Unit V

States of Consciousness

Modules

Consciousness can be a funny thing. It offers us weird experiences, as when entering sleep or leaving a dream, and sometimes it leaves us wondering who is really in control. After zoning me out with nitrous oxide, my dentist tells me to turn my head to the left. My conscious mind resists: *"No way,"* I silently say. *"You can't boss me around!"* Whereupon my robotic head, ignoring my conscious mind, turns obligingly under the dentist's control.

During my noontime pickup basketball games, I am sometimes mildly irritated as my body passes the ball while my conscious mind is saying, *"No, stop! Sarah is going to intercept!"* Alas, my body completes the pass. Other times, as psychologist Daniel Wegner (2002) noted in *The Illusion of Conscious Will,* people believe their consciousness is controlling their actions when it isn't. In one experiment, two people jointly controlled a computer mouse. Even when their partner (who was actually the experimenter's accomplice) caused the mouse to stop on a predetermined square, the participants perceived that *they* had caused it to stop there.

Then there are those times when consciousness seems to split. Reading *Green Eggs and Ham* to one of my preschoolers for the umpteenth time, my obliging mouth could say the words while my mind wandered elsewhere. And if someone asks what you're doing for lunch while you're texting, it's not a problem. Your thumbs complete the message as you suggest getting tacos.

What do such experiences reveal? Was my drug-induced dental experience akin to people's experiences with other *psychoactive drugs* (mood- and perception-altering substances)? Was my automatic obedience to my dentist like people's responses to a hypnotist? Does a split in consciousness, as when our minds go elsewhere while reading or texting, explain people's behavior while under hypnosis? And during sleep, when do those weird dream experiences occur, and why? Before considering these questions and more, let's ask a fundamental question: What is *consciousness?*

Module 22

Understanding Consciousness and Hypnosis

ZUMA Press, Inc./Alamy

Module Learning Objectives

22-1 Describe the place of consciousness in psychology's history.

22-2 Define *hypnosis*, and describe how a hypnotist can influence a hypnotized subject.

22-3 Discuss whether hypnosis is an extension of normal consciousness or an altered state.

Every science has concepts so fundamental they are nearly impossible to define. Biologists agree on what is alive but not on precisely what life is. In physics, *matter* and *energy* elude simple definition. To psychologists, consciousness is similarly a fundamental yet slippery concept.

Defining Consciousness

22-1 What is the place of consciousness in psychology's history?

At its beginning, *psychology* was "the description and explanation of states of consciousness" (Ladd, 1887). But during the first half of the twentieth century, the difficulty of scientifically studying consciousness led many psychologists—including those in the emerging school of *behaviorism* (Module 26)—to turn to direct observations of behavior. By the 1960s, psychology had nearly lost consciousness and was defining itself as "the science of behavior." Consciousness was likened to a car's speedometer: "It doesn't make the car go, it just reflects what's happening" (Seligman, 1991, p. 24).

> "Psychology must discard all reference to consciousness."
> -Behaviorist John B. Watson (1913)

After 1960, mental concepts reemerged. Neuroscience advances related brain activity to sleeping, dreaming, and other mental states. Researchers began studying consciousness altered by hypnosis and drugs. Psychologists of all persuasions were affirming the importance of *cognition,* or mental processes. Psychology was regaining consciousness.

Most psychologists now define **consciousness** as our awareness of ourselves and our environment. As we saw in Module 13, our conscious awareness is one part of the *dual processing* that goes on in our two-track minds. Although much of our information processing is conscious, much is unconscious and automatic—outside our awareness. Module 16 highlighted our *selective attention,* which directs the spotlight of our awareness, allowing us to assemble information from many sources as we reflect on our past and plan for our future. We are also attentive when we learn a complex concept or behavior. When learning to ride a bike, we focus on obstacles that we have to steer around and on how to use the brakes. With practice, riding a bike becomes semi-automatic, freeing us to focus our attention on other things. As we do so, we experience what the early psychologist William James called a continuous "stream of consciousness," with each moment flowing into the next. Over time, we flit between different *states of consciousness,* including sleeping, waking, and various altered states (**FIGURE 22.1**).

AP® Exam Tip

Note that our modern-day understanding of the unconscious is very different from Sigmund Freud's theory of the unconscious (Module 55). Freud believed the unconscious was a hiding place for our most anxiety-provoking ideas and emotions, and that uncovering those hidden thoughts could lead to healing. Now, most psychologists simply view the unconscious track as one that operates without awareness. Make sure you keep these two ideas of the unconscious straight.

Some states occur spontaneously	Daydreaming	Drowsiness	Dreaming
Some are physiologically induced	Hallucinations	Orgasm	Food or oxygen starvation
Some are psychologically induced	Sensory deprivation	Hypnosis	Meditation

Maria Teijeiro/Getty Images

Stuart Franklin/Magnum Photos

Figure 22.1
States of consciousness
In addition to normal, waking awareness, consciousness comes to us in altered states, including daydreaming and meditating.

Hypnosis

22-2 What is hypnosis, and what powers does a hypnotist have over a hypnotized subject?

Imagine you are about to be hypnotized. The hypnotist invites you to sit back, fix your gaze on a spot high on the wall, and relax. In a quiet voice the hypnotist suggests, "Your eyes are growing tired. . . . Your eyelids are becoming heavy . . . now heavier and heavier. . . . They are beginning to close. . . . You are becoming more deeply relaxed. . . . Your breathing is now deep and regular. . . . Your muscles are becoming more and more relaxed. Your whole body is beginning to feel like lead."

After a few minutes of this *hypnotic induction,* you may experience **hypnosis.** When the hypnotist suggests, "Your eyelids are shutting so tight that you cannot open them even if you try," it may indeed seem beyond your control to open your eyelids. Told to forget the number 6, you may be puzzled when you count 11 fingers on your hands. Invited to smell a sensuous perfume that is actually ammonia, you may linger delightedly over its pungent odor. Told that you cannot see a certain object, such as a chair, you may indeed report that it is not there, although you manage to avoid the chair when walking around (illustrating once again that two-track mind of yours).

But is hypnosis really an *altered* state of consciousness? Let's start with some frequently asked questions.

Frequently Asked Questions About Hypnosis

Hypnotists have no magical mind-control power. Their power resides in the subjects' openness to suggestion, their ability to focus on certain images or behaviors (Bowers, 1984). But how open to suggestions are we?

consciousness our awareness of ourselves and our environment.

hypnosis a social interaction in which one person (the subject) responds to another person's (the hypnotist's) suggestions that certain perceptions, feelings, thoughts, or behaviors will spontaneously occur.

- ***Can anyone experience hypnosis?*** To some extent, we are all open to suggestion. When people stand upright with their eyes closed and are told that they are swaying back and forth, most will indeed sway a little. In fact, *postural sway* is one of the items assessed on the Stanford Hypnotic Susceptibility Scale. People who respond to such suggestions without hypnosis are the same people who respond with hypnosis (Kirsch & Braffman, 2001).

  Highly hypnotizable people—say, the 20 percent who can carry out a suggestion not to smell or react to a bottle of ammonia held under their nose—typically become deeply absorbed in imaginative activities (Barnier & McConkey, 2004; Silva & Kirsch, 1992). Many researchers refer to this as hypnotic ability—the ability to focus attention totally on a task, to become imaginatively absorbed in it, to entertain fanciful possibilities.
- ***Can hypnosis enhance recall of forgotten events?*** Most people believe (wrongly, as Module 32 will explain) that our experiences are all "in there," recorded in our brain and available for recall if only we can break through our own defenses (Loftus, 1980). But 60 years of memory research disputes such beliefs. We do not encode everything that occurs around us. We permanently store only some of our experiences, and we may be unable to retrieve some memories we have stored.

  "Hypnotically refreshed" memories combine fact with fiction. Since 1980, thousands of people have reported being abducted by UFOs, but most such reports have come from people who are predisposed to believe in aliens, are highly hypnotizable, and have undergone hypnosis (Newman & Baumeister, 1996; Nickell, 1996). Without either person being aware of what is going on, a hypnotist's hints—"Did you hear loud noises?"—can plant ideas that become the subject's pseudomemory.

AP® Exam Tip

Psychological research corrects the mistaken popular belief that hypnosis or other methods can be used to tap into a pure and complete memory bank. You will learn much more about how memory really works when you get to Unit VII.

"Hypnosis is not a psychological truth serum and to regard it as such has been a source of considerable mischief." -Researcher Kenneth Bowers (1987)

So should testimony obtained under hypnosis be admissible in court? American, Australian, and British courts have agreed it should not. They generally ban testimony from witnesses who have been hypnotized (Druckman & Bjork, 1994; Gibson, 1995; McConkey, 1995).

FYI

See Module 33 for a more detailed discussion of how people may construct false memories.

- ***Can hypnosis force people to act against their will?*** Researchers have induced hypnotized people to perform an apparently dangerous act: plunging one hand briefly into fuming "acid," then throwing the "acid" in a researcher's face (Orne & Evans, 1965). Interviewed a day later, these people emphatically denied their acts and said they would never follow such orders.

  Had hypnosis given the hypnotist a special power to control others against their will? To find out, researchers Martin Orne and Frederich Evans unleashed that enemy of so many illusory beliefs—the control group. Orne asked other individuals to *pretend* they were hypnotized. Laboratory assistants, unaware that those in the experiment's control group had not been hypnotized, treated both groups the same. The result? All the *un*hypnotized participants (perhaps believing that the laboratory context assured safety) performed the same acts as those who were hypnotized.
- ***Can hypnosis be therapeutic?*** *Hypnotherapists* try to help patients harness their own healing powers (Baker, 1987). **Posthypnotic suggestions** have helped alleviate headaches, asthma, and stress-related skin disorders.

  In one statistical digest of 18 studies, the average client whose therapy was supplemented with hypnosis showed greater improvement than 70 percent of other therapy patients (Kirsch et al., 1995, 1996). Hypnosis seemed especially helpful for the treatment of obesity. However, drug, alcohol, and smoking addictions have not responded well to hypnosis (Nash, 2001). In controlled studies, hypnosis speeds the disappearance of warts, but so do the same positive suggestions given without hypnosis (Spanos, 1991, 1996).

"It wasn't what I expected. But facts are facts, and if one is proved to be wrong, one must just be humble about it and start again." -Agatha Christie's Miss Marple

posthypnotic suggestion
a suggestion, made during a hypnosis session, to be carried out after the subject is no longer hypnotized; used by some clinicians to help control undesired symptoms and behaviors.

- ***Can hypnosis relieve pain?*** Hypnosis *can* relieve pain (Druckman & Bjork, 1994; Jensen, 2008). When unhypnotized people put their arm in an ice bath, they feel intense pain within 25 seconds. When hypnotized people do the same after being given suggestions to feel no pain, they indeed report feeling little pain. As some dentists know, light hypnosis can reduce fear, thus reducing hypersensitivity to pain.

  Hypnosis inhibits pain-related brain activity. In surgical experiments, hypnotized patients have required less medication, recovered sooner, and left the hospital earlier than unhypnotized control patients (Askay & Patterson, 2007; Hammond, 2008; Spiegel, 2007). Nearly 10 percent of us can become so deeply hypnotized that even major surgery can be performed without anesthesia. Half of us can gain at least some pain relief from hypnosis. The surgical use of hypnosis has flourished in Europe, where one Belgian medical team has performed more than 5000 surgeries with a combination of hypnosis, local anesthesia, and a mild sedative (Song, 2006).


BSIP SA/Alamy

Hypnotherapy This therapy aims to help people uncover problem-causing thoughts and feelings, or to change an unwanted behavior.

Explaining the Hypnotized State

22-3 Is hypnosis an extension of normal consciousness or an altered state?

We have seen that hypnosis involves heightened suggestibility. We have also seen that hypnotic procedures do not endow a person with special powers but can sometimes help people overcome stress-related ailments and cope with pain. So, just what *is* hypnosis? Psychologists have proposed two explanations.

HYPNOSIS AS A SOCIAL PHENOMENON

Our attentional spotlight and interpretations powerfully influence our ordinary perceptions. Might hypnotic phenomena reflect such workings of normal consciousness, as well as the power of social influence (Lynn et al., 1990; Spanos & Coe, 1992)? Advocates of the *social influence theory of hypnosis* believe they do.

Does this mean that subjects consciously fake hypnosis? *No*—like actors caught up in their roles, they begin to feel and behave in ways appropriate for "good hypnotic subjects." The more they like and trust the hypnotist, the more they allow that person to direct their attention and fantasies (Gfeller et al., 1987). "The hypnotist's ideas become the subject's thoughts," explained Theodore Barber (2000), "and the subject's thoughts produce the hypnotic experiences and behaviors." Told to scratch their ear later when they hear the word *psychology,* subjects will likely do so—but only if they think the experiment is still under way. If an experimenter eliminates their motivation for acting hypnotized—by stating that hypnosis reveals their "gullibility"—subjects become unresponsive. Such findings support the idea that hypnotic phenomena are an extension of normal social and cognitive processes.

These views illustrate a principle that Module 75 emphasizes: *An authoritative person in a legitimate context can induce people—hypnotized or not—to perform some unlikely acts.* Or as hypnosis researcher Nicholas Spanos (1982) put it, "The overt behaviors of hypnotic subjects are well within normal limits."

HYPNOSIS AS DIVIDED CONSCIOUSNESS

Other hypnosis researchers believe hypnosis is more than inducing someone to play the role of "good subject." How, they ask, can we explain why hypnotized subjects sometimes carry out suggested behaviors on cue, even when they believe no one is watching (Perugini et al., 1998)? And why does distinctive brain activity accompany hypnosis (Oakley & Halligan, 2009)? In one experiment, deeply hypnotized people were asked to imagine a color, and areas of their brain activated as if they were really seeing the color. To the hypnotized person's brain, mere imagination had become a compelling hallucination (Kosslyn et al., 2000). In another experiment, researchers invited hypnotizable and nonhypnotizable people to say the color of letters. This is an easy task, but it slows if, say, green letters form the conflicting word RED, a phenomenon known as the *Stroop effect* (Raz et al., 2005). When easily hypnotized people were given a suggestion to focus on the color and to perceive the letters as irrelevant gibberish, they were much less slowed by the word-color conflict. (Brain areas that decode words and detect conflict remained inactive.)

dissociation a split in consciousness, which allows some thoughts and behaviors to occur simultaneously with others.

These results would not have surprised famed researcher Ernest Hilgard (1986, 1992), who believed hypnosis involves not only social influence but also a special dual-processing state of **dissociation**—a split between different levels of consciousness. Hilgard viewed hypnotic dissociation as a vivid form of everyday mind splits—similar to doodling while listening to a lecture or typing the end of a sentence while starting a conversation. Hilgard felt that when, for example, hypnotized people lower their arm into an ice bath, as in **FIGURE 22.2**, the hypnosis dissociates the sensation of the pain stimulus (of which the subjects are still aware) from the emotional suffering that defines their experience of pain. The ice water therefore feels cold—very cold—but not painful.

Figure 22.2
Dissociation or role playing? A hypnotized woman tested by Ernest Hilgard exhibited no pain when her arm was placed in an ice bath. But asked to press a key if some part of her felt the pain, she did so. To Hilgard, this was evidence of dissociation, or divided consciousness. Proponents of social influence theory, however, maintain that people responding this way are caught up in playing the role of "good subject."

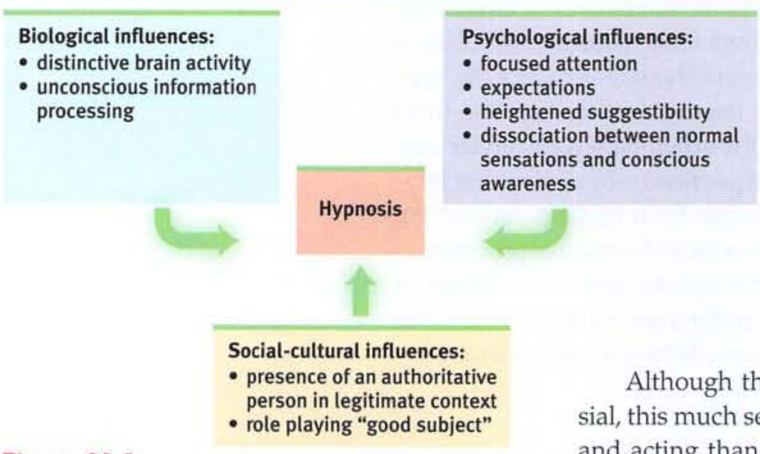


Figure 22.3
Levels of analysis for hypnosis Using a biopsychosocial approach, researchers explore hypnosis from complementary perspectives.

Another form of dual processing—*selective attention*—may also play a role in hypnotic pain relief. PET scans show that hypnosis reduces brain activity in a region that processes painful stimuli, but not in the sensory cortex, which receives the raw sensory input (Rainville et al., 1997). Hypnosis does not block sensory input, but it may block our attention to those stimuli. This helps explain why an injured athlete, caught up in the competition, may feel little or no pain until the game ends.

Although the divided-consciousness theory of hypnosis is controversial, this much seems clear: There is, without doubt, much more to thinking and acting than we are conscious of. Our information processing, which starts with selective attention, is divided into simultaneous conscious and nonconscious realms. In hypnosis as in life, *much of our behavior occurs on autopilot.* We have two-track minds (**FIGURE 22.3**).

Before You Move On

▶ ASK YOURSELF

You've read about two examples of dissociated consciousness: talking while texting, and thinking about something else while reading a child a bedtime story. Can you think of another example that you have experienced?

▶ TEST YOURSELF

When is the use of hypnosis potentially harmful, and when can hypnosis be used to help?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 22 Review

22-1 What is the place of consciousness in psychology's history?

- After initially claiming consciousness as its area of study in the nineteenth century, psychologists had abandoned it in the first half of the twentieth century, turning instead to the study of observable behavior because they believed consciousness was too difficult to study scientifically.
- Since 1960, under the influence of cognitive psychology and neuroscience, *consciousness* (our awareness of ourselves and our environment) has resumed its place as an important area of research.

22-2 What is hypnosis, and what powers does a hypnotist have over a hypnotized subject?

- *Hypnosis* is a social interaction in which one person suggests to another that certain perceptions, feelings, thoughts, or behaviors will spontaneously occur.
- Hypnosis does not enhance recall of forgotten events (it may even evoke false memories).
- It cannot force people to act against their will, though hypnotized people, like unhypnotized people, may perform unlikely acts.
- *Posthypnotic suggestions* have helped people harness their own healing powers but have not been very effective in treating addiction. Hypnosis can help relieve pain.

22-3 Is hypnosis an extension of normal consciousness or an altered state?

- Many psychologists believe that hypnosis is a form of normal social influence and that hypnotized people act out the role of "good subject" by following directions given by an authoritative person.
- Other psychologists view hypnosis as a *dissociation*—a split between normal sensations and conscious awareness. Selective attention may also contribute by blocking attention to certain stimuli.

Multiple-Choice Questions

1. What do we call awareness of our environment and ourselves?

a. Selective attention
b. Hypnotism
c. Posthypnotic suggestion
d. Dissociation
e. Consciousness

2. Which of the following is true about daydreaming?

a. It occurs spontaneously.
b. It is physiologically induced.
c. It is psychologically induced.
d. It is considered the same as waking awareness.
e. It is more like meditation than it is like dreaming.

3. Which of the following states of consciousness occurs when one person suggests to another that certain thoughts or behaviors will spontaneously occur?

a. Dreaming
b. Hypnosis
c. Daydreaming
d. Hallucination
e. Waking awareness

4. Which of the following is the term most closely associated with the split in consciousness that allows some thoughts and behaviors to occur simultaneously with others?

a. Consciousness
b. Hypnosis
c. Hallucination
d. Dissociation
e. Meditation

Practice FRQs

1. Identify two states of consciousness that are psychologically induced and two that occur spontaneously.

Answer

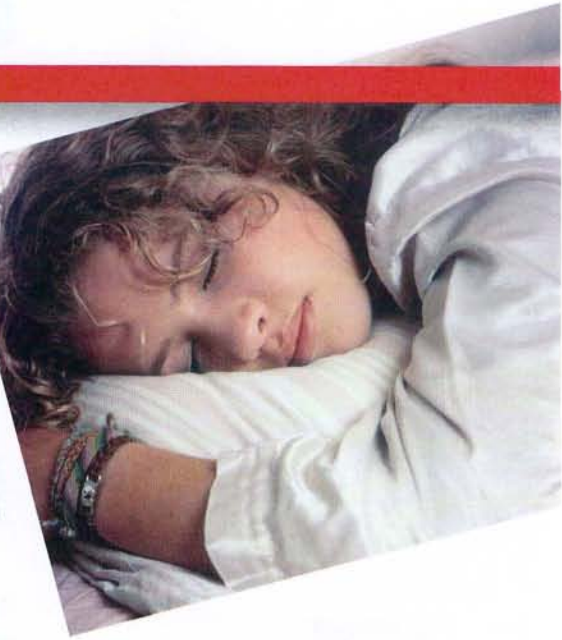
1 point: For any two psychologically induced states: sensory deprivation, hypnosis, or meditation.

1 point: For any two spontaneously occurring states: daydreaming, drowsiness, or dreaming.

2. According to the biopsychosocial approach, identify a biological, a psychological, and a social-cultural influence on hypnosis.

(3 points)

Module 23



Sleep Patterns and Sleep Theories

Module Learning Objectives

23-1 Describe how our biological rhythms influence our daily functioning.

23-2 Describe the biological rhythm of our sleeping and dreaming stages.

23-3 Explain how biology and environment interact in our sleep patterns.

23-4 Describe sleep's functions.

Sleep—the irresistible tempter to whom we inevitably succumb. Sleep—the equalizer of teachers and teens. Sleep—sweet, renewing, mysterious sleep. While sleeping, you may feel "dead to the world," but you are not. Even when you are deeply asleep, your perceptual window is open a crack. You move around on your bed, but you manage not to fall out. The occasional roar of passing vehicles may leave your deep sleep undisturbed, but a cry from a baby's room quickly interrupts it. So does the sound of your name. Electroencephalograph (EEG) recordings confirm that the brain's auditory cortex responds to sound stimuli even during sleep (Kutas, 1990). And when you are asleep, as when you are awake, you process most information outside your conscious awareness.

"I love to sleep. Do you? Isn't it great? It really is the best of both worlds. You get to be alive and unconscious." -Comedian Rita Rudner, 1993

Many of sleep's mysteries are now being solved as some people sleep, attached to recording devices, while others observe. By recording brain waves and muscle movements, and by observing and occasionally waking sleepers, researchers are glimpsing things that a thousand years of common sense never told us. Perhaps you can anticipate some of their discoveries. Are the following statements true or false?

1. When people dream of performing some activity, their limbs often move in concert with the dream.
2. Older adults sleep more than young adults.
3. Sleepwalkers are acting out their dreams.
4. Sleep experts recommend treating insomnia with an occasional sleeping pill.
5. Some people dream every night; others seldom dream.

All these statements (adapted from Palladino & Carducci, 1983) are *false*. To see why, read on.

Biological Rhythms and Sleep

Like the ocean, life has its rhythmic tides. Over varying periods, our bodies fluctuate, and with them, our minds. Let's look more closely at two of those biological rhythms—our 24-hour biological clock and our 90-minute sleep cycle.

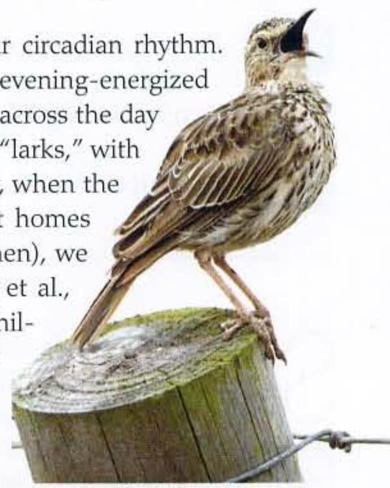
Circadian Rhythm

23-1 How do our biological rhythms influence our daily functioning?

The rhythm of the day parallels the rhythm of life—from our waking at a new day's birth to our nightly return to what Shakespeare called "death's counterfeit." Our bodies roughly synchronize with the 24-hour cycle of day and night by an internal biological clock called the **circadian rhythm** (from the Latin *circa,* "about," and *diem,* "day"). As morning approaches, body temperature rises, then peaks during the day, dips for a time in early afternoon (when many people take siestas), and begins to drop again in the evening. Thinking is sharpest and memory most accurate when we are at our daily peak in circadian arousal. Try pulling an all-nighter or working an occasional night shift. You'll feel groggiest in the middle of the night but may gain new energy when your normal wake-up time arrives.


Eric Isselée/Shutterstock

Age and experience can alter our circadian rhythm. Most teens and young adults are evening-energized "owls," with performance improving across the day (May & Hasher, 1998). Most older adults are morning-loving "larks," with performance declining as the day wears on. By mid-evening, when the night has hardly begun for many young adults, retirement homes are typically quiet. At about age 20 (slightly earlier for women), we begin to shift from being owls to being larks (Roenneberg et al., 2004). Women become more morning oriented as they have children and also as they transition to menopause (Leonhard & Randler, 2009; Randler & Bausback, 2010). Morning types tend to do better in school, to take more initiative, and to be less vulnerable to depression (Randler, 2008, 2009; Randler & Frech, 2009).


Peter Chadwick/Science Source

FYI

Dolphins, porpoises, and whales sleep with one side of their brain at a time (Miller et al., 2008).

Sleep Stages

23-2 What is the biological rhythm of our sleeping and dreaming stages?

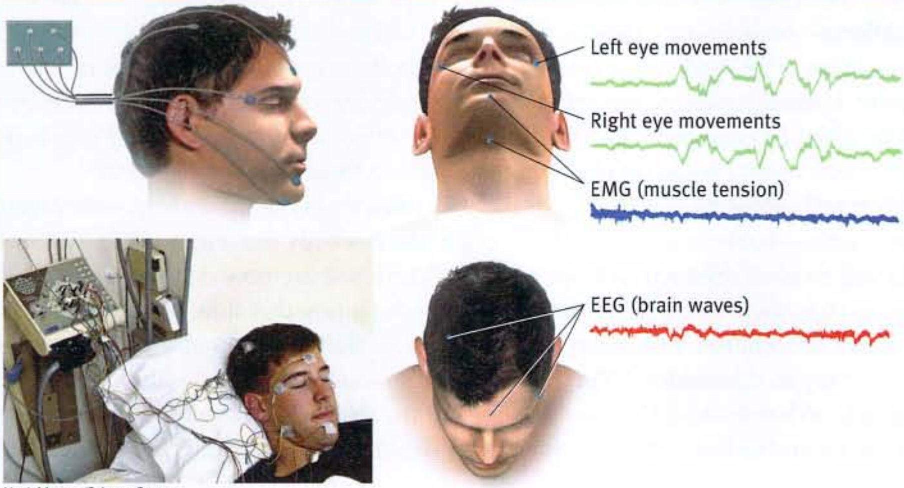
Sooner or later, sleep overtakes us and consciousness fades as different parts of our brain's cortex stop communicating (Massimini et al., 2005). Yet the sleeping brain remains active and has its own biological rhythm.

About every 90 minutes, we cycle through four distinct sleep stages. This simple fact apparently was unknown until 8-year-old Armond Aserinsky went to bed one night in 1952. His father, Eugene, a University of Chicago graduate student, needed to test an electroencephalograph he had repaired that day (Aserinsky, 1988; Seligman & Yellen, 1987). Placing electrodes near Armond's eyes to record the rolling eye movements then believed to occur during sleep, Aserinsky watched the machine go wild, tracing deep zigzags on the graph paper. Could the machine still be broken? As the night proceeded and the activity recurred, Aserinsky realized that the periods of fast, jerky eye movements were accompanied by energetic brain activity. Awakened during one such episode, Armond reported having a dream. Aserinsky had discovered what we now know as **REM sleep** (*r*apid *e*ye *m*ovement sleep).

Similar procedures used with thousands of volunteers showed the cycles were a normal part of sleep (Kleitman, 1960). To appreciate these studies, imagine yourself as a participant. As the hour grows late, you feel sleepy and yawn in response to reduced brain metabolism. (Yawning, which can be socially contagious, stretches your neck muscles and increases your heart rate, which increases your alertness [Moorcroft, 2003].) When you are ready for bed, a

circadian [ser-KAY-dee-an] **rhythm** the biological clock; regular bodily rhythms (for example, of temperature and wakefulness) that occur on a 24-hour cycle.

REM sleep rapid eye movement sleep; a recurring sleep stage during which vivid dreams commonly occur. Also known as *paradoxical sleep,* because the muscles are relaxed (except for minor twitches) but other body systems are active.



Hank Morgan/Science Source

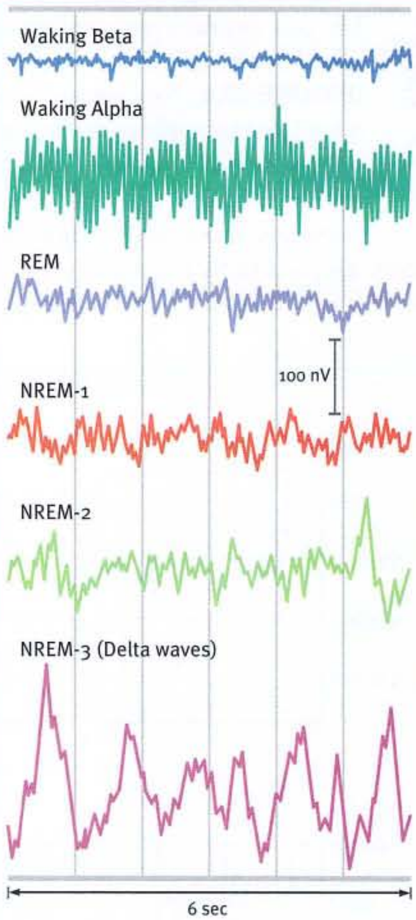
Figure 23.1

Measuring sleep activity Sleep researchers measure brain-wave activity, eye movements, and muscle tension by electrodes that pick up weak electrical signals from the brain, eye, and facial muscles. (From Dement, 1978.)

researcher comes in and tapes electrodes to your scalp (to detect your brain waves), on your chin (to detect muscle tension), and just outside the corners of your eyes (to detect eye movements) (**FIGURE 23.1**). Other devices will record your heart rate, respiration rate, and genital arousal.

When you are in bed with your eyes closed, the researcher in the next room sees on the EEG the relatively slow **alpha waves** of your awake but relaxed state (**FIGURE 23.2**). As you adapt to all this equipment, you grow tired and, in an unremembered moment, slip into **sleep** (**FIGURE 23.3**). The transition is marked by the slowed breathing and the irregular brain waves of non-REM stage 1 sleep. Using the new American Academy of Sleep Medicine classification of sleep stages, this is called NREM-1 (Silber et al., 2008).

In one of his 15,000 research participants, William Dement (1999) observed the moment the brain's perceptual window to the outside world slammed shut. Dement asked this sleep-deprived young man, lying on his back with eyelids taped open, to press a button every time a strobe light flashed in his eyes (about every 6 seconds). After a few minutes the young man missed one. Asked why, he said, "Because there was no flash." But there was a flash. He missed it because (as his brain activity revealed) he had fallen asleep for 2 seconds, missing not only the flash 6 inches from his nose but also the awareness of the abrupt moment of entry into sleep.



Rebecca Spencer, University of Massachusetts, assisted with this figure.

Figure 23.2

Brain waves and sleep stages The beta waves of an alert, waking state and the regular alpha waves of an awake, relaxed state differ from the slower, larger delta waves of deep NREM-3 sleep. Although the rapid REM sleep waves resemble the near-waking NREM-1 sleep waves, the body is more aroused during REM sleep than during NREM sleep.

alpha waves the relatively slow brain waves of a relaxed, awake state.

sleep periodic, natural loss of consciousness—as distinct from unconsciousness resulting from a coma, general anesthesia, or hibernation. (Adapted from Dement, 1999.)

Figure 23.3

The moment of sleep We seem unaware of the moment we fall into sleep, but someone watching our brain waves could tell. (From Dement, 1999.)

hallucinations false sensory experiences, such as seeing something in the absence of an external visual stimulus.

delta waves the large, slow brain waves associated with deep sleep.

NREM sleep non–rapid eye movement sleep; encompasses all sleep stages except for REM sleep.

During this brief NREM-1 sleep you may experience fantastic images resembling **hallucinations**—sensory experiences that occur without a sensory stimulus. You may have a sensation of falling (at which moment your body may suddenly jerk) or of floating weightlessly. These *hypnagogic* sensations may later be incorporated into your memories. People who claim to have been abducted by aliens—often shortly after getting into bed—commonly recall being floated off of or pinned down on their beds (Clancy, 2005).

You then relax more deeply and begin about 20 minutes of NREM-2 sleep, with its periodic *sleep spindles*—bursts of rapid, rhythmic brain-wave activity (see Figure 23.2). Although you could still be awakened without too much difficulty, you are now clearly asleep.

Then you transition to the deep sleep of NREM-3. During this slow-wave sleep, which lasts for about 30 minutes, your brain emits large, slow **delta waves** and you are hard to awaken. Ever say to classmates, "That thunder was so loud last night," only to have them respond, "What thunder?" Those who missed the storm may have been in delta sleep. (It is at the end of the deep, slow-wave NREM-3 sleep that children may wet the bed.)

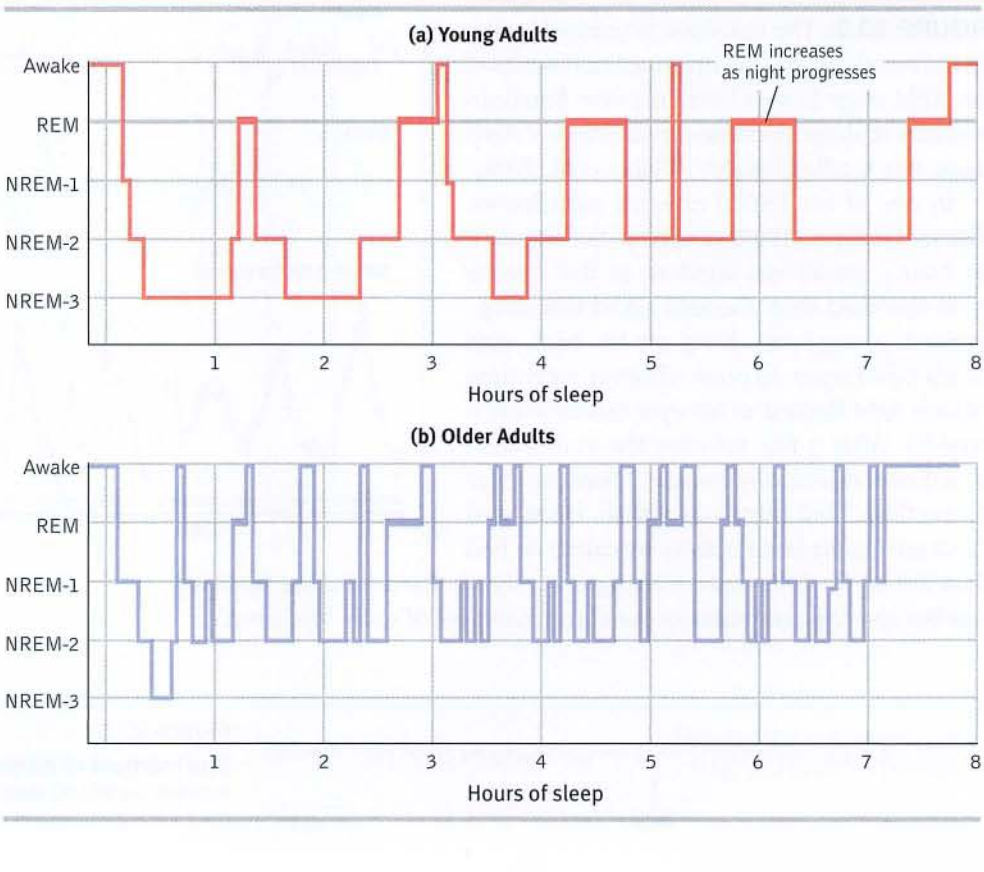
"Boy are my eyes tired! I had REM sleep all night long."

REM SLEEP

About an hour after you first fall asleep, a strange thing happens. You start to leave behind the stages known as **NREM sleep.** Rather than continuing in deep slumber, you ascend from your initial sleep dive. Returning through NREM-2 (where you spend about half your night), you enter the most intriguing sleep phase—REM sleep (**FIGURE 23.4**). For about 10 minutes, your brain waves become rapid and saw-toothed, more like those of the nearly awake NREM-1 sleep. But unlike NREM-1, during REM sleep your heart rate rises, your breathing becomes rapid and irregular, and every half-minute or so your eyes dart around in momentary bursts of activity behind closed lids. These eye movements announce the beginning of a dream—often emotional, usually story-like, and richly hallucinatory. Because anyone watching a sleeper's eyes can notice these REM bursts, it is amazing that science was ignorant of REM sleep until 1952.

Figure 23.4

The stages in a typical night's sleep People pass through a multistage sleep cycle several times each night, with the periods of deep sleep diminishing and REM sleep periods increasing in duration. As people age, sleep becomes more fragile, with awakenings common among older adults (Kamel et al., 2006; Neubauer, 1999).



AP® Exam Tip

Study this cycle of sleep carefully. One common mistake that students make is to believe that REM sleep comes directly after deep NREM-3 sleep. As you can see, it does not. Generally, NREM-2 follows NREM-3. Then comes REM.

Except during very scary dreams, your genitals become aroused during REM sleep. You have an erection or increased vaginal lubrication, regardless of whether the dream's content is sexual (Karacan et al., 1966). Men's common "morning erection" stems from the night's last REM period, often just before waking.

Your brain's motor cortex is active during REM sleep, but your brainstem blocks its messages. This leaves your muscles relaxed, so much so that, except for an occasional finger, toe, or facial twitch, you are essentially paralyzed. Moreover, you cannot easily be awakened. (This immobility may occasionally linger as you awaken from REM sleep, producing a disturbing experience of *sleep paralysis* [Santomauro & French, 2009].) REM sleep is thus sometimes called *paradoxical* sleep: The body is internally aroused, with waking-like brain activity, yet asleep and externally calm.

FYI

People rarely snore during dreams. When REM starts, snoring stops.

FYI

Horses, which spend 92 percent of each day standing and can sleep standing, must lie down for REM sleep (Morrison, 2003).

The sleep cycle repeats itself about every 90 minutes. As the night wears on, deep NREM-3 sleep grows shorter and disappears. The REM and NREM-2 sleep periods get longer (see Figure 23.4). By morning, we have spent 20 to 25 percent of an average night's sleep—some 100 minutes—in REM sleep. Thirty-seven percent of people report rarely or never having dreams "that you can remember the next morning" (Moore, 2004). Yet even they will, more than 80 percent of the time, recall a dream after being awakened during REM sleep. We spend about 600 hours a year experiencing some 1500 dreams, or more than 100,000 dreams over a typical lifetime—dreams swallowed by the night but not acted out, thanks to REM's protective paralysis.

Uriel Sinai/Getty Images

Safety in numbers? Why would communal sleeping provide added protection for those whose safety depends upon vigilance, such as these soldiers?

ANSWER: With each soldier cycling through the sleep stages independently, it is very likely that at any given time at least one of them will be awake or easily wakened in the event of a threat.

What Affects Our Sleep Patterns?

23-3 How do biology and environment interact in our sleep patterns?

The idea that "everyone needs 8 hours of sleep" is untrue. Newborns often sleep two-thirds of their day, most adults no more than one-third. Still, there is more to our sleep differences than age. Some of us thrive with fewer than 6 hours per night; others regularly rack up 9 hours or more. Such sleep patterns are genetically influenced (Hor & Tafti, 2009). In studies of fraternal and identical twins, only the identical twins had strikingly similar sleep patterns and durations (Webb & Campbell, 1983). Today's researchers are discovering the genes that regulate sleep in humans and animals (Donlea et al., 2009; He et al., 2009).

Sleep patterns are also culturally influenced. In the United States and Canada, adults average 7 to 8 hours per night (Hurst, 2008; National Sleep Foundation, 2010; Robinson & Martin, 2009). (The weeknight sleep of many students and workers falls short of this average [NSF, 2008].) North Americans are nevertheless sleeping less than their counterparts a century ago. Thanks to modern lighting, shift work, and social media and other diversions, those who would have gone to bed at 9:00 P.M. are now up until 11:00 P.M. or later. With sleep, as with waking behavior, biology and environment interact.

Bright morning light tweaks the circadian clock by activating light-sensitive retinal proteins. These proteins control the circadian clock by triggering signals to the brain's **suprachiasmatic nucleus (SCN)**—a pair of grain-of-rice-sized, 10,000-cell clusters in the hypothalamus (Wirz-Justice, 2009). The SCN does its job in part by causing the brain's pineal gland to decrease its production of the sleep-inducing hormone *melatonin* in the morning and to increase it in the evening (**FIGURE 23.5** on the next page).

suprachiasmatic nucleus (SCN) a pair of cell clusters in the hypothalamus that controls circadian rhythm. In response to light, the SCN causes the pineal gland to adjust melatonin production, thus modifying our feelings of sleepiness.

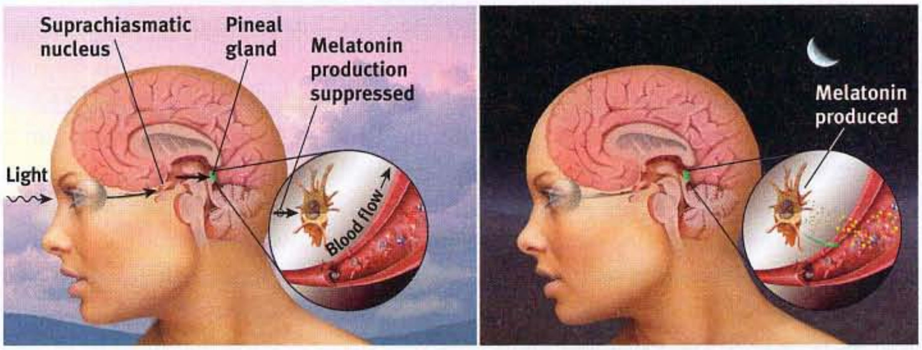


Figure 23.5
The biological clock Light striking the retina signals the suprachiasmatic nucleus (SCN) to suppress the pineal gland's production of the sleep hormone melatonin. At night, the SCN quiets down, allowing the pineal gland to release melatonin into the bloodstream.

Being bathed in light disrupts our 24-hour biological clock (Czeisler et al., 1999; Dement, 1999). Curiously—given that our ancestors' body clocks were attuned to the rising and setting Sun of the 24-hour day—many of today's young adults adopt something closer to a 25-hour day, by staying up too late to get 8 hours of sleep. For this, we can thank (or blame) Thomas Edison, inventor of the light bulb. This helps explain why, until our later years, we must discipline ourselves to go to bed and force ourselves to get up. Most animals, too, when placed under unnatural constant illumination will exceed a 24-hour day. Artificial light delays sleep.

Sleep often eludes those who stay up late and sleep in on weekends, and then go to bed earlier on Sunday evening in preparation for the new school week (Oren & Terman, 1998). They are like New Yorkers whose biology is on California time. For North Americans who fly to Europe and need to be up when their circadian rhythm cries *"SLEEP,"* bright light (spending the next day outdoors) helps reset the biological clock (Czeisler et al., 1986, 1989; Eastman et al., 1995).

Try This

If our natural circadian rhythm were attuned to a 23-hour cycle, would we instead need to discipline ourselves to stay up later at night and sleep in longer in the morning?

FYI

A circadian disadvantage: One study of a decade's 24,121 Major League Baseball games found that teams who had crossed three time zones before playing a multiday series had nearly a 60 percent chance of losing their first game (Winter et al., 2009).

Sleep Theories

23-4 What are sleep's functions?

So, our sleep patterns differ from person to person and from culture to culture. But why do we have this need for sleep?

Psychologists believe sleep may have evolved for five reasons.

"Sleep faster, we need the pillows." -Yiddish Proverb

1. ***Sleep protects.*** When darkness shut down the day's hunting, food gathering, and travel, our distant ancestors were better off asleep in a cave, out of harm's way. Those who didn't try to navigate around rocks and cliffs at night were more likely to leave descendants. This fits a broader principle: A species' sleep pattern tends to suit its ecological niche (Siegel, 2009). Animals with the greatest need to graze and the least ability to hide tend to sleep less. (For a sampling of animal sleep times, see **FIGURE 23.6.**)
2. ***Sleep helps us recuperate.*** It helps restore and repair brain tissue. Bats and other animals with high waking metabolism burn a lot of calories, producing a lot of *free radicals,* molecules that are toxic to neurons. Sleeping a lot gives resting neurons time to repair themselves, while pruning or weakening unused connections (Gilestro et al., 2009; Siegel, 2003; Vyazovskiy et al., 2008). Think of it this way: When consciousness leaves your house, brain construction workers come in for a makeover.

Figure 23.6
Animal sleep time Would you rather be a brown bat and sleep 20 hours a day or a giraffe and sleep 2 hours daily (data from NIH, 2010)? Kruglov_Orda/Shutterstock; Courtesy of Andrew D. Myers; Utekhina Anna/Shutterstock; Steffen Foerster Photography/Shutterstock; The Agency Collection/Punchstock; Eric Isselée/Shutterstock; pandapaw/Shutterstock

3. ***Sleep helps restore and rebuild our fading memories of the day's experiences.*** Sleep consolidates our memories—it strengthens and stabilizes neural memory traces (Racsmány et al., 2010; Rasch & Born, 2008). People trained to perform tasks therefore recall them better after a night's sleep, or even after a short nap, than after several hours awake (Stickgold & Ellenbogen, 2008). Among older adults, more sleep leads to better memory of recently learned material (Drummond, 2010). After sleeping well, seniors remember more. And in both humans and rats, neural activity during slow-wave sleep re-enacts and promotes recall of prior novel experiences (Peigneux et al., 2004; Ribeiro et al., 2004). Sleep, it seems, strengthens memories in a way that being awake does not.
4. ***Sleep feeds creative thinking.*** On occasion, dreams have inspired noteworthy literary, artistic, and scientific achievements, such as the dream that clued chemist August Kekulé to the structure of benzene (Ross, 2006). More commonplace is the boost that a complete night's sleep gives to our thinking and learning. After working on a task, then sleeping on it, people solve problems more insightfully than do those who stay awake (Wagner et al., 2004). They also are better at spotting connections among novel pieces of information (Ellenbogen et al., 2007). To think smart and see connections, it often pays to sleep on it.
5. ***Sleep supports growth.*** During deep sleep, the pituitary gland releases a growth hormone. This hormone is necessary for muscle development. A regular full night's sleep can also "*dramatically* improve your athletic ability," report James Maas and Rebecca Robbins (see Close-up: Sleep and Athletic Performance). As we age, we release less of this hormone and spend less time in deep sleep (Pekkanen, 1982).

"Corduroy pillows make headlines." -ANONYMOUS

Given all the benefits of sleep, it's no wonder that sleep loss hits us so hard.

Close-up

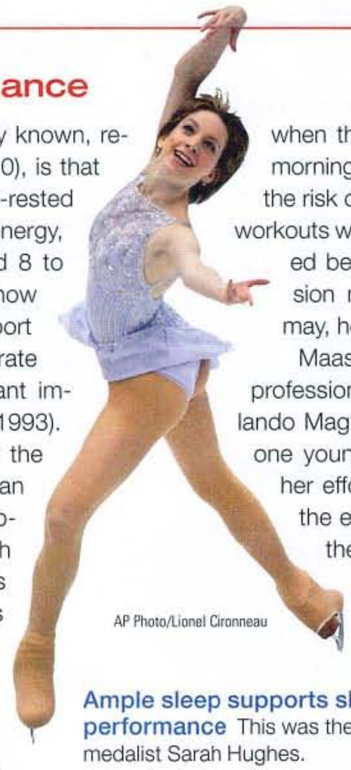
Sleep and Athletic Performance

Exercise improves sleep. What's not as widely known, report James Maas and Rebecca Robbins (2010), is that sleep improves athletic performance. Well-rested athletes have faster reaction times, more energy, and greater endurance, and teams that build 8 to 10 hours of daily sleep into their training show improved performance. Top violinists also report sleeping 8.5 hours a day on average, and rate practice and sleep as the two most important improvement-fostering activities (Ericsson et al., 1993).

Slow-wave sleep, which occurs mostly in the first half of a night's sleep, produces the human growth hormone necessary for muscle development. REM sleep and NREM-2 sleep, which occur mostly in the final hours of a long night's sleep, help strengthen the neural connections that build enduring memories, including the "muscle memories" learned while practicing tennis or shooting baskets.

The optimal exercise time is late afternoon or early evening, Maas and Robbins advise, when the body's natural cooling is most efficient. Early morning workouts are ill-advised, because they increase the risk of injury and rob athletes of valuable sleep. Heavy workouts within three hours of bedtime should also be avoided because the arousal disrupts falling asleep. Precision muscle training, such as shooting free throws, may, however, benefit when followed by sleep.

Maas has been a sleep consultant for college and professional athletes and teams. On Maas' advice, the Orlando Magic cut early morning practices. He also advised one young woman, Sarah Hughes, who felt stymied in her efforts to excel in figure-skating competition. "Cut the early morning practice," he instructed, as part of the recommended sleep regimen. Soon thereafter, Hughes' performance scores increased, ultimately culminating in her 2002 Olympic gold medal.


AP Photo/Lionel Cironneau

Ample sleep supports skill learning and high performance This was the experience of Olympic gold medalist Sarah Hughes.

Before You Move On

▶ ASK YOURSELF

Would you consider yourself a night owl or a morning lark? When do you usually feel most energetic? What time of day works best for you to study?

▶ TEST YOURSELF

What five theories explain our need for sleep?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 23 Review

23-1 How do our biological rhythms influence our daily functioning?

- Our bodies have an internal biological clock, roughly synchronized with the 24-hour cycle of night and day.
- This *circadian rhythm* appears in our daily patterns of body temperature, arousal, sleeping, and waking. Age and experiences can alter these patterns, resetting our biological clock.

23-2 What is the biological rhythm of our sleeping and dreaming stages?

- We cycle through four distinct *sleep* stages about every 90 minutes.
- Leaving the *alpha waves* of the awake, relaxed stage, we descend into the irregular brain waves of non-REM stage 1 sleep (NREM-1), often with the sensation of falling or floating.
- NREM-2 sleep (in which we spend the most time) follows, lasting about 20 minutes, with its characteristic sleep spindles.
- We then enter NREM-3 sleep, lasting about 30 minutes, with large, slow *delta waves.*
- About an hour after falling asleep, we begin periods of *REM (rapid eye movement) sleep.*
- Most dreaming occurs in this REM stage (also known as paradoxical sleep) of internal arousal but outward paralysis.
- During a normal night's sleep, NREM-3 sleep shortens and REM and NREM-2 sleep lengthens.

23-3 How do biology and environment interact in our sleep patterns?

- Biology—our circadian rhythm as well as our age and our body's production of melatonin (influenced by the brain's suprachiasmatic nucleus)—interacts with cultural expectations and individual behaviors to determine our sleeping and waking patterns.

23-4 What are sleep's functions?

- Sleep may have played a protective role in human evolution by keeping people safe during potentially dangerous periods.
- Sleep also helps restore and repair damaged neurons.
- REM and NREM-2 sleep help strengthen neural connections that build enduring memories.
- Sleep promotes creative problem solving the next day.
- During slow-wave sleep, the pituitary gland secretes human growth hormone, which is necessary for muscle development.

Multiple-Choice Questions

1. Which of the following represents a circadian rhythm?

a. A burst of growth occurs during puberty.
b. A full Moon occurs about once a month.
c. Body temperature rises each day as morning approaches.
d. When it is summer in the northern hemisphere, it is winter in the southern hemisphere.
e. Pulse rate increases when we exercise.

2. In which stage of sleep are you likely to experience hypnagogic sensations of falling?

a. Alpha sleep
b. NREM-1
c. NREM-2
d. NREM-3
e. REM

3. What is the role of the suprachiasmatic nucleus (SCN) in sleep?

a. It induces REM sleep approximately every 90 minutes during sleep.
b. It causes the pineal gland to increase the production of melatonin.
c. It causes the pituitary gland to increase the release of human growth hormone.
d. It causes the pituitary gland to decrease the release of human growth hormone.
e. It causes the pineal gland to decrease the production of melatonin.

4. Which of the following sleep theories emphasizes sleep's role in restoring and repairing brain tissue?

a. Memory
b. Protection
c. Growth
d. Recuperation
e. Creativity

Practice FRQs

1. Sleep serves many functions for us. Briefly explain how sleep can

- provide protection.
- promote physical growth.

Answer

1 point: Sleep kept our ancestors safe from nighttime dangers.

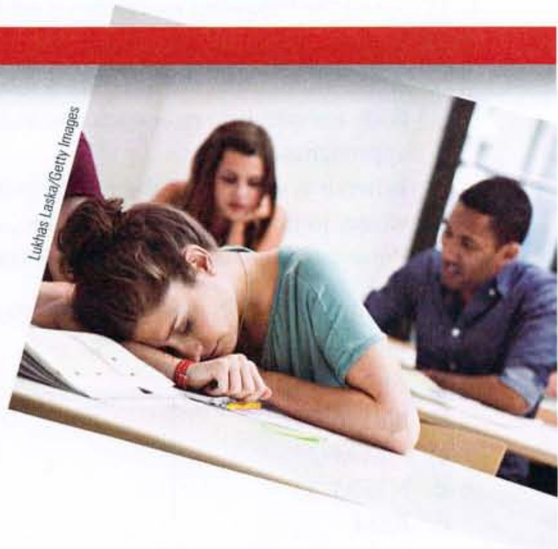
1 point: Sleep promotes the release of pituitary growth hormone.

2. Name and briefly describe three stages of sleep when rapid eye movements are not occurring.

(3 points)

Module 24

Sleep Deprivation, Sleep Disorders, and Dreams



Lukhas Laska/Getty Images

Module Learning Objectives

24-1 Describe the effects of sleep loss, and identify the major sleep disorders.

24-2 Describe the most common content of dreams.

24-3 Identify proposed explanations for why we dream.

Sleep Deprivation and Sleep Disorders

24-1 How does sleep loss affect us, and what are the major sleep disorders?

When our body yearns for sleep but does not get it, we begin to feel terrible. Trying to stay awake, we will eventually lose. It's easy to spot students who have stayed up late to study for a test or finish a term paper: They are often fighting the "nods" (their heads bobbing downward in seconds-long "microsleeps") as they fight to stay awake.

In the tiredness battle, sleep always wins. In 1989, Michael Doucette was named America's Safest Driving Teen. In 1990, while driving home from college, he fell asleep at the wheel and collided with an oncoming car, killing both himself and the other driver. Michael's driving instructor later acknowledged never having mentioned sleep deprivation and drowsy driving (Dement, 1999).

Effects of Sleep Loss

Today, more than ever, our sleep patterns leave us not only sleepy but drained of energy and feelings of well-being. After a succession of 5-hour nights, we accumulate a sleep debt that need not be entirely repaid but cannot be satisfied by one long sleep. "The brain keeps an accurate count of sleep debt for at least two weeks," reported sleep researcher William Dement (1999, p. 64).

Obviously, then, we need sleep. Sleep commands roughly one-third of our lives—some 25 years, on average. But why?

Allowed to sleep unhindered, most adults will sleep at least 9 hours a night (Coren, 1996). With that much sleep, we awake refreshed, sustain better moods, and perform more efficient and accurate work. The U.S. Navy and the National Institutes of Health have demonstrated the benefits of unrestricted sleep in experiments in which volunteers spent 14 hours daily in bed for at least a week. For the first few days, the volunteers averaged 12 hours of sleep a day or more, apparently paying off a sleep debt that averaged 25 to 30 hours.

That accomplished, they then settled back to 7.5 to 9 hours nightly and felt energized and happier (Dement, 1999). In one Gallup survey (Mason, 2005), 63 percent of adults who reported getting the sleep they needed also reported being "very satisfied" with their personal life (as did only 36 percent of those needing more sleep). And when 909 working women reported on their daily moods, the researchers were struck by what mattered little (such as money, so long as the person was not battling poverty), and what mattered a lot: less time pressure at work and a good night's sleep (Kahneman et al., 2004). Perhaps it's not surprising, then, that when asked if they had felt well rested on the previous day, 3 in 10 Americans said they had not (Pelham, 2010).

College and university students are especially sleep deprived; 69 percent in one national survey reported "feeling tired" or "having little energy" on several or more days in the last two weeks (AP, 2009). In another survey, 28 percent of high school students acknowledged falling asleep in class at least once a week (Sleep Foundation, 2006). The going needn't get boring before students start snoring. (To test whether you are one of the many sleep-deprived students, see **TABLE 24.1.**)

Sleep loss is a predictor of depression. Researchers who studied 15,500 young people, 12 to 18 years old, found that those who slept 5 or fewer hours a night had a 71 percent higher risk of depression than their peers who slept 8 hours or more (Gangwisch et al., 2010). This link does not appear to reflect sleep difficulties caused by depression. When children and youth are followed through time, sleep loss predicts depression rather than

MARK RALSTON/AFP/Getty Images

Sleepless and suffering These fatigued, sleep-deprived earthquake rescue workers in China may experience a depressed immune system, impaired concentration, and greater vulnerability to accidents.

FYI

In a 2001 Gallup poll, 61 percent of men, but only 47 percent of women, said they got enough sleep.

Table 24.1

Cornell University psychologist James Maas has reported that most students suffer the consequences of sleeping less than they should. To see if you are in that group, answer the following true-false questions:

True	False	
____	____	1. I need an alarm clock in order to wake up at the appropriate time.
____	____	2. It's a struggle for me to get out of bed in the morning.
____	____	3. Weekday mornings I hit snooze several times to get more sleep.
____	____	4. I feel tired, irritable, and stressed out during the week.
____	____	5. I have trouble concentrating and remembering.
____	____	6. I feel slow with critical thinking, problem solving, and being creative.
____	____	7. I often fall asleep watching TV.
____	____	8. I often fall asleep in boring meetings or lectures or in warm rooms.
____	____	9. I often fall asleep after heavy meals.
____	____	10. I often fall asleep while relaxing after dinner.
____	____	11. I often fall asleep within five minutes of getting into bed.
____	____	12. I often feel drowsy while driving.
____	____	13. I often sleep extra hours on weekend mornings.
____	____	14. I often need a nap to get through the day.
____	____	15. I have dark circles around my eyes.

If you answered "true" to three or more items, you probably are not getting enough sleep. To determine your sleep needs, Maas recommends that you "go to bed 15 minutes earlier than usual every night for the next week—and continue this practice by adding 15 more minutes each week—until you wake without an alarm clock and feel alert all day." (Sleep Quiz reprinted with permission from James B. Maas, "Sleep to Win!" (Bloomington, IN: AuthorHouse, 2013).)

vice versa (Gregory et al., 2009). Moreover, REM sleep's processing of emotional experiences helps protect against depression (Walker & van der Helm, 2009). After a good night's sleep, we often do feel better the next day. And that may help to explain why parentally enforced bedtimes predict less depression, and why pushing back school start time leads to improved adolescent sleep, alertness, and mood (Gregory et al., 2009; Owens et al., 2010).

Even when awake, students often function below their peak. And they know it: Four in five teens and three in five 18- to 29-year-olds wish they could get more sleep on weekdays (Mason, 2003, 2005). Yet that teen who staggers glumly out of bed in response to an unwelcome alarm, yawns through morning classes, and feels half-depressed much of the day may be energized at 11:00 P.M. and mindless of the next day's looming sleepiness (Carskadon, 2002). "Sleep deprivation has consequences—difficulty studying, diminished productivity, tendency to make mistakes, irritability, fatigue," noted Dement (1999, p. 231). A large sleep debt "makes you stupid."

AP® Exam Tip

Many students try to get by on less and less sleep to try to fit everything in. The irony is that if you stay up too late studying, it can be counterproductive. Sleep deprivation makes it difficult to concentrate and increases the likelihood you will make silly mistakes on tests. The impact on your immune system means you are more likely to get sick. To be the best student you can be, make sleep a priority.

It can also make you fatter. Sleep deprivation increases *ghrelin,* a hunger-arousing hormone, and decreases its hunger-suppressing partner, *leptin* (more on these in Module 38). It also increases cortisol, a stress hormone that stimulates the body to make fat. Sure enough, children and adults who sleep less than normal are fatter than those who sleep more (Chen et al., 2008; Knutson et al., 2007; Schoenborn & Adams, 2008). And experimental sleep deprivation of adults increases appetite and eating (Nixon et al., 2008; Patel et al., 2006; Spiegel et al., 2004; Van Cauter et al., 2007). This may help explain the common weight gain among sleep-deprived students (although a review of 11 studies reveals that the mythical college student's "freshman 15" is, on average, closer to a "first-year 4" [Hull et al., 2007]).

In addition to making us more vulnerable to obesity, sleep deprivation can suppress immune cells that fight off viral infections and cancer (Motivala & Irwin, 2007). One experiment exposed volunteers to a cold virus. Those who had been averaging less than 7 hours sleep a night were 3 times more likely to develop a cold than were those sleeping 8 or more hours a night (Cohen et al., 2009). Sleep's protective effect may help explain why people who sleep 7 to 8 hours a night tend to outlive those who are chronically sleep deprived, and why older adults who have no difficulty falling or staying asleep tend to live longer than their sleep-deprived agemates (Dement, 1999; Dew et al., 2003). When infections do set in, we typically sleep more, boosting our immune cells.

"So shut your eyes
Kiss me goodbye
And sleep
Just sleep."
-Song by My Chemical Romance

Sleep deprivation slows reactions and increases errors on visual attention tasks similar to those involved in screening airport baggage, performing surgery, and reading X-rays (Lim & Dinges, 2010). Similarly, the result can be devastating for driving, piloting, and equipment operating. Driver fatigue has contributed to an estimated 20 percent of American traffic accidents (Brody, 2002) and to some 30 percent of Australian highway deaths (Maas, 1999). One two-year study examined the driving accident rates of more than 20,000 Virginia 16- to 18-year-olds in two major cities. In one city, the high schools started 75 to 80 minutes later than in the other. The late starters had about 25 percent fewer crashes (Vorona et al., 2011). Consider, too, the timing of four industrial disasters—the 1989 *Exxon Valdez* tanker hitting rocks and spilling millions of gallons of oil on the shores of Alaska; Union Carbide's 1984 release of toxic gas that killed thousands in Bhopal, India; and the 1979 Three Mile Island and 1986 Chernobyl nuclear accidents. All occurred after midnight, when operators in charge were likely to be drowsiest and unresponsive to signals requiring an alert response. Likewise, the 2013 Asiana Airlines crash landing at San Francisco Airport happened at 3:30 A.M. Korea time, after a 10-hour flight from Seoul. When sleepy frontal lobes confront an unexpected situation, misfortune often results.

Stanley Coren capitalized on what is, for many North Americans, a semi-annual sleep-manipulation experiment—the "spring forward" to "daylight savings" time and "fall backward" to "standard" time. Searching millions of records, Coren found that in both Canada and the United States, accidents increased immediately after the time change that shortens sleep (**FIGURE 24.1**).

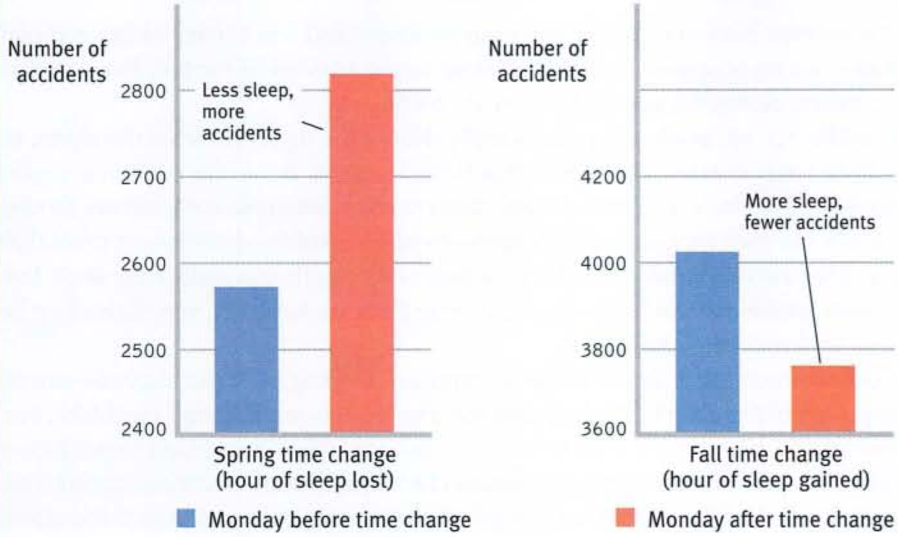


Figure 24.1

Canadian traffic accidents On the Monday after the spring time change, when people lose one hour of sleep, accidents increased, as compared with the Monday before. In the fall, traffic accidents normally increase because of greater snow, ice, and darkness, but they diminished after the time change. (Adapted from Coren, 1996.)

FIGURE 24.2 summarizes the effects of sleep deprivation. But there is good news! Psychologists have discovered a treatment that strengthens memory, increases concentration, boosts mood, moderates hunger and obesity, fortifies the disease-fighting immune system, and lessens the risk of fatal accidents. Even better news: The treatment feels good, it can be self-administered, the supplies are limitless, and it's available free! If you are a typical high school student, often going to bed near midnight and dragged out of bed six or seven hours later by the dreaded alarm, the treatment is simple: Each night just add 15 minutes to your sleep. Ignore that last text, resist the urge to check in with friends online, and succumb to sleep, "the gentle tyrant."

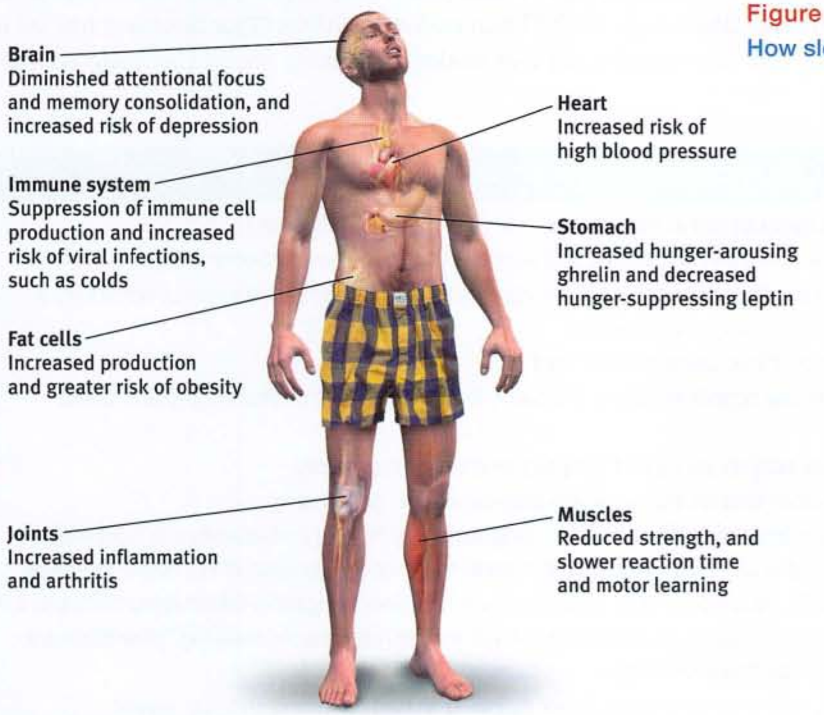


Figure 24.2

How sleep deprivation affects us

"The lion and the lamb shall lie down together, but the lamb will not be very sleepy." -Woody Allen, in the movie *Love and Death*, 1975

"Sleep is like love or happiness. If you pursue it too ardently it will elude you." -Wilse Webb, *Sleep: The Gentle Tyrant*, 1992

insomnia recurring problems in falling or staying asleep.

narcolepsy a sleep disorder characterized by uncontrollable sleep attacks. The sufferer may lapse directly into REM sleep, often at inopportune times.

MAJOR SLEEP DISORDERS

No matter what their normal need for sleep, 1 in 10 adults, and 1 in 4 older adults, complain of **insomnia**—not an occasional inability to sleep when anxious or excited, but persistent problems in falling or staying asleep (Irwin et al., 2006).

From middle age on, awakening occasionally during the night becomes the norm, not something to fret over or treat with medication (Vitiello, 2009). Ironically, insomnia is worsened by fretting about one's insomnia. In laboratory studies, insomnia complainers do sleep less than others, but they typically overestimate—by about double—how long it takes them to fall asleep. They also underestimate by nearly half how long they actually have slept. Even if we have been awake only an hour or two, we may *think* we have had very little sleep because it's the waking part we remember.

The most common quick fixes for true insomnia—sleeping pills and alcohol—can aggravate the problem, reducing REM sleep and leaving the person with next-day blahs. Such aids can also lead to *tolerance*—a state in which increasing doses are needed to produce an effect. An ideal sleep aid would mimic the natural chemicals that are abundant during sleep, without side effects. Until scientists can supply this magic pill, sleep experts have offered some tips for getting better quality sleep (**TABLE 24.2**).

Falling asleep is not the problem for people with **narcolepsy** (from *narco,* "numbness," and *lepsy,* "seizure"), who have sudden attacks of overwhelming sleepiness, usually lasting less than 5 minutes. Narcolepsy attacks can occur at the most inopportune times, perhaps just after taking a terrific swing at a softball or when laughing loudly, shouting angrily, or having sex (Dement, 1978, 1999). In severe cases, the person collapses directly into a brief period of REM sleep, with loss of muscular tension. People with narcolepsy—1 in 2000 of us, estimated the Stanford University Center for Narcolepsy (2002)—must therefore live with extra caution. As a traffic menace, "snoozing is second only to boozing," says the American Sleep Disorders Association, and those with narcolepsy are especially at risk (Aldrich, 1989).

Researchers have discovered genes that cause narcolepsy in dogs and humans (Miyagawa et al., 2008; Taheri, 2004). Genes help sculpt the brain, and neuroscientists are searching the brain for narcolepsy-linked abnormalities. One team discovered a relative absence of a hypothalamic neural center that produces *orexin* (also called hypocretin), a neurotransmitter linked to alertness (Taheri et al., 2002; Thannickal et al., 2000). (That discovery has led to the clinical testing of a new sleeping pill that works by blocking orexin's arousing activity.)

Table 24.2 Some Natural Sleep Aids

- Exercise regularly but not in the late evening. (Late afternoon is best.)
- Avoid caffeine after early afternoon, and avoid food and drink near bedtime. The exception would be a glass of milk, which provides raw materials for the manufacture of serotonin, a neurotransmitter that facilitates sleep.
- Relax before bedtime, using dimmer light.
- Sleep on a regular schedule (rise at the same time even after a restless night) and avoid naps.
- Hide the clock face so you aren't tempted to check it repeatedly.
- Reassure yourself that temporary sleep loss causes no great harm.
- Realize that for any stressed organism, being vigilant is natural and adaptive. A personal conflict during the day often means a fitful sleep that night (Åkerstedt et al., 2007; Brissette & Cohen, 2002). And a traumatic stressful event can take a lingering toll on sleep (Babson & Feldner, 2010). Managing your stress levels will enable more restful sleeping. (See Modules 43, 44, and 84 for more on stress.)
- If all else fails, settle for less sleep, either by going to bed later or getting up earlier.

AP Photo/Paul Sakuma, File

Economic recession and stress can rob sleep A National Sleep Foundation (2009) survey found 27 percent of people reporting sleeplessness related to the economy, their personal finances, and employment, as seems evident in this man looking for work.

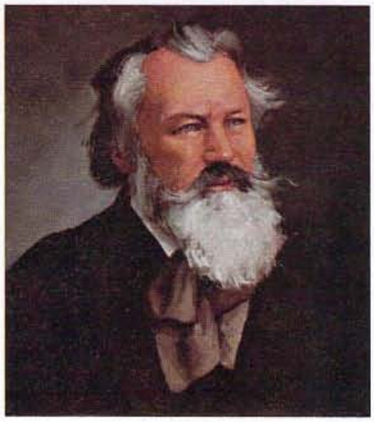
sleep apnea a sleep disorder characterized by temporary cessations of breathing during sleep and repeated momentary awakenings.

night terrors a sleep disorder characterized by high arousal and an appearance of being terrified; unlike nightmares, night terrors occur during NREM-3 sleep, within two or three hours of falling asleep, and are seldom remembered.

Narcolepsy, it is now clear, is a brain disease; it is not just "in your mind." And this gives hope that narcolepsy might be effectively relieved by a drug that mimics the missing orexin and can sneak through the blood-brain barrier (Fujiki et al., 2003; Siegel, 2000). In the meantime, physicians are prescribing other drugs to relieve narcolepsy's sleepiness in humans.

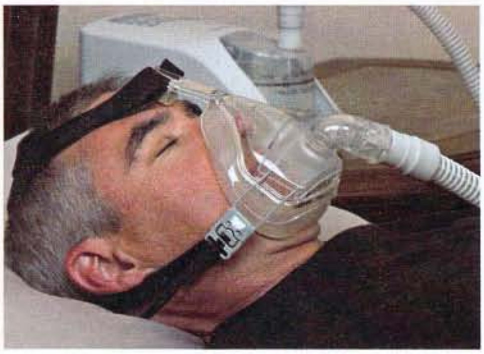
Although 1 in 20 of us have **sleep apnea,** it was unknown before modern sleep research. *Apnea* means "with no breath," and people with this condition intermittently stop breathing during sleep. After an airless minute or so, decreased blood oxygen arouses them and they wake up enough to snort in air for a few seconds, in a process that repeats hundreds of times each night, depriving them of slow-wave sleep. Apnea sufferers don't recall these episodes the next day. So, despite feeling fatigued and depressed—and hearing their mate's complaints about their loud "snoring"—many are unaware of their disorder (Peppard et al., 2006).

Sleep apnea is associated with obesity, and as the number of obese Americans has increased, so has this disorder, particularly among overweight men, including some football players (Keller, 2007). Other warning signs are loud snoring, daytime sleepiness and irritability, and (possibly) high blood pressure, which increases the risk of a stroke or heart attack (Dement, 1999). If one doesn't mind looking a little goofy in the dark (imagine a snorkeler at a slumber party), the treatment—a masklike device with an air pump that keeps the sleeper's airway open—can effectively relieve apnea symptoms.



The Granger Collection, New York

Did Brahms need his own lullabies? Cranky, overweight, and nap-prone, Johannes Brahms exhibited common symptoms of sleep apnea (Margolis, 2000).



Brian Chase/Shutterstock

Now I lay me down to sleep For many with sleep apnea, a continuous positive airway pressure (CPAP) machine makes for sounder sleeping and better quality of life.

Unlike sleep apnea, **night terrors** target mostly children, who may sit up or walk around, talk incoherently, experience doubled heart and breathing rates, and appear terrified (Hartmann, 1981). They seldom wake up fully during an episode and recall little or nothing the next morning—at most, a fleeting, frightening image. Night terrors are not nightmares (which, like other dreams, typically occur during early morning REM sleep); night terrors usually occur during the first few hours of NREM-3.

Sleepwalking—another NREM-3 sleep disorder—and *sleep talking* are usually childhood disorders, and like narcolepsy, they run in families. (Sleep talking—usually garbled or nonsensical—can occur during any sleep stage [Mahowald & Ettinger, 1990].) Occasional childhood sleepwalking occurs for about one-third of those with a sleepwalking fraternal twin and half of those with a sleepwalking identical twin. The same is true for sleep talking (Hublin et al., 1997, 1998). Sleepwalking is usually harmless. After returning to bed on their own or with the help of a family member, few sleepwalkers recall their trip the next morning. About 20 percent of 3- to 12-year-olds have at least one episode of sleepwalking, usually lasting 2 to 10 minutes; some 5 percent have repeated episodes (Giles et al., 1994). Young children, who have the deepest and lengthiest NREM-3 sleep, are the most likely to experience both night terrors and sleepwalking. As we grow older and deep NREM-3 sleep diminishes, so do night terrors and sleepwalking. After being sleep deprived, we sleep more deeply, which increases any tendency to sleepwalk (Zadra et al., 2008).


Photofest/Warner Bros. Pictures

A dreamy take on dreamland The 2010 movie *Inception* creatively played off our interest in finding meaning in our dreams, and in understanding the layers of our consciousness. It further explored the idea of creating false memories through the power of suggestion—an idea we will explore in Module 33.

Dreams

Now playing at an inner theater near you: the premiere showing of a sleeping person's vivid dream. This never-before-seen mental movie features captivating characters wrapped in a plot so original and unlikely, yet so intricate and so seemingly real, that the viewer later marvels at its creation.

Waking from a troubling dream, wrenched by its emotions, who among us has not wondered about this weird state of consciousness? How can our brain so creatively, colorfully, and completely construct this alternative world? In the shadowland between our dreaming and waking consciousness, we may even wonder for a moment which is real.

Discovering the link between REM sleep and dreaming opened a new era in dream research. Instead of relying on someone's hazy recall hours or days after having a dream, researchers could catch dreams as they happened. They could awaken people during or within 3 minutes after a REM sleep period and hear a vivid account.

dream a sequence of images, emotions, and thoughts passing through a sleeping person's mind. Dreams are notable for their hallucinatory imagery, discontinuities, and incongruities, and for the dreamer's delusional acceptance of the content and later difficulties remembering it.

What We Dream

24-2 What do we dream?

Daydreams tend to involve the familiar details of our life—perhaps picturing ourselves explaining to a teacher why a paper will be late, or replaying in our minds personal encounters we relish or regret. REM **dreams**—"hallucinations of the sleeping mind"(Loftus & Ketcham, 1994, p. 67)—are vivid, emotional, and bizarre—so vivid we may confuse them with reality. Awakening from a nightmare, a 4-year-old may be sure there is a bear in the house.

"I do not believe that I am now dreaming, but I cannot prove that I am not." -Philosopher Bertrand Russell (1872–1970)

We spend six years of our life in dreams, many of which are anything but sweet. For both women and men, 8 in 10 dreams are marked by at least one negative event or emotion (Domhoff, 2007). Common themes are repeatedly failing in an attempt to do something; of being attacked, pursued, or rejected; or of experiencing misfortune (Hall et al., 1982). Dreams with sexual imagery occur less often than you might think. In one study, only 1 in 10 dreams among young men and 1 in 30 among young women had sexual content (Domhoff, 1996). More commonly, the story line of our dreams incorporates traces of previous days' nonsexual experiences and preoccupations (De Koninck, 2000):

- After suffering a trauma, people commonly report nightmares, which help extinguish daytime fears (Levin & Nielsen, 2007, 2009). One sample of Americans recording their dreams during September 2001 reported an increase in threatening dreams following the 9/11 terrorist attacks (Propper et al., 2007).
- After playing the computer game *Tetris* for 7 hours and then being awakened repeatedly during their first hour of sleep, 3 in 4 people reported experiencing images of the game's falling blocks (Stickgold et al., 2000).
- Compared with city-dwellers, people in hunter-gatherer societies more often dream of animals (Mestel, 1997). Compared with nonmusicians, musicians report twice as many dreams of music (Uga et al., 2006).

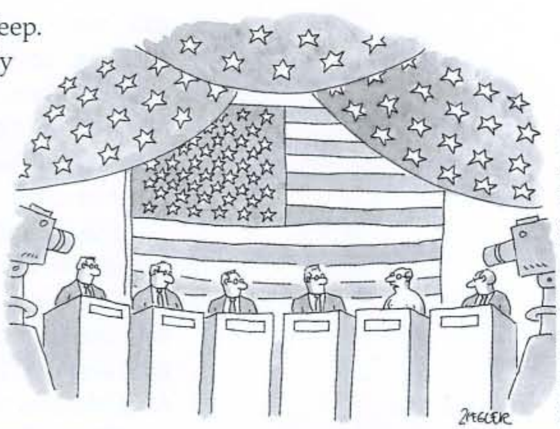
FYI

Would you suppose that people dream if blind from birth? Studies in France, Hungary, Egypt, and the United States all found blind people dreaming of using their nonvisual senses—hearing, touching, smelling, tasting (Buquet, 1988; Taha, 1972; Vekassy, 1977).

"For what one has dwelt on by day, these things are seen in visions of the night." -Menander of Athens (342–292 B.C.E.), *The Principal Fragments*

Our two-track mind is also monitoring our environment while we sleep. Sensory stimuli—a particular odor or a phone's ringing—may be instantly and ingeniously woven into the dream story. In a classic experiment, researchers lightly sprayed cold water on dreamers' faces (Dement & Wolpert, 1958). Compared with sleepers who did not get the cold-water treatment, these people were more likely to dream about a waterfall, a leaky roof, or even about being sprayed by someone.

So, could we learn a foreign language by hearing it played while we sleep? If only it were so easy. While sleeping we can learn to associate a sound with a mild electric shock (and to react to the sound accordingly). But we do not remember recorded information played while we are soundly asleep (Eich, 1990; Wyatt & Bootzin, 1994). In fact, anything that happens during the 5 minutes just before we fall asleep is typically lost from memory (Roth et al., 1988). This explains why sleep apnea patients, who repeatedly awaken with a gasp and then immediately fall back to sleep, do not recall the episodes. It also explains why dreams that momentarily awaken us are mostly forgotten by morning. To remember a dream, get up and stay awake for a few minutes.



"Uh-oh. I think I'm having one of those dreams again."

"Follow your dreams, except for that one where you're naked at work." -ATTRIBUTED TO COMEDIAN HENNY YOUNGMAN

Why We Dream

24-3 What are the functions of dreams?

Dream theorists have proposed several explanations of why we dream, including these:

To satisfy our own wishes. In 1900, in his landmark book *The Interpretation of Dreams,* Sigmund Freud offered what he thought was "the most valuable of all the discoveries it has been my good fortune to make." He proposed that dreams provide a psychic safety valve that discharges otherwise unacceptable feelings. He viewed a dream's **manifest content** (the apparent and remembered story line) as a censored, symbolic version of its **latent content,** the unconscious drives and wishes that would be threatening if expressed directly. Although most dreams have no overt sexual imagery, Freud nevertheless believed that most adult dreams could be "traced back by analysis to erotic wishes." Thus, a gun might be a disguised representation of a penis.

Freud considered dreams the key to understanding our inner conflicts. However, his critics say it is time to wake up from Freud's dream theory, which is a scientific nightmare. Based on the accumulated science, "there is no reason to believe any of Freud's specific claims about dreams and their purposes," observed dream researcher William Domhoff (2003). Some contend that even if dreams are symbolic, they could be interpreted any way one wished. Others maintain that dreams hide nothing. A dream about a gun is a dream about a gun. Legend has it that even Freud, who loved to smoke cigars, acknowledged that "sometimes, a cigar is just a cigar." Freud's wish-fulfillment theory of dreams has in large part given way to other theories.

To file away memories. The *information-processing* perspective proposes that dreams may help sift, sort, and fix the day's experiences in our memory. Some studies support this view. When tested the next day after learning a task, those deprived of both slow-wave and REM sleep did not do as well on their new learning as those who slept undisturbed (Stickgold et al., 2000, 2001). People who hear unusual phrases or learn to find hidden visual images before bedtime remember less the next morning if awakened every time they begin REM sleep than they do if awakened during other sleep stages (Empson & Clarke, 1970; Karni & Sagi, 1994).

Brain scans confirm the link between REM sleep and memory. The brain regions that buzz as rats learn to navigate a maze, or as people learn to perform a visual-discrimination

FYI

A popular sleep myth: If you dream you are falling and hit the ground (or if you dream of dying), you die. (Unfortunately, those who could confirm these ideas are not around to do so. Some people, however, have had such dreams and are alive to report them.)

"When people interpret [a dream] as if it were meaningful and then sell those interpretations, it's quackery." -SLEEP RESEARCHER J. ALLAN HOBSON (1995)

manifest content according to Freud, the remembered story line of a dream (as distinct from its latent, or hidden, content).

latent content according to Freud, the underlying meaning of a dream (as distinct from its manifest content).

task, buzz again during later REM sleep (Louie & Wilson, 2001; Maquet, 2001). So precise are these activity patterns that scientists can tell where in the maze the rat would be if awake. Others, unpersuaded by these studies, note that memory consolidation may also occur during non-REM sleep (Siegel, 2001; Vertes & Siegel, 2005). This much seems true: A night of solid sleep (and dreaming) has an important place in our lives. To sleep, perchance to remember.

This is important news for students, many of whom, observed researcher Robert Stickgold (2000), suffer from a kind of sleep bulimia—binge-sleeping on the weekend. "If you don't get good sleep and enough sleep after you learn new stuff, you won't integrate it effectively into your memories," he warned. That helps explain why high school students with high grades have averaged 25 minutes more sleep a night than their lower-achieving classmates (Wolfson & Carskadon, 1998).

FYI

Rapid eye movements also stir the liquid behind the cornea; this delivers fresh oxygen to corneal cells, preventing their suffocation.

To develop and preserve neural pathways. Perhaps dreams, or the brain activity associated with REM sleep, serve a *physiological* function, providing the sleeping brain with periodic stimulation. This theory makes developmental sense. As you will see in Unit IX, stimulating experiences preserve and expand the brain's neural pathways. Infants, whose neural networks are fast developing, spend much of their abundant sleep time in REM sleep (**FIGURE 24.3**).

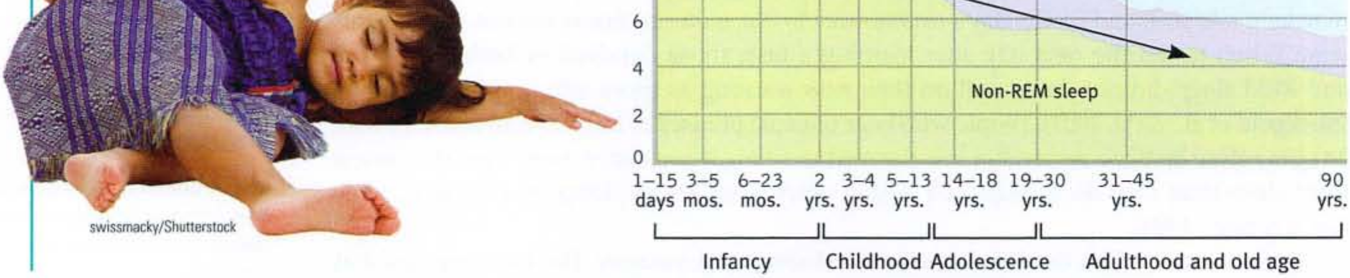
To make sense of neural static. Other theories propose that dreams erupt from *neural activation* spreading upward from the brainstem (Antrobus, 1991; Hobson, 2003, 2004, 2009). According to one version, dreams are the brain's attempt to make sense of random neural activity. Much as a neurosurgeon can produce hallucinations by stimulating different parts of a patient's cortex, so can stimulation originating within the brain. These internal stimuli activate brain areas that process visual images, but not the visual cortex area, which receives raw input from the eyes. As Freud might have expected, PET scans of sleeping people also reveal increased activity in the emotion-related limbic system (in the amygdala) during REM sleep. In contrast, frontal lobe regions responsible for inhibition and logical thinking seem to idle, which may explain why we are less inhibited in our dreams than when awake (Maquet et al., 1996). Add the limbic system's emotional tone to the brain's visual bursts and—voila!—we dream. Damage either the limbic system or the visual centers active during dreaming, and dreaming itself may be impaired (Domhoff, 2003).

FYI

Question: Does eating spicy foods cause one to dream more?
Answer: Any food that causes you to awaken more increases your chance of recalling a dream (Moorcroft, 2003).

Figure 24.3

Sleep across the life span As we age, our sleep patterns change. During our first few months, we spend progressively less time in REM sleep. During our first 20 years, we spend progressively less time asleep. (Adapted from Snyder & Scott, 1972.)



To reflect cognitive development. Some dream researchers dispute both the Freudian and neural activation theories, preferring instead to see dreams as part of brain maturation and cognitive development (Domhoff, 2010, 2011; Foulkes, 1999). For example, prior to age 9, children's dreams seem more like a slide show and less like an active story in which the dreamer is an actor. Dreams overlap with waking cognition and feature coherent speech. They simulate reality by drawing on our concepts and knowledge. They engage brain networks that also are active during daydreaming. Unlike the idea that dreams arise from bottom-up brain activation, the cognitive perspective emphasizes our mind's top-down control of our dream content (Nir & Tononi, 2010).

TABLE 24.2 compares major dream theories. Although today's sleep researchers debate dreams' function—and some are skeptical that dreams serve any function—there is one thing they agree on: We need REM sleep. Deprived of it by repeatedly being awakened, people return more and more quickly to the REM stage after falling back to sleep. When finally allowed to sleep undisturbed, they literally sleep like babies—with increased REM sleep, a phenomenon called **REM rebound.** Withdrawing REM-suppressing sleeping medications also increases REM sleep, but with accompanying nightmares.

REM rebound the tendency for REM sleep to increase following REM sleep deprivation (created by repeated awakenings during REM sleep).

Most other mammals also experience REM rebound, suggesting that the causes and functions of REM sleep are deeply biological. That REM sleep occurs in mammals—and not in animals such as fish, whose behavior is less influenced by learning—also fits the information-processing theory of dreams.

So does this mean that because dreams serve physiological functions and extend normal cognition, they are psychologically meaningless? Not necessarily. Every psychologically meaningful experience involves an active brain. We are once again reminded of a basic principle: *Biological and psychological explanations of behavior are partners, not competitors.*

Table 24.2 Dream Theories

Theory	Explanation	Critical Considerations
Freud's wish-fulfillment	Dreams provide a "psychic safety valve"—expressing otherwise unacceptable feelings; contain manifest (remembered) content and a deeper layer of latent content—a hidden meaning.	Lacks any scientific support; dreams may be interpreted in many different ways.
Information-processing	Dreams help us sort out the day's events and consolidate our memories.	But why do we sometimes dream about things we have not experienced?
Physiological function	Regular brain stimulation from REM sleep may help develop and preserve neural pathways.	This does not explain why we experience meaningful dreams.
Neural activation	REM sleep triggers neural activity that evokes random visual memories, which our sleeping brain weaves into stories.	The individual's brain is weaving the stories, which still tells us something about the dreamer.
Cognitive development	Dream content reflects dreamers' cognitive development—their knowledge and understanding.	Does not address the neuroscience of dreams.

Before You Move On

▶ ASK YOURSELF

In some places, the school day for teenagers runs from 9:00 A.M. to 4:00 P.M. But in the United States, the teen school day often runs from 8:00 A.M. to 3:00 P.M., or even 7:00 A.M. to 2:00 P.M. Early to rise isn't making kids wise, say critics—it's making them sleepy. For optimal alertness and well-being, teens need 8 to 9 hours of sleep a night. So, should early-start schools move to a later start time, even if it requires buying more buses or switching start times with elementary schools? Or is this impractical, and would it do little to remedy the tired-teen problem?

▶ TEST YOURSELF

Are you getting enough sleep? What might you ask yourself to answer this question?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 24 Review

24-1 How does sleep loss affect us, and what are the major sleep disorders?

- Sleep deprivation causes fatigue and irritability, and it impairs concentration, productivity, and memory consolidation. It can also lead to depression, obesity, joint pain, a suppressed immune system, and slowed performance (with greater vulnerability to accidents).
- Sleep disorders include *insomnia* (recurring wakefulness); *narcolepsy* (sudden uncontrollable sleepiness or lapsing into REM sleep); *sleep apnea* (the stopping of breathing while asleep; associated with obesity, especially in men); *night terrors* (high arousal and the appearance of being terrified; NREM-3 disorder found mainly in children); sleepwalking (NREM-3 disorder also found mainly in children); and sleep talking.

24-2 What do we dream?

- We usually *dream* of ordinary events and everyday experiences, most involving some anxiety or misfortune.
- Fewer than 10 percent (and less among women) of dreams have any sexual content.
- Most dreams occur during REM sleep; those that happen during NREM sleep tend to be vague fleeting images.

24-3 What are the functions of dreams?

- There are five major views of the function of dreams.
- Freud's wish-fulfillment: Dreams provide a psychic "safety valve," with *manifest content* (story line) acting as a censored version of *latent content* (underlying meaning that gratifies our unconscious wishes).
- Information-processing: Dreams help us sort out the day's events and consolidate them in memory.
- Physiological function: Regular brain stimulation may help develop and preserve neural pathways in the brain.
- Neural activation: The brain attempts to make sense of neural static by weaving it into a story line.
- Cognitive development: Dreams reflect the dreamer's level of development.
- Most sleep theorists agree that REM sleep and its associated dreams serve an important function, as shown by the *REM rebound* that occurs following REM deprivation in humans and other species.

Multiple-Choice Questions

1. Sleep deprivation can lead to weight gain, reduced muscle strength, suppression of the cells that fight common colds, and most likely which of the following?

a Increased productivity
b. Depression
c. Decreased mistakes on homework
d. Increased feeling of well-being
e. Sleep apnea

2. What do we call the sleep disorder that causes you to stop breathing and awaken in order to take a breath?

a. Narcolepsy
b. Insomnia
c. Sleep apnea
d. Nightmares
e. Night terrors

3. Which of the following dream theories states that dreams help us sort out the day's events and consolidate our memories?

a. Information-processing
b. Wish-fulfillment
c. Physiological function
d. Neural activation
e. Neural disconnection

4. According to research, which of the following are we most likely to experience after sleep deprivation?

a. Night terrors
b. Sleep apnea
c. Manifest content dreams
d. Narcolepsy
e. REM rebound

Practice FRQs

1. Identify and briefly describe the three major sleep disorders experienced by adults.

Answer

2 points: Sleep apnea: stops breathing during sleep.

2 points: Narcolepsy: falls asleep suddenly.

2 points: Insomnia: can't fall asleep.

2. Explain the following two theories regarding why we dream. Include a criticism each faces:

- Freud's theory
- Neural activation theory

(4 points)

Module 25

Psychoactive Drugs

Module Learning Objectives

25-1 Define substance use disorders, and explain the roles of tolerance, withdrawal, and addiction.

25-2 Identify the depressants, and describe their effects.

25-3 Identify the stimulants, and describe their effects.

25-4 Identify the hallucinogens, and describe their effects.

Let's imagine a day in the life of a legal-drug-using business executive. It begins with a wake-up latte. By midday, several cigarettes have calmed frazzled nerves before an appointment at the plastic surgeon's office for wrinkle-smoothing Botox injections. A diet pill before dinner helps stem the appetite, and its stimulating effects can later be partially offset with a glass of wine and two Tylenol PMs. And if performance needs enhancing, there are beta blockers for onstage performers, Viagra for middle-aged men, hormone-delivering "libido patches" for middle-aged women, and Adderall for those hoping to focus their concentration. Before drifting off into REM-depressed sleep, our hypothetical drug user is dismayed by news reports of pill-sharing, pill-popping students.

Tolerance and Addiction

25-1 What are substance use disorders, and what role do tolerance, withdrawal, and addiction play in these disorders?

Most of us manage to use some nonprescription drugs in moderation and without disrupting our lives. But some of us develop a self-harming **substance use disorder** (**TABLE 25.1**). In such cases, the substances being used are **psychoactive drugs,** chemicals that change perceptions and moods. A drug's overall effect depends not only on its biological effects but also on the psychology of the user's expectations, which vary with social and cultural contexts (Ward, 1994). If one culture assumes that a particular drug produces euphoria (or aggression or sexual arousal) and another does not, each culture may find its expectations fulfilled. In Module 81, we'll take a closer look at these interacting forces in the use and potential abuse of particular psychoactive drugs. But here let's consider how our bodies react to the ongoing use of psychoactive drugs.

Why might a person who rarely drinks alcohol get buzzed on one can of beer while a long-term drinker shows few effects until the second six-pack? The answer is **tolerance.** With continued use of alcohol and some other drugs (marijuana is an exception), the user's brain chemistry adapts to offset the drug effect (a process called *neuroadaptation*). To experience the

substance use disorder continued substance craving and use despite significant life disruption and/or physical risk.

psychoactive drug a chemical substance that alters perceptions and moods.

tolerance the diminishing effect with regular use of the same dose of a drug, requiring the user to take larger and larger doses before experiencing the drug's effect.

Table 25.1 When Is Drug Use a Disorder?

A person may be diagnosed with *substance use disorder* when drug use continues despite significant life disruption. Resulting changes in brain circuits may persist after quitting use of the substance (thus leading to strong cravings when exposed to people and situations that trigger memories of drug use). The severity of substance use disorder varies from *mild* (two to three symptoms) to *moderate* (four to five symptoms) to *severe* (six or more symptoms) (American Psychiatric Association, 2013).

Impaired Control

1. Uses more substance, or for longer, than intended.
2. Tries unsuccessfully to regulate substance use.
3. Spends much time gaining, using, or recovering from substance use.
4. Craves the substance.

Social Impairment

5. Use disrupts obligations at work, school, or home.
6. Continues use despite social problems.
7. Use causes reduced social, recreational, and work activities.

Risky Use

8. Continues use despite hazards.
9. Continues use despite worsening physical or psychological problems.

Drug Action

10. Experiences tolerance (needing more substance for the desired effect).
11. Experiences withdrawal when attempting to end use.

same effect, the user requires larger and larger doses (**FIGURE 25.1**). In chronic alcohol abuse, for example, the person's brain, heart, and liver suffer damage from the excessive amounts of alcohol being "tolerated." Ever-increasing doses of most psychoactive drugs can pose a serious threat to health and may lead to **addiction:** The person craves and uses the substance despite its adverse consequences. (See Thinking Critically About: Addiction on the next page.) The World Health Organization (2008) has reported that, worldwide, 90 million people suffer from such problems related to alcohol and other drugs. Regular users often try to fight their addiction, but abruptly stopping the drug may lead to the undesirable side effects of **withdrawal.**

FYI

The odds of getting hooked after using various drugs:

Tobacco	32%
Heroin	23%
Alcohol	15%
Marijuana	9%

Source: National Academy of Science, Institute of Medicine (Brody, 2003).

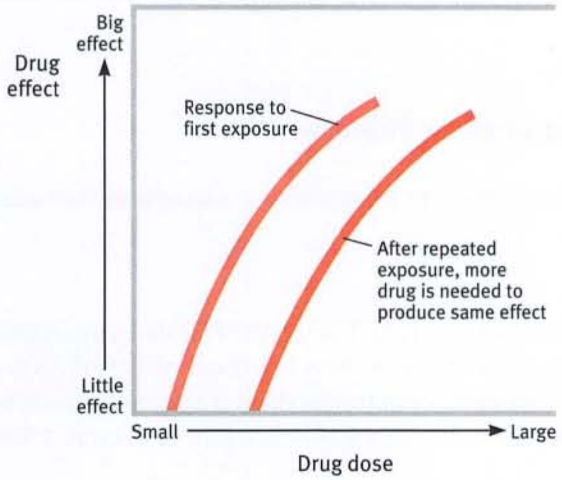


Figure 25.1

Drug tolerance With repeated exposure to a psychoactive drug, the drug's effect lessens. Thus, it takes larger doses to get the desired effect.

addiction compulsive craving of drugs or certain behaviors (such as gambling) despite known adverse consequences.

withdrawal the discomfort and distress that follow discontinuing an addictive drug or behavior.

Thinking Critically About

Addiction

In recent years, the concept of addiction has been extended to cover many behaviors formerly considered bad habits or even sins. Psychologists debate whether the concept has been stretched too far, and whether addictions are really as irresistible as commonly believed. For example, "even for a very addictive drug like cocaine, only 15 to 16 percent of people become addicted within 10 years of first use," observed Terry Robinson and Kent Berridge (2003).

Addictions can be powerful, and many addicts do benefit from therapy or group support. Alcoholics Anonymous has supported millions of people in overcoming their alcohol addiction. But viewing addiction as an uncontrollable disease can undermine people's self-confidence and their belief that they can change. And that, critics say, would be unfortunate, for many people do voluntarily stop using addictive drugs, without any treatment. Most ex-smokers, for example, have kicked the habit on their own.

The addiction-as-disease-needing-treatment idea has been offered for a host of driven, excessive behaviors—eating, shopping, gambling, work, and sex. However, critics suggest that "addiction" can become an all-purpose excuse when used not as a metaphor ("I'm a science fiction addict") but as reality. Moreover, they note that labeling a behavior doesn't explain it. Attributing serial adultery, as in the case of Tiger Woods, to a "sex addiction" does not explain the sexual impulsiveness (Radford, 2010).

Sometimes, though, behaviors such as gambling, video gaming, or online surfing do become compulsive and dysfunctional, much like abusive drug taking (Gentile, 2009; Griffiths, 2001; Hoeft et al., 2008). Thus, psychiatry's manual of disorders now includes behavior addictions such as "gambling disorder" and proposes "Internet gaming disorder" for further study (American Psychiatric Association, 2013). Some Internet users, for example, display an apparent inability to resist logging on, and staying on, even when this excessive use impairs their work and relationships (Ko et al., 2005). Stay tuned. Debates over the nature of addiction continue.

David Horsey/Hearst Newspapers

A social networking addiction?

Types of Psychoactive Drugs

AP® Exam Tip

These three categories—depressants, stimulants, and hallucinogens—are important. There are likely to be questions on the AP® exam that will require you to know how a particular psychoactive drug is classified.

The three major categories of psychoactive drugs are *depressants, stimulants,* and *hallucinogens.* All do their work at the brain's synapses, inhibiting, stimulating, or mimicking the activity of the brain's own chemical messengers, the neurotransmitters.

Depressants

25-2 What are depressants, and what are their effects?

Depressants are drugs such as alcohol, barbiturates (tranquilizers), and opiates that calm neural activity and slow body functions.

depressants drugs (such as alcohol, barbiturates, and opiates) that reduce neural activity and slow body functions.

ALCOHOL

True or false? In small amounts, alcohol is a stimulant. *False.* Low doses of alcohol may, indeed, enliven a drinker, but they do so by acting as a *disinhibitor*—they slow brain activity that controls judgment and inhibitions. Alcohol is an equal-opportunity drug: It increases (disinhibits) helpful tendencies, as when tipsy restaurant patrons leave extravagant tips (Lynn, 1988).

And it increases harmful tendencies, as when sexually aroused men become more disposed to sexual aggression.

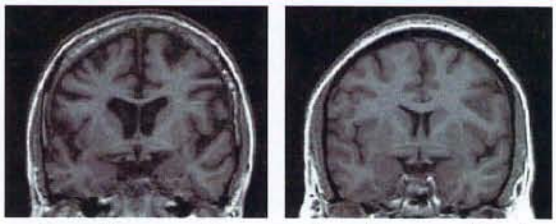
Alcohol + sex = the perfect storm. When drinking, both men and women are more disposed to casual sex (Cooper, 2006; Ebel-Lam et al., 2009). *The urges you would feel if sober are the ones you will more likely act upon when intoxicated.*

Ray Ng/Time & Life Pictures/Getty Images

Dangerous disinhibition Alcohol consumption leads to feelings of invincibility, which become especially dangerous behind the wheel of a car, such as this one totaled by a teenage drunk driver. This Colorado University Alcohol Awareness Week exhibit prompted many students to post their own anti-drinking pledges (white flags).

SLOWED NEURAL PROCESSING Low doses of alcohol relax the drinker by slowing sympathetic nervous system activity. Larger doses cause reactions to slow, speech to slur, and skilled performance to deteriorate. Paired with sleep deprivation, alcohol is a potent sedative. Add these physical effects to lowered inhibitions, and the result can be deadly. Worldwide, several hundred thousand lives are lost each year in alcohol-related accidents and violent crime. As blood-alcohol levels rise and judgment falters, people's qualms about drinking and driving lessen. In experiments, virtually all drinkers who had insisted when sober that they would not drive under the influence later decided to drive home from a bar, even when given a breathalyzer test and told they were intoxicated (Denton & Krebs, 1990; MacDonald et al., 1995). Alcohol can also be life threatening when heavy drinking follows an earlier period of moderate drinking, which depresses the vomiting response. People may poison themselves with an overdose that their bodies would normally throw up.

MEMORY DISRUPTION Alcohol can disrupt memory formation, and heavy drinking can have long-term effects on the brain and cognition. In rats, at a developmental period corresponding to human adolescence, binge drinking contributes to nerve cell death and reduces the birth of new nerve cells. It also impairs the growth of synaptic connections (Crews et al., 2006, 2007). In humans, heavy drinking may lead to blackouts, in which drinkers are unable to recall people they met the night before or what they said or did while intoxicated. These blackouts result partly from the way alcohol suppresses REM sleep, which helps fix the day's experiences into permanent memories.



Daniel Hommer, NIAAA, NIH, HHS

Scan of woman with alcohol use disorder

Scan of woman without alcohol use disorder

Figure 25.2

Disordered drinking shrinks the brain MRI scans show brain shrinkage in women with alcohol use disorder (left) compared with women in a control group (right).

The prolonged and excessive drinking that characterizes **alcohol use disorder** can shrink the brain (**FIGURE 25.2**). Girls and young women (who have less of a stomach enzyme that digests alcohol) can become addicted to alcohol more quickly than boys and young men do, and they are at risk for lung, brain, and liver damage at lower consumption levels (CASA, 2003; Wuethrich, 2001).

REDUCED SELF-AWARENESS AND SELF-CONTROL In one experiment, those who consumed alcohol (rather than a placebo beverage) were doubly likely to be caught mind-wandering during a reading task, yet were *less* likely to notice that they zoned out (Sayette et al., 2009). Alcohol not only reduces self-awareness, it also produces a sort of "myopia" by focusing attention on an arousing situation (such as a provocation) and distracting attention from normal inhibitions and future consequences (Giancola et al., 2010; Hull et al., 1986; Steele & Josephs, 1990).

Reduced self-awareness may help explain why people who want to suppress their awareness of failures or shortcomings are more likely to drink than are those who feel good about themselves. Losing a business deal, a game, or a romantic partner sometimes elicits a drinking binge.

alcohol use disorder (popularly known as *alcoholism*). Alcohol use marked by tolerance, withdrawal, and a drive to continue problematic use.

EXPECTANCY EFFECTS As with other drugs, expectations influence behavior. When people *believe* that alcohol affects social behavior in certain ways, and *believe,* rightly or wrongly, that they have been drinking alcohol, they will behave accordingly (Moss & Albery, 2009). In a classic experiment, researchers gave Rutgers University men (who had volunteered for a study on "alcohol and sexual stimulation") either an alcoholic or a nonalcoholic drink (Abrams & Wilson, 1983). (Both had strong tastes that masked any alcohol.) In each group, half the participants thought they were drinking alcohol and half thought they were not. After watching an erotic movie clip, the men who *thought* they had consumed alcohol were more likely to report having strong sexual fantasies and feeling guilt free. Being able to *attribute* their sexual responses to alcohol released their inhibitions—whether or not they had actually consumed any alcohol. Alcohol's effect lies partly in that powerful sex organ, the mind.

BARBITURATES

Like alcohol, the **barbiturate** drugs, or *tranquilizers,* depress nervous system activity. Barbiturates such as Nembutal, Seconal, and Amytal are sometimes prescribed to induce sleep or reduce anxiety. In larger doses, they can impair memory and judgment. If combined with alcohol—as sometimes happens when people take a sleeping pill after an evening of heavy drinking—the total depressive effect on body functions can be lethal.

OPIATES

The **opiates**—opium and its derivatives—also depress neural functioning. When using the opiates, which include *heroin,* a user's pupils constrict, breathing slows, and lethargy sets in as blissful pleasure replaces pain and anxiety. For this short-term pleasure, opiate users may pay a long-term price: a gnawing craving for another fix, a need for progressively larger doses (as tolerance develops), and the extreme discomfort of withdrawal. When repeatedly flooded with an artificial opiate, the brain eventually stops producing *endorphins,* its own opiates. If the artificial opiate is then withdrawn, the brain lacks the normal level of these painkilling neurotransmitters. Those who cannot or choose not to tolerate this state may pay an ultimate price—death by overdose. Opiates include the *narcotics,* such as codeine and morphine, which physicians prescribe for pain relief.

Stimulants

25-3 What are stimulants, and what are their effects?

A **stimulant** excites neural activity and speeds up body functions. Pupils dilate, heart and breathing rates increase, and blood sugar levels rise, causing a drop in appetite. Energy and self-confidence also rise.

Vasca/Shutterstock

Stimulants include caffeine, nicotine, the **amphetamines,** cocaine, methamphetamine ("speed"), and Ecstasy (which is also a mild hallucinogen). People use stimulants to feel alert, lose weight, or boost mood or athletic performance. Unfortunately, stimulants can be addictive, as you may know if you are one of the many who use caffeine daily in your coffee, tea, soda, or energy drinks. Cut off from your usual dose, you may crash into fatigue, headaches, irritability, and depression (Silverman et al., 1992). A mild dose of caffeine typically lasts three or four hours, which—if taken in the evening—may be long enough to impair sleep.

NICOTINE

One of the most addictive stimulants is **nicotine,** found in cigarettes and other tobacco products. Imagine that cigarettes were harmless—except, once in every 25,000 packs, an occasional innocent-looking one is filled with dynamite instead of tobacco. Not such a bad

barbiturates drugs that depress central nervous system activity, reducing anxiety but impairing memory and judgment.

opiates opium and its derivatives, such as morphine and heroin; they depress neural activity, temporarily lessening pain and anxiety.

stimulants drugs (such as caffeine, nicotine, and the more powerful amphetamines, cocaine, Ecstasy, and methamphetamine) that excite neural activity and speed up body functions.

amphetamines drugs that stimulate neural activity, causing speeded-up body functions and associated energy and mood changes.

nicotine a stimulating and highly addictive psychoactive drug in tobacco.

risk of having your head blown off. But with 250 million packs a day consumed worldwide, we could expect more than 10,000 gruesome daily deaths (more than three times the 9/11 fatalities each and every day)—surely enough to have cigarettes banned everywhere.[1]

The lost lives from these dynamite-loaded cigarettes approximate those from today's actual cigarettes. A teen-to-the-grave smoker has a 50 percent chance of dying from the habit, and each year, tobacco kills nearly 5.4 million of its 1.3 billion customers worldwide. (Imagine the outrage if terrorists took down an equivalent of 25 loaded jumbo jets today, let alone tomorrow and every day thereafter.) By 2030, annual deaths are expected to increase to 8 million. That means that *1 billion* twenty-first-century people may be killed by tobacco (WHO, 2008). Eliminating smoking would increase life expectancy more than any other preventive measure.

FYI

Smoke a cigarette and nature will charge you 12 minutes—ironically, just about the length of time you spend smoking it (*Discover,* 1996).

Those addicted to nicotine find it very hard to quit because tobacco products are as powerfully and quickly addictive as heroin and cocaine. Attempts to quit even within the first weeks of smoking often fail (DiFranza, 2008). As with other addictions, smokers develop *tolerance,* and quitting causes nicotine-withdrawal symptoms, including craving, insomnia, anxiety, irritability, and distractibility. Nicotine-deprived smokers trying to focus on a task experience a tripled rate of mind-wandering (Sayette et al., 2010). When not craving a cigarette, they tend to underestimate the power of such cravings (Sayette et al., 2008).

Humorist Dave Barry (1995) recalling why he smoked his first cigarette the summer he turned 15: "Arguments against smoking: 'It's a repulsive addiction that slowly but surely turns you into a gasping, gray-skinned, tumor-ridden invalid, hacking up brownish gobs of toxic waste from your one remaining lung.' Arguments for smoking: 'Other teenagers are doing it.' Case closed! Let's light up!"

All it takes to relieve this aversive state is a cigarette—a portable nicotine dispenser. Within 7 seconds, a rush of nicotine signals the central nervous system to release a flood of neurotransmitters (**FIGURE 25.3**). Epinephrine and norepinephrine diminish appetite and boost alertness and mental efficiency. Dopamine and opioids calm anxiety and reduce sensitivity to pain (Nowak, 1994; Scott et al., 2004).

[1] This analogy, adapted here with world-based numbers, was suggested by mathematician Sam Saunders, as reported by K. C. Cole (1998).

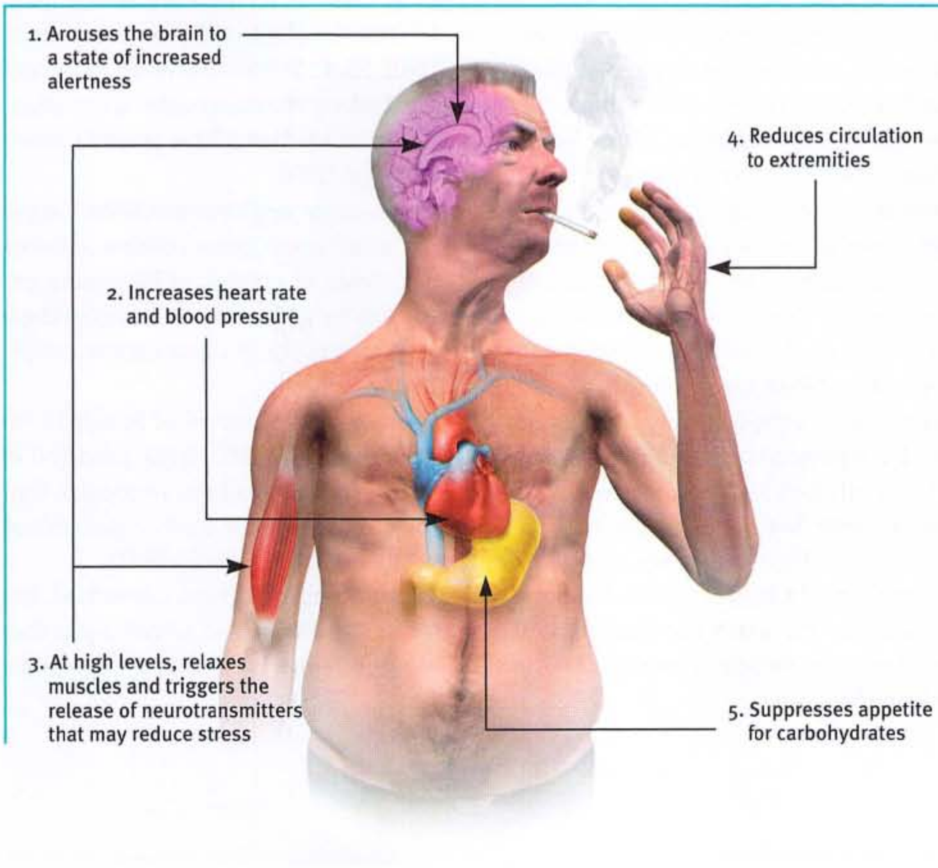
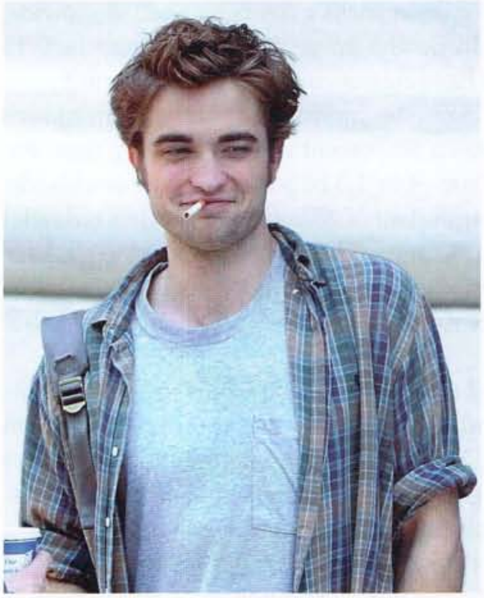


Figure 25.3

Where there's smoke . . . : The physiological effects of nicotine Nicotine reaches the brain within 7 seconds, twice as fast as intravenous heroin. Within minutes, the amount in the blood soars.

Nic-A-Teen Virtually nobody starts smoking past the vulnerable teen years. Eager to hook customers whose addiction will give them business for years to come, cigarette companies target teens. Portrayals of smoking by popular actors, such as Robert Pattinson in *Remember Me*, entice teens to imitate.



James Devaney/WireImage

These rewards keep people smoking, even among the 8 in 10 smokers who wish they could stop (Jones, 2007). Each year, fewer than 1 in 7 smokers who want to quit will be able to. Even those who know they are committing slow-motion suicide may be unable to stop (Saad, 2002). Asked "If you had to do it all over again, would you start smoking?" more than 85 percent of adult smokers have answered *No* (Slovic et al., 2002).

Nevertheless, repeated attempts seem to pay off. Half of all Americans who have ever smoked have quit, sometimes aided by a nicotine replacement drug and with encouragement from a counselor or a support group. Success is equally likely whether smokers quit abruptly or gradually (Fiore et al., 2008; Lichtenstein et al., 2010; Lindson et al., 2010). For those who endure, the acute craving and withdrawal symptoms gradually dissipate over the ensuing 6 months (Ward et al., 1997). After a year's abstinence, only 10 percent will relapse in the next year (Hughes et al., 2010). These nonsmokers may live not only healthier but also happier lives. Smoking correlates with higher rates of depression, chronic disabilities, and divorce (Doherty & Doherty, 1998; Vita et al., 1998). Healthy living seems to add both years to life and life to years.

"Cocaine makes you a new man. And the first thing that new man wants is more cocaine." -Comedian George Carlin (1937–2008)

COCAINE

The recipe for Coca-Cola originally included an extract of the coca plant, creating a **cocaine** tonic for tired elderly people. Between 1896 and 1905, Coke was indeed "the real thing." But no longer. Cocaine is now snorted, injected, or smoked. It enters the bloodstream quickly, producing a rush of euphoria that depletes the brain's supply of the neurotransmitters dopamine, serotonin, and norepinephrine (**FIGURE 25.4**). Within the hour, a crash of agitated depression follows as the drug's effect wears off. Many regular cocaine users chasing this high become addicted. In the lab, cocaine-addicted monkeys have pressed levers more than 12,000 times to gain one cocaine injection (Siegel, 1990).

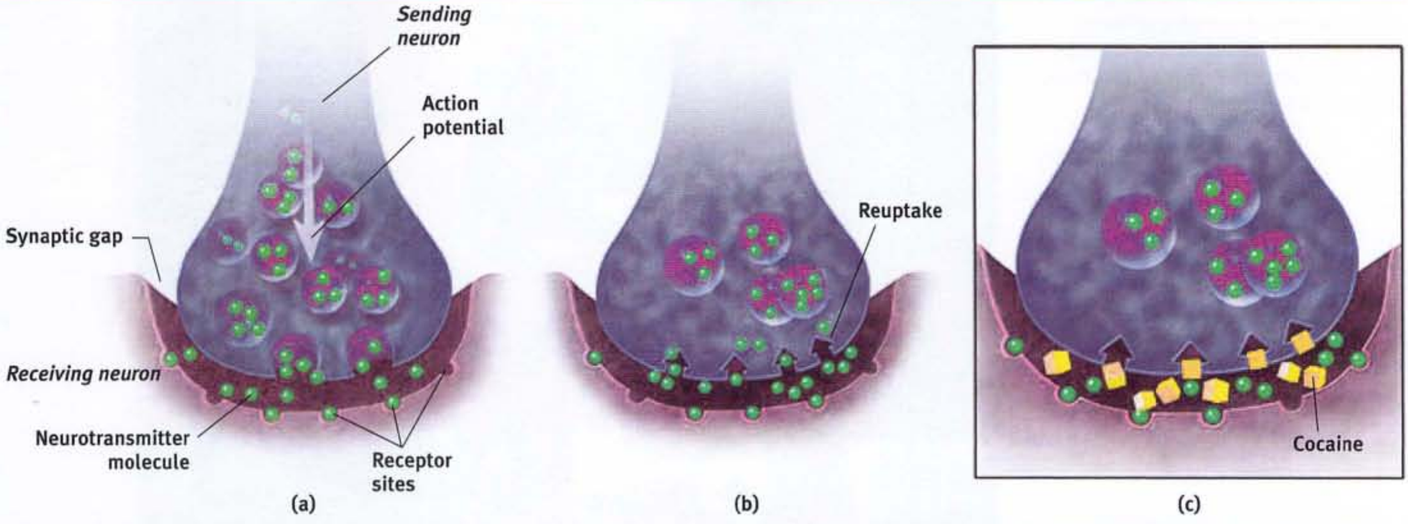
In situations that trigger aggression, ingesting cocaine may heighten reactions. Caged rats fight when given foot shocks, and they fight even more when given cocaine *and* foot shocks. Likewise, humans who voluntarily ingest high doses of cocaine in laboratory experiments impose higher shock levels on a presumed opponent than do those receiving a placebo (Licata et al., 1993). Cocaine use may also lead to emotional disturbances, suspiciousness, convulsions, cardiac arrest, or respiratory failure.

In national surveys, 3 percent of U.S. high school seniors and 6 percent of British 18- to 24-year-olds reported having tried cocaine during the past year (ACMD, 2009; Johnston et al., 2011). Nearly half had smoked *crack*, a faster-working crystallized form of cocaine that produces a briefer but more intense high, followed by a more intense crash. After several hours, the craving for more wanes, only to return several days later (Gawin, 1991).

Cocaine's psychological effects depend in part on the dosage and form consumed, but the situation and the user's expectations and personality also play a role. Given a placebo, cocaine users who *thought* they were taking cocaine often had a cocaine-like experience (Van Dyke & Byck, 1982).

cocaine a powerful and addictive stimulant, derived from the coca plant, producing temporarily increased alertness and euphoria.

methamphetamine a powerfully addictive drug that stimulates the central nervous system, with speeded-up body functions and associated energy and mood changes; over time, appears to reduce baseline dopamine levels.



(a) Neurotransmitters carry a message from a sending neuron across a synapse to receptor sites on a receiving neuron.

(b) The sending neuron normally reabsorbs excess neurotransmitter molecules, a process called reuptake.

(c) By binding to the sites that normally reabsorb neurotransmitter molecules, cocaine blocks reuptake of dopamine, norepinephrine, and serotonin (Ray & Ksir, 1990). The extra neurotransmitter molecules therefore remain in the synapse, intensifying their normal mood-altering effects and producing a euphoric rush. When the cocaine level drops, the absence of these neurotransmitters produces a crash.

Figure 25.4
Cocaine euphoria and crash

AP® Exam Tip

Figure 25.4 is an excellent review of how neurotransmitters work. If there is any part of this that you don't understand, head back to Module 9 for a complete explanation.

METHAMPHETAMINE

Methamphetamine is chemically related to its parent drug, *amphetamine* (NIDA, 2002, 2005) but has even greater effects. Methamphetamine triggers the release of the neurotransmitter dopamine, which stimulates brain cells that enhance energy and mood, leading to eight hours or so of heightened energy and euphoria. Its aftereffects may include irritability, insomnia, hypertension, seizures, social isolation, depression, and occasional violent outbursts (Homer et al., 2008). Over time, methamphetamine may reduce baseline dopamine levels, leaving the user with depressed functioning.

National Pictures/Topham/The Image Works

Dramatic drug-induced decline This woman's methamphetamine addiction led to obvious physical changes. Her decline is evident in these two photos, taken at age 36 (left) and, after four years of addiction, at age 40 (right).

ECSTASY

Ecstasy, a street name for **MDMA** (methylenedioxymethamphetamine), is both a stimulant and a mild hallucinogen. As an amphetamine derivative, Ecstasy triggers dopamine release, but its major effect is releasing stored serotonin and blocking its reuptake, thus prolonging serotonin's feel-good flood (Braun, 2001). Users feel the effect about a half-hour after taking an Ecstasy pill. For three or four hours, they experience high energy, emotional elevation, and (given a social context) connectedness with those around them ("I love everyone").

During the 1990s, Ecstasy's popularity soared as a "club drug" taken at nightclubs and all-night raves (Landry, 2002). The drug's popularity crosses national borders, with an estimated 60 million tablets consumed annually in Britain (ACMD, 2009). There are, however, reasons not to be ecstatic about Ecstasy. One is its dehydrating effect, which—when combined with prolonged dancing—can lead to severe overheating, increased

Ecstasy (MDMA) a synthetic stimulant and mild hallucinogen. Produces euphoria and social intimacy, but with short-term health risks and longer-term harm to serotonin-producing neurons and to mood and cognition.

Meth bust As use of the dangerously addictive stimulant methamphetamine has increased, enforcement agencies have increased their efforts to snuff out the labs that produce it.

Bill Greenblatt UPI Photo Service/Newscom

blood pressure, and death. Another is that long-term, repeated leaching of brain serotonin can damage serotonin-producing neurons, leading to decreased output and increased risk of permanently depressed mood (Croft et al., 2001; McCann et al., 2001; Roiser et al., 2005). Ecstasy also suppresses the disease-fighting immune system, impairs memory, slows thought, and disrupts sleep by interfering with serotonin's control of the circadian clock (Laws & Kokkalis, 2007; Pacifici et al., 2001; Schilt et al., 2007). Ecstasy delights for the night but dispirits the morrow.

Hallucinogens

25-4 What are hallucinogens, and what are their effects?

hallucinogens psychedelic ("mind-manifesting") drugs, such as LSD, that distort perceptions and evoke sensory images in the absence of sensory input.

LSD a powerful hallucinogenic drug; also known as acid *(lysergic acid diethylamide).*

Hallucinogens distort perceptions and evoke sensory images in the absence of sensory input (which is why these drugs are also called *psychedelics,* meaning "mind-manifesting"). Some, such as LSD and MDMA (Ecstasy), are synthetic. Others, including the mild hallucinogen marijuana, are natural substances.

LSD

Chemist Albert Hofmann created—and on one Friday afternoon in April 1943 accidentally ingested—**LSD** (lysergic acid diethylamide). The result—"an uninterrupted stream of fantastic pictures, extraordinary shapes with intense, kaleidoscopic play of colors"—reminded him of a childhood mystical experience that had left him longing for another glimpse of "a miraculous, powerful, unfathomable reality" (Siegel, 1984; Smith, 2006).

The emotions of an LSD trip vary from euphoria to detachment to panic. The user's current mood and expectations color the emotional experience, but the perceptual distortions and hallucinations have some commonalities. Whether provoked to hallucinate by drugs, loss of oxygen, or extreme sensory deprivation, the brain hallucinates in basically the same way (Siegel, 1982). The experience typically begins with simple geometric forms, such as a lattice, cobweb, or spiral. The next phase consists of more meaningful images; some may be superimposed on a tunnel or funnel, others may be replays of past emotional experiences. As the hallucination peaks, people frequently feel separated from their body and experience dreamlike scenes so real that they may become panic-stricken or harm themselves.

These sensations are strikingly similar to the **near-death experience,** an altered state of consciousness reported by about 15 percent of patients revived from cardiac arrest (Agrillo, 2011; Greyson, 2010). Many describe visions of tunnels (**FIGURE 25.5**), bright lights or beings of light, a replay of old memories, and out-of-body sensations (Siegel, 1980). Given that oxygen deprivation and other insults to the brain are known to produce hallucinations, it is difficult to resist wondering whether a brain under stress manufactures the near-death experience. Following temporal lobe seizures, patients have reported similarly profound mystical experiences. So have solitary sailors and polar explorers while enduring monotony, isolation, and cold (Suedfeld & Mocellin, 1987).

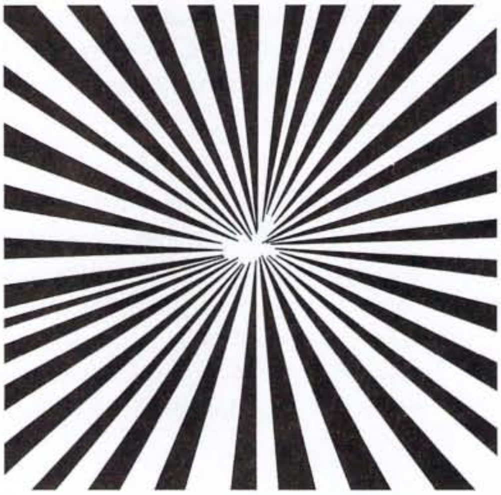


Figure 25.5
Near-death vision or hallucination? Psychologist Ronald Siegel (1977) reported that people under the influence of hallucinogenic drugs often see "a bright light in the center of the field of vision. . . . The location of this point of light create[s] a tunnel-like perspective." This is very similar to others' near-death experiences.

MARIJUANA

For 5000 years, hemp has been cultivated for its fiber. The leaves and flowers of this plant, which are sold as marijuana, contain **THC** (delta-9-tetrahydrocannabinol). Whether smoked (getting to the brain in about 7 seconds) or eaten (causing its peak concentration to be reached at a slower, unpredictable rate), THC produces a mix of effects. *Synthetic marijuana* (also called *K2* or *Spice*) mimics THC. Its harmful side effects, which can include agitation and hallucinations, led to its ingredient becoming illegal under the U.S. Synthetic Drug Abuse Prevention Act of 2012.

Marijuana is a difficult drug to classify. It is a mild hallucinogen, amplifying sensitivity to colors, sounds, tastes, and smells. But like alcohol, marijuana relaxes, disinhibits, and may produce a euphoric high. Both alcohol and marijuana impair the motor coordination, perceptual skills, and reaction time necessary for safely operating an automobile or other machine. "THC causes animals to misjudge events," reported Ronald Siegel (1990, p. 163). "Pigeons wait too long to respond to buzzers or lights that tell them food is available for brief periods; and rats turn the wrong way in mazes."

Marijuana and alcohol also differ. The body eliminates alcohol within hours. THC and its by-products linger in the body for a week or more, which means that regular users experience less abrupt withdrawal and may achieve a high with smaller amounts of the drug than would be needed by occasional users. This is contrary to the usual path of tolerance, in which repeat users need to take larger doses to feel the same effect.

A user's experience can vary with the situation. If the person feels anxious or depressed, using marijuana may intensify these feelings. The more often the person uses marijuana, especially during adolescence and in today's stronger, purified form, the greater the risk of anxiety or depression (Bambico et al., 2010; Hall, 2006; Murray et al., 2007). Daily use bodes a worse outcome than infrequent use.

Marijuana also disrupts memory formation and interferes with immediate recall of information learned only a few minutes before. Such cognitive effects outlast the period of smoking (Messinis et al., 2006). Heavy adult use for over 20 years is associated with a shrinkage of brain areas that process memories and emotions (Yücel et al., 2008). Prenatal exposure through maternal marijuana use impairs brain development (Berghuis et al., 2007; Huizink & Mulder, 2006).

To free up resources to fight crime, some states and countries have passed laws legalizing the possession of small quantities of marijuana. In some cases, legal *medical marijuana* use has been granted to relieve the pain and nausea associated with diseases such

near-death experience an altered state of consciousness reported after a close brush with death (such as by cardiac arrest); often similar to drug-induced hallucinations.

THC the major active ingredient in marijuana; triggers a variety of effects, including mild hallucinations.

as AIDS, glaucoma, and cancer (Munsey, 2010; Watson et al., 2000). In such cases, the Institute of Medicine recommends delivering the THC with medical inhalers. Marijuana smoke, like cigarette smoke, is toxic and can cause cancer, lung damage, and pregnancy complications.

* * *

Despite their differences, the psychoactive drugs summarized in **TABLE 25.2** share a common feature: They trigger negative aftereffects that offset their immediate positive effects and grow stronger with repetition. And this helps explain both tolerance and withdrawal. As the opposing, negative aftereffects grow stronger, it takes larger and larger doses to produce the desired high *(tolerance)*, causing the aftereffects to worsen in the drug's absence *(withdrawal)*. This in turn creates a need to switch off the withdrawal symptoms by taking yet more of the drug (which may lead to *addiction*).

Table 25.2 A Guide to Selected Psychoactive Drugs

Drug	Type	Pleasurable Effects	Adverse Effects
Alcohol	Depressant	Initial high followed by relaxation and disinhibition	Depression, memory loss, organ damage, impaired reactions
Heroin	Depressant	Rush of euphoria, relief from pain	Depressed physiology, agonizing withdrawal
Caffeine	Stimulant	Increased alertness and wakefulness	Anxiety, restlessness, and insomnia in high doses; uncomfortable withdrawal
Methamphetamine	Stimulant	Euphoria, alertness, energy	Irritability, insomnia, hypertension, seizures
Cocaine	Stimulant	Rush of euphoria, confidence, energy	Cardiovascular stress, suspiciousness, depressive crash
Nicotine	Stimulant	Arousal and relaxation, sense of well-being	Heart disease, cancer
Ecstasy (MDMA)	Stimulant; mild hallucinogen	Emotional elevation, disinhibition	Dehydration, overheating, depressed mood, impaired cognitive and immune functioning
Marijuana	Mild hallucinogen	Enhanced sensation, relief of pain, distortion of time, relaxation	Impaired learning and memory, increased risk of psychological disorders, lung damage from smoke

To learn about the influences on drug use, see Module 81.

Before You Move On

▶ ASK YOURSELF

Do you think people can become addicted not only to psychoactive drugs but also to other repetitive, pleasure-seeking behaviors (such as gambling or "Internet game playing")?

▶ TEST YOURSELF

Why do tobacco companies try so hard to get customers hooked as teens?

Answers to the Test Yourself questions can be found in Appendix E at the end of the book.

Module 25 Review

25-1 What are substance use disorders, and what role do tolerance, withdrawal, and addiction play in these disorders?

- Those with a *substance use disorder* may exhibit impaired control, social disruption, risky behavior, and the physical effects of tolerance and withdrawal.
- *Psychoactive drugs* alter perceptions and moods.
- These drugs may produce *tolerance*—requiring larger doses to achieve the desired effect—and *withdrawal*—significant discomfort accompanying efforts to quit.
- *Addiction* is compulsive craving and use of drugs or certain behaviors (such as gambling) despite known adverse consequences.

25-2 What are depressants, and what are their effects?

- *Depressants,* such as alcohol, *barbiturates,* and the *opiates* (which include narcotics), dampen neural activity and slow body functions.
- Alcohol tends to disinhibit, increasing the likelihood that we will act on our impulses, whether harmful or helpful. It also impairs judgment, disrupts memory processes by suppressing REM sleep, and reduces self-awareness and self-control.
- User expectations strongly influence alcohol's behavioral effects.

25-3 What are stimulants, and what are their effects?

- *Stimulants*—including caffeine, *nicotine,* cocaine, the *amphetamines, methamphetamine,* and *Ecstasy*—excite neural activity and speed up body functions, triggering energy and mood changes. All are highly addictive.
- Nicotine's effects make smoking a difficult habit to kick, yet the percentage of Americans who smoke has been dramatically decreasing.
- Cocaine gives users a fast high, followed within an hour by a crash. Its risks include cardiovascular stress and suspiciousness.
- Use of methamphetamines may permanently reduce dopamine production.
- Ecstasy (MDMA) is a combined stimulant and mild hallucinogen that produces euphoria and feelings of intimacy. Its users risk immune system suppression, permanent damage to mood and memory, and (if taken during physical activity) dehydration and escalating body temperatures.

25-4 What are hallucinogens, and what are their effects?

- *Hallucinogens*—such as *LSD* and marijuana—distort perceptions and evoke *hallucinations*—sensory images in the absence of sensory input. The user's mood and expectations influence the effects of LSD, but common experiences are hallucinations and emotions varying from euphoria to panic.
- Marijuana's main ingredient, *THC,* may trigger feelings of disinhibition, euphoria, relaxation, relief from pain, and intense sensitivity to sensory stimuli. It may also increase feelings of depression or anxiety, impair motor coordination and reaction time, disrupt memory formation, and damage lung tissue (because of the inhaled smoke).

Multiple-Choice Questions

1. Which of the following represents drug tolerance?

a. Hans has grown to accept the fact that his wife likes to have a beer with her dinner, even though he personally does not approve of the use of alcohol.
b. Jose often wakes up with a headache that lasts until he has his morning cup of coffee.
c. Pierre enjoys the effect of marijuana and is now using the drug several times a week.
d. Jacob had to increase the dosage of his pain medication when the old dosage no longer effectively controlled the pain from his chronic back condition.
e. Chau lost his job and is now homeless as a result of his drug use.

2. Which of the following drugs is classified as an opiate?

a. Nicotine
b. Marijuana
c. Heroin
d. Methamphetamine
e. Cocaine

3. Which of the following drugs produces effects similar to a near-death experience?

a. Ecstasy
b. Nicotine
c. Barbiturate
d. Methamphetamine
e. LSD

4. Which of the following statements is true of alcohol?

a. Alcohol is a stimulant because it produces insomnia.
b. Alcohol is a depressant because it produces bipolar disorder.
c. Alcohol is a stimulant because people do foolish things while under its influence.
d. Alcohol is a depressant because it calms neural activity and slows body function.
e. Alcohol is a stimulant because it increases instances of casual sex.

Practice FRQs

1. Name and compare the effects of the two hallucinogens discussed in the text.

Answer

1 point: LSD creates vivid hallucinations and strong emotions.

1 point: Marijuana creates mild hallucinations, enhanced sensory experiences, and impaired judgment.

2. Three of the most widely used psychoactive drugs—alcohol, caffeine, and nicotine—are legal for large segments of the population. Name the category that each of these drugs belongs to, and describe one effect of each.

(6 points)

Unit V Review

Key Terms and Concepts to Remember

consciousness, p. 219
hypnosis, p. 219
posthypnotic suggestion, p. 220
dissociation, p. 222
circadian [ser-KAY-dee-an] rhythm, p. 226
REM sleep, p. 226
alpha waves, p. 227
sleep, p. 227
hallucinations, p. 228
delta waves, p. 228
NREM sleep, p. 228
suprachiasmatic nucleus (SCN), p. 229
insomnia, p. 238
narcolepsy, p. 238
sleep apnea, p. 239
night terrors, p. 239
dream, p. 240
manifest content, p. 241
latent content, p. 241
REM rebound, p. 243
substance use disorder, p. 246
psychoactive drug, p. 246
tolerance, p. 246
addiction, p. 247
withdrawal, p. 247
depressants, p. 248
alcohol use disorder, p. 249
barbiturates, p. 250
opiates, p. 250
stimulants, p. 250
amphetamines, p. 250
nicotine, p. 250
cocaine, p. 252
methamphetamine, p. 253
Ecstasy (MDMA), p. 253
hallucinogens, p. 254
LSD, p. 254
near-death experience, p. 255
THC, p. 255

Key Contributors to Remember

William James, p. 219
Ernest Hilgard, p. 222
Sigmund Freud, p. 241

AP® Exam Practice Questions

Multiple-Choice Questions

1. Sudden sleep attacks at inopportune times are symptomatic of which sleep disorder?

a. Sleep apnea
b. Insomnia
c. Night terrors
d. Sleepwalking
e. Narcolepsy

2. Deep sleep occurs in which stage?

a. Hypnagogic
b. REM
c. Alpha
d. NREM-1
e. Delta

3. Recurring problems in falling asleep or staying asleep are characteristic of which sleep disorder?

a. Sleep apnea
b. Narcolepsy
c. Insomnia
d. Sleep talking
e. Sleepwalking

4. What is the pineal gland's role in sleep?

a. Activating the suprachiasmatic nucleus
b. The production of melatonin
c. The location of hypnagogic images
d. Remembering dreams upon waking
e. Emitting alpha waves

5. What are bursts of rapid, rhythmic brain-wave activity that occur during NREM-2 sleep?

a. Hallucinations
b. Circadian rhythms
c. Alpha waves
d. Sleep spindles
e. Delta waves

6. Increasing amounts of paradoxical sleep following a period of sleep deprivation is known as what?

a. Circadian sleep
b. Sleep shifting
c. Narcolepsy
d. Sleep apnea
e. REM rebound

7. Which of these drugs, which acts as both a stimulant and a hallucinogen, can also cause dangerous dehydration?

a. LSD
b. Ecstasy
c. Alcohol
d. Cocaine
e. Caffeine

8. Recent research most consistently supports the effectiveness of hypnosis in which of the following areas?

a. Pain relief
b. Recovery of lost memories
c. Reduction of sleep deprivation
d. Forcing people to act against their will
e. Cessation of smoking

9. What are the three major categories of drugs?

a. Hallucinogens, depressants, and stimulants
b. Stimulants, barbiturates, and hallucinogens
c. Amphetamines, barbiturates, and opiates
d. MDMA, LSD, and THC
e. Alcohol, caffeine, and nicotine

10. Jarod's muscles are relaxed, his body is basically paralyzed, and he is hard to awaken. Which sleep state is Jarod probably experiencing?

a. Sleep apnea
b. Hypnagogic
c. Paradoxical
d. Delta
e. Sleep deprivation

11. The effects of opiates are similar to the effects of which neurotransmitter?

a. Barbiturates
b. Endorphins
c. Tranquilizers
d. Nembutal
e. Acetylcholine

12. Slowed reactions, slurred speech, and decreased skill performance are associated with abuse of which drug?

a. Nicotine
b. Methamphetamine
c. Caffeine
d. Alcohol
e. Ecstasy

13. What term did Ernest Hilgard use to describe a split between different levels of consciousness?

a. Hypnagogic imagery
b. REM sleep
c. Delta waves
d. Spindles
e. Dissociation

14. Psychologists who study the brain's activity during sleep are most likely to use which of these technologies?

a. MRI
b. CT scan
d. PET scan
d. EEG
e. EKG

15. What term describes the brain's adaptation to a drug's chemistry, requiring larger and larger doses to experience the same effect?

a. Withdrawal
b. Tolerance
c. Addiction
d. Substance use disorder
e. Disinhibiting

Free-Response Questions

1. Different biological changes are associated with different states of consciousness. Explain the biological changes (if any) typically associated with the following consciousness-related concepts:

- Sleep deprivation
- REM
- Tolerance
- Opiates

Rubric for Free Response Question 1

1 point: Sleep deprivation causes a wide range of biological changes in the body, all associated with decreased performance while awake. These biological changes include lack of energy, falling asleep during the day, changes in appetite, suppression of the immune system, decreased focus and attention, and depressed mood. Pages 234–237

1 point: The REM stage of the sleep cycle is associated with dramatic biological changes. Brain waves and breathing become irregular, heart rate increases, and eyes dart back and forth beneath the eyelids. Pages 228–229

1 point: After repeated use of some drugs, humans develop tolerance for those substances, meaning that increasing dosages of those drugs are needed to produce the same effect. Tolerance occurs because of biological changes in the brain. The brain's chemistry changes when some psychoactive drugs are repeatedly ingested, interfering with the brain's ability to produce or use some neurotransmitters. Pages 246–247

1 point: Drugs categorized as opiates cause a range of biological changes in the body. Some of the changes mentioned in the text are: pupil constriction, slower breathing, lethargy, and eventually, painful withdrawal symptoms as the brain loses its ability to produce "natural" endorphins. Page 250

2. Ernest, a psychology major, is discussing hypnosis with his roommate, Phil. Phil says: "I can't believe so many people fall for that hypnosis stuff. Hypnosis is just like dreaming. It's just a different state of consciousness, and a dream can affect someone just like a supposed hypnotic state can."

Explain how Ernest might use the following terms as he discusses the validity of Phil's claims.

- Posthypnotic suggestion
- Divided-consciousness theory
- Social influence theory
- Dissociation

(4 points)

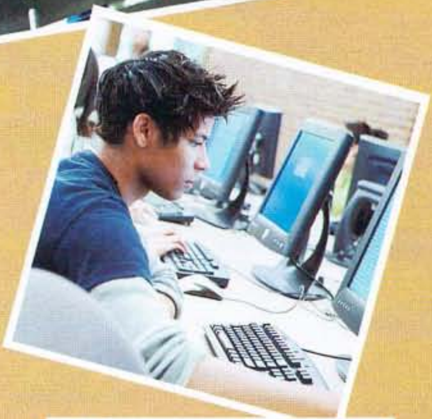
3. Consciousness has been defined and studied differently throughout the history of psychology. In your own words, explain how modern psychologists define consciousness, and explain how the following "altered" states of consciousness relate to your definition.

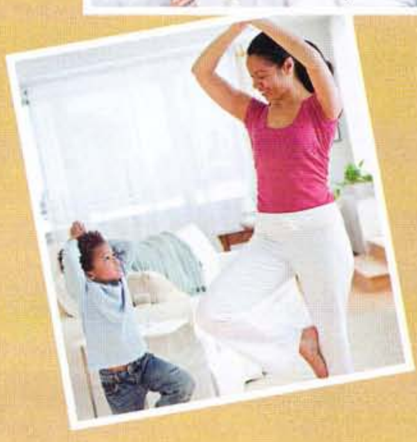
- Hypnosis
- Sleep stages
- Dreams
- Psychoactive drugs

(5 points)

Multiple-choice self-tests and more may be found at www.worthpublishers.com/MyersAP2e

Unit VI





Learning

Modules

When a chinook salmon first emerges from its egg in a stream's gravel bed, its genes provide most of the behavioral instructions it needs for life. It knows instinctively how and where to swim, what to eat, and most spectacularly, where to go and when and how to return to its birthplace. Guided by the scent of its home stream, it pursues an upstream odyssey to its ancestral spawning ground and seeks out the best gravel and water flow for breeding. It then mates and, its life mission accomplished, dies.

Unlike salmon, we are not born with a genetic plan for life. Much of what we do we learn from experience. Although we struggle to find the life direction a salmon is born with, our learning gives us more flexibility. We can learn how to build grass huts or snow shelters, submarines or space stations, and thereby adjust to almost any environment. Indeed, nature's most important gift to us may be our *adaptability*—our capacity to learn new behaviors that help us cope with changing circumstances.

Learning breeds hope. What is learnable we can potentially teach—a fact that encourages parents, teachers, coaches, and animal trainers. What has been learned we can potentially change by new learning—an assumption that underlies counseling, psychotherapy, and rehabilitation programs. No matter how unhappy, unsuccessful, or unloving we are, that need not be the end of our story.