4 consciousness


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An Introduction to Consciousness

EXPLORING OUTER AND INNER SPACE Dr. Divya Chander was in first grade when she decided to become an astronaut. Her dream nearly came true at the age of 32, when she made it to the final round of astronaut selection for NASA. Although she did not end up traveling to outer space (not yet, at least), her exploration continued. Rather than studying far-flung corners of the solar system, Dr. Chander has been investigating a dark and mysterious place right here on Earth—the human brain.

Every day that Dr. Chander walks into the hospital, she assumes a tremendous responsibility: keeping people alive and comfortable as they are sliced, prodded, and stitched back together by surgeons. Dr. Chander is an anesthesiologist, a medical doctor whose primary responsibility is to oversee a patient's vital functions and manage pain before, during, and after surgery. Using powerful drugs that manipulate the nervous system, she makes sure a patient's heart rate, blood pressure, and other critical processes remain in a safe range. Her anesthetic drugs also block pain, paralyze muscles, and prevent memory formation (temporarily, of course). Without the work of anesthesiologists like Dr. Chander, many of today's common medical procedures would be too painful or emotionally traumatic for patients to tolerate.

The Explorer
Dr. Divya Chander at the age of 3 or 4 (left). A couple of years after this photo was taken, young Divya decided she would become a neuroscientist and an astronaut. She went on to earn both an MD and a PhD in neuroscience and now practices anesthesiology at Stanford University. As for the astronaut dream, it nearly became reality when she made it to the final round of NASA's astronaut selection. Dr. Chander still aspires to become a space explorer, but for now her exploration centers on what you might call "inner space"—uncovering the mysteries of consciousness. Left: Dr. Divya Chander. Right: Macmillan Learning, photo by Norbert von der Groeben.

Ancient Opium
Wall art from the Tomb of Horemheb in Egypt's Valley of the Kings depicts a person holding two round vessels representing poppy flowers. The ancient Egyptians used the poppy opiate morphine for pain relief, but its therapeutic role was controversial (El Ansary, Steigerwald, & Esser, 2003). Gianni Dagli Orti/Corbis.

It's Written All Over the EEG
Dr. Chander and a colleague review an electroencephalogram (EEG), the technology she uses to monitor her patients' level of consciousness. By observing the changes in wave frequency, she can tell if the patient is in a deep unconscious state, approaching wakefulness, or somewhere in between. Macmillan Higher Education photo by Norbert von der Groeben.

consciousness The state of being aware of oneself, one's thoughts, and/or the environment; includes various levels of conscious awareness.

Anesthesiology is as old as recorded history. 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 (Schroeder, 2013), and its chemical relatives are employed by modern-day physicians and hospitals all over the world (for example, *morphine* for pain relief and *codeine* for cough suppression).

But it took many centuries for anesthesia to become a regular part of surgery. Before the mid-1800s, surgery was so painful that 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 literally knocked the patient 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 operation.

"I am very, very privileged that, as an anesthesiologist, I have access to these drugs that I use on a regular basis in order to make [patients'] lives better, to make surgery possible for them," Dr. Chander explains. These same drugs also enable Dr. Chander to observe the brain as it falls into the deeper-than-sleep state of general anesthesia, losing awareness of the outside world, and then emerges from the darkness, awake and alert. In other words, she can study human brains as they pass through various levels of *consciousness.*

What Is Consciousness?

LO 1 **Define consciousness.**

Consciousness is a concept that can be difficult to pinpoint. Psychologist 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). Thus, consciousness might be conceived as a 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). Indeed, says Dr. Chander, "there are neuroscientists who believe that dreaming should be considered a conscious state." Take this example: 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 in your brain. This ability to register a sound while asleep helps us be vigilant about dangers day and night. For our primitive

Note: Quotations attributed to Dr. Divya Chander and Matt Utesch are personal communications.

ancestors, this might have meant hearing a predator rustling in the bushes, and for modern people, hearing a fire alarm or smoke detector. Researchers have conducted numerous studies to determine the types of sounds most likely to 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 (Thomas & Bruck, 2010). This type of work is done by human factors engineers, who explore the interaction of consciousness and the design of machines.

CONNECTIONS

In **Chapter 1,** we introduced the evolutionary perspective. The adaptive trait to remain aware even while asleep has evolved through natural selection, allowing our ancestors to defend against predators and other dangerous situations.

"Sometimes people think that when you lose consciousness, or you go to sleep, that your brain is less active," explains Dr. Chander. "In some dimensions it is less active," she notes, "[but] a better characterization might be that it's less functionally connected to itself." In other words, there is less communication occurring between different parts of the brain. As a person lies on the operating table, in a "less conscious" state, the brain also seems to be doing fewer calculations, processing less information. "When I say 'less conscious,' I do literally mean that because I do think it's an entire spectrum," Dr. Chander explains. "There isn't just 'unconscious' and 'conscious.' There are varied depths of consciousness."

NIGHTMARE ON THE OPERATING TABLE For a patient undergoing major surgery, the goal is to decrease the level of consciousness to a point where pain is no longer felt and awareness of the outside world dissipates. But the anesthesiologist must be careful; giving too much anesthetic can suppress vital functions and kill a person. (Musical legend Michael Jackson died from an overdose of the commonly used anesthetic propofol.) To reduce consciousness and keep patients safe, the anesthesiologist must give just the right combination, and proper dosage, of anesthetic drugs.

On very rare occasions (about 1 in 10,000, according to some research), the anesthetic cocktail does not work as intended—patients become aware during general anesthesia (Mashour & Avidan, 2015). For some, this could simply mean hearing the voices of surgeons and nurses as they work; other people actually wake up, or become completely aware, and perhaps even feel pain during the procedure (Cook et al., 2014). Just imagine lying on the operating table, unable to move or speak (you've been paralyzed by the anesthetic drugs). Meanwhile, the surgical team is sawing through your femur bone or cutting into your eye. For some patients, this horrifying experience leads to posttraumatic stress syndrome (Cook et al., 2014).

None of Dr. Chander's patients have reported this type of "accidental awareness" during surgery, and they probably never will. That's because Dr. Chander is constantly monitoring their brain activity with an electroencephalogram (EEG), which picks up electrical signals from the brain's surface (the cortex) and displays this information on a screen. Looking at the EEG monitor, Dr. Chander can determine a patient's depth of anesthesia, or the degree to which the drugs have induced a "hypnotic state," or changed his level of consciousness. The changes in wave frequency on the EEG monitor tell her when a patient is becoming "light" (getting close to waking up), "deep" (in a profound slumber, deeper than sleep), and even when he is receiving a particular drug.

Dr. Chander is unusual in this respect; most anesthesiologists are not trained to read an EEG with this level of precision (Dr. Chander is both an anesthesiologist and a neuroscientist). Instead they rely on other, less direct, indicators of consciousness, such as **blood pressure** and heart rate. This approach actually works very well because the amount of anesthetic needed to suppress blood pressure, heart rate, and movement is greater than that required to suppress consciousness (Aranake, Mashour, & Avidan, 2013). Dr. Chander's ability to read raw EEG data, and her deep knowledge of neuroscience, put her in an ideal position to track levels of consciousness in her patients—and discover the secrets of consciousness in general. ●

CONNECTIONS

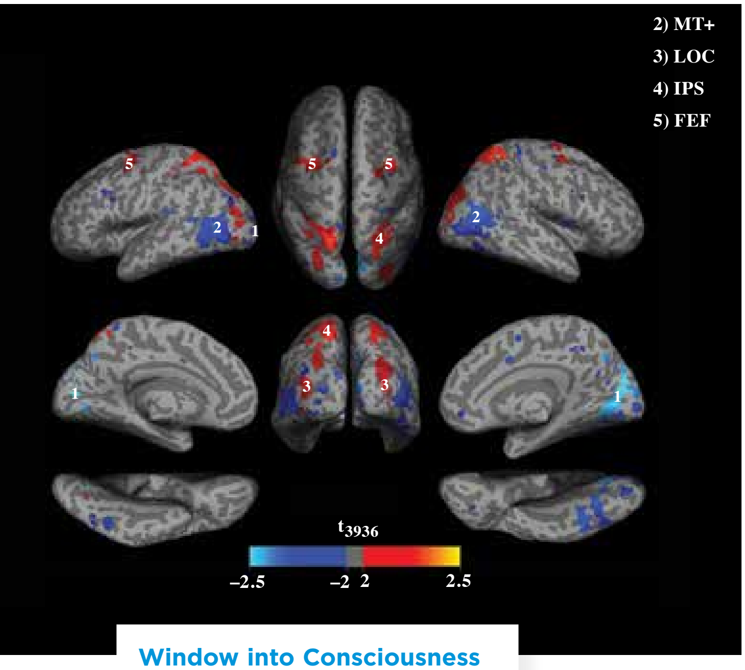
Anesthetic drugs can lower blood pressure and heart rate by suppressing the sympathetic nervous system. In **Chapter 2,** we discussed how the sympathetic nervous system orchestrates the "fight-or-flight" response, prepping the body to respond to stressful situations. Surgery would certainly qualify as a stressful situation.

CONNECTIONS

In **Chapter 1,** we discussed the contributions of these early psychologists. Wundt founded the first psychology laboratory, edited the first psychology journal, and used experimentation to measure psychological processes. Titchener was particularly interested in examining consciousness and the "atoms" of the mind.

Studying Consciousness

The field of psychology began with the study of consciousness. **Wilhelm Wundt and his student Edward Titchener** founded psychology as a science based on exploring consciousness and its contents. Another early psychologist, William James, regarded consciousness as a "stream" that provides a sense of day-to-day continuity (James, 1890/1983). Think about how this "stream" 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). You notice your shoe is untied, think about school starting tomorrow, and remember the utility bill sitting on the counter, all 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 other times they don't seem to be connected by anything other than your stream of consciousness.



Window into Consciousness Using fMRI, researchers showed it was possible to monitor participants' conscious perceptions of ambiguous images in real time. The red areas indicate areas of high blood flow, while blue areas signal lower blood flow (Reichert et al., 2014). © 2014 Reichert C., Fendrich R., Bernarding J., Tempelmann C., Hinrichs H. and Rieger J.W. (2014) Online tracking of the contents of conscious perception using realtime fMRI. *Front. Neurosci. 8,* 116. doi: 10.3389/fnins.2014.00116.

Although psychology started with the introspective study of consciousness, American psychologists John Watson, B. F. Skinner, and other behaviorists insisted that the science of psychology should restrict itself to the study of observable behaviors. 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 and unconscious mental processes 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 investigate its mysteries.

In her neuroscience research, Dr. Chander has used a cutting-edge technology called optogenetics to search for groups of neurons that may act as "on" or "off" switches for different states of consciousness (asleep versus awake, for example). With optogenetics, researchers can activate or deactivate neurons or groups of neurons over milliseconds (the time-scale in which neurons fire), and see how it affects animals' behavior (Deisseroth, 2015).

Technologies like optogenetics and functional magnetic resonance imaging (fMRI) have added to our growing knowledge base (Reichert et al., 2014; Song & Knöpfel, 2016), yet barriers to studying consciousness remain. One is that consciousness is **subjective**, pertaining only to the individual who experiences it. Thus, some have argued it is impossible to *objectively* study another's conscious experience (Blackmore, 2005; Farthing, 1992). To make matters more complicated, one's consciousness changes 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. Welcome to the world of consciousness and its many shades of gray.

CONNECTIONS

In **Chapter 1,** we presented the concept of objective reports, which are free of opinions, beliefs, expectations, and values. Here, we note that descriptions of consciousness are subjective (unique or personal), and do not lend themselves to objective reporting.

The Nature of Consciousness

There are many elements of conscious experience, including desire, thought, language, sensation, perception, and knowledge of self. Memory is also involved, as conscious experiences usually involve the retrieval of memories. Essentially, any cognitive process is potentially a part of your conscious experience. 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 recognition of 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). While browsing products, you access various memories (which link you just clicked, the shoes you saw last week, and so on)—all of this is part of your consciousness, your stream of thought.

LO 2 Explain how automatic processing relates to consciousness.

AUTOMATIC PROCESSING Stop reading and listen. Do you hear background sounds you didn't notice before—a soft breeze rustling through the curtains, a clock ticking? You may not have picked up on these sounds, because you were not paying attention to them, but your brain was monitoring all this activity. In describing consciousness, psychologists often distinguish between cognitive processes that occur *automatically* (without effort, awareness, or control) and cognitive activity that requires us to focus our attention on specific sensory input (with effort and awareness, we choose what to attend to and where to direct our focus). Our **sensory systems** absorb an enormous amount of information, and the brain must sift through these data and determine what is important and needs immediate attention, what can be ignored, and what can be processed and stored for later use. 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). Without automatic processing, we would be overwhelmed with data.

Automatic processing can also refer to the involuntary cognitive activity guiding some behaviors. We are seemingly able to carry out routine tasks without focusing our attention. Behaviors seem to occur without intentional awareness, and without getting in the way of our other activities (Hassin, Bargh, & Zimerman, 2009). Do you remember the last time you walked a familiar route, checking your phone and daydreaming the entire time? Somehow you arrived at your destination without noticing much about your surroundings or the traffic. You were conscious enough to complete complex tasks, but not enough to realize that you were doing so. This type of multitasking is commonplace, although the great majority of people have difficulty trying to accomplish more than one demanding task (Medeiros-Ward, Watson, & Strayer, 2015). See TABLE 4.1 on the next page for solutions to some multitasking problems.

In Class: Collaborate and Report

In your group, discuss and record examples of **A)** when it is to your advantage to use automatic processing and **B)** when automatic processing could be risky or problematic. **C)** Decide if you think the benefits outweigh the risks.

Although unconscious processes direct various behaviors, we can also make conscious decisions about where to focus our attention. While walking to class, you might focus intently on a conversation you just had with your friend or an exam you will take in an hour. In these cases, we deliberately channel or direct our attention.

LO 3 Describe how we narrow our focus through selective attention.

SELECTIVE ATTENTION Although we have access to a vast amount of information in our internal and external environments, we can only focus our attention on a small portion at one time. This narrow focus on specific stimuli is known as **selective attention**. Talking to someone in a crowded room, you are able to block out the chatter and noise around you and immerse yourself in the conversation. This efficient use of selective attention is known as the *cocktail-party effect,* and it is evident in the way the brain responds to speech that is attended to and speech that is ignored (Golumbic et al., 2013; Koch, Lawo, Fels, & Vorländer, 2011). Studies suggest selective attention

CONNECTIONS

In **Chapter 3,** we introduced the concept of sensory adaptation, which is the tendency to become less sensitive to and less aware of constant stimuli over time. This better prepares us to detect changes in the environment, which can signal important activities that require attention. Here, we see how this can occur with automatic processing.

Acting Without Thinking
Do you recall dropping your keys in your bag this morning? Many routine activities, such as putting away keys and locking the door, occur without our awareness. We might not remember these events because we never gave them our attention in the first place. Ariel Skelley/Blend Images/Getty Images.

cognitive psychology The scientific study of mental processes such as thinking, problem solving, and language.

automatic processing Collection and sometimes storage of information without conscious effort or awareness.

selective attention The ability to focus awareness on a small segment of information that is available through our sensory systems.

TABLE 4.1 BE SMART ABOUT MULTITASKING

Problem	Solution
You think you can drive safely while using your phone, because you can text and talk without even looking at the screen.	If you're like the overwhelming majority of drivers (97.5%, according to one study), you cannot drive safely while using a cell phone (Watson & Strayer, 2010). Those of us who feel most confident in our multitasking abilities are often the worst at doing so (Sanbonmatsu, Strayer, Medeiros-Ward, & Watson, 2013; Strayer, 2015). The only safe way to use a phone when behind the wheel is to pull over and off the road.
Sometimes you can't resist checking Instagram and Facebook during study sessions.	Intersperse your study sessions with "media breaks." For example, allow yourself 5 minutes of screen time for every 1 hour of studying. This is better than constantly switching your focus between studying and media, because every little adjustment requires time (Carrier, Rosena, Cheeverb, & Lima, 2015).
You know you shouldn't text during class, but you must respond to a time-sensitive message before the lecture is over.	If you must text during class, and you know your instructor will permit this, choose a strategic time to do so. Rather than replying instantly, wait until your instructor has finished expressing a thought or explaining a concept (Carrier et al., 2015).
You know it's rude, but you can't help glancing at your phone while talking to your partner.	Put away your phone or turn down the volume during face-to-face conversations, especially with the people you love. Snubbing someone with your phone ("phubbing") can cause conflict in romantic relationships, which may lead to lower levels of "life satisfaction" (Roberts & David, 2016).

Multitasking with technology cannot always be avoided. But with strategies like those listed above, you can avoid some of the negative effects of juggling media with other tasks.

can be influenced by emotions. Anger, for example, increases our ability to selectively attend to something or someone (Finucane, 2011). So, too, does repeated exposure to important stimuli (Brascamp, Blake, & Kristjánsson, 2011). We also get better at ignoring distractions as we age (Couperus, 2011).

This doesn't mean other information goes undetected (remember, the brain is constantly gathering data through automatic processing). Our tendency is to adapt to continuous input, and ignore the unimportant sensory stimuli that bombard us at every moment. 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 & Andrés, 2010). 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—until something changes (someone yells, for example). Then your attention might be directed to that specific event.

CONNECTIONS

In **Chapter 2,** we described the reticular formation, an intricate web of neurons responsible for levels of arousal. It also plays a role in selectively attending to important information by sifting through sensory data, picking out what's relevant, and ignoring the rest. Here, we see how the brain pays attention to unexpected changes in the environment.

INATTENTIONAL BLINDNESS Selective attention is great if you need to study for a psychology test as people around you are playing video games, but it can also be dangerous. Suppose a friend sends you a hilarious text message while you are walking toward 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, you might 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 illustrated 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 the participants diligently followed the basketball with their eyes, counting each pass, a partially transparent woman holding an umbrella was superimposed walking

What Umbrella?
In an elegant demonstration of inattentional blindness, researchers asked a group of participants to watch a video of men passing around a basketball. As the participants kept careful tabs on the players' passes, a semi-transparent image of a woman with an umbrella appeared among them. Only 21% of the participants (1 out of 5) even noticed; the others had been focusing their attention elsewhere (Most et al., 2001).

across the basketball court. Only 21% of the participants even noticed the woman (Most et al., 2001; Simons, 2010); the others had been too fixated on counting the basketball passes to see her (Mack, 2003). It turns out even experts can fall prey to this phenomenon. In one study, researchers embedded an image of a gorilla on a CAT scan of a lung. Twenty out of 24 expert radiologists failed to detect the gorilla (Drew, Vo, & Wolfe, 2013).

LEVELS OF CONSCIOUSNESS People often equate consciousness with being awake and alert, and unconsciousness with being passed out or comatose. But the distinction is not so clear, because there are different *levels of conscious awareness*, including wakefulness, sleepiness, dreaming, as well as drug-induced, hypnotic, and meditative states. One way to define these levels of consciousness is to determine how much control you have over your awareness. A high level of awareness might occur when you focus intensely on a task (using a sharp knife); a lower level might occur as you daydream, 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 may result from drugs, alcohol, or hypnosis—all topics covered in this chapter.

Wherever your attention is focused at this moment, that is your conscious experience—but there are times when attention essentially shuts down. 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.

Is That a Gorilla in My Lung?
Look on the upper right side of this lung scan. Do you see a gorilla? Researchers showed this image to a group of radiologists, medical professionals who specialize in reading computerized axial tomography (CAT) scans like this. A whopping 83% did not notice the gorilla, even though it was 48 times bigger than the lung nodules they identify on a regular basis (Drew, Vo, & Wolfe, 2013). A beautiful illustration of inattentional blindness. Trafton Drew.

show what you know

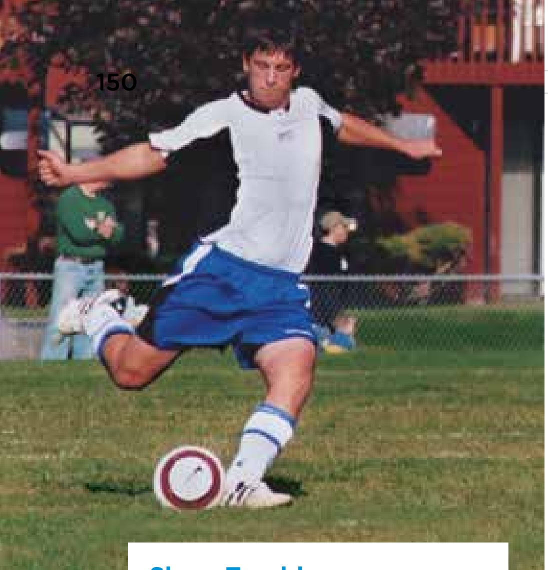
1. __________ is the state of being aware of oneself, one's thoughts, and/or the environment.

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

   a. consciousness
   b. automatic processing
   c. depressants
   d. inattentional blindness

3. Inattentional blindness is the tendency to "look without seeing." Given what you know about selective attention, how would you advise someone to avoid inattentional blindness?

✓ CHECK YOUR ANSWERS IN APPENDIX C.



Sleep Troubles
Matt Utesch was active and full of energy as a child, but come sophomore year in high school, he periodically fell asleep throughout the day. Matt was beginning to experience the symptoms of a serious sleep disorder. Courtesy Matthew Utesch.

Matt, in His Own Words

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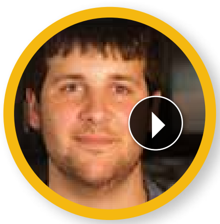


Photo: Macmillan Learning.

Croc Sleep
A crocodile dozes while swimming, one eye cracked open and the other closed. Researchers suspect that saltwater crocs are able to sleep with just one brain hemisphere at a time. The eye linked to the awake hemisphere remains open, allowing the animal to maintain awareness of its surroundings (Kelly et al., 2015). Westend61/Getty Images.

Sleep

4x6/Getty Images.

ASLEEP AT THE WHEEL 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 mininaps 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 nodded off. Most of Matt's teachers assumed he was just another teenager exhausted from late-night partying. Nobody, not even Matt's doctor, suspected he had a serious medical condition—until the accident happened.

It was the summer before his 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. A few weeks after the accident, Matt went to the woman's home to bring her flowers. She invited him inside, and they sat down and began to chat. Then, right in the midst of their conversation, Matt fell asleep. ●

An Introduction to Sleep

Most animals sleep or engage in some rest activity that resembles sleep, and the amount they need varies across species (Siegel, 2008). Crocodiles snooze keeping one eye cracked open most of the time; horses can sleep standing up (although they also lay down to sleep); and some birds appear to doze mid-flight (Kelly, Peters, Tisdale, & Lesku, 2015; U.S. Fish & Wildlife Service, 2006). There are animals that require plenty 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, but the National Sleep Foundation recommends adults get between 7 and 9 hours per night (Hirshkowitz et al., 2015). Do the math and that translates to about a third of the day, and therefore a third of your *life*. Clearly, sleep serves some important function, but what is it? And how does it relate to consciousness? How can sleep go so wrong, as happened for Matt? Before tackling these questions, let's get a handle on 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, you inevitably begin feeling tired around 2:00 or 3:00 P.M.; it's like clockwork. That's because it is clockwork. Many things your body does, including sleep, are regulated by a biological clock. Body temperature rises during the day, reaching its maximum in the early evening. Hormones are secreted in a cyclical fashion. Growth hormone is released at night, and the stress hormone cortisol soars in the morning, reaching levels 10 to 20 times higher than at night (Wright, 2002). These are just a few of the body functions that follow predictable daily patterns, affecting our behaviors, alertness, and activity levels. Such patterns in our physiological functioning roughly follow the 24-hour cycle of daylight and darkness; they follow a **circadian rhythm** (ser-KAY-dee-an).

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 midafternoon, between 2:00 and 4:00 P.M. (Lohr, 2015, September/October), when many college students seem to have trouble keeping their eyes open in class. This is a time when many, but not all, people nap. One study found that members of "preindustrial societies," who were hunter-gatherers/horticulturalists living in Tanzania, Bolivia, and Namibia, slept between 6 and 7 hours daily, with minimal napping. Temperature seemed to regulate their sleep duration and timing (Yetish et al., 2015).

Not all biological rhythms are circadian. Some occur over longer time intervals (monthly menstruation), and others cycle much faster (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. Biological clocks are everywhere in nature, acting as day planners for organisms as basic as bacteria and slime mold (Wright, 2002; Summa & Turek, 2015, February).

SUPRACHIASMATIC NUCLEUS Where in the human 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 master of clocks, known as the *suprachiasmatic nucleus (SCN)*, actually consists of two clusters, each no bigger than an ant, totaling around 20,000 neurons (Bedrosian, Fonken, & Nelson, 2016; 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 on the next page).

Although tucked away in the recesses of the brain, the SCN knows the difference between day and night by receiving signals from a special type of **light-sensing cells** in the eye, called *retinal ganglion cells.* 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 (Bedrosian et al., 2016). 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 the melatonin get to work.

Digital technology is great for helping us monitor the time, and therefore keeping our internal clocks on schedule. But we must be careful about when and where we use them.

DIDN'T SEE THAT COMING

Are Screens Ruining Your Rhythm?

It's been a long day, and you're ready to snuggle under your soft, warm covers. On the way to your bedroom, you pass by your phone. *Let me check my e-mail one last time,* you think to yourself as you crawl into bed. One e-mail turns into two, two into three, and before you know it, you're logging into Facebook to see if you missed any good posts since you brushed your teeth. Your desire to sleep has now been replaced by excitement over new videos, photos, and status updates.

PROTECT YOUR CLOCK.

CONNECTIONS

In **Chapter 2,** we explained the functions of the hypothalamus. For example, it maintains blood pressure, temperature, and electrolyte balance. It also is involved in regulating sleep-wake cycles, sexual arousal, and appetite.

CONNECTIONS

In **Chapter 3,** we described how light enters the eye and is directed to the retina. The rods and cones in the retina are photoreceptors, which absorb light energy and turn it into electrical and chemical signals. Here, we see how light-sensing cells relay information to the SCN.

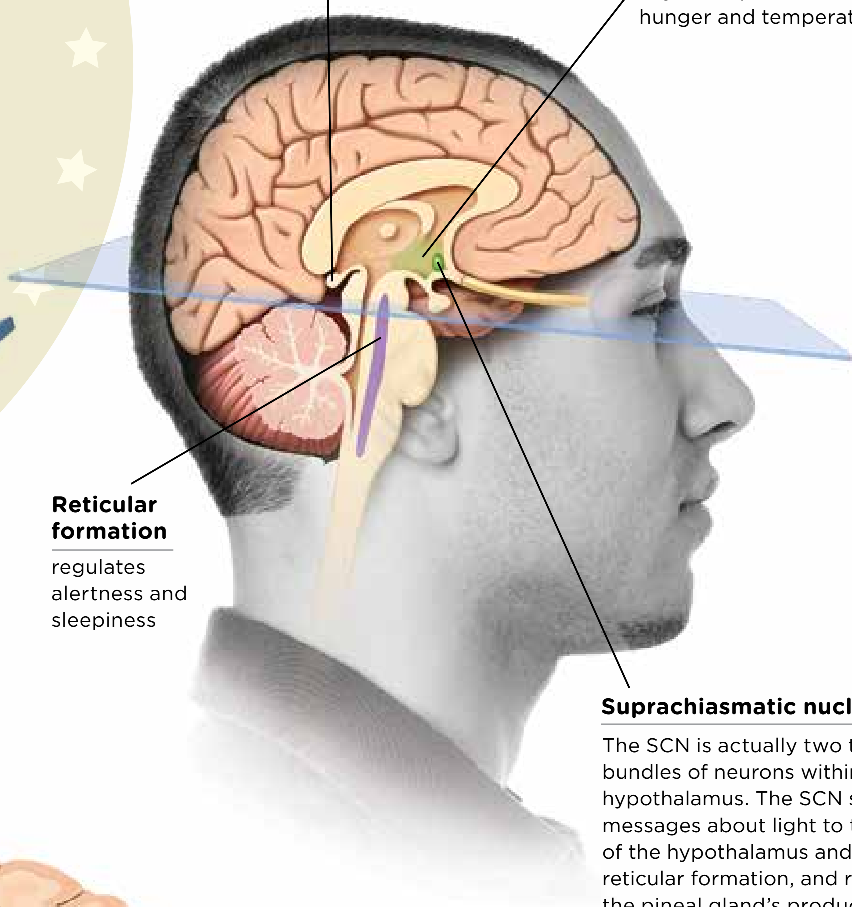
CONNECTIONS

In **Chapter 2,** we presented the endocrine system, a communication system that uses glands to convey messages within the body. The messages are delivered by hormones, which are chemicals released in the bloodstream. The pineal gland, a part of the endocrine system, secretes melatonin, a hormone that is involved in sleep-wake cycles.

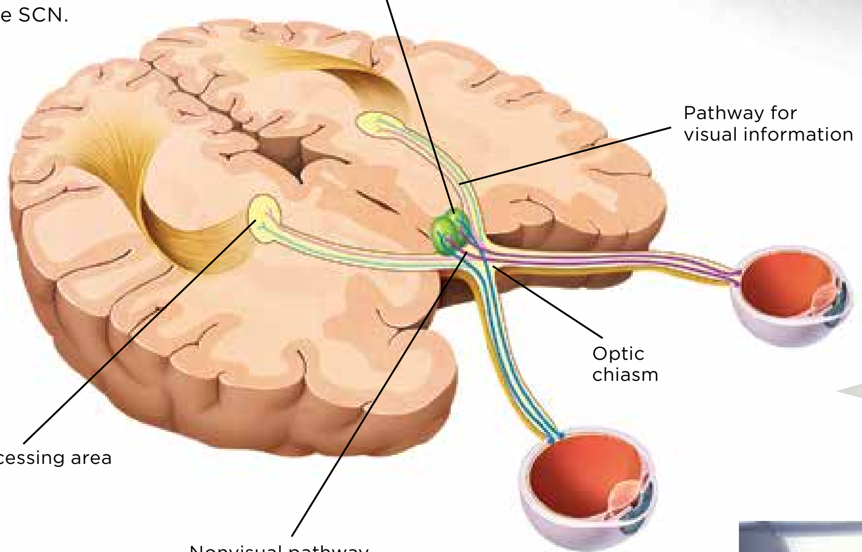
circadian rhythm The daily patterns roughly following the 24-hour cycle of daylight and darkness; a 24-hour cycle of physiological and behavioral functioning.

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.



Supra is Latin for "above." ***Suprachiasmatic*** means "above the chiasm." The SCN's long name helps you find it in the brain!

For the 20% of the U.S. workforce doing shift work, normal sleep schedules are disrupted. This leads 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.

Credits: Head, Citizen Stock/Alamy; Control room, ©Hank Morgan/Science Source.

If this experience sounds familiar, you are not alone. Many Americans (as many as 90% of adults) use smartphones, tablets, and computers within 1 hour of bedtime, often to the detriment of their sleep (Bedrosian et al., 2016). Researchers have found that the blue light wavelengths emitted by LEDs (light-emitting diodes) may suppress the sleep-promoting hormone melatonin (Galbraith, 2015, April 7; Wood, Rea, Plitnick, & Figueiro, 2013). This finding is particularly relevant for adolescents, who tend to stay up later and need to wake early for school. For these young people, screen time before bed may lead to less sleep, sleepiness during the day, and reduced cognitive performance (van der Lely et al., 2015). Those over the age of 45 may be less vulnerable to such effects because, as we age, the eye filters out some of the blue light coming from the environment. This is partly a result of the pupil constricting and the lens becoming more yellow (Turner & Mainster, 2008). Regardless of your age, staring at LED screens close to bedtime can disrupt circadian rhythms (Wood et al., 2013). The brighter the light and the closer the device to the eye, the greater the impact (Galbraith, 2015, April 7).

How can we take this knowledge gleaned from research and use it to improve our sleep quality? The National Sleep Foundation (2016) suggests removing electronics from the bedroom a minimum of 1 hour before sleep. If you must check your e-mail close to bedtime, be quick and turn down the backlight, which gives off blue wavelengths. You may even consider using a "warm white" lightbulb (they emit a lower percentage of blue wavelengths) to illuminate your bedroom (Galbraith, 2015, April 7).

Want to Sleep Tight? Cut Out the Blue Light
The blue light emitted by LED screens of smartphones, computers, and other electronics may suppress the sleep hormone melatonin, and thereby disrupt sleep–wake cycles. Sam Diephuis/Getty Images.

LARKS AND OWLS Everyone has her 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, you roll out of bed feeling energized and alert, get more accomplished early in the day, yet grow weary as the day drags on (Ferrante et al., 2015). 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 later in the day (Ferrante et al., 2015), making it easy to stay up late posting to Instagram or reading your textbook. These types of circadian rhythms impact peak performance in athletes (Facer-Childs & Brandstaetter, 2015) as well as college students.

In Class: Collaborate and Report

College students are often portrayed as owls, but is this just a stereotype? In your group, discuss **A)** whether something in the college environment influences sleep–wake cycles, or is there a biological explanation. **B)** If you were to use the experimental method to explore this question, what would your independent and dependent variables be? **C)** What variables would you have to control for to make sure your groups are similar to each other?

JET LAG AND SHIFT WORK Whether you are a lark or an owl, your biological clock is likely to become confused when you travel across time zones. Your clock does not automatically reset to match the new time. The physical and mental consequences of this delayed adjustment, known as "jet lag," may 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, 2016, June 6). Jet lag is frustrating, but at least it's only temporary, and there are things that can help lessen its effects. Researchers recommend strategies such as getting as much sleep as possible before traveling, avoiding caffeine and alcohol during your trip, and shifting your sleep schedule ahead of time so that it's more aligned with the time zone of your destination (Weingarten & Collop, 2013).

Night Shift
A young man works the night shift at the Jia Ling motorcycle factory in Chongqing, China. Factory workers are among the many professionals who clock in and out at all hours of the day. Working alternating or night shifts can disrupt circadian rhythms, leading to fatigue, irritability, and diminished mental sharpness. Physical activity and good sleep habits will help counteract the negative effects (Costa, 2003).
China Photos/Getty Images.

A related phenomenon, *social jet lag,* affects 70% of the U.S. population and occurs when we use our alarm clocks to get up to go to work or school, and then sleep later on the days we have off (Baron & Reid, 2014). Our day-to-day responsibilities can make it difficult to support our natural sleeping routines, so we are not getting as much sleep as we need (Bedrosian et al., 2016).

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 snuggles 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; Wright, Bogan, & Wyatt, 2013). 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. Picture yourself coming off the night shift 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 mood disorders, diabetes, and other chronic diseases (Baron & Reid, 2014; Bedrosian et al., 2016; Wright et al., 2013). Shift workers also face an elevated risk of becoming overweight, and of developing stomach ulcers and heart disease (Baron & Reid, 2014; Monk & Buysse, 2013). In addition, an estimated 5% to 10% of shift workers have been diagnosed with *circadian rhythm sleep–wake disorders,* characterized by excessive sleepiness at work and insomnia at home (American Psychiatric Association, 2013).

Because of the varied schedules shift workers endure, it is difficult to minimize circadian disturbances. Remember that light is the master clock's most important external cue. Maximizing light exposure during work time and steering clear of it close to bedtime can help (Bedrosian et al., 2016). 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, as can getting regular exercise (Bedrosian et al., 2016; Harvard Medical School, 2007).

The Stages of Sleep

LO 5 **Summarize 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 revealed by an electroencephalogram (EEG), monitoring activity on the surface of the brain. If you could look at an EEG trace of your brain right at this moment, you would probably see a series of tiny, short spikes in rapid-fire succession. These high-frequency brain waves are called **beta waves,** and they appear when you are solving a math problem, reading a book, or any time you are alert (INFOGRAPHIC 4.2). Researchers call this Stage W, indicating a "waking state," and this stage can range from being fully alert to slightly drowsy (Berry et al., 2016). Now let's say you climb into bed, close your eyes, and relax. As you become more and more drowsy, the EEG would likely begin showing **alpha waves,** which are lower in frequency than beta waves (Cantero, Atienza, Salas, & Gómez, 1999; Silber et al., 2007). At some point, you drift into a different level of

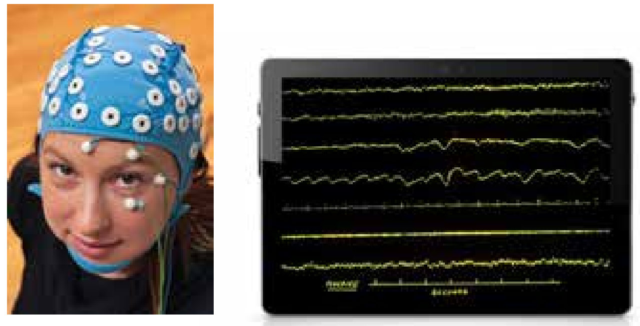
beta waves Brain waves that indicate an alert, awake state.

alpha waves Brain waves that indicate a relaxed, drowsy state.

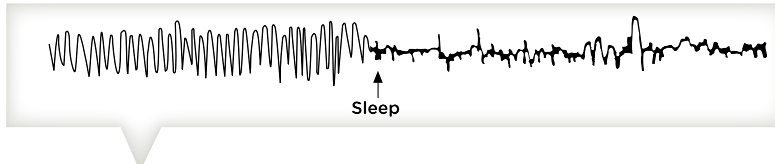
Sleep

Looking in on a sleep study, you'll see that the brain is actually very active during sleep, cycling through non-REM 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 below. 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. Currently, only two thirds of U.S. adults get the recommended minimum of 7 hours per night (Liu et al., 2016).

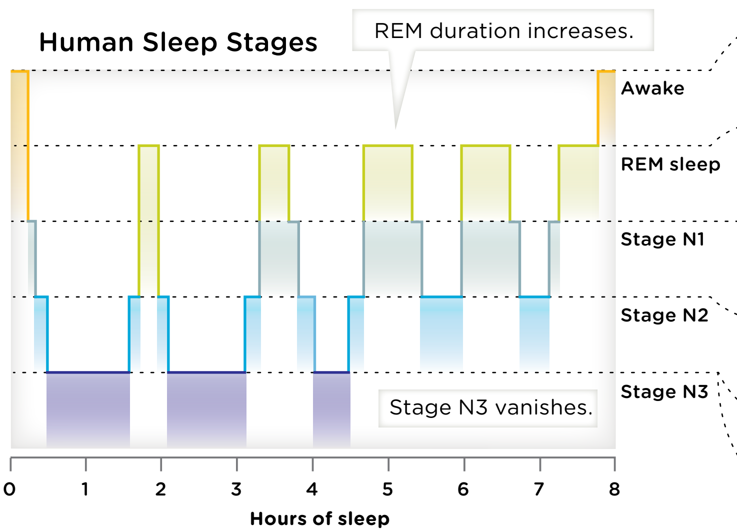


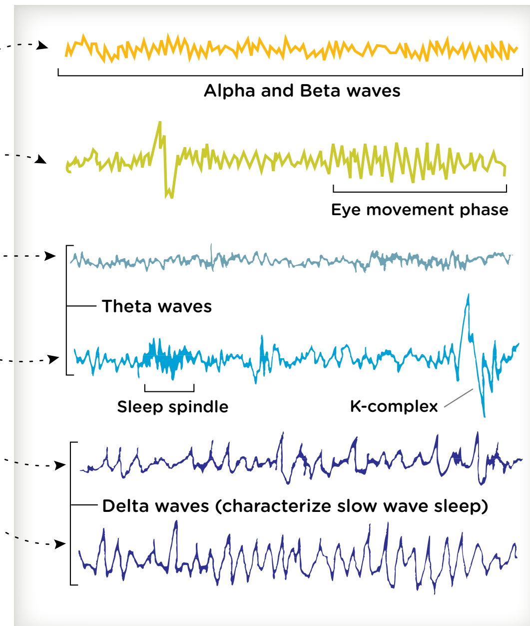
This sleep study participant wears electrodes that will measure her brain waves and body movements during sleep.



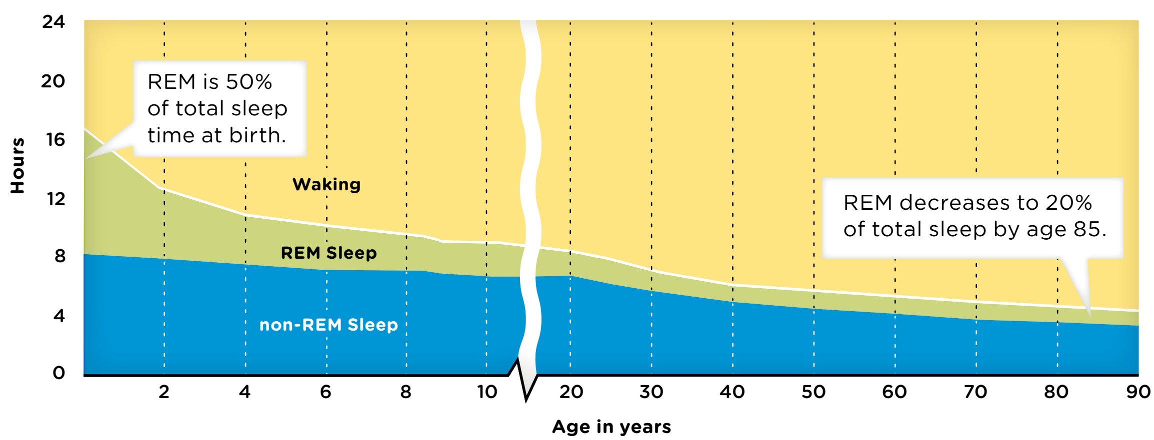
Looking at brain waves allows us to trace a person's stage of sleep. Here we can see a clear shift from waking to sleeping patterns.
(FROM DEMENT & VAUGHAN, 1999.)

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

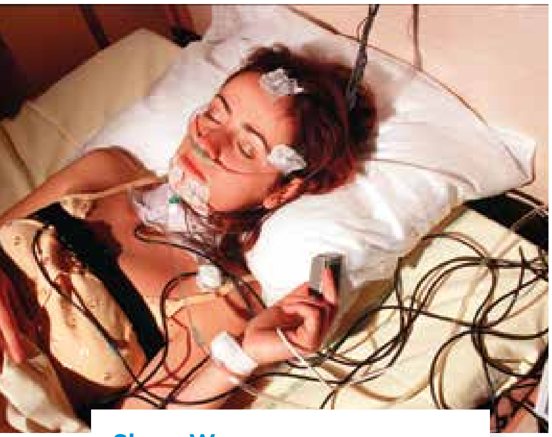




As we age, we need fewer hours of sleep, and the proportion of time spent in REM diminishes.



Credits: Sleep study participant and readings, James King-Holmes/Science Source; ipad, iStock/Getty Images.



Sleep Waves
A sleep study participant undergoes an EEG. Electrodes attached to her head pick up electrical activity from her brain, which is transformed into a series of spikes on a computer screen. Through careful study of EEG data, researchers have come to understand the various stages of sleep. Garo/Phanie/Superstock.

consciousness known as sleep. Over the years, researchers have developed a variety of methods to study sleep and diagnose sleep disorders. These technologies have helped researchers characterize the different stages of sleep, and create standard procedures for studying sleep (Berry et al., 2016).

NON-REM SLEEP A normal sleeper begins the night in **non-rapid eye movement (non-REM** or **NREM)**, or nondreaming, sleep, which has three stages (Berry et al., 2016; Infographic 4.2). The first and lightest is Stage N1 (NREM 1 sleep), also known as "light sleep." During Stage N1, 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 N1, 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 snooze 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 floating images as 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 that occur during the limbo between wakefulness and sleep are called *hypnagogic* (hip-nuh-GOJ-ik) *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 N1, you move on to the next phase of non-REM sleep, called Stage N2 (NREM 2 sleep), which is slightly deeper than Stage N1, so you are harder to awaken. 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; Laventure et al., 2016). 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, while others believe they are the mechanism for remaining asleep in spite of disturbing stimuli (Colrain, 2005). They are also thought to be involved in the consolidation of some types of memories (Caporro et al., 2012).

After passing through Stages N1 and N2, the sleeper descends into Stage N3 (NREM 3 sleep), when it can be most difficult to awaken. Stage N3 is considered slow-wave sleep, because it is characterized by tall, low-frequency **delta waves**. Stage N3 contains a higher proportion of delta waves than the prior stages (at least 20%; Berry & Wagner, 2015). Waking a person from slow-wave sleep is not easy. Most of us feel groggy, disoriented, and downright irritated when jarred from a slow-wave slumber. This is also the peak time for the secretion of growth hormone, which helps children to grow taller and stronger, and to build tissue (Awikunprasert & Sittiprapapom, 2012).

REM SLEEP You don't stay in deep sleep for the remainder of the night, however. After about 40 minutes of Stage N3 sleep, you work your way back through the lighter stages of sleep to Stage N2. Then, instead of waking up, you enter Stage R, or **rapid eye movement (REM)** sleep. During REM sleep, the eyes often dart around, even though they are closed (hence the name "rapid eye movement" sleep). The brain is very active, with EEG recordings showing faster and shorter waves similar to those of someone who is wide awake. 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

You Asked, Matt Answers

http://qrs.ly/di5a5ak

In hindsight, did you notice any changes that may have foreshadowed the onset of narcolepsy?

scan this ➜

non-rapid eye movement (non-REM or NREM) The nondreaming sleep that occurs during sleep Stages N1 to N3.

theta waves Brain waves that indicate light sleep.

delta waves Brain waves that indicate a deep sleep.

rapid eye movement (REM) The stage of sleep associated with dreaming; sleep characterized by bursts of eye movements, with brain activity similar to that of a waking state, but with a lack of muscle tone.

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).

Kitty Dreams This cat may be dreaming of chasing mice and birds, but its body is essentially paralyzed during REM sleep. Disable the neurons responsible for this paralysis and you will see some very interesting behavior—the cat will act out its dream. iStock/Getty Images.

SLEEP ARCHITECTURE Congratulations. You have just completed one sleep cycle, working your way through Stages N1, N2, and N3 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. The composition of these 90-minute sleep cycles changes during the night. During the first two cycles, a considerable amount of time is devoted to the deep sleep Stage N3. Halfway through the night, however, Stage N3 vanishes. Meanwhile, the REM periods become progressively longer, with the first REM episode lasting only 5 to 10 minutes, and the final one lasting nearly a half-hour (Siegel, 2005). Therefore, we pack in most of our non-REM sleep early in the night and most of the dreaming toward the end; and the sleep stage we spend the most time in—nearly half the night—is Stage N2 (Epstein & Mardon, 2007).

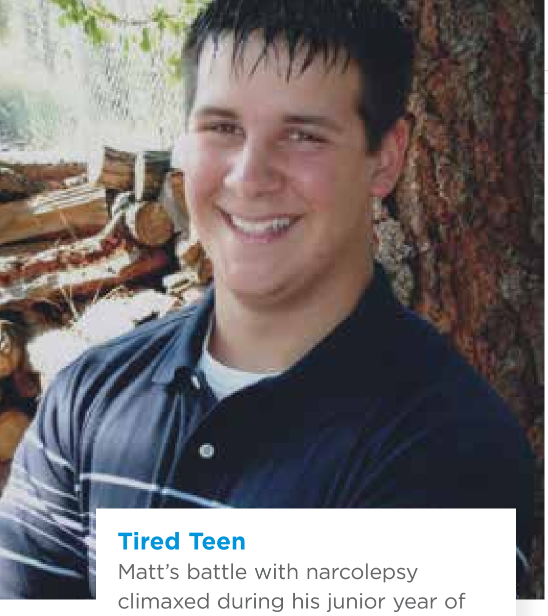
The makeup of our sleep cycles, or *sleep architecture,* changes throughout life. Infants spend almost half of their sleep in REM periods (Skeldon, Derks, & Dijk, 2016). Older people spend far less time in REM sleep and the deeply refreshing stages of non-REM sleep (N3). Instead, they experience longer periods of light sleep (Stages N1 and N2), which can be interrupted easily by noises and movements, and a decrease in the deeper sleep stages that include the slow brain waves (Cirelli, 2012; Ohayon, Carskadon, Guilleminault, & Vitiello, 2004; Scullin & Bliwise, 2015). Could this be the reason 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.

On a typical weeknight, the average American sleeps 6 hours and 40 minutes, but there is significant deviation from this "average" (National Sleep Foundation, 2009). A large number of people—about 28% of the population—get fewer than 6 hours, and another 9% snooze longer than 8 hours (Schoenborn, Adams, & Peregoy, 2013).

Wake Up! Some of us feel refreshed after sleeping 6 or 7 hours. Others can barely grasp a glass of orange juice without a solid 8. Sleep habits appear to be a blend of biological and environmental forces—both nature and nurture. Ariel Skelley/Corbis.

PROBLEM IDENTIFIED: NARCOLEPSY 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" (American Psychiatric Association, 2013, p. 372). With narcolepsy, 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 awoke, 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

narcolepsy A neurological disorder characterized by excessive daytime sleepiness, which includes lapses into sleep and napping.



Tired Teen
Matt's battle with narcolepsy climaxed during his junior year of high school. In addition to falling asleep 20 to 30 times a day, he was experiencing frequent bouts of cataplexy, an abrupt loss of muscle tone that occurs while one is awake. Cataplexy struck Matt anytime, anywhere—up to 100 times a day.
Courtesy Matthew Utesch.

longer have been reported (National Institute of Neurological Disorders and Stroke, 2013, September). By the time Matt was a junior in high school, his uncontrollable naps were striking upward of 20 to 30 times a day.

Sleep Disturbances

LO 6 **Recognize various sleep disorders and their symptoms.**

CATAPLEXY And that wasn't all. Matt developed another debilitating symptom of narcolepsy: *cataplexy,* an abrupt loss of strength or muscle tone that occurs 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. Cataplexy attacks come on suddenly, usually during periods of emotional excitement (American Psychiatric Association, 2013). The effects usually wear off after several seconds, but severe attacks can immobilize a person for minutes.

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. By junior year, Matt 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 (American Psychiatric Association, 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. Researchers have found that a wide range of people have experienced sleep paralysis at least once in their lives: from around 8% of the general population to 28% of college students (Jalal & Ramachandran, 2014; Jalal, Taylor, & Hinton, 2014; Sharpless & Barber, 2011). Episodes usually last a few seconds, but some go on for several minutes—a terrifying experience for most people.

Did She Have Narcolepsy?
Harriet Tubman is famous for helping hundreds of people escape slavery through the Underground Railroad. But few people know that Tubman suffered from symptoms of narcolepsy. Her sleep problems began after an incident that occurred when she was still a slave: An overseer struck her in the head as punishment for protesting the beating of a fellow slave (Michals, 2015; Poole, 2016, April 20).
UniversalImagesGroup/Getty Images.

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 N1 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 stabbing him in the chest. Upon awakening, Matt 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).

BATTLING NARCOLEPSY 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. It was during this time 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 recognize the warning signs of his 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.

Approximately 1 in 2,500 people suffers 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 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 a summary of this and other sleep disturbances in TABLE 4.2 on the following page).

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" (American Psychiatric Association, 2013, p. 408). People with REM sleep behavior disorder are much like the cats in Morrison's 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 people with REM sleep behavior disorder tend to be unusually violent and action-packed, involving fights with wild animals and other attackers (Fantini, Corona, Clerici, & Ferini-Strambi, 2005). 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 reported (American Psychiatric Association, 2013; Aurora et al., 2010). REM sleep behavior disorder primarily affects older men (age 50 and up) and frequently foreshadows the development of serious neurodegenerative disorders—conditions such as Parkinson's disease and dementia that are associated with the gradual decline and death of neurons (Boeve et al., 2007; Fantini et al., 2005; Postuma et al., 2009; Schenck & Mahowald, 2002). Women and younger people are diagnosed with this disorder as well (American Psychiatric Association, 2013).

BREATHING-RELATED SLEEP DISORDERS There are several breathing-related sleep disorders, but the most common is **obstructive sleep apnea hypopnea** (hi-POP-nee-uh), 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 (American Psychiatric Association, 2013). Breathing stops for 10 seconds or more, causing blood oxygen levels to drop (Chung & Elsaid, 2009; Teodorescu et al., 2015). 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

You Asked, Matt Answers

http://qrs.ly/xs5a5ao

What kind of physician did you visit in order to be diagnosed with narcolepsy?

scan this ➜

Does Rosie Snore?
Actor and TV personality Rosie O'Donnell is among the millions of Americans who suffer from obstructive sleep apnea hypopnea (Schocker, 2012, September 25). Research suggests this sleep disorder affects between 3% and 7% of the adult population (Punjabi, 2008). Steve Mack/FilmMagic/Getty Images.

REM sleep behavior disorder
A sleep disturbance in which the mechanism responsible for paralyzing the body during REM sleep is not functioning, resulting in the acting out of dreams.

obstructive sleep apnea hypopnea
A serious disturbance of non-REM sleep characterized by complete absence of air flow (apnea) or reduced air flow (hypopnea).

TABLE 4.2 SLEEP DISTURBANCES

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

Problems can arise during both REM and non-REM sleep. This table outlines some of the most common sleep disturbances and their defining characteristics.

stages of sleep so crucial for feeling reenergized in the morning. Most people have no memory of the repeated awakenings and wonder why they feel so exhausted during the day; they are completely unaware that they suffer from this serious sleep disturbance. Obstructive sleep apnea hypopnea is more common among men than women and is more prevalent in the obese, and in women after menopause. This condition is linked to increased risk of death in the elderly, traffic accidents, and reduced quality of life, as well as elevated blood pressure, which increases the risk of cardiovascular disease (American Psychiatric Association, 2013). These risks are not limited to adults; researchers have noted a correlation between obstructive sleep apnea and sudden infant death syndrome (SIDS), failure-to-thrive, and other developmental issues (Katz, Mitchell, & D'Ambrosio, 2012).

INSOMNIA The most prevalent sleep disturbance is **insomnia**, which is characterized by an inability to fall asleep or stay asleep. Those experiencing this condition may complain of waking up in the middle of the night or arising too early, and not being able to fall back asleep. People with insomnia often report that the quantity or quality of their sleep is not good. Sleepiness during the day and difficulties with cognitive tasks are also reported (American Psychiatric Association, 2013). About a third of adults experience some symptoms of insomnia, and 6% to 10% meet diagnostic criteria for *insomnia disorder* (American Psychiatric Association, 2013; Mai & Buysse, 2008; Roth, 2007). Insomnia is, to a certain degree, inherited (Van Someren et al., 2015), but its symptoms can be triggered by many factors, including the stress of a new job, college studies, depression, anxiety, jet lag, aging, drug use, and chronic pain.

OTHER SLEEP DISTURBANCES A common sleep disturbance that can occur during non-REM sleep (typically Stage N3) 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; Petit et al., 2015). Here are some

Synonyms

sleepwalking somnambulism (som-NAM-byuh-liz-um)

sleep terrors night terrors

insomnia Sleep disturbance characterized by an inability to fall asleep or stay asleep, impacting both the quality and quantity of sleep.

sleep terrors A disturbance of non-REM sleep, generally occurring in children; characterized by screaming, staring fearfully, and usually no memory of the episode the following morning.

nightmares Frightening dreams that occur during REM sleep.

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 (American Psychiatric Association, 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 (American Psychiatric Association, 2013).

Sleep terrors are non-REM sleep disturbances primarily affecting children. A child experiencing a night terror may sit up in bed, stare fearfully at nothing, and scream. Parents may find the child crying hysterically, breathing rapidly, and sweating. 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. Children generally do not remember the episode the next day (American Psychiatric Association, 2013).

Nightmares are frightening dreams that occur in REM sleep. Nightmare disorder affects approximately 4% of the population (Aurora et al., 2010). 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 (American Psychiatric Association, 2013). Recent research suggests that people who frequently experience nightmares may be "more susceptible to daily stressors" and are associated with a variety of other problems like depression and insomnia (Hochard, Heym, & Townsend, 2016, p. 47; Nadorff, Nadorff, & Germain, 2015). In some cases, nightmares may not have an apparent cause; in other cases, they may be related to issues such as posttraumatic stress disorder (PTSD; see Chapter 12), substance abuse, and anxiety. Approximately 80% of people with PTSD report having nightmares (Aurora et al., 2010).

"Disturbia" or Insomnia?
Rihanna appears to get plenty of beauty sleep, but her social media activity suggests otherwise. The singer/songwriter has been known to Tweet about her sleep troubles: "Waited all yr + Finally I have time off, time 4 rest n quiet. Suddenly all the silence is being drowned by my thoughts! No sleep" (Klein, 2014, March 6; Rihanna, 2012, January 4). Kevin Mazur/Getty Images for FENTY PUMA.

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 feel 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. He forgot about homework assignments and couldn't recall 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, September).

Let's face it. No one can function optimally without a good night's sleep. But the expression "good night's sleep" can mean something quite different from one person to the next. Newborns sleep anywhere from 10.5 to 18 hours per day, toddlers 11 to 14 hours, school-aged children 9 to 11 hours, and teens 8 to 10 hours (National Sleep Foundation, 2015a, 2015c). The average adult needs between 7 and 8 hours to feel restored, though some (including Madonna and Jay Leno) claim they get by on just 4 (Breus, 2009, May 6). Adults who average less than 4 or more than 11 hours of sleep are very rare (Horne, 2006).

"Wake up, Tom. You're having the American dream again."

Peter Steiner/The New Yorker Collection/www.cartoonbank.com.

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

Sleep Culture A rickshaw driver in New Delhi, India, snoozes in the bright sun. Afternoon siestas are common in countries such as India and Spain, but atypical in the United States (Randall, 2012, September 22). Cultural norms regarding sleep vary significantly around the world. Christine Welman/Alamy.

Record-Breaking Randy A half-century ago, 17-year-old Randy Gardner set the record for the longest documented period of self-imposed sleep deprivation. With the help and encouragement of two friends, and no caffeine or stimulants of any sort, the young man went 11 consecutive days without snoozing (Gulevich et al., 1966). San Diego History Center.

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, September; Van Someren et al., 2015). Sleepy people find it especially challenging to accomplish tasks that are monotonous and boring; those deprived of sleep have trouble focusing on a single activity, like keeping their 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—driving under these circumstances is dangerous (Watson et al., 2015; Williamson & Feyer, 2000). Sleep loss also makes you more prone to *microsleeps,* or uncontrollable mininaps lasting several seconds—enough time to miss a traffic light turning red. Staying awake for several days at a time (11 days is the current world record, based on experimental data; Gillin, 2002, March 25) produces a host of disabling effects, including fragmented speech, cognitive deficits, mood swings, and hallucinations (Gulevich, Dement, & Johnson, 1966).

A more chronic form of sleep deprivation results from insufficient sleep night-upon-night for weeks, months, or years. People in this category are less likely than their well-rested peers to exercise, eat healthy foods, have sex, and attend family events (National Sleep Foundation, 2009). They also face a greater risk for heart disease, diabetes, cancer, and weight gain (Luyster, Strollo, Zee, & Walsh, 2012), and have decreased immune system responses and slower reaction times (Besedovsky, Lange, & Born, 2012; Orzeł-Gryglewska, 2010). Many researchers suspect the obesity epidemic currently plaguing industrialized countries like the United States is partially linked to chronic sleep deprivation. Skimping on sleep appears to disrupt appetite-regulating hormones, which may lead to excessive hunger and overeating (Van Someren et al., 2015; Willyard, 2008).

REM DEPRIVATION So far we have only covered sleep loss in general. What happens if REM sleep is compromised? Preliminary research suggests depriving people of REM sleep can cause emotional overreactions to threatening situations (Rosales-Lagarde et al., 2012). REM deprivation can also lead to **REM rebound**, an increased amount of time spent in REM sleep when one finally gets an opportunity to sleep in peace. Researchers report that sleep disturbances following surgery, for example, often result in REM sleep rebound (Chouchou, Khoury, Chauny, Denis, & Lavigne, 2014).

WHY DO WE SLEEP? The purpose of sleep has yet to be conclusively identified (Assefa, Diaz-Abad, Wickwire, & Scharf, 2015). 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 4.3). Here are three of the major ones:

- The *restorative theory* says we sleep because it allows for growth and repair of the body and brain. 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 (Borbély, Daan, Wirz-Justice, & Deboer, 2016; Hobson, 1989).
- An *evolutionary theory* says sleep serves an adaptive function; it evolved because it helped us survive. For much of human history, nighttime was very dark—and very unsafe. Humans have poor night vision compared to animals hunting for prey, so it was adaptive for us to avoid moving around our environments in the dark of night. The development of our circadian rhythms driving us to sleep at night has served an important evolutionary purpose (Barton & Capellini, 2016).

REM rebound An increased amount of time spent in REM after sleep deprivation.

TABLE 4.3 THEORIES OF SLEEP

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

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.

- Another popular theory suggests that sleep helps with the *consolidation* of memories and learning (Tononi & Cirelli, 2014). Researchers disagree about 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). 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). Similarly, in humans, positron emission tomography (PET) scans have shown common patterns of brain activity when research participants were awake and learning and later while asleep (Maquet, 2000).

Whatever the purpose of sleep, there is no denying its importance. After a couple of sleepless nights, we are grumpy, clumsy, and unable to think straight. Although we may appreciate the value of sleep, we don't always practice the best sleep habits—or know what they are. Read on to discover some behaviors and assumptions you should avoid.

THINK IT THROUGH
9 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.

NO IPADS ALLOWED IN THE BED!

- **Drinking alcohol before bed helps you sleep better:** Alcohol helps you fall asleep, but it undermines sleep quality and may cause you to awaken in the night (Ebrahim, Shapiro, Williams, & Fenwick, 2013). So, too, can one or two cups of coffee. Although moderate caffeine consumption heightens alertness (Epstein & Mardon, 2007; Volkow et al., 2015), be careful not to drink too much or too close to bedtime; either action may lead to further sleep disruption (Drake, Roehrs, Shambroom, & Roth, 2013).
- **Yawning means you are exhausted:** It likely means you are hot. Yawning appears to be related to temperature, and functions to help keep the brain cool (Massen, Dusch, Eldakar, & Gallup, 2014).
- **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; Uchida et al., 2012). 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:** Experts recommend that we get more than 7 hours of sleep each night (Watson et al., 2015), but sleep needs can range greatly from person to person. Some people do fine with 6 hours; others genuinely need 9 or 10 (Schoenborn et al., 2013).
- **Watching TV or using your computer just before bed helps get you into the sleep zone:** Screen time is not advised as a transition to sleep time. The stimulation of TV and computers can inhibit sleep (National Sleep Foundation, 2015b).
- **You can catch up on days or weeks of 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).
- **Pressing snooze is a good way to catch a few more minutes of rest:** Because we need more than a few minutes of sleep to feel rested, hitting snooze is a good indication that you are not getting enough sleep (Oexman, 2013, May 5).
- **Insomnia is no big deal. Everyone has trouble sleeping from time to time:** Insomnia disorder is a mentally and physically debilitating condition that can result in mood changes, memory problems, difficulty with concentration and coordination, physical injuries, and other life-altering impairments (Kessler et al., 2012; 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 sleep eating, sleep sex, and "driving while not fully awake" (U.S. Food and Drug Administration, n.d., para. 5).

Before moving on to the next section, look at **TABLE 4.4** for some ideas on how to get better sleep.

TABLE 4.4 HOW TO GET A GOOD NIGHT'S SLEEP

To Get Good Sleep	Reasoning
Get on a schedule.	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.
Set the stage for sleep.	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.
Watch your eating, drinking, and smoking.	Beware of foods that create heartburn, and avoid excessive use of alcohol, caffeine, and nicotine (known enemies of sleep) especially late in the day.
Move it or lose it.	Exercise is associated with better sleep, but not right before bed. Exercising 2 to 3 hours before bed can actually prevent good sleep.

If you frequently wake up feeling groggy and unrestored, there are several simple measures you can take to improve the quality of your sleep.
Information from: NIH, 2012.

show what you know

1. The suprachiasmatic nucleus obtains its information about day and night from:
   a. circadian rhythms.
   b. beta waves.
   c. K-complexes.
   d. retinal ganglion cells.
2. In which of the following stages of sleep do adults spend the most time at night?
   a. Stage N1
   b. Stage N2
   c. Stage N3
   d. Stage W
3. Narcolepsy is a neurological disorder characterized by excessive daytime sleepiness and other sleep-related disturbances such as ___________, which refers to an abrupt loss of muscle tone that occurs when a person is awake.
4. Make a drawing of the 90-minute sleep cycle. Label each stage with its associated brain wave(s).

✓ CHECK YOUR ANSWERS IN APPENDIX C.

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, characterized by brain waves that 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.

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. 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.

Now a college graduate and working professional, Matt manages his narcolepsy quite successfully. 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 School of Medicine, 2015 n.d.). Although several medications are available to help control symptoms, there is no known cure for narcolepsy.

Now when Matt goes to sleep at night, he no longer imagines people coming to murder him. In dreams, he soars through the skies like Superman, barreling 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." If you wonder what Matt is doing these days, he works at a credit union (he is one of the top producers in his company) and is pursuing his master's of business administration (MBA). Onward and upward, like Superman. ●

You Asked, Matt Answers
http://qrs.ly/hh5a5ar
What sorts of medications help to control narcolepsy?
scan this ➔

Under Control
After a few very challenging years, Matt developed effective strategies for managing his narcolepsy. In addition to using a medication that helps him sleep more soundly at night, Matt takes strategic power naps and sticks to a regular bedtime and wake-up schedule. Courtesy Matthew Utesch.

In Your Dreams

LO 7 Summarize the theories of why we dream.

What are dreams, and why do we have them? People have contemplated the significance of dreams for millennia, and scholars have developed many intriguing theories to explain them.

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 and 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 a dream, is the actual story line of the dream itself—what you remember when you wake up. **Latent content** is the hidden meaning of a dream, and represents unconscious conflicts and desires. During therapy sessions, psychoanalysts look deeper than the actual story line of a dream, using its latent content to uncover what's occurring unconsciously. Critics of Freud's approach to dream analysis would note there are an infinite number of ways to interpret any dream, all of which are impossible to prove wrong.

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 a great deal of neural activity. According to the activation–synthesis model, we create meaning in response to this activity, even though this sensory excitement is only random chatter among neurons (Hobson & Pace-Schott, 2002). Our creative minds make up stories to match this activity, and these stories are our dreams. During REM sleep, the brain is also trying to make sense of neural activity in the **vestibular system**. If the vestibular system is active while we are lying still, then the brain may interpret this as floating or flying—both common experiences reported by dreamers. As advances in research have enabled further study on dreaming, researchers have built upon the activation–synthesis model of dreaming. We not only create meaning in response to the neural activity, but our recent waking experiences influence our dreams as well (Hobson, 2009; Hobson & Friston, 2012).

CONNECTIONS

In **Chapter 3,** we noted that the vestibular system is responsible for balance. Accordingly, if its associated area in the nervous system is active while we are asleep, the sensations we normally feel when we are awake may be interpreted in a congruent manner.

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 brain areas either do not have dreams, or their dreams are not normal. Research suggests that dreaming and daydreaming activate similar brain regions (Domhoff & Fox, 2015), suggesting that this network of neurons is common to both mind-wandering and dreaming.

Additional support for this theory comes from studies of children; it turns out that the dreams of children differ from those of adults. Before about 13 to 15 years of age, children report dreams that are less vivid and seem to have less of a story line. Apparently, an underlying neural network must develop or mature before a child can dream like an adult.

The neurocognitive theory of dreams does not suggest that dreams necessarily serve a purpose. Instead, they seem to be the result of how sleep and consciousness have evolved in humans and are a by-product of how memories are consolidated (Domhoff, 2001; Murkar et al., 2014). As noted earlier, memory consolidation seems to be facilitated by sleep, with some theorists emphasizing the important role of REM (Murkar, Smith, Dale, & Miller, 2014).

manifest content The apparent meaning of a dream; the remembered story line of a dream.

latent content The hidden meaning of a dream, often concealed by the manifest content of the dream.

activation–synthesis model Theory proposing that humans respond to random neural activity while in REM sleep as if it has meaning.

In Class: Collaborate and Report

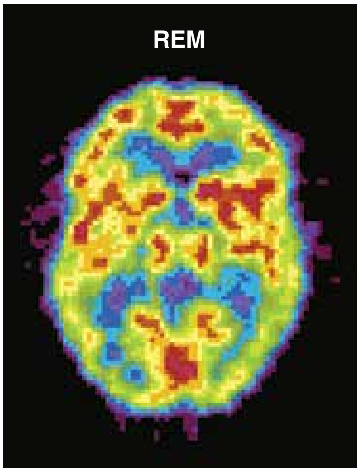
Team up and discuss the three models of dreaming. Use at least two of the eight perspectives introduced in Chapter 1 (see Table 1.4) to explain dreams.

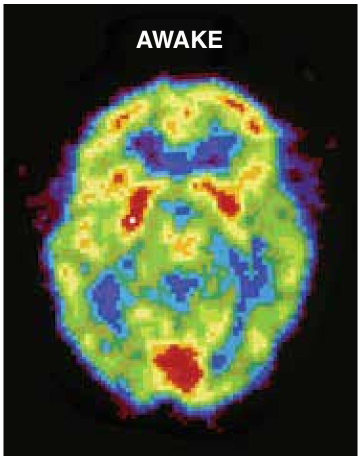
Dream a Little Dream

Most dreams feature ordinary, everyday scenarios like driving a car or sitting in class. The content of dreams is repetitive and frequently in line with our activities, emotions, and what we think about when we are awake. In particular, intense emotional "waking-life experiences" are incorporated more often in the content of dreams (Malinowski & Horton, 2014). The content of dreams is relatively consistent across cultures. For example, dreams about teachers, school, flying, being chased, sexual experiences, and eating delicious foods were the most frequent themes for both Chinese and German participants across dream studies (Mathes, Schredl, & Göritz, 2014; Yu, 2015). Dreams are more likely to include sad events than happy ones and, contrary to popular assumption, 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 most likely wrong. Most individuals who insist they don't dream simply fail to remember their dreams. If awakened during a dream, one is more likely to recall it at that moment than if asked to remember it at lunchtime. Typically, 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 hours of dreaming per night. An interesting feature of dreams is that they happen in real time. In one early study investigating this phenomenon, researchers roused a small number of 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). Eighty percent of the participants gave the right answer (Dement & Kleitman, 1957).

Have you ever realized that you are in the middle of a dream? A *lucid dream* is one that you are aware of having, 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 potentially contentious claim because dreams cannot be experienced by an outsider, making them challenging to "verify objectively" (LaBerge, 2014). Fantastical, funny, or frightening, dreams represent a distinct state of consciousness, and consciousness is a fluid, ever-changing entity. Now it's time to explore how consciousness transforms when chemicals are introduced into our bodies, or when we undergo hypnosis. On to the "altered states". . . .





Dreaming Brain
PET scans reveal the high levels of brain activity during REM sleep (top) and wakefulness (bottom). During REM, the brain is abuzz with excitement. (This is especially true of the sensory areas.) According to the activation–synthesis model, dreams may result when the brain tries to make sense of all this neural activity.
Hank Morgan/Science Source.

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. What occurs in the brain when you dream?

4. 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.

✓ CHECK YOUR ANSWERS IN APPENDIX C.

Altered States of Consciousness

UNDER THE KNIFE You awake in the morning with a dull pain around your belly button. By the time you get to your 10:00 A.M. class, the pain is sharper and has migrated to your lower right abdomen, so you head to the local emergency room. Doctors diagnose you with appendicitis, an inflammation of the appendix often caused by infection (and potentially fatal, if allowed to progress too far). You need an emergency operation to remove your appendix. You've never had surgery, and the prospect of "going under" is making you very nervous: *I hate needles—do I have to have an IV? What if I wake up in excruciating pain? What if I never wake up?*

Going Under
Dr. Chander uses various drugs to lull her surgical patients into a deeper-than-sleep state. She may administer a gas, such as nitrous oxide, or a volatile liquid, such as isoflurane, through a mask (as demonstrated here). In other instances, she delivers drugs through injection. Macmillan Learning, photo by Norbert von der Groeben.

Dr. Chander, introduced at the start of the chapter, is your anesthesiologist. She is there to keep you safe and comfortable throughout the process; she also may be able to ease your anxiety by connecting with you on a human level. "The most important thing, in addition to assessing what their surgical and anesthetic risk is, is to form that quick bond, and rapport with that patient," Dr. Chander explains. "If you're an anesthesiologist that can really connect to humans . . . you can really make a difference in someone's life," she adds. "I think you can impact their entire healing process by taking away a lot of their fear in the beginning."

After taking notes on your medical history and examining your heart, lungs, and airways, Dr. Chander explains the procedure you are about to undergo. When you're ready, she starts an IV, delivering a drug such as Versed (midazolam) to ease your anxiety and interfere with your ability to form new memories for the next 20 minutes or so. Why the need for this temporary memory block? The moments before surgery are terrifying; many patients tremble and cry in anticipation. But everyone is different; a small number of Dr. Chander's patients refuse the Versed because they want to remember their presurgery experience.

The Versed kicks in; you start to feel relaxed and sleepy; and before you know it, you're in the operating room, hooked up to all sorts of tubes and monitors. Dr. Chander lulls you into unconsciousness with a drug called propofol, and blunts your perception of pain with a powerful narcotic such as fentanyl. She also paralyzes your muscles with drugs such as rocuronium or vecuronium, whose effects are readily reversible. These drugs are modern derivatives of *curare,* an arrowhead poison used by South American natives. Curare works by blocking the activity of the neurotransmitter **acetylcholine**, which stimulates muscle contractions. 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).

CONNECTIONS
In **Chapter 2,** we described neurotransmitters and their role in the nervous system. Acetylcholine is a neurotransmitter that relays messages from motor neurons to muscles, enabling movement. Here, we see how drugs can block the normal activity of acetylcholine, causing the paralysis useful during surgery.

A few minutes ago, you were awake, sensing, perceiving, thinking, and talking. Now you see nothing, hear nothing, feel nothing. It's like you are gone. The anesthetics Dr. Chander used to produce these effects are called *psychoactive drugs*. ●

Psychoactive Drugs

LO 8 **Define psychoactive drugs.**

Psychoactive drugs cause changes in psychological activities such as sensation, perception, attention, judgment, memory, self-control, emotion, thinking, and behavior—all of which are associated with our conscious experiences. You don't have to visit a 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 some medicines (Alpert, 2012; Gurpegui, Aguilar, Martínez-Ortega, Diaz, & 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. In one study, 9.4% of Americans aged 12 and older reported that they had used illegal drugs over the past month (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014).

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—depressants, stimulants, and hallucinogens—but keep in mind that some drugs fall into more than one group.

Vulnerable Youth
Young smokers are more inclined than their nonsmoking peers to use illegal drugs, display aggression, and develop mental health problems. They also have a harder time quitting than those who start smoking in adulthood (American Cancer Society, 2013, November 15). National Geographic/Getty Images.

Depressants

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

In the operating room, Dr. Chander relies heavily on a group of psychoactive drugs that suppress certain kinds of activity in the central nervous system, or slow things down. They are known as sedative-hypnotics or, more broadly, **depressants**. In the example above, you learned how she used Versed to ease anxiety. Versed is a benzodiazepine, which acts as a *tranquilizer*—a type of depressant with a calming, sleep-inducing effect. Other examples of tranquilizers are Valium (diazepam) and Xanax (alprazolam), used to treat anxiety disorders. A more recent addition to the tranquilizer family is Rohypnol (flunitrazepam), also known as the "date rape drug" or "roofies," which is legally manufactured and approved as a treatment for insomnia in other countries, but banned in the United States (Drug Enforcement Administration [DEA], 2012). Sex predators have been known to slip roofies into their victims' drinks (a potentially deadly combination), especially darker-colored cocktails where the blue pills dissolve unseen. Rohypnol can cause confusion, amnesia, lowered inhibitions, and sometimes loss of consciousness, preventing victims from defending themselves or remembering the details of a sexual assault.

BARBITURATES Once a patient is in the operating room and ready for surgery, Dr. Chander puts him "to sleep," a process called *induction*. In the past, anesthesiologists sometimes induced patients with another type of depressant termed a **barbiturate** (bar-BICH-er-it), which is a sedative (calming or sleep-inducing) drug that decreases neural activity. In low doses, barbiturates cause many of the same effects as alcohol (discussed below)—relaxation, lowering of spirits, or alternatively, aggression (Julien, Advokat, & Comaty, 2014)—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 with alcohol, for example, the muscles of the diaphragm may relax to the point of suffocation (INFOGRAPHIC 4.3 on the next page).

OPIOIDS Putting a patient to sleep is not enough to prepare him for a major surgery; he also needs drugs that combat pain. Even when a patient is out cold on the operating table, his brain can receive pain impulses, and pain during surgery can lead to greater pain during recovery. "When the surgeon's cutting, it causes trauma to the body whether or not you're consciously perceiving it," explains Dr. Chander. "If you don't block pain receptors up front, you could have significant pain afterwards, sometimes lasting well beyond the period of healing from the surgery. We call this conversion from acute to chronic pain." For this purpose, Dr. Chander may use an **opioid**, a drug

Synonyms

depressants downers

barbiturates yellow jackets, pink ladies, goof balls, reds, rainbows

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.

barbiturates Depressant drugs that decrease neural activity and reduce anxiety; a type of sedative.

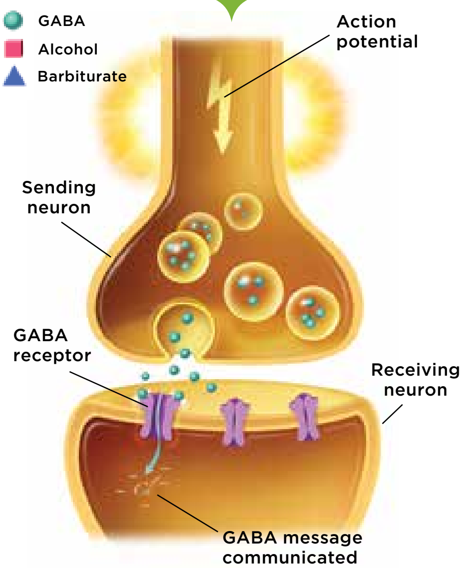
opioids A class of psychoactive drugs that minimize perceptions of pain.

The Dangers of Drugs in Combination

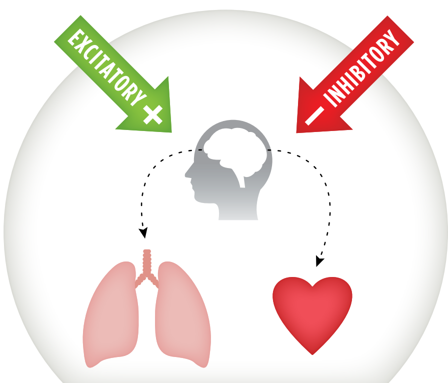
Taking multiple drugs simultaneously can lead to unintended and potentially fatal consequences because of how they work in the brain. Drugs can modify neurotransmission by increasing or decreasing the chemical activity. When two drugs work on the same system, their effects can be additive, greatly increasing 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).

NORMAL GABA ACTIVITY



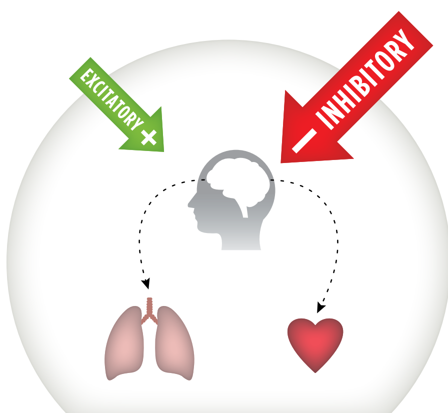
GABA activation, which calms nervous system activity, is essential for proper functioning of the central nervous system. Without GABA, nerve cells fire too frequently.



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.

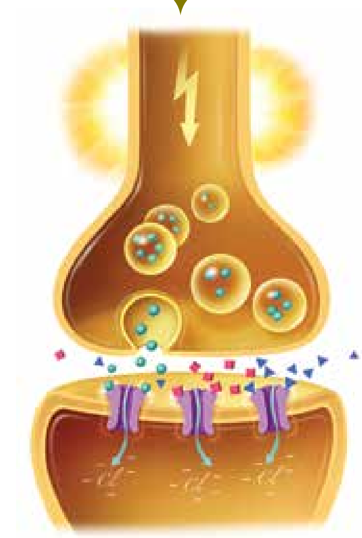
ALCOHOL

Alcohol activates the same receptors, increasing GABA's activity.

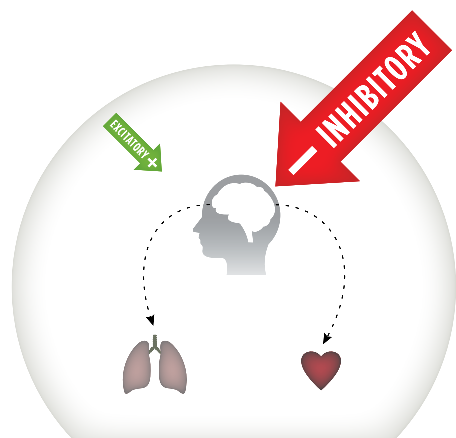


When alcohol increases GABA's inhibitory signals, excitatory and inhibitory signals in the CNS are out of balance. Along with increased relaxation, heart and breathing rates decrease. Increasing levels of alcohol could eventually lead to stupor and coma.

ALCOHOL + BARBITURATE



Barbiturates bind to and activate GABA receptors too, creating even more GABA-related inhibition.

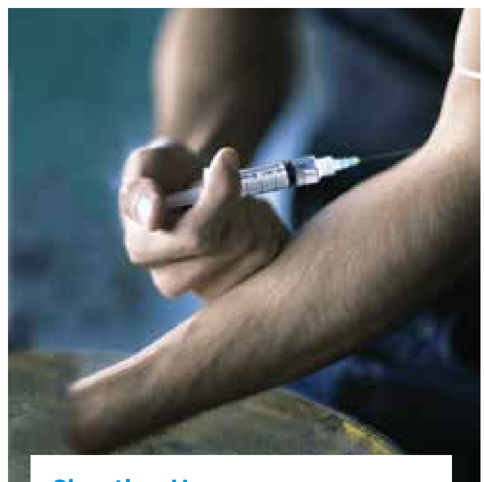


Together, alcohol and barbiturates further unbalance excitatory and inhibitory signals, suppressing heart rate and the impulse to breathe.

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., 2014). There are two types of naturally occurring opioids: the endorphins produced by your body, and the **opiates** found in the opium poppy. Morphine, which is derived from the opium poppy, is used to alleviate pain in medical settings; it also serves as the raw material for making the street drug heroin, which enters the brain more quickly and has 3 times its strength (Julien et al., 2014).

Opium Poppy
Naturally occurring opioids, or opiates, are found in the opium poppy, the same plant that produces those little black seeds on your breakfast bagel. Doctors have been using the poppy opiate morphine to alleviate pain since the 1800s (Julien et al., 2014). AtWaG/Getty Images.

PRESCRIPTION DRUG ABUSE It was once believed that few people in the United States actually use heroin (less than 1%; SAMHSA, 2014), but studies now suggest the numbers are on the rise (Cicero, Ellis, Surratt, & Kurtz, 2014). It seems that another class of opioids is serving as a gateway to heroin—synthetic painkillers such as Vicodin (hydrocodone) and OxyContin (oxycodone; Cicero et al., 2014; 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 or in a way not prescribed by a doctor (for example, taking too much of a medication) can lead to *prescription drug abuse,* and this behavior is shockingly common among teenagers, who are more vulnerable to becoming hooked or addicted (Santye, 2013, July 14; Zhang et al., 2009). Where are teens getting prescription meds? The majority obtain these drugs from friends and family members (National Institute on Drug Abuse, 2014a). Opioid abuse is an epidemic among high school students, and many don't understand how easy it is to become hooked on these drugs. Sadly, drug overdose deaths have surpassed the number of deaths resulting from car accidents in the United States (Moisse, 2011, September 20). Opioids were implicated in 28,647 deaths in 2014 alone (Rudd, Aleshire, Zibbell, & Gladden, January 2016).



Shooting Up
Heroin is one of the most pleasure-inducing—and dangerous—drugs in the world. About 23% of heroin users get hooked, and the consequences of chronic use are serious: boils on the skin, HIV and hepatitis (from contaminated needles), liver disease, spontaneous abortion, to name but a few (National Institute on Drug Abuse, 2013b). PhotoAlto/Alamy.

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 reviewed the research. Studies have linked binge drinking to poor grades, aggressive behavior, sexual promiscuity, and accidental death. Each year, almost 2,000 college students in the United States die in alcohol-related accidents (Hingson, Zha, & Weitzman, 2009; National Institute on Alcohol Abuse and Alcoholism, n.d.). Think getting wasted is sexy? Consider this: Too much alcohol impairs sexual performance, particularly for men, who may have trouble obtaining and sustaining an erection.

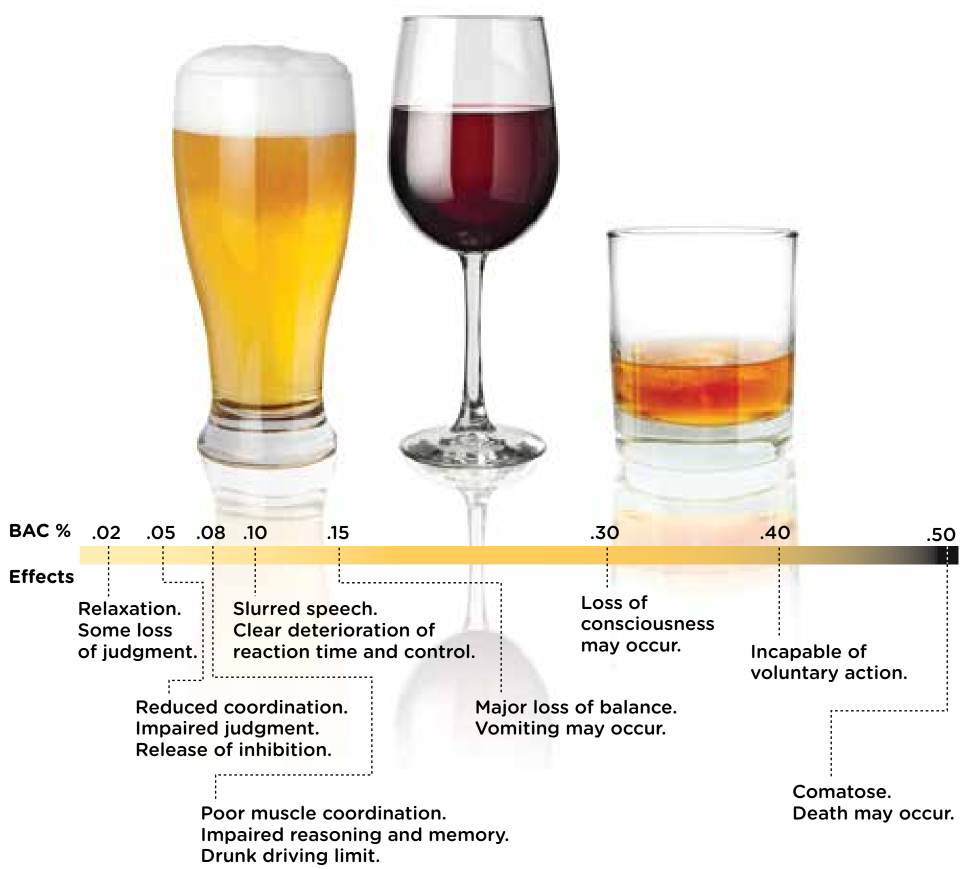
You don't have to binge drink in order to have an alcohol problem. Some people cannot get through the day without a midday drink; others need alcohol to unwind or fall asleep. The point is there are many forms of alcohol misuse. About 8.5% of the adult population in the United States (nearly 1 in 10 people) struggle with alcohol dependence

opiates A class of psychoactive drugs that cause a sense of euphoria; a drug that imitates the endorphins naturally produced in the brain.

FIGURE 4.1

Blood Alcohol Concentration (BAC)

The effects of one drink—a 12-oz bottle of beer, 4-oz glass of wine, or 1-oz shot of hard liquor—vary depending on weight, ethnicity, gender, and other factors. Across most of the United States, a BAC of .08 is the legal limit for driving. But even at lower levels, our coordination and focus may be impaired. Data from Centers for Disease Control and Prevention, 2011, February 11. Photos: (left & center) Danny Smythe/Shutterstock; (right) Thinkstock.



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/Corbis.

or some other type of drinking problem (American Psychiatric Association, 2013; Grant et al., 2004). Drinking can destroy families, careers, and human lives.

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. This release of social inhibition 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 (Infographic 4.3).

The female body is less efficient at breaking down (metabolizing) alcohol. Even when we control for body size and 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, June 24).

THE CONSEQUENCES OF DRINKING Light alcohol consumption by adults—one to two drinks a day—may boost cardiovascular health, although some of the observed benefits may be specific to red wine (American Heart Association, 2015).

However, if you look at the overall impact of alcohol consumption among people worldwide, the risks outweigh the benefits (Rehm, Shield, Roerecke, & Gmel, 2016). Excessive drinking is associated with a host of health problems. Overuse of alcohol can lead to malnourishment, cirrhosis of the liver, and *Wernicke–Korsakoff syndrome,* whose symptoms include confusion and memory problems. Excessive drinking has also been linked to heart disease, various types of cancer, tens of thousands of yearly traffic deaths, and *fetal-alcohol syndrome* in children whose mothers drank during pregnancy. Deaths due to overuse of alcohol number about 88,000 annually, shortening people's lives, on average, by 30 years (Centers for Disease Control and Prevention [CDC], 2016b). These types of deaths have been reported as the fourth most common type of preventable death in the United States (Stahre, Roeber, Kanny, Brewer, & Zhang, 2014). If you suspect that you or someone you care about is overusing alcohol, take a look at the warning signs of problematic drinking presented in **FIGURE 4.2.**

- 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.

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:* APA, 2012, March; NIH, National Institute on Alcohol Abuse and Alcoholism, 2013.

Stimulants

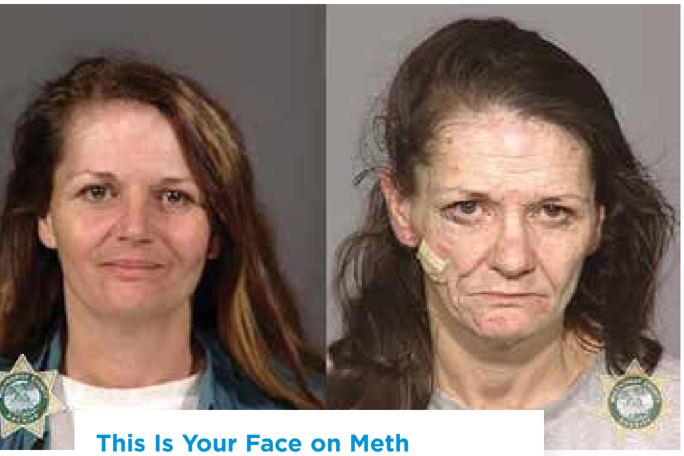
Not all drugs used in anesthesia are depressants. Did you know that some doctors use cocaine as a local anesthetic for nose and throat surgeries (MedicineNet, 2015, June 1)? Cocaine is a **stimulant**—a drug that increases neural activity in the central nervous system, producing heightened alertness, energy, elevated mood, and other effects (Julien et al., 2014). When applied topically, cocaine blocks sensation in the peripheral nerves and thereby numbs the area.

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 (Schroeder, 2013). The coca plant, they believed, was a divine gift; chewing the leaves quenched their hunger, reduced their sadness, and restored their energy. Thousands of years later, in 1860, a German chemist named Albert Niemann extracted an active part of the coca leaf and dubbed it "cocaine" (Julien et al., 2014; 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, 2013a). 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 has been implicated in

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). Corbis.

stimulants A class of drugs that increase neural activity in the central nervous system.



This Is Your Face on Meth
This woman appears to have aged 15 or 20 years, but the time elapsed between these two photos is just 2 1/2 years. Methamphetamine ravages the body, the brain, and one's overall appearance. Some meth users have lingering symptoms: Imagine experiencing horrific tactile hallucinations that cause you to believe bugs have invaded your skin and are crawling underneath it, and that in response you tear your skin to the bone in order to kill them. Multnomah County Sheriff/Splash/Newscom.

more emergency room visits than any other illegal drug (Drug Abuse Warning Network, 2011). 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 (Julien et al., 2014).

Cocaine use grew rampant in the 1980s. That was the decade *crack*—an ultra-potent (and ultra-cheap) crystalline form of cocaine—began to ravage America's inner cities. Although cocaine is still a major problem, another stimulant—methamphetamine—has come to rival it in popularity.

AMPHETAMINES *Methamphetamine* belongs to a family of stimulants called the **amphetamines** (am-FET-uh-meens). In the 1930s and 1940s, doctors used amphetamines to treat medical conditions as diverse as excessive hiccups and hypotension (unusually low blood pressure; Julien et al., 2014). During World War II, soldiers and factory workers used methamphetamine to increase energy and boost performance (Lineberry & Bostwick, 2006). Nonprescription use of methamphetamine is illegal, but people have learned how to brew this drug in their own laboratories, using ingredients from ordinary household products such as drain cleaner, battery acid, and over-the-counter cough medicines. "Cooking meth" is a dangerous enterprise. The flammable ingredients, combined with the reckless mentality of "tweaking" cookers, make for toxic fumes and thousands of accidental explosions every year (Lineberry & Bostwick, 2006; Melnikova et al., 2011). Despite the enormous risk, many people continue to cook meth at home, endangering and sometimes killing their own children.

Ridiculously cheap, easy to make, and capable of producing a euphoric high lasting many hours, 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 sex drive and suppress one's appetite for food. But unlike cocaine, which the body eliminates quickly, meth lingers in the body (National Institute on Drug Abuse, 2013d). 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 ("meth mouth"); and psychosis with hallucinations that can come and go for months, if not years, after quitting (National Institute on Drug Abuse, 2013d).

Uncertain About "Heisenberg"
How accurately did the AMC series *Breaking Bad* portray the methamphetamine underworld? The show got some things wrong; for example, there is no such thing as pure blue meth (Wickman, 2013, September 26). But as far as representing the horrors of drug trafficking, Breaking Bad comes uncomfortably close to the truth (Keefe, 2012, July 13). AMC-TV/THE KOBAL COLLECTION at Art Resource, NY.

CAFFEINE Most people have not experimented with illegal stimulants like cocaine and meth, but many are regular users of 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 energy bars. Caffeine works by blocking the action of adenosine, a neurotransmitter that normally muffles the activity of excitatory neurons in the brain (Julien et al., 2014). 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

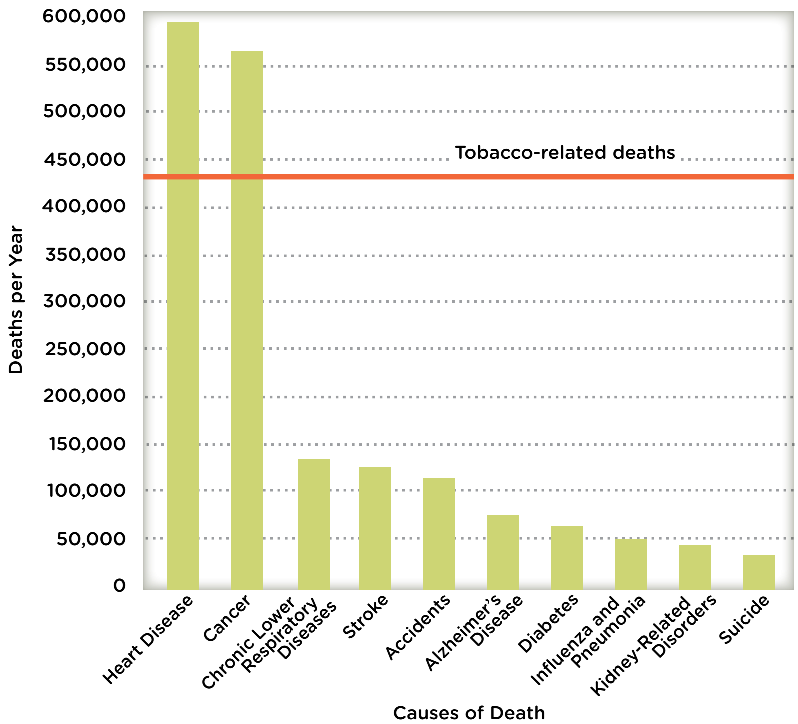


FIGURE 4.3
Leading Causes of Death in the United States
The leading killers in this country—heart disease, cancer, and chronic lower respiratory diseases—are largely driven by smoking. Tobacco exposure is behind nearly half a million deaths every year. Data from Kochanek et al., 2011. Photo: David J. Green—Lifestyle/Alamy.

and suicide, and reduced cognitive decline with aging (Lara, 2010; Rosso, Mossey & Lippa, 2008). But just because researchers find a **link** between caffeine and positive health outcomes, we should not necessarily conclude that caffeine is responsible for it. We need to remember that correlation does not prove causation. What's more, **too much caffeine** can make your heart race, your hands tremble, and your mood turn irritable. It takes several hours for your body to metabolize 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.

CONNECTIONS
In **Chapter 1,** we discussed the problem with possible third variables and correlations. Here, we need to be cautious about making too strong a statement about coffee causing positive health outcomes, because third variables could be involved in increased caffeine consumption and better health.

CONNECTIONS
In **Chapter 2,** we discussed how caffeine acts as an antagonist, blocking the receptors for the neurotransmitter adenosine. We also noted some benefits and negative consequences of its use.

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, November 20; World Health Organization [WHO], 2008). Cigarette smoking claims over 480,000 "premature deaths" every year in the United States (CDC, 2015f). Smoking can lead to lung cancer, emphysema, heart disease, and stroke (American Lung Association, 2014). The average smoker loses approximately 10 to 15 years of her life.

Despite these harrowing statistics, about 17% of adults in the United States continue to light up (CDC, 2015, November 13). 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. 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 activated by cocaine, another drug that is extremely difficult to give up (Pich et al., 1997; Zhang, Dong, Doyon, & Dani, 2012). The few who 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

Synonyms
methamphetamines meth, crystal meth, crank
amphetamines speed, uppers, bennies
secondhand smoke passive smoke

amphetamines Stimulant drugs; methamphetamine falls in this class of drugs.

particularly dangerous for children, whose developing tissues are highly vulnerable (Chapter 8). By smoking, parents increase their children's risk for sudden infant death syndrome (SIDS), respiratory infections, asthma, and bronchitis (CDC, 2014a). 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 (2014a), "There is no risk-free level of exposure" (para. 3). Researchers have also become concerned about the health implications of thirdhand smoke (especially in infants and children), the combination of cigarette toxins (including lead, which is a known neurotoxin) that lingers 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* (Ferrante et al., 2013; Winickoff et al., 2009).

Hallucinogens

LO 10 **Discuss how hallucinogens alter consciousness.**

We have learned how various depressants and stimulants are used in anesthesia. Believe it or not, there is also a place for **hallucinogens** (huh-LOO-suh-nuh-gens)—drugs that produce hallucinations (sights, sounds, odors, or other sensations of things that are not 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 in surgical patients during the 1950s and 1960s (Julien et al., 2014). 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. Doctors stopped giving PCP to patients long ago; its effect was just too erratic.

Ketamine, on the other hand, continues to be used in hospitals across the country. Unlike many of the depressants used in anesthesia, which can reduce respiratory drive to the point of death (hence the need for the breathing tube and ventilator), ketamine causes less interference with breathing and respiratory reflexes. "Ketamine is an amazing drug for preventing pain," Dr. Chander says. "It's great to use in trauma. You can give it in the muscle, especially if somebody can't start an IV . . . and help them go to sleep that way," she adds. "But used in medicinal ways, or even for recreational purposes, it can have long-lasting effects, much like LSD, a structurally analogous drug, which can cause later flashbacks. Ketamine can in fact induce lasting plastic changes in the brain. Some of these changes can be positive. Interestingly, researchers are finding that ketamine may contribute antidepressant effects through different brain networks than the ones that provide analgesia (pain relief). The drug is being investigated further for this."

LSD Sheets
Lysergic acid diethylamide, or LSD, is usually taken by mouth, administered through candy, sugar cubes, or blotter sheets like the one pictured here. A popular drug during the "hippie" era of the 1960s and 1970s, LSD has now fallen out of favor. Science Source.

LSD The most well-known hallucinogen is probably **lysergic acid diethylamide (LSD;** lih-SER-jic; die-eth-ul-AM-ide)—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 experience a crossover of sensations, such as "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., 2014). 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 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 (Centre for Addiction and Mental Health, 2010).

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 **methylenedioxymethamphetamine** (MDMA; meth-ul-een-die-ox-ee-meth-am-FET-uh-meen), commonly known as *Ecstasy* or *Molly.* 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, 2013c).

An Ecstasy trip might bring on feelings of euphoria, love, openness, heightened energy, and floating sensations. Ecstasy has also been found to have "unusual sociability-enhancing effects," meaning it seems to increase behaviors that benefit others. Some researchers are exploring the potential therapeutic use of MDMA for people dealing with trauma, for example (Kamilar-Britt & Bedi, 2015). But Ecstasy can also cause a host of troubling changes in the body, including decreased appetite, lockjaw, blurred vision, dizziness, heightened anxiety, rapid heart rate, and dehydration. Dancing in hot, crowded conditions while on Ecstasy can lead to severe heat stroke, seizures, even cardiac arrest and death (Gordon, 2001, July 5; Noller, 2009; Parrott, 2004, 2015). Despite its dangers, Ecstasy continues to be a popular illicit drug (Roberts, Jones, & Montgomery, 2016; SAMHSA, 2012).

Ecstasy triggers a sudden general unloading of **serotonin** in the brain, after which serotonin activity is temporarily depleted until its levels are restored (Klugman & Gruzelier, 2003; Roberts et al., 2016). Studies of animals have shown that even short-term exposure to MDMA can result in long-term, perhaps even permanent, damage to the brain's serotonin pathways, and there is evidence that a similar type of damage affecting reuptake from the synapse and storage of serotonin occurs in humans as well (Campbell & Rosner, 2008; 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; Parrott, 2015; Roberts et al., 2016). Studies also suggest that Ecstasy users are more likely to experience symptoms of depression (Guillot, 2007; Parrott, 2015).

MARIJUANA The most widely used illegal (in most of the United States) drug, and one of the most popular in all the Western world, is *marijuana* (Compton, Grant, Colliver, Glantz, & Stinson, 2004; Degenhardt & Hall, 2012; SAMHSA, 2014). Forty-four percent of high school seniors in the United States have tried this drug (National Institute on Drug Abuse, 2014b). "It's no big deal," a user might say, "you can't get addicted." But these kinds of assumptions are misleading. 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). 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, 2015a; Schweinsburg, Brown, & Tapert, 2008). Some identify marijuana as a cause of several chronic psychological disorders (Reece, 2009). Long-term use has been associated with reduced motivation (Reece, 2009), as well as respiratory problems, impaired lung functioning, and suppression of the immune system (Iversen, 2003; Pletcher

CONNECTIONS

In **Chapter 2,** we reported that serotonin is critical for the regulation of mood, appetite, aggression, and automatic behaviors like sleep. Here, we see how the use of Ecstasy can alter levels of this neurotransmitter.

Synonyms

hallucinogens psychedelic drugs

methylenedioxymethamphetamine E, X

mescaline peyote

marijuana Mary Jane, M.J., grass, reefer, weed, pot, ganja, hemp

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.

Cannabis
Marijuana is the most commonly used illicit drug in the world, consumed by 2.6% to 5% of the adult population. It is also the primary reason people seek drug treatment in many regions of the world, including North America (United Nations, 2012). Its use in the treatment of a variety of illnesses, including arthritis and multiple sclerosis, is still controversial (Feinstein, Freeman, & Lo, 2015; Kalant, 2015). iStock/Getty Images.

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 (Keys, 1945). These days, doctors prescribe marijuana to stimulate patients' appetites 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 **tetrahydrocannabinol** (**THC**; te-truh-high-druh-kuh-NAB-uh-nawl), 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). It's important to recognize that not all products called "marijuana" contain THC. A relatively new group of psychoactive drugs collectively known as "synthetic marijuana" target the same receptors as THC, but they do not come from the hemp plant, or any plant for that matter (National Institute on Drug Abuse, 2015b).

from the pages of SCIENTIFIC AMERICAN

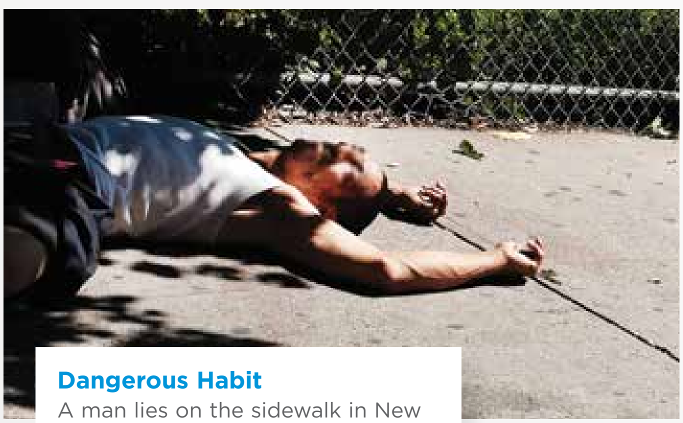
Fake Weed, Real Crisis

Synthetic cannabinoids are cheap, widespread, hard to track and highly toxic.

When powerful street drugs collectively known as synthetic pot are smoked, the resulting high mimics the effects of marijuana. Yet these man-made cannabinoids are not marijuana at all. The drugs, more commonly called spice, fake weed or K2, are made up of any number of dried, shredded plants sprayed with chemicals that live in a murky legality zone. They are highly dangerous—and their use is on the rise.

Synthetic pot, which first hit the market in the early 2000s, has especially caught the attention of public health officials in the past couple of years, stemming from a surge in hospitalizations and violent episodes. Although the drugs act on the same brain pathway as weed's active ingredient, they can trigger harsher reactions, including heart attacks, strokes, kidney damage and delusions. Between June and early August usage of these drugs led to roughly 2,300 emergency room visits in New York State alone. Nationwide more than 6,000 incidents involving spice have been reported to U.S. poison-control centers this year—about double the number of calls in 2013.

Ever changing recipes make it possible for spice sellers to elude the authorities. Each time an ingredient is banned, producers swap in another compound. The drugs are then sold on the Internet or at gas stations and convenience stores at prices lower than genuine marijuana. The changing formulations also pose a challenge for researchers trying to match the chemicals with their side effects or to develop tests to identify them in a user's system. "The drugs are present in blood for only a short period, so it's very difficult to detect them," says Marilyn Huestis, chief of the Chemistry and Drug Metabolism Section at the National Institute on Drug Abuse. Huestis is now working to identify synthetic cannabinoid by-products via a method that captures all ions present in a single test sample. It can take a month to evaluate one compound, but to keep up with the influx of pot knockoffs, she says, "I think this [method] is our only hope." **Dina Fine Maron. Reproduced with permission.**



Dangerous Habit
A man lies on the sidewalk in New York City, apparently unconscious after using synthetic marijuana. Use of this drug, also called "Spice" or "K2," may lead to a variety of undesirable outcomes, including paranoia, violent behavior, seizures, dangerous increases in blood pressure, and sometimes death (National Institute on Drug Abuse, 2015b). Spencer Platt/Getty Images.

Overuse and Addiction

We often joke about being "addicted" to our coffee or soda, but do we understand what this really means? In spite of frequent references to *addiction* in everyday conversations, the term has been omitted from the American Psychiatric Association's diagnostic manual due to its "uncertain definition and potentially negative connotation" (American Psychiatric Association, 2013, p. 485). Historically, the term addiction has been used (both by laypeople and professionals) to refer to the urges people experience to use a drug or engage in an activity to such an extent that it interferes with their functioning or is dangerous. 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. Social media addiction . . . really?

SOCIAL MEDIA AND PSYCHOLOGY

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-mails? 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).

THE URGE TO USE MEDIA WAS HARDER TO RESIST THAN SEX, SPENDING MONEY, ALCOHOL. . . .

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 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 something 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* addictions to be mental disorders. Further, the National Institute on Drug Abuse (2014c) defines addiction to drugs, in particular, as "a chronic, relapsing brain disease that is characterized by compulsive drug seeking and use, despite harmful consequences" (para. 1). You read it right: Addiction changes your brain.

In Class: Collaborate and Report

With your group, design a study using the correlational method to examine the potential impact of social media use. **A)** List measurable variables of social media use (for example, amount of time spent on social media; time lapsed between checking social media). **B)** List measurable variables you think might be associated with social media use (for example, GPA; time spent studying; number of friends). **C)** Record several examples of two variables (one from each list) and the predicted direction of their correlation (for example, hours on social media and GPA expected to have a negative correlation). **D)** Why can't we prove that the variables listed in **A** cause changes to the variables listed in **B**?

LO 11 **Explain how physiological and psychological dependence differ.**

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 (see FIGURE 4.4 on the next page). 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,*

tetrahydrocannabinol (THC) The active ingredient of marijuana.

physiological dependence With constant use of some psychoactive drugs, the body no longer functions normally without the drug.

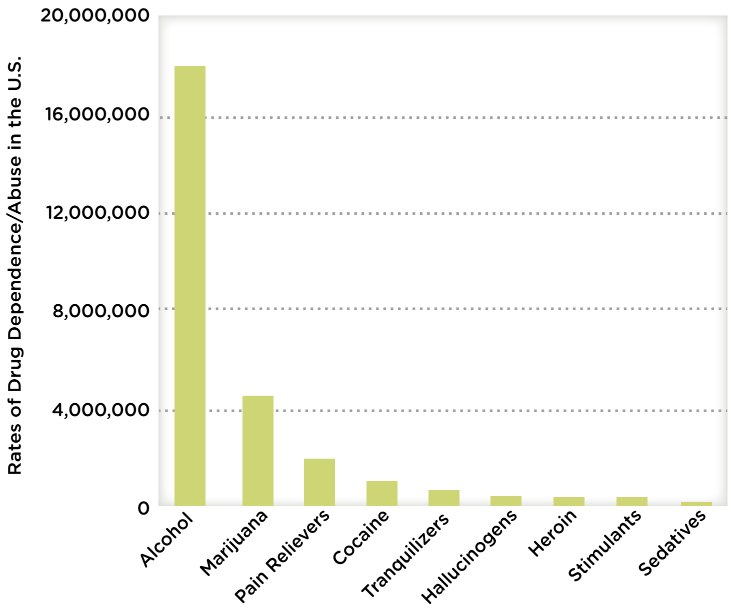


FIGURE 4.4
Rates of Drug Dependence in the United States
This graph depicts the rates of drug dependence/abuse in the United States. As you can see, alcohol tops the list, followed by marijuana, and then pain relievers such as Vicodin and Oxycontin. The sedatives category includes barbiturates, which are powerful nervous system depressants. Data from National Institute on Drug Abuse, 2012, July. Photo: Alec Macdonald/Alamy.

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. If a person who is physiologically dependent on alcohol suddenly stops drinking, she may suffer from **delirium tremens (DTs)**, withdrawal symptoms that include sweating, restlessness, hallucinations, severe tremors, seizures, and even death. Withdrawal symptoms disappear when you take the drug again, and this of course makes you more likely to continue using it. (The removal of the unpleasant symptoms acts as negative reinforcement for taking the drug, a process you can learn about in Chapter 5.) In this way, withdrawal powers the addiction cycle.

Another sign of physiological dependence is **tolerance**. Persistent use of alcohol and other drugs alters the chemistry of the brain and body. Over time, your system adapts to the drug and therefore needs more and more to re-create its original effect. If it once took you 2 beers to unwind, but now it takes you 4, then tolerance has probably set in. Tolerance increases the risk for accidental overdose, because more of the drug is needed to obtain the desired effect.

Psychological dependence is indicated by a host of problematic symptoms distinct from tolerance and withdrawal. 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. Psychological dependence is an urge or craving, not a physical need. The cues associated with using the telephone facilitate the smoker's urge to light up (Bold, Yoon, Chapman, & McCarthy, 2013).

Psychologists and psychiatrists use specific criteria for drawing the line between use and overuse of drugs. 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.

WE'RE ALL DIFFERENT We have discussed the general effects of psychoactive drugs, but keep in mind that people respond to drugs in distinct, and sometimes unpredictable,

withdrawal With constant use of some psychoactive drugs, a condition in which the body becomes dependent and then reacts when the drug is withheld; a sign of physiological dependence.

delirium tremens (DTs) Withdrawal symptoms that can occur when a person who is physiologically dependent on alcohol suddenly stops drinking; can include sweating, restlessness, hallucinations, severe tremors, and seizures.

tolerance With constant use of some psychoactive drugs, a condition in which the body requires more and more of the drug to create the original effect; a sign of physiological dependence.

psychological dependence With constant use of some psychoactive drugs, a strong desire or need to continue using the substance occurs without the evidence of tolerance or withdrawal symptoms.

ways. Dr. Chander sees evidence of this in her daily practice. For example, patients require varying doses of Versed in order to become calm and drowsy before going into the operating room. Similarly, patients have distinct ways of waking up from anesthesia; their EEGs look different, and these differences seem to be linked to their pain experience during recovery (Chander, Garcia, MacColl, Illing, & Sleigh, 2014).

Some of the variability in drug response relates to gender, age, body weight, and other easy-to-identify characteristics. But our reactions to drugs also seem to be inherited; in other words, they are determined by our genes. Wouldn't it be wonderful if doctors had a way of predicting drug responses *before* patients went under anesthesia? Imagine taking a drop of blood, putting it on a chip, analyzing it, and producing a genetic profile that indicates how a person will react to different drugs. This concept of "personalized medicine" is the future, and Dr. Chander is bringing us closer to it with her Anesthesia and Pharmacogenomics Initiative at Stanford University.

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 4.5). But is it possible to enter an altered state of consciousness without using a substance? It is time to explore hypnosis.

TABLE 4.5 PSYCHOACTIVE DRUGS

Drug	Classification	Effects	Potential Harm
Alcohol	Depressant	Disinhibition, feeling "high"	Coma, death
Barbiturates	Depressant	Decreased neural activity, relaxation, possible aggression	Loss of consciousness, coma, death
Caffeine	Stimulant	Alertness, enhanced recall, elevated mood, endurance	Heart racing, trembling, insomnia
Cocaine	Stimulant	Energy, euphoria, rush of pleasure	Heart attack, stroke, anxiety, psychosis
Heroin	Depressant	Pleasure-inducing, reduces pain, rush of euphoria and relaxation	Boils on the skin, hepatitis, liver disease, spontaneous abortion
LSD	Hallucinogen	Extreme changes in sensation and perception, emotional roller coaster	Depression, long-term flashbacks, other psychological problems
Marijuana	Hallucinogen	Stimulates appetite, suppresses nausea, relaxation, mild euphoria, distortion of time, intense sensory experiences	Respiratory problems, immune system suppression, cancer, memory impairment, deficits in attention and learning
MDMA	Stimulant; hallucinogen	Euphoria, heightened energy, and anxiety	Blurred vision, dizziness, rapid heart rate, dehydration, heat stroke, seizures, cardiac arrest, and death
Methamphetamine	Stimulant	Energy, alertness, increases sex drive, suppresses appetite	Lasting memory and movement problems, severe weight loss, tooth decay, psychosis, sudden death
Opioids	Depressant	Blocks pain, induces drowsiness, euphoria, slows down breathing	Respiratory problems during sleep, falls, constipation, sexual problems, overdose
Tobacco	Stimulant	Relaxed, alert, more tolerant of pain	Cancer, emphysema, heart disease, stroke, reduction in life span

Most drugs can be classified under one of the major categories listed above, but there are substances, such as MDMA, that fall into more than one class. Psychoactive drugs carry serious risks.

Mesmerizing
A 19th-century doctor attempts to heal a patient using the hypnotic techniques created by Franz Mesmer in the 1770s. Mesmer believed that every person was surrounded by a magnetic field, or "animal magnetism," that could be summoned for therapeutic purposes (Wobst, 2007). The word "mesmerize" derives from Mesmer's name. Jean-Loup Charmet/Science Source.

Hypnosis

LO 12 Describe hypnosis and explain how it works.

The term *hypnosis* was taken from the Greek root word for "sleep," but hypnosis is by no means the equivalent of sleep. Most would agree **hypnosis** is an altered state of consciousness in which changes in perceptions and behaviors result from suggestions made by a 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 *is not.*

CONTROVERSIES

False Claims About Hypnosis

NO ONE CAN FORCE YOU TO BECOME HYPNOTIZED

Popular conceptions of hypnosis often clash with scientists' understanding of the phenomenon. Let's take a look at some examples.

- **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, 2014).
- **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; and (5) high responsivity to suggestions (Hoeft et al., 2012; 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). Some have found hypnotherapy beneficial in helping people confront their fear of going to the dentist (Butler, 2015). Hypnosis has also been used on children to alleviate chronic pain, insomnia, and anxiety related to routine medical procedures (Adinolfi & Gava, 2013). And, others have demonstrated the benefits of hypnosis in conjunction with traditional therapies for the treatment of chronic issues such as tension headaches (Shahkhase, Gharaei, Fathi, Yaghoobi, & Bayazi, 2014). Some research suggests that hypnosis can ease the pain associated with childbirth and surgery, reducing the need for painkillers (Cyna,

hypnosis An altered state of consciousness allowing for changes in perceptions and behaviors, which result from suggestions made by a hypnotist.

McAuliffe, & Andrew, 2004; Wobst, 2007), although more recent research finds that hypnosis did not reduce the use of painkillers during labor and childbirth (Cyna et al., 2013; Wemer, Uldbjerg, Zachariae, Rosen, & Nohr, 2013).

A SESSION WITH A HYPNOTIST Imagine you are using hypnosis for one of these purposes—to address constant 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. Alternatively, the hypnotist might suggest that you are walking down steps, and ask you to focus attention on her voice. Hypnotists who are very good at this procedure can perform an induction in less than a minute, especially if they know the individual being hypnotized.

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 gave spoken reports of 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.

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, 1997, August 15). The perception of pain is complex, and "virtually all of the brain areas involved in the processing of pain have been shown to be impacted by hypnosis" (Jensen et al., 2015, p. 41). Hypnosis, meditation, and other relaxation techniques can indeed reduce anxiety and pain. But 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.

Hypnosis for Pain
A doctor in Belgium performs hypnosis on a patient undergoing a painful procedure. For those who are susceptible to hypnosis, this approach may diminish the need for anesthesia.
Universal Images Group/Getty Images.

THEORIES OF HYPNOSIS There are many theories to explain hypnosis. One hypothesis, referred to briefly above, is that hypnotized people experience a "split" in awareness or consciousness (Hilgard, 1977, 1994). According to this perspective, 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.

Some researchers have suggested that hypnosis is not a distinct state of consciousness, but more of a role-play (Crabtree, 2012; Lynn, Rhue, & Weekes, 1990). 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 fulfilling the role we think we should assume. And this is particularly true when good rapport exists between the hypnotist and the person being hypnotized.

FADE TO BLACK It is almost time to conclude our discussion of consciousness, so 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. Chander that anesthetic drugs can profoundly alter consciousness. The same is true of drugs used outside of medical supervision; legal or not, many drugs can lead to dependence, health problems, and death. And although somewhat controversial and misunderstood, hypnosis appears to induce an altered state of consciousness and may have useful applications.

show what you know

1. Match the drug in the left column with an outcome on the right:

   _____1. depressant — **a.** blocks pain

   _____2. opioid — **b.** slows down activity in the CNS

   _____3. alcohol — **c.** increases neural activity in the CNS

   _____4. cocaine — **d.** cirrhosis of the liver

2. An acquaintance described an odorless, tasteless, and colorless substance he took many years ago. He discussed a variety of changes to his sensations and perceptions, including seeing colors and spirals. It is likely he had taken which of the following hallucinogens?

   a. alcohol **c.** LSD

   b. nicotine **d.** cocaine

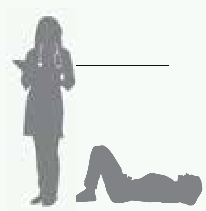
3. Dr. Chander uses a range of __________ to inhibit memories of surgery and change levels of consciousness.

4. People often describe dangerous or risky behaviors as being addictive. You might hear a character in a movie say that he is addicted to driving fast, for example. Given what you have learned about physiological and psychological dependence, how would you determine if behaviors are problematic?

✓ CHECK YOUR ANSWERS IN APPENDIX C.

Improve your grade! Use LearningCurve adaptive quizzing to create your personalized study plan, which will direct you to the resources that will help you most in LaunchPad

4 summary of concepts



LO 1 Define consciousness. (p. 144)

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.

LO 2 Explain how automatic processing relates to consciousness. (p. 147)

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.

LO 3 Describe how we narrow our focus through selective attention. (p. 147)

We can only direct our attention toward a small portion of the information that is available to us. This narrow focus on specific stimuli is referred to as selective attention. In particular, 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. 150)

Predictable daily patterns influence our behaviors, alertness, and activity levels in a cyclical fashion. These circadian rhythms in our physiological functioning roughly follow the 24-hour cycle of daylight and darkness. 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 midafternoon, around 2:00 or 3:00 P.M.

LO 5 Summarize the stages of sleep. (p. 154)

Sleep begins in non-rapid eye movement (non-REM), or nondreaming sleep, which has three stages. The lightest is Stage N1; this is the time during which imaginary sensations can occur. Stage N1 lasts only a few minutes before Stage N2 begins. At this point, it is more difficult to rouse the sleeper before she drifts even further into Stage N3, also known as slow-wave sleep. The sleeper then works her way back up to Stage N2. And instead of waking up, she enters the R Stage, 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 N1 through REM, lasts about 90 minutes, and the average adult loops through five complete cycles per night. The composition of these cycles changes as the night progresses.

LO 6 Recognize various sleep disorders and their symptoms. (p. 158)

Narcolepsy is a neurological disorder characterized by excessive daytime sleepiness and other sleep-related disturbances. REM sleep behavior disorder occurs when the mechanism responsible for paralyzing the body during REM sleep does not function properly. As a result, the individual is able to move around and act out dreams. Obstructive sleep apnea hypopnea is a serious disturbance of non-REM sleep characterized by periodic blockage of breathing. The upper throat muscles go limp, allowing the airway to close. The sleeper awakens and gasps for air, then drifts back to sleep. Insomnia is the inability to fall asleep or stay asleep. People with insomnia report poor quantity or quality of sleep, and some may complain about waking up too early and being unable to fall back to sleep.

LO 7 Summarize the theories of why we dream. (p. 165)

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. Latent content contains the hidden meaning of the dream, consisting of unconscious conflicts and desires. The activation–synthesis model suggests that dreams have no meaning whatsoever: We respond to random neural activity of the sleeping brain 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. 168)

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, for example, depress activity in the central nervous system, produce hallucinations, or cause a sense of euphoria.

LO 9 Identify several depressants and stimulants and know their effects. (p. 169)

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

LO 10 Discuss how hallucinogens alter consciousness. (p. 176)

Hallucinogens produce hallucinations, altered moods, and distorted perception and thought. The most well-known is lysergic acid diethylamide (LSD). This odorless, tasteless, and colorless substance often produces extreme changes in sensation and perception. Others are the "club drugs," or synthetic "designer drugs," used at parties, raves, and dance venues. Of these, the most popular is methylenedioxymethamphetamine (MDMA), which is chemically similar to the stimulant methamphetamine, producing a combination of stimulant and hallucinogenic effects. The most widely used illegal (in most of the United States) drug is marijuana. At high doses, its tetrahydrocannabinol (THC) can induce mild euphoria and create intense sensory experiences.

LO 11 Explain how physiological and psychological dependence differ. (p. 179)
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. 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 health consequences.

LO 12 Describe hypnosis and explain how it works. (p. 182)
Hypnosis is an altered state of consciousness that can create changes in perceptions and behaviors, usually resulting from suggestions made by a hypnotist. Hypnosis has been used during childbirth and surgery to reduce pain. One theory suggests that hypnotized people experience a "split" in awareness or consciousness. Others suggest hypnosis is not a distinct state of consciousness, but more of a role-play.

key terms

activation–synthesis model, p. 166
alpha waves, p. 154
amphetamines, p. 174
automatic processing, p. 147
barbiturates, p. 169
beta waves, p. 154
circadian rhythm, p. 151
cognitive psychology, p. 146
consciousness, p. 144
delirium tremens (DTs), p. 180
delta waves, p. 156
depressants, p. 169
hallucinogens, p. 176
hypnosis, p. 182
insomnia, p. 160
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lysergic acid diethylamide (LSD), p. 176
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methylenedioxymethamphetamine (MDMA), p. 177
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opiates, p. 171
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physiological dependence, p. 179
psychoactive drugs, p. 168
psychological dependence, p. 180
rapid eye movement (REM), p. 156
REM rebound, p. 162
REM sleep behavior disorder, p. 159
selective attention, p. 147
sleep terrors, p. 161
stimulants, p. 173
tetrahydrocannabinol (THC), p. 178
theta waves, p. 156
tolerance, p. 180
withdrawal, p. 180

test prep *are you ready?*

1. William James proposed that ___________ is like a "stream" that provides a sense of 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. waking consciousness.
d. creation of memories.

3. Turrell was able to focus on talking with his friend while they were at a loud fraternity fundraiser. His ability to ignore everything else and focus on their conversation is known as:
a. the cocktail-party effect.
b. inattentional blindness.
c. automatic processing.
d. the circadian rhythm.

4. Sleep-wake cycles, body temperature, and growth hormone secretion follow predictable patterns over a 24-hour period. These patterns are driven by our:
a. blood pressure.
b. need for sleep.
c. levels of consciousness.
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. Mary Ann is a shift worker and is having problems with her sleep-wake cycle. This often results 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. alpha
c. beta
d. theta

8. The fourth 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. Depriving people of REM sleep 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 C.

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