Chapter 5
Sensation

Review 5.1: Vision
Jamail is a software engineer who is animating a new soccer computer game. The visible light from the computer screen, which is only a small portion of the (1) electromagnetic spectrum of energy, has two physical characteristics: the distance from one wave peak to the next is its (2) wavelength, which determines the (3) hue—for example, the blue shorts and green background Jamail has chosen for his animation—and the height, or (4) amplitude, from peak to trough of the wave, which determines the amount of energy in a light wave, or its (5) intensity, which we perceive as brightness. For Jamail’s eyes to see, they must transform particles of light energy into colorful objects in this sequence: Light enters Jamail’s eyes through the protective (6) cornea and then passes through a small opening, the (7) pupil, which is regulated by a colored muscle, the (8) iris. Next, light passes through the (9) lens, which, by a process called (10) accommodation, focuses the light on the eye’s (11) retina. When the image from the computer screen reaches Jamail’s retina, it stimulates two receptor cells: the (12) rods, in the periphery, for black-and-white vision, and the (13) cones, in the fovea, for color vision, which stimulate the (14) bipolar cells, which then activate the (15) ganglion cells, whose axons form the (16) optic nerve that carries information to Jamail’s (17) brain.

Review 5.2: Hearing
As Jamail programs the new soccer computer game, he is careful to adjust the sound track in order to regulate the sound waves’ two physical characteristics: the waves’ length, which determines their (1) frequency, which we perceive as (2) pitch, and the strength, or (3) amplitude of the waves, which we perceive as (4) loudness. Jamail is able to perceive these psychological properties of sound, because the sound waves enter his outer ear and are channeled through the (5) auditory canal to the membrane that vibrates in response to the pressure, which is called the (6) eardrum. The vibrations are then transmitted to three tiny bones: the (7) hammer, (8) anvil, and (9) stirrup, which cause the (10) oval window of the snail-shaped tube called the (11) cochlea to vibrate. In this tube, the vibrations from Jamail’s characters’ screams, grunts, and groans cause fluid to move, creating ripples in the (12) basilar membrane, which is lined with (13) hair cells that bend, triggering impulses in (14) nerve fibers that form the (15) auditory nerve, which sends the information to the auditory (16) cortex in the brains (17) temporal lobe.

Review 5.3: Pain
Jamail has spent so many hours on the computer, hand wrapped around the mouse, that his middle fingers feel numb and pain is shooting up his arm. According to the (1) gate-control theory, Jamail’s spinal cord contains two types of fibers: small fibers, which (2) open the gate to the brain, so that Jamail (3) does feel pain, and large fibers, which (4) close the gate to the brain, so that Jamail (5) does not feel pain. Because Jamail has an approaching deadline, he plods on. He belongs to a (6) culture that encourages stoicism in the face of pain. Also, he is (7) distracted from the pain by thoughts of the deadline as well as by the cool snow scenes in the cyber environment in which he is operating to create his game, which is similar to (8) virtual-reality pain control.

Review 5.4: Hearing, Smell, Taste, and Interaction
It’s time for Jamail to take a break. He closes his eyes to relax, but the phone, which is to the left of him, rings. With his eyes still closed, he is able to pick up the phone. He does this because the (1) just noticeable difference of the sound reaching his two ears tells his sense of (2) kinesthesis where to move his hand. Jamail’s ability illustrates the concept that one sense may influence another, which is called (3) sensory interaction. This principle works for all of his senses. For example, Jamail finishes talking to his friend and goes to the kitchen for a snack, where the smell of freshly baked bread activates the receptors in the (4) olfactory membrane, which transmits electric signals to higher regions of the brain by way of converged (5) axons.
Because the receptors for smell are located near the brain’s ancient (6) limbic centers, the smell of the bread evokes (7) memories of his childhood, when his mother spent Saturdays baking for the family. Jamail takes a piece of bread. Adding to the smell and texture of the bread, his taste (8) buds give him the flavor of banana bread, and this information is sent to the brain’s (9) temporal lobe, which is near where olfactory information is received.