

CHAPTER NINETEEN

Answers to WHAT DID YOU LEARN?

1. A sensation is our conscious awareness of incoming sensory information. A stimulus is a change in the environment that is detected by a receptor. Only a stimulus leading to an impulse that reaches the cerebral cortex results in a sensation.
2. Transduction is the transformation of the energy of one system into a different form of energy (e.g., a flashlight converts the chemical energy in a battery into light energy). In sensory receptors, transduction results in the conversion of the stimulus (touch, temperature, sound) into nerve impulses.
3. The three groups of receptors classified by stimulus origin are exteroceptors, which detect stimuli from the external environment; interoceptors, which detect stimuli in internal organs; and proprioceptors, which detect body and limb movements.
4. Mechanoreceptors respond to touch, pressure, vibration, and stretch. Thermoreceptors respond to increases or decreases in temperature.
5. Unencapsulated receptors have no connective tissue wrapping around them and are relatively simple in structure. Encapsulated receptors are covered either by connective tissue or glial cells.
6. Tactile discs are flattened, unencapsulated nerve terminals that function as tonic receptors for fine touch. These receptors are important in distinguishing the texture and shape of the stimulating agent. Tactile discs are associated with special tactile cells (Merkel cells), located in the stratum basale of the epidermis.
7. Ruffini corpuscles are encapsulated receptors that detect both continuous deep pressure and distortion in the skin. They are tonic receptors that do not exhibit adaptation; they are housed within the dermis and subcutaneous tissue. Ruffini corpuscles are the least lamellated of the encapsulated receptors. Some are located within joint capsules, where they detect the position and movement of the joint.
8. Tactile corpuscles are large, encapsulated oval receptors. They are formed from highly intertwined dendrites that are enclosed by modified neurolemmocytes, which are then covered with dense irregular connective tissue. Tactile corpuscles are phasic receptors for fine touch and texture. They are housed within the dermal papillae of the skin, especially in the eyelids, fingertips, genitalia, nipples, and palms.
9. The papillae on the tongue are filiform, fungiform, vallate papillae, and foliate. Filiform papillae are short and spikelike, distributed on the anterior two-thirds of the tongue surface, and do not house taste buds. Fungiform papillae are blocklike projections located primarily on the tip and sides of the tongue. They contain only a few taste buds each. Vallate (circumvallate) papillae are the least numerous and the largest tongue papillae. They are arranged in an inverted V-shape on the posterior dorsal surface of the tongue. Most of our taste buds are housed within the walls of these papillae. Foliate papillae are not well developed on the human tongue. They extend as ridges on the posterior lateral sides of the tongue and house only a few taste buds during infancy and early childhood.

10. Cranial nerves VII and IX receive taste sensations from the tongue. Cranial nerves V and X receive general sensory information from the tongue.
11. Within the nasal cavity, paired olfactory organs provide the sense of smell. The lining of their olfactory epithelium is composed of three distinct cell types: olfactory nerves (also called olfactory receptor cells) to detect odors; supporting cells that sandwich the olfactory nerves and sustain and maintain the receptors; and basal cells that function as stem cells to replace olfactory epithelium components.
12. Olfactory hairs are cilia that project into the mucus and house receptors for inhaled airborne molecules.
13. A lacrimal gland continuously produces lacrimal fluid. Excretory ducts conduct the lacrimal fluid into the conjunctival sac of the superior eyelid. There, the blinking motion of the eyelids “washes” the lacrimal fluid over the eyes. The lacrimal fluid drains through the lacrimal puncta into the lacrimal canaliculi. A lacrimal sac temporarily stores the fluid. The nasolacrimal duct receives the lacrimal fluid and delivers it into the nasal cavity.
14. The fibrous tunic, the external layer of the eye wall, is composed of the anterior cornea and the posterior sclera. The cornea refracts incoming light rays into the interior of the eye, while the tough, white sclera provides for eye shape and protects its delicate internal components. The vascular tunic, the middle layer of the eye wall is composed of three distinct regions: the choroid, the ciliary body, and the iris (from posterior to the anterior). The choroid houses a vast network of capillaries that supply both nutrients and oxygen to the retina. Cells of the choroid are filled with pigment from the numerous melanocytes in this region. The ciliary body is composed of four bands of smooth muscle organized into a ring and collectively called the ciliary muscle, which functions in lens shape change for near and far vision. The most anterior region of the middle layer of the eye is the iris. It is readily visible anteriorly as the colored diaphragm with a central black hole, called the pupil. The iris is composed of two layers of pigment-forming cells (anterior and posterior layers), and two groups of smooth muscle fibers, whose contractions adjust the diameter of the pupil to regulate light entry. The internal tunic is called the retina. It is composed an outer pigmented layer and an inner neural retina. The outer pigmented layer absorbs light rays that pass through the inner layer. The inner neural layer houses all of the photoreceptors and their associated neurons. This layer of the neural tunic is responsible for receiving light rays and converting them into nerve impulses that are transmitted to the brain.
15. The three cell layers of the retina are the photoreceptors, bipolar cells, and ganglionic cells. Photoreceptors include the visual receptor cells called rods and cones, which detect incoming light. The rods and cones converge to synapse on the bipolar cells. Neuronal convergence continues as bipolar neurons transmit information about stimulated rods and cones to ganglionic neurons. The axons of the ganglionic neurons form the optic nerve, which conducts visual information to the brain.

16. Accommodation is controlled by the parasympathetic division of the ANS. Stimulation of the ciliary muscle causes it to contract. When the ciliary muscle contracts, the entire ciliary body moves anteriorly and thus closer to the lens itself. This reduces the tension in the suspensory ligaments and releases some of their “pull” on the lens, so the lens can become more spherical.
17. The auditory ossicles conduct the energy of sound waves striking the tympanic membrane to the inner ear, causing the footplate of the stapes to move in and out of the oval window. The movement of the stapes initiates pressure waves in the fluid within the closed compartment of the inner ear.
18. Membranous labyrinths are membrane-lined, fluid-filled tubes and spaces within bone. The membranous labyrinth is housed within a cavernous space in dense bone, called the bony labyrinth, which is located within the petrous portion of the temporal bone.
19. The macula is a small, raised oval area in the saccule and utricle along the internal wall of both sacs. Its function is to report on changes in the position of the head.
20. Tilting of the head due to either acceleration or deceleration causes the statoconic membrane to shift its position on the macula surface, resulting in distortion of the stereocilia. As a consequence, bending of the stereocilia results in the sending of impulses to the brain indicating that the head has tilted.