function during anesthesia. Depressant drugs that minimize perceptions of pain include barbiturates, a class of psychoactive drugs that decreases neural activity. In low doses, barbiturates cause many of the same effects as alcohol—relaxation, lowering of spirits, or alternatively, aggression (Julien et al., 2011)—which may explain why they have become so popular among recreational users. But these substances are addictive and extremely dangerous when taken in excess or mixed with other drugs. If barbiturates are taken alongside alcohol, for example, the muscles of the diaphragm may relax to the point of suffocation (INFOGRAPHIC 4.3).

OPIOIDS Recall from the beginning of the chapter that the brain continues to function during anesthesia. Without proper painkilling drugs, these signals can give rise to what Dr. Julien calls “autonomic instability,” a disruption of heart rate, blood pressure, and other activities regulated by the autonomic nervous system. One way to maintain autonomic stability is to give the patient an opioid, a drug that minimizes the brain’s perception of pain. “Opioid” is an umbrella term for a large group of similarly acting drugs, some found in nature and others concocted in laboratories (synthesized replacements such as methadone). Opioids block pain, induce drowsiness and euphoria, and slow down breathing (Julien et al., 2011). There are two types of naturally occurring opioids: the endorphins produced by your body, and the opiates found in the opium poppy. The poppy-derived opioid morphine alleviates patients’ pain. Morphine is also the raw material used in making the street drug heroin, which enters the brain more quickly and has 3 times the strength (Julien et al., 2011).

PRESCRIPTION DRUG ABUSE Few people in the United States actually use heroin (less than 1%), and some studies suggest that number is decreasing. But another class of opioids appears to be taking its place—synthetic painkillers such as Vicodin (hydrocodone) and OxyContin (oxycodone; Fischer & Rehm, 2007; SAMHSA, 2010). Unlike heroin, these medications are legally manufactured by drug companies and legitimately prescribed by physicians. Intentionally using a medication without a doctor’s approval can lead to prescription drug abuse, and this behavior is shockingly common among teenagers, who are more vulnerable to becoming hooked or addicted (Zhang et al., 2009). Prescription drug abuse can also occur when a medication is used in a way that is not prescribed by a doctor (for example, taking too much of a medication). Nearly 1 in 10 high school seniors in the United States has abused Vicodin, and 1 in 20 has abused OxyContin. Over half report getting such prescription meds from friends and relatives (National Institute on Drug Abuse, 2011). Opioid abuse is an epidemic among high school students, and many don’t understand how easy it is to become tolerant of these drugs. Sadly, drug overdose deaths recently surpassed the number of deaths resulting from car accidents in the United States (Moisse, 2011, September 20).

barbiturate Depressant drug that decreases neural activity and reduces anxiety; a type of sedative.
opioids A class of psychoactive drugs that minimizes perceptions of pain.
opiates A class of psychoactive drugs that cause a sense of euphoria; a drug that imitates the endorphins naturally produced in the brain.
Alcohol activates the same receptors, increasing GABA’s activity. When two drugs work on the same system, their effects can be additive, greatly increasing the risk of overdose. For example, alcohol and barbiturates both bind to GABA receptors. GABA’s inhibitory action has a sedating effect, which is a good thing when you need to relax. But too much GABA will relax physiological processes to the point where unconscious, life-sustaining activities shut down, causing you to stop breathing and die.

Hundreds of deaths are caused annually in the U.S. when drugs like alcohol and barbiturates are taken in combination (Kochanek, et al., 2012). In 2009 alone, 519,650 emergency room visits were attributed to use of alcohol in combination with other drugs (SAMHSA, 2010).

GABA activation, which calms nervous system activity, is essential for proper functioning of the central nervous system. Without GABA, nerve cells fire too frequently.

When systems are functioning normally, GABA’s inhibitory signals perfectly balance excitatory signals in the central nervous system (CNS). This results in regular breathing and heart rate.

When alcohol increases GABA’s inhibitory signals, excitatory and inhibitory signals in the CNS are out of balance. Along with increased relaxation, heart and breathing rates decrease. Increasing levels of alcohol could eventually lead to stupor and coma.

Together, alcohol and barbiturates further unbalance excitatory and inhibitory signals, suppressing heart rate and the impulse to breathe.
Alcohol

We end our coverage of depressants with alcohol, which, like other drugs in its class, has played a central role in the history of anesthesia. The ancient Greek doctor Dioscorides gave his surgical patients a special concoction of wine and mandrake plant (Keys, 1945), and 19th-century Europeans used an alcohol-opium mixture called laudanum for anesthetic purposes (Barash, Cullen, Stoelting, & Cahalan, 2009). These days, you won’t find anesthesiologists knocking out patients with alcohol, but you will encounter plenty of people intoxicating themselves.

BINGE DRINKING  Alcohol is the most commonly used depressant in the United States. Around 15% of adults and 25% of teenagers report that they binge drink (consuming four or more drinks for women and five or more for men, on one occasion or within a short time span) at least once a month (Naimi et al., 2003; Wen et al., 2012). Many people think binge drinking is fun, but they might change their minds if they read the research. Studies have linked binge drinking to poor grades, aggressive behavior, sexual promiscuity, and accidental death. In 2005 almost 2,000 college students in the United States died in alcohol-related accidents (Hingson, Zha, & Weitzman, 2009). Think getting wasted is sexy? Consider this: Alcohol impairs sexual performance, particularly for men, who may have trouble obtaining and sustaining an erection.

You don’t have to binge drink in order to have an alcohol problem (Figure 4.1). Some people cannot get through the day without a midday drink; others need alcohol to unwind or fall asleep. The point is there are many forms of alcohol misuse. About 8.5% of the adult population in the United States (nearly 1 in 10 people) struggles with alcohol dependence or some other type of drinking problem (Grant et al., 2004). Drinking can destroy families, careers, and human life.
ALCOHOL AND THE BODY  Let’s stop for a minute and examine how alcohol influences consciousness (Figure 4.1). People sometimes say they feel “high” when they drink. How can such a statement be true when alcohol is a depressant, a drug that slows down activity in the central nervous system? Alcohol boosts the activity of GABA, a neurotransmitter that dampens activity in certain neural networks, including those that regulate social inhibition—a type of self-restraint that keeps you from doing things you will regret the next morning. It is this release of social inhibition that can lead to feelings of euphoria. Drinking affects other conscious processes, such as reaction time, balance, attention span, memory, speech, and involuntary life-sustaining activities like breathing (Howland et al., 2010; McKinney & Coyle, 2006). Drink enough, and these vital functions will shut down entirely, leading to coma and even death.

The female body is less efficient at breaking down (metabolizing) alcohol. Even when we control for body size and the muscle-to-fat ratio, we see that women achieve higher blood alcohol levels (and thus a significantly stronger “buzz”) than men who have consumed equal amounts. Why? Because men have more of an alcohol-metabolizing enzyme in their stomachs, which means they start to break down alcohol almost immediately after ingestion. In a woman, most of the alcohol clears the stomach and enters the bloodstream and brain before the liver finally breaks it down (Toufexis, 2001).

THE CONSEQUENCES OF DRINKING  Light alcohol consumption by adults—one to two drinks of wine, beer, or liquor a day—may have some cardiovascular and cognitive benefits (Cervilla, Prince, Joels, Lovestone, & Mann, 2000; Mukamal, Maclure, Muller, Sherwood, & Mittleman, 2001). Excessive drinking, on the other hand, is associated with a host of health problems. Overuse of alcohol can lead to malnourishment, cirrhosis of the liver, and Wernicke–Korsakoff Syndrome, which can include symptoms such as confusion and memory problems. It has also been linked to heart disease, various types of cancer, tens of thousands of traffic deaths every year, and fetal-alcohol syndrome in children with mothers who drank during pregnancy. Deaths due to overuse of alcohol, numbering about 75,000 annually, are the third most common type of preventable death in the United States (Centers for Disease Control and Prevention [CDC], 2004; Mokdad, Marks, Stroup, & Gerberding, 2004). Read through Figure 4.2 for some warning signs of problematic drinking.

Stimulants and Hallucinogens

Not all drugs used in anesthesia are depressants. Did you know that some doctors use cocaine as a local anesthetic for nose and throat surgeries (Simmer, 2012)? Cocaine is a stimulant—a drug that increases neural activity in the central nervous system, producing effects such as heightened alertness, energy, and an elevated mood (Julien et al., 2011). When applied topically, cocaine blocks sensation in the peripheral nerves and thereby numbs the area.

Binge Drinking

Binge drinking has been associated with reduced mental and physical health. This effect appears to intensify with increasing levels of alcohol ingestion (Wen et al., 2012). ©Pascal Deloche/GODONG/Godong/Corbis

FIGURE 4.2
Warning Signs of Problematic Drinking

The presence of one or more of these warning signs could indicate a developing problem with alcohol. Sources: American Psychological Association, 2012; NIH, National Institute on Alcohol Abuse and Alcoholism, 2013.

• Having your friends or relatives express concern.
• Becoming annoyed when people criticize your drinking behavior.
• Feeling guilty about your drinking behavior.
• Thinking you should drink less but being unable to do so.
• Needing a morning drink as an “eye-opener” or to relieve a hangover.
• Not fulfilling responsibilities at work, home, or school because of your drinking.
• Engaging in dangerous behavior (like driving under the influence).
• Having legal or social problems due to your drinking.

Cocaine in Cola

The original recipe for Coca Cola included cocaine, but the company removed the drug from its cola in 1900, one year before the city of Atlanta banned its nonprescription use (Musto, 1991). ©Bettmann/CORBIS
COCAINE  The first to tap into cocaine’s pain-zapping potential were the ancient Peruvians, who chewed the leaves of the coca plant (which contain about 1% cocaine) and then applied their saliva to surgical incisions. The coca plant, they believed, was a divine gift; chewing the leaves quenched their hunger, lifted their sadness, and restored their energy. Thousands of years later, in 1860, a German chemist named Albert Niemann extracted the active ingredient in the coca leaf and dubbed it “cocaine” (Julien et al., 2011; Keys, 1945). Within a few decades doctors were using cocaine for anesthesia, Sigmund Freud was giving it to patients (and himself), and Coca-Cola was putting it in soda (Keys, 1945; Musto, 1991).

While cocaine is illegal in the United States and most other countries, it is among the most widely used illicit drugs. Depending on the form in which it is prepared (powder, rocks, and so on), it can be snorted, injected, or smoked. The sense of energy, euphoria, and other alterations of consciousness that cocaine induces after entering the bloodstream and infiltrating the brain last anywhere from 5 to 30 minutes (National Institute on Drug Abuse, 2010a). Cocaine produces a rush of pleasure and excitement by amplifying the effects of dopamine and norepinephrine. But the coke high comes at a steep price. Any time you take cocaine, you put yourself at risk for suffering a stroke or heart attack, even if you are young and healthy. Cocaine is implicated in more emergency room visits than any other illegal drug (Drug Abuse Warning Network, 2009). It is also extremely addictive. Many users find they can never quite duplicate the high they experienced the first time, so they take increasingly higher doses, developing a physical need for the drug, increasing their risk of effects such as anxiety, insomnia, and schizophrenia-like psychosis when they stop using it (Julien et al., 2011).

Cocaine use grew rampant in the 1980s. That was the decade crack—an ultra-potent (and ultra-cheap) crystalline form of cocaine—began poisoning America’s inner cities. Although cocaine is still a major problem, another stimulant has come to rival it in popularity—one that is ridiculously cheap, easy to make, and capable of producing a 24-hour high or euphoric rush—methamphetamine.

AMPHETAMINES Methamphetamine belongs to a family of stimulants called the amphetamines. Doctors used amphetamines to treat medical conditions as diverse as head injury and excessive hiccups in the 1930s and 1940s (Julien et al., 2011). Methamphetamine was once used by soldiers and factory workers during World War II for energy and to enhance performance (Lineberry & Bostwick, 2006). Nonprescription use of methamphetamine is illegal, but people have learned how to brew it in their own laboratories, using ingredients from ordinary household products such as over-the-counter cough medicines, drain cleaner, and battery acid. “Cooking meth” is a dangerous enterprise. The flammable ingredients, combined with the reckless mentality of “tweaking” cooks, make for toxic fumes and thousands of accidental explosions every year (Lineberry & Bostwick, 2006). Despite the enormous risk, many people continue to cook meth at home, endangering and sometimes killing their own children.

Methamphetamine stimulates the release of the brain’s pleasure-producing neurotransmitter dopamine, causing a surge in energy and alertness similar to a cocaine high. It also tends to increase one’s sex drive and suppress appetite. But unlike cocaine, which the body eliminates quickly, meth lingers in the body (National Institute on Drug Abuse, 2006). Brain imaging studies show that chronic meth use causes serious brain damage in the frontal lobes and other areas, still visible even among those who have been clean for 11 months. This may explain why so many meth users suffer from lasting memory and movement problems (Krasnova & Cadet, 2009; Volkow et al., 2001). Other severe consequences of meth use include extreme weight loss; tooth decay

Synonyms
methamphetamine  meth, crystal meth, crank
amphetamines  speed, uppers, bennies

amphetamines  Stimulant drugs, also referred to as speed, uppers, or bennies; methamphetamine falls in this class of drugs.
CAFFEINE  Most people have not experimented with illegal stimulants like cocaine and meth, but many have used caffeine. We usually associate caffeine with beverages like coffee, but this pick-me-up drug also lurks in places you wouldn’t expect, such as in over-the-counter cough medicines, chocolate, and face creams. Caffeine works by blocking the action of adenosine, a neurotransmitter that normally mutes the activity of excitatory neurons in the brain (Julien et al., 2011). By interfering with adenosine’s calming effect, caffeine makes you feel physically and mentally wired. A cup of coffee might help you stay up later, exercise longer and harder, and get through more pages in your textbooks. Moderate caffeine use (up to four cups of coffee per day) has been associated with increased alertness, enhanced recall ability, elevated mood, and greater endurance during physical exercise (Ruxton, 2008). Some studies have also linked moderate long-term consumption with lower rates of depression and suicide, and even reduced cognitive decline with aging (Lara, 2010; Rosso, Mossey & Lippa, 2008).

With all these promising data about caffeine, you may feel like running to your local coffee shop to order a triple-shot latte. But just because researchers find a link, for example, between caffeine and positive health outcomes, we should not necessarily conclude that caffeine is responsible for it. Maybe people who have a low risk for depression and dementia also enjoy drinking coffee. Or perhaps coffee drinkers are more likely to engage in regular exercise, an activity linked to improved mood and cognition. Remember, correlation does not prove causation. What’s more, too much caffeine can make your heart race, your hands tremble, and your mood turn sour and irritable. It takes several hours for your body to metabolize, or break down, caffeine, so a late afternoon mocha latte may still be present in your system as you lie in bed at midnight counting sheep—with no luck.

TOBACCO  What do you think is the number one cause of premature death worldwide—AIDS, illegal drugs, road accidents, murder, suicide? None of the above (FIGURE 4.3). Tobacco causes more deaths than any of these other factors combined (BBC News, 2010; World Health Organization [WHO], 2008). The use of cigarettes (”meth mouth”); psychosis with hallucinations that can come and go for months, if not years, after quitting; and sudden death (National Institute on Drug Abuse, 2006).
and other tobacco products claims 5 million lives every year, and half a million in the United States alone (Kasisomayajula et al., 2010). Smoking can lead to lung cancer, emphysema, heart disease, and stroke (CDC, 2008). The average smoker loses approximately 10 to 15 years of her life.

Despite these harrowing statistics, about 1 in 5 adults in the United States continues to light up (CDC, 2010). They say it makes them feel relaxed yet more alert, less hungry, and more tolerant of pain. And those who try to kick the habit find it exceedingly difficult to do so. Cigarettes and other tobacco products contain a highly addictive stimulant called nicotine, which sparks the release of epinephrine and norepinephrine. Nicotine use appears to be associated with activity in the same brain area that is activated with cocaine, another drug that is also extremely difficult to give up (Pich et al., 1997; Zhang, Dong, Doyon, & Dani, 2012). The few who do succeed face a steep uphill battle. Around 90% of quitters relapse within 6 months (Nonnemaker et al., 2011), suggesting that relapse is a normal experience when quitting, not a sign of failure.

Smoking is not just a problem for the smoker. It is a problem for spouses, children, friends, and anyone who is exposed to the secondhand smoke. Secondhand smoke is particularly dangerous for children, whose developing tissues are especially vulnerable (Chapter 8). By smoking, parents increase their children’s risk for sudden infant death syndrome (SIDS), respiratory infections, asthma, and lung cancer (CDC, 2012). Secondhand smoke contributes to 21,400 lung cancer deaths and 379,000 heart disease deaths worldwide (Öberg, Jaakkola, Woodward, Peruga, & Prüss-Ustün, 2011), and according to the Centers for Disease Control and Prevention (2012), “There is no risk-free level of exposure” (p. 1). In recent years, researchers have also become concerned about the health implications of thirdhand smoke, the combination of cigarette toxins (including lead, which is a known neurotoxin) that linger in rooms, elevators, and other small spaces long after a smoker has left the scene. Thirdhand smoke is what you smell when you walk into a hotel room and think, “Hmm, someone’s been smoking in here” (Winickoff et al., 2009).

**LO 10** Discuss some of the hallucinogens.

We have learned how various depressants and stimulants are used in anesthesia. Believe it or not, there is also a place for **hallucinogens**—drugs that produce hallucinations (sights, sounds, odors, or other sensations of things that aren’t actually present), altered moods, and distorted perception and thought. Phencyclidine (PCP or angel dust) and ketamine (Special K) are sometimes referred to as psychedelic anesthetics because they were developed to block pain and memory in surgical patients during the 1950s and 1960s (Julien et al., 2011). PCP is highly addictive and extremely dangerous. Because users cannot feel normal pain signals, they run the risk of unintentionally harming or killing themselves. Long-term use can lead to depression and memory impairment. The milder of the two, ketamine, continues to be used in hospitals, but PCP was abandoned long ago. Its effect was just too erratic. **LSD**

The most well-known hallucinogen is probably **lysergic acid diethylamide (LSD)**—the odorless, tasteless, and colorless substance that produces extreme changes in sensation and perception. People using LSD may report seeing “far out” colors and visions of spirals and other geometric forms. Some people experience a crossover of sensations, “tasting sound” or “hearing colors.” Emotions run wild and bleed into one another; the person “tripping” can quickly flip between depression and joy, excitement and terror (Julien et al., 2011). Trapped on this sensory and emotional roller coaster, some people panic and injure themselves. Others believe that LSD opens their minds, offers new insights, and expands their consciousness. The outcome of a “trip” depends a great deal on the environment and people who

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**Synonyms**

*secondhand smoke* passive smoke

*hallucinogens* psychedelic drugs

**hallucinogens** A group of psychoactive drugs that can produce hallucinations (auditory, visual, or kinesthetic), distorted sensory experiences, alterations of mood, and distorted thinking.

**lysergic acid diethylamide (LSD)** A synthetically produced, odorless, tasteless, and colorless hallucinogen that is very potent; produces extreme changes in sensations and perceptions.

**methylenedioxymethamphetamine (MDMA)** A synthetic drug chemically similar to the stimulant methamphetamine and the hallucinogen mescaline; produces a combination of stimulant and hallucinogenic effects.
are there. LSD is not often overused, and its reported use has remained at an all-time low (Johnston, O’Malley, Bachman, & Schulenberg, 2012). Long-term use may be associated with depression and other psychological problems, including flashbacks that can occur weeks, months, or years after taking the drug. Fatigue, stress, and illness may trigger flashbacks (Thurlow & Girvin, 1971).

**MDMA** In addition to the traditional hallucinogens, there are quite a few “club drugs,” or synthetic “designer drugs,” used at parties, raves, and dance venues. The most popular among them is methylendioxymethamphetamine (MDMA), commonly known as Ecstasy. Ecstasy is chemically similar to the stimulant methamphetamine and the hallucinogen mescaline, and thus produces a combination of stimulant and hallucinogenic effects (Barnes et al., 2009; National Institute on Drug Abuse, 2010b).

An Ecstasy trip might bring on feelings of euphoria, love, openness, heightened energy, and floating sensations, as well as intense anxiety and depersonalization, with the user feeling like a detached spectator, watching himself from the outside without having any control. Ecstasy can also cause a host of changes to the body, including decreased appetite, lockjaw, blurred vision, dizziness, rapid heart rate, and dehydration (Gordon, 2001, July 5; Noller, 2009). Dancing in hot, crowded conditions while on Ecstasy can lead to severe heat stroke, seizures, even cardiac arrest and death (Parrott, 2004). Every year, thousands of Ecstasy users leave raves and all-night parties in ambulances. Between 2004 and 2009, the number of emergency room visits associated with the drug climbed by 123% (Drug Abuse Warning Network, 2009). Despite its dangers, Ecstasy is still a popular illicit drug (SAMHSA, 2012).

Ecstasy triggers a sudden general unloading of serotonin in the brain, after which serotonin activity is depleted until the neurotransmitters’ levels are restored (Klugman & Gruzelier, 2003). Studies of animals have shown that even short-term exposure to MDMA can cause long-term, perhaps even permanent, damage to the brain’s serotonin pathways, and there is mounting evidence that a similar type of damage in reuptake from the synapse and storage of serotonin occurs in humans as well (Campbell & Rosner, 2008; Reneman et al., 2001; Ricaurte & McCann, 2001). One study found evidence that women’s brains are more susceptible to Ecstasy damage than men’s, but larger studies are needed to confirm this finding (Reneman et al., 2001). The growing consensus is that even light-to-moderate Ecstasy use can handicap the brain’s memory system, and heavy use may impair higher-level cortical functions, such as planning for the future and shifting attention (Klugman & Gruzelier, 2003). Studies also suggest that Ecstasy users are more likely to experience symptoms of depression (Guillot, 2007).

**MARIJUANA** We end our discussion with the most widely used illegal (in most states) drug, and one of the most popular in all the Western world: marijuana (Compton, Grant, Colliver, Glantz, & Stinson, 2004; SAMHSA, 2008). Forty-two percent of American teenagers have already tried marijuana by the time they graduate from high school (National Institute on Drug Abuse, 2010c). Attitudes tend to be more casual about marijuana than other illegal drugs. “It’s no big deal,” a user might say, “you can’t get addicted.” But these kinds of assumptions are misleading. Recent studies suggest that marijuana use can lead to dependence, memory impairment, and deficits in attention and learning (Harvey, Sellman, Porter, & Frampton, 2007; Kleber & DuPont, 2012). Others identify it as a cause of some chronic psychological disorders (Reece, 2009). The long-term use of marijuana has also been associated with reduced motivation (Reece 2009), and linked to respiratory problems, impaired lung functioning, and suppression of the immune system (Iversen, 2003; Pletcher et al., 2012). In addition, the smoke from marijuana contains 50 to 70% more cancer-causing hydrocarbons than tobacco (Kothadia et al., 2012). Smoking marijuana also causes a temporary dip in sperm production and a greater proportion of abnormal sperm (Brown & Dobs, 2002).
Marijuana comes from the hemp plant Cannabis sativa, which has long been used as—surprise—an anesthetic. The 3rd-century Chinese physician Hua T’o reportedly used hemp to put his patients to sleep before performing surgery (Keys, 1945). These days, doctors prescribe marijuana to stimulate patients’ appetite and suppress nausea, but its medicinal use is not without debate. Studies suggest that marijuana does effectively reduce the nausea and vomiting linked to chemotherapy (Grotenhermen & Müller-Vahl, 2012; Iversen, 2003), but there is conflicting evidence about its long-term effects on the brain (Schreiner & Dunn, 2012).

Marijuana’s active ingredient is tetrahydracannabinol (THC), which toys with consciousness in a variety of ways, making it hard to classify the drug into a single category (for example, stimulant, depressant, or hallucinogen). In addition to altering pain perception, THC can induce mild euphoria, and create intense sensory experiences and distortions of time. At higher doses, THC may cause hallucinations and delusions (Murray, Morrison, Henquet, & Di Forti, 2007).

Some of marijuana’s effects linger long after the initial high is over. Impairments in learning and memory may persist for days in adults (weeks for adolescents), and long-term use may lead to addiction (National Institute on Drug Abuse, 2010c; Schweinsburg, Brown, & Tapert, 2008).

Overuse and Addiction

We often joke about being “addicted” to our coffee or soda, but do we understand what this really means? Historically, the term addiction has been used (both by laypeople and professionals) to refer to the urges people experience for using a drug or engaging in an activity to such an extent that it interferes with their functioning or may even be dangerous (see Figure 4.4 on drug dependence in the United States). This could mean a gambling habit that depletes your bank account, a sexual appetite that destroys your marriage, or perhaps even a social media fixation that prevents you from holding down a job. It is important to note the term addiction has been omitted from the American Psychiatric Association’s diagnostic manual due to its “uncertain definition and potentially negative connotation” (APA, 2013, p.485).

Can’t Get Enough

Is it difficult for you to sit through a movie without checking your Twitter “Mentions”? Are you constantly looking at your Facebook News feed in between work e-mail? Do you sleep with your iPhone? If you answered “yes” to any of the above, you are not alone. People around the world, from Indonesia to the United Kingdom, are getting hooked on social media—so hooked in some cases that they are receiving treatment for social media addiction (Maulia, 2013, February 15; NBC Universal, 2013, February 12).

Facebook and Twitter may be habit forming, but you would think these sites would be easier to resist than, say, coffee or cigarettes. Such is not the case, according to one recent study. With the help of smartphones, researchers kept tabs on the daily desires of 205 young adults and found the urge to use media was harder to resist than sex, spending money, alcohol, coffee, or cigarettes (Hofmann, Vohs, & Baumeister, 2012). These findings are thought provoking, and this line of research is one to follow, but don’t allow one study to minimize the serious and long-standing issue of drug addiction. The American Psychiatric Association (2013) does not consider behavioral additions as mental disorders. Further, the National Institute on Drug Abuse (2009) defines addiction to drugs, in particular, as “a chronic, relapsing disease characterized by compulsive drug seeking and abuse and by long-lasting neurochemical and molecular changes in the brain” (p. 1). You read it right: Substance use changes your brain.
PHYSIOLOGICAL AND PSYCHOLOGICAL DEPENDENCE Substance use can be fueled by both physiological and psychological dependence. **Physiological dependence** means the body no longer functions normally without the drug. Want to know if you are physiologically dependent on your morning cup of Joe? Try removing it from your routine for a few days and see if you get a headache or feel fatigued. If your answers are yes and yes, odds are that you have experienced withdrawal, a sign of physiological dependence. Withdrawal is the constellation of symptoms that surface when a drug is removed or withheld from the body, and it’s not always as mild as a headache and fatigue. An alcoholic who suddenly stops drinking (or significantly cuts down) may suffer from **delirium tremens (DTs)**, withdrawal symptoms that include sweating, restlessness, hallucinations, severe tremors, and seizures. Withdrawal symptoms disappear when you take the drug again, and because the symptoms do go away, you are more likely to continue using the drug. The removal of the unpleasant symptoms acts as negative reinforcement for taking the drug (Chapter 5). In this way, withdrawal powers the addiction cycle.

Another sign of physiological dependence is **tolerance**. Persistent drug and alcohol use alters the chemistry of the brain and body. Over time, your system adapts to the drug and therefore needs more and more of the substance to re-create the original effect. If it once took you two beers to unwind, but now takes four, then tolerance has probably set in. Tolerance increases the risk for accidental overdose, because more drug is needed to obtain the desired effect.

**Psychological dependence** occurs without the evidence of tolerance or withdrawal symptoms, but is indicated by many other problematic symptoms. Individuals with psychological dependence believe, for example, they need the drug because it will increase their emotional or mental well-being. The “pleasant” effects of a drug can act as positive reinforcement for taking the drug (Chapter 5). Let’s say a smoker has a cigarette, fulfilling her physical need for nicotine. If the phone rings, she might answer it and light up a cigarette, because she has become accustomed to smoking and talking on the phone at the same time. It is an urge or craving, not a physical need. The cues associated with using the telephone facilitated the smoker’s urge to light up (Bold, Yoon, Chapman, & McCarthy, 2013).

Psychologists and psychiatrists have developed specific criteria for drawing the line between use and overuse. Overuse is maladaptive and causes significant impairment.
or distress to the user and/or his family: problems at work or school, neglect of children or household duties, physically dangerous behaviors, and so forth. In addition, the behavior has to be sustained for a certain period of time (that is, over a 12-month period). The American Psychiatric Association (2013) has established these criteria to help professionals distinguish between drug use and substance use disorder.

Depressants, stimulants, hallucinogens, marijuana—every drug we have discussed, and every drug imaginable—must gain entrance to the body in order to access the brain. Some are inhaled, others snorted or injected directly into the veins, all altering the state of consciousness of the user (Table 4.4). But is it possible to enter an altered state of consciousness without using a substance? It is time to explore hypnosis.

Hypnosis

LO 12 Describe hypnosis and explain how it works.

Ask mothers to report their most physically painful experience, and the odds are fairly good that they will say childbirth. Some women welcome the pain of labor, viewing it as a rite of passage into motherhood. Others opt for some form of pain management, often taking drugs. Some choose meditation, a form of relaxation, which has been associated with a reduction in “negative” emotions (Chapter 12). Many women choose deep-breathing. Some even call upon the use of hypnosis.

There is research suggesting that hypnosis does ease the pain associated with childbirth and surgery, reducing the need for painkillers (Cyna, McAuliffe, & Andrew, 2004;
Wobst, 2007). With the help of PET scans, some researchers have found evidence that hypnosis induces changes in the brain that might explain this diminished pain perception (Faymonville et al., 2000; Rainville, Duncan, Price, Carrier, & Bushnell, 1999). Dr. Julien agrees that hypnosis, meditation, and other relaxation techniques may indeed reduce anxiety and pain, but only to a certain extent. So if you plan to go under the knife with hypnosis as your sole form of pain management, don’t be surprised if you feel the piercing sensation of the scalpel.

The term hypnosis was taken from the Greek root word for “sleep,” but it is by no means the equivalent of sleep. Most would agree hypnosis is an altered state of consciousness that allows for changes in perceptions and behaviors, which result from suggestions made by the hypnotist. “Changes in perceptions and behaviors” can mean a lot of things, of course, and there is some debate about what hypnosis is. Before going any further, let’s be clear about what hypnosis isn’t.

CONTROVERSIES

False Claims About Hypnosis

- People can be hypnotized without consent: You cannot force someone to be hypnotized; they must be willing.
- Hypnotized people will act against their own will: Stage hypnotists seem to make people walk like chickens or miscount their fingers, but these are things they would likely be willing to do when not hypnotized.
- Hypnotized people can exhibit “superhuman” strength: Hypnotized or not, people have the same capabilities (Druckman & Bjork, 1994). Stage hypnotists often choose feats that their hypnotized performers could achieve under normal circumstances.
- Hypnosis helps people retrieve lost memories: Studies find that hypnosis may actually promote the formation of false memories and one’s confidence in those memories (Kihlstrom, 1985).
- Hypnotized people experience age regression. In other words, they act childlike: Hypnotized people may indeed act immaturely, but the underlying cognitive activity is that of an adult (Nash, 2001).
- Hypnosis induces long-term amnesia: Hypnosis cannot make you forget your first day of kindergarten or your wedding. Short-term amnesia is possible if the hypnotist specifically suggests that something will be forgotten after the hypnosis wears off.

Now that some misconceptions about hypnosis have been cleared up, let’s focus on what we know. Researchers propose the following characteristics are evident in a hypnotized person: (1) ability to focus intently, ignoring all extraneous stimuli; (2) heightened imagination; (3) an unresisting and receptive attitude; (4) decreased pain awareness; (5) high responsivity to suggestions (Kosslyn, Thompson, Costantini-Ferrando, Alpert, & Spiegel, 2000; Silva & Kirsch, 1992).

Does this process have any application to real life? With some limited success, hypnosis has been used therapeutically to treat phobias and commercially to help people change lifestyle habits (Green, 1999; Kraft, 2012). Hypnosis can also be used to reduce headaches and other pains associated with stress (Patterson & Jensen, 2003). Athletes use self-hypnosis to improve performance.

Imagine you are using hypnosis for one of these purposes, headaches, for example. How would a session with a hypnotist proceed? Probably something like this: The hypnotist talks to you in a calm, quiet voice, running through a list of suggestions on how to relax. She might suggest that you sit back in your chair and choose a place to
focus your eyes. Then she quietly suggests that your eyelids are starting to droop, and you feel like you need to yawn. You grow tired and more relaxed. Your breathing slows. Your arms feel so heavy that you can barely lift them off the chair. Or the hypnotist might suggest that you are going down steps, and ask you to focus attention on her voice. Hypnotists who are very good at this procedure can do an induction in less than a minute, especially if they know the individual being hypnotized.

Once you are in this altered state of consciousness, you may be open to suggestion. If, say, the hypnotist suggested you could not lift your feet off the ground, then you might actually feel this way. Or if she suggested that you will not remember your own middle name after coming out of hypnosis, this posthypnotic suggestion may very well play out.

People in hypnotic states sometimes report having sensory experiences that deviate from reality; they may, for example, see or hear things that are not there. In a classic experiment, participants were hypnotized to believe they wouldn’t experience pain when asked to place one hand in a container filled with ice-cold water. With their other hand, they were asked to press a button if they experienced pain. Amazingly, the participants reported feeling no pain. However, they actually did press the button indicating pain during their hypnotic session (Hilgard, Morgan, & Macdonald, 1975). This suggests a “divided consciousness,” that is, part of our consciousness is always aware, even when hypnotized and instructed to feel no pain. People under hypnotic states can also experience temporary blindness and deafness.

THEORIES OF HYPNOSIS There are many theories to explain hypnosis. According to Hilgard (1977, 1994), hypnotized people experience a “split” in awareness, or consciousness. There is an ever-present hidden observer that oversees the events of our daily lives. You are listening to a boring lecture, picking up a little content here and there, but also thinking about that juicy gossip you heard before class. Your mind is working on different levels, and the hidden observer is keeping track of everything. In a hypnotic state, the hidden observer is still aware of what is transpiring in the environment, while another stream of mental activity focuses on the hypnotic suggestions.

Others have suggested that hypnosis is not a distinct state of consciousness, but more of a role-playing exercise. Have you ever watched a little boy pretend he was a firefighter? He becomes so enthralled in his play that he really believes he is a firefighter. His tricycle is now his fire engine; his baseball cap his firefighter’s hat. He is the firefighter. Something similar happens when we are hypnotized. We have an expectation of how a hypnotized person should act or behave; therefore, our hypnotized response is nothing more than the role we think we should take on. And this is particularly true when good rapport exists between the hypnotist and the person being hypnotized.

Fade to Black? It is time to conclude our discussion of consciousness, but first let’s run through some of the big picture concepts you should take away from this chapter. Consciousness refers to a state of awareness—awareness of self and things outside of self—that has many gradations and dimensions. During sleep, awareness decreases, but it does not fade entirely (remember that alarm clock that becomes part of your dream about a wailing siren). Sleep has many stages, but the two main forms are non-REM and REM. Dreams may serve a purpose, but they may also be nothing more than your brain’s interpretation of neurons signaling in the night. You learned from Dr. Julien that anesthetic drugs can profoundly alter consciousness. The same is true of recreational drugs, the use of which can lead to dependence, health problems, and death. Although somewhat controversial and misunderstood, hypnosis appears to induce an altered state of consciousness and may have useful therapeutic applications.
LO 1 Define consciousness. (p. 4-3)

Consciousness is the state of being aware of oneself, one’s thoughts, and/or the environment. There are various levels of conscious awareness, including wakefulness, sleepiness, drug-induced states, dreaming, hypnotic states, and meditative states, to name a few.

LO 2 Explain how automatic processing relates to consciousness. (p. 4-6)

Because our sensory systems absorb large amounts of information, being consciously aware of all of it is not possible. Without our awareness, the brain determines what is important, what requires immediate attention, and what can be processed and stored for later use if necessary. This automatic processing happens involuntarily, with little or no conscious effort.

LO 3 Describe how we narrow our focus on specific stimuli to attend to them. (p. 4-7)

We have access to a great deal of information in our internal and external environments, but we can only focus our attention on a small portion of that information. This narrow focus on specific stimuli is referred to as selective attention. We are designed to pay attention to changes in environmental stimuli, to unfamiliar stimuli, and to especially strong stimuli.

LO 4 Identify how circadian rhythm relates to sleep. (p. 4-9)

Predictable daily patterns influence our behaviors, alertness, and activity levels in a cyclical fashion. These daily patterns in our physiological functioning roughly follow the 24-hour cycle of daylight and darkness, driven by our circadian rhythm. In the circadian rhythm for sleep and wakefulness, there are two times when the desire for sleep hits hardest. The first occurs in the early hours of the morning, between about 2:00 to 6:00 A.M., and the second, less intense desire for sleep strikes mid-afternoon, around 2:00 or 3:00 P.M.

LO 5 Summarize the stages of sleep. (p. 4-13)

Sleep begins in non-rapid eye movement (non-REM), or nondreaming sleep, which has four stages. The lightest stage of sleep is Stage 1; it is the time during which hallucinations, or imaginary sensations, can occur. This stage lasts only a few minutes before Stage 2 sleep begins. At this point, it is a little more difficult to rouse the sleeper before she drifts even further into Stage 3 sleep and then Stage 4 sleep, slow-wave sleep. Stage 4 being the deepest sleep. As the night progresses, the sleeper goes back to Stage 1 from Stage 4. And instead of waking up, the sleeper enters a 5th stage of sleep known as rapid eye movement (REM) sleep. During this stage, closed eyes dart around, and brain activity changes. People awakened from REM sleep often report having vivid dreams. Each cycle, from Stage 1 to REM, lasts about 90 minutes, and the average adult loops through five complete cycles per night. These cycles change in composition throughout the night.

LO 6 Recognize various sleep disorders and their symptoms. (p. 4-18)

Narcolepsy is a neurological disorder characterized by excessive daytime sleepiness and other sleep-related disturbances. REM sleep behavior disorder is a disorder of sleep in which the mechanism responsible for paralyzing bodies during REM sleep does not function properly. The individual is able to move around and act out dreams. Obstructive sleep apnea hypopnea is a serious disturbance
LO 7 Summarize how the theories of why we dream differ. (p. 4-26)

Freud believed dreams have two levels of content. Manifest content, the apparent meaning of the dream, is the actual story line of the dream itself—what you remember when you wake up. Latent content contains the hidden meaning of the dream, which represents the unconscious conflicts and desires. The activation–synthesis model suggests that dreams have no meaning whatsoever; we respond to random neural activity of the brain during sleep as if it has meaning. Neurocognitive theory suggests there is a network of neurons in the brain necessary for dreaming to occur. According to this theory, dreams are the result of how sleep and consciousness have evolved in humans.

LO 8 Define psychoactive drugs. (p. 4-29)

Psychoactive drugs can cause changes in psychological activities such as sensation, perception, attention, judgment, memory, self-control, emotion, thinking, and behavior. These drugs alter consciousness in an untold number of ways. They can depress activity in the central nervous system, produce hallucinations, and cause a sense of euphoria.

LO 9 Identify several depressants and stimulants and know their effects. (p. 4-29)

Depressants decrease the activities in the central nervous system. These include barbiturates, opioids, and alcohol. Stimulants are drugs that increase neural activity in the central nervous system, producing effects such as heightened alertness and energy and an elevated mood. These include cocaine, amphetamines, methamphetamine, caffeine, and nicotine.

LO 10 Discuss some of the hallucinogens. (p. 4-36)

Hallucinogens are drugs that produce hallucinations, altered moods, and distorted perception and thought. The most well-known hallucinogen is lysergic acid diethylamide (LSD). This odorless, tasteless, and colorless substance often produces extreme changes in sensation and perception. In addition to the traditional hallucinogens, a number of “club drugs,” or synthetic “designer drugs,” are commonly used at parties, raves, and dance venues. The most popular is methylenedioxymethamphetamine (MDMA), which is chemically similar to the stimulant methamphetamine, producing a combination of stimulant and hallucinogen effects. The most widely used illegal (in most states) drug is marijuana, and at high doses, tetrahydrocannabinol (THC) can induce mild euphoria and create intense sensory experiences.

LO 11 Explain how physiological and psychological dependence differ. (p. 4-39)

With constant use of some psychoactive drugs, a condition can develop in which the body becomes dependent on the drug. Signs of this physiological dependence include tolerance and withdrawal. Psychological dependence occurs without the evidence of tolerance or withdrawal symptoms, but is indicated by many other problematic symptoms of people who use drugs. People with psychological dependence believe they need the drug because it increases their emotional or mental well-being. Physiological dependence is physical and has serious physical consequences. Psychological dependence is associated with beliefs and emotions.

LO 12 Describe hypnosis and explain how it works. (p. 4-40)

Hypnosis is an altered state of consciousness that can create changes in perceptions and behaviors, usually resulting from suggestions made by a hypnotist. Hypnosis is known to ease pain associated with childbirth and surgery, and can reduce the need for painkillers. One theory suggests that hypnotized people experience a “split” in awareness or consciousness. Others suggest hypnosis is a role-playing exercise.

key terms

activation–synthesis model, p. 4-27
alpha waves, p. 4-13
amphetamine, p. 4-34
automatic processing, p. 4-6
barbiturate, p. 4-30
beta waves, p. 4-13
consciousness, p. 4-3
delirium tremens (DTs), p. 4-39
delta waves, p. 4-14
depressants, p. 4-29
hallucinogens, p. 4-36
hypnosis, p. 4-41
insomnia, p. 4-21
latent content, p. 4-26
lysergic acid diethylamide (LSD), p. 4-36
manifest content, p. 4-26
methylenedioxymethamphetamine (MDMA), p. 4-37
narcolepsy, p. 4-17
nightmares, p. 4-20
non-rapid eye movement (non-REM), p. 4-13
obstructive sleep apnea
hypopnea, p. 4-19
opiates, p. 4-30
opioid, p. 4-30
physiological dependence, p. 4-39
psychotropic drugs, p. 4-29
psychological dependence, p. 4-39
TEST PREP  are you ready?

1. William James was interested in studying ____________, which he described as a “stream” that provides day-to-day continuity.
   a. dreams  b. automatic processing  c. selective attention  d. consciousness
2. A great deal of information is available in our internal and external environments, but we can only focus on a small portion of it. This narrow focus on specific stimuli is known as:
   a. stream of consciousness.  b. selective attention.  c. encoding of memories.  d. circadian rhythm
3. ____________ refers to the ability to block out the chatter and noise in a busy environment so that you can pay attention to your ongoing conversation with someone.
   a. The cocktail-party effect  b. Inattentive blindness  c. Automatic processing  d. The circadian rhythm
4. The daily patterns of our physiological functioning, such as our temperature, roughly follow the 24-hour cycle of daylight and darkness. This pattern is driven by our:
   a. blood pressure.  b. levels of consciousness.  c. need for sleep.  d. circadian rhythm.
5. The suprachiasmatic nucleus (SCN) can be thought of as a master clock for our daily rhythm. The SCN sends messages to the ____________, which regulates patterns of hunger and temperature, and the ____________, which regulates alertness and sleepiness.
   a. reticular formation; retinal ganglion cells  b. retinal ganglion cells; hypothalamus  c. hypothalamus; reticular formation  d. thalamus; hypothalamus
6. Shift workers can have problems with their sleep–wake cycles, sometimes resulting in ____________, which refers to difficulty falling asleep and sleeping soundly.
   a. insomnia  b. cataplexy  c. narcolepsy  d. hypnagogic hallucinations
7. If we hook you up to an electroencephalogram (EEG) as you become drowsy, the EEG would begin to show ____________ waves.
   a. fast  b. beta  c. alpha  d. theta
8. The fifth stage of sleep is known as ____________, when brain activity looks similar to that of someone who is wide awake.
   a. sleep paralysis  b. cataplexy  c. non-REM sleep  d. REM sleep
9. If you deprive people of REM sleep, this can result in:
   a. REM rebound.  b. insomnia.  c. more beta waves while they sleep.  d. increased energy levels.
10. According to Sigmund Freud’s theory, dreams are a form of:
    a. REM rebound.  b. wish fulfillment.  c. microsleep.  d. sleep terror.
11. People with damage to specific areas of the limbic system and forebrain do not have dreams or experience abnormal dreams. Which of the following explains this finding?
    a. the theory of evolution  b. the activation-synthesis model  c. the psychoanalytic theory  d. the neurocognitive theory
12. ____________ such as caffeine, alcohol, and hallucinogens can cause changes in psychological activities, for example, sensation, perception, attention, and judgment.
    a. Tranquilizers  b. Depressants  c. Psychoactive drugs  d. Stimulants
13. Methamphetamine stimulates the release of the brain’s pleasure-producing neurotransmitter ____________, causing a surge in energy and alertness.
    a. dopamine  b. serotonin  c. acetylcholine  d. adenosine
14. Which is the number one cause of premature death worldwide?
    a. AIDS  b. tobacco  c. road accidents  d. illegal drugs
15. Drug use can be fueled by dependence. ____________, dependence means the body no longer functions normally without the drug, and one sign of this type of dependence is ____________, as indicated by the symptoms that occur when the drug is withheld.
    a. Psychological; tolerance  b. Physiological; substance abuse  c. Physiological; withdrawal  d. Psychological; withdrawal
16. Give an example showing that you are still conscious when asleep.
17. Describe automatic processing, and give two reasons why it is important.
18. Interns and residents in hospitals sometimes work 48-hour shifts. Why would you not want a doctor keeping such a schedule to care for you at the end of her shift?
19. Name and describe four different sleep disturbances. Differentiate them by describing their characteristics.
20. Give four examples of drugs that people use legally on a daily basis.

CHECK YOUR ANSWERS IN APPENDIX A.
About the Cover
SCIENTIFIC AMERICAN: PSYCHOLOGY integrates the stories of real people through each chapter. On the cover is Julius Achon, a Ugandan Olympic runner and humanitarian featured in the Social Psychology chapter. Julius started the Achon Uganda Children’s Fund, which works to improve the quality of life in rural Northern Uganda through access to health care and education, improvements to infrastructure, and means of self-sufficiency. For more information, go to: achonugandachildren.org

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