

## Chapter 8 The Nervous System—Senses

### OVERVIEW

The purpose of this chapter is to teach the anatomy and physiology of the body's senses and to present select concepts associated with pathophysiology or disease issues of the five senses.

Chapter figures can be found in the Online Learning Center (OLC). Discussion points, group activities, and quizzes listed in the summary table below are explained under their individual outcomes following the table. Answer keys to the text chapter review questions, workbook concept maps, and workbook review questions are located at the end of the chapter.

A review guide is also available on the OLC. This guide lists all of the learning outcomes for the chapter and gives space for students to take notes and make sketches. This can be an important tool to encourage students to pay attention to what they are learning and to use to either take initial notes or to organize their existing notes before exams.

### COMPETENCY CORRELATION GRID

Learning Outcome	CAAHEP Competencies	ABHES Competencies
8.1 Use medical terminology related to the senses of the nervous system.	I.C.1. Describe structural organization of the human body	3.a. Define and use entire basic structure of medical words and be able to accurately identify in the correct context, i.e., root, prefix, suffix, combinations, spelling and definitions
8.2 Classify the senses in terms of what is sensed and where the receptors are located.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.3 Describe the sensory receptors for the general senses in the skin.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.4 Explain the types of information transmitted by sensory receptors in the skin.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

8.5 Describe the pathway for pain.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.6 Describe the sensory receptors for taste.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.7 Describe the different tastes and explain how flavor is perceived.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.8 Describe the pathway for taste.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.9 Describe the sensory receptors for smell.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.10 Explain how odors are perceived.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.11 Describe the pathway for smell.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.12 Describe the anatomy of the ear.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.13 Explain how sound is perceived.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.14 Describe the pathway for hearing.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.15 Describe the anatomy of the vestibular apparatus.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.16 Explain how equilibrium is perceived.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.17 Describe the pathway for equilibrium.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

8.18 Describe the anatomy of the eye.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.19 Explain how vision is perceived.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.20 Describe the pathway for vision.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.21 Describe the effects of aging on the senses.	I.C.10. Compare body structure and function of the human body across the life span	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.22 Describe common diagnostic tests used to diagnose disorders of the senses.	I.C.10. Compare body structure and function of the human body across the life span	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
8.23 Describe disorders of the senses and relate abnormal function to the pathology.	I.C.6. Identify common pathology related to each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

## SUMMARY TABLE 8

LEARNING OUTCOME	LECTURE OUTLINE	ACTIVITIES – TALKING POINTS	ASSESSMENTS
8.1 Use medical terminology related to the senses of the nervous system.			<b>WkBk Review Questions:</b> <ul style="list-style-type: none"> <li>Word Deconstruction: 1-5</li> </ul>
8.2 Classify the senses in regard to what is sensed and where the receptors are located.	I. Overview	<b>Discussion Point:</b> Ask the students which sense they consider the most important and why. This leads into Group Activity 1.  <b>Group Activity:</b> 1	<b>WkBk Review Questions:</b> <ul style="list-style-type: none"> <li>MS: 1</li> </ul>
8.3 Describe the sensory receptors for the general senses in the skin.	II. General senses A. Anatomy of receptors in	<b>WkBk Concept Maps:</b> <ul style="list-style-type: none"> <li>Skin receptors</li> </ul>	<b>Spot check:</b> 1

	<p>the skin</p> <p><b>Chapter Figure:</b> 8.2 (Receptors in the skin)</p> <p><b>Table:</b> 8.1 (Receptors in the skin)</p>	Figure 8.4 (Skin receptors concept map)	<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>MS: 9</li> </ul>
8.4 Explain the types of information transmitted by sensory receptors in the skin.	<p>B. Physiology of general senses in the skin</p> <ol style="list-style-type: none"> <li>Type of sensation</li> <li>Location</li> <li>Intensity</li> <li>Duration</li> </ol> <p><b>Chapter Figure:</b> 8.3 (Receptive fields)</p>	<p><b>WkBk Concept Maps:</b></p> <ul style="list-style-type: none"> <li>Skin receptors</li> </ul> <p>Figure 8.4 (skin receptors concept map)</p>	<p><b>Spot check:</b> 2</p> <p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>MS: 10</li> <li>Completion: 1</li> </ul>
8.5 Describe the pathway for pain.	<p>a. Pathway for pain</p> <p><b>Chapter Figure:</b> 8.4 (Pathways for pain)</p>	<p><b>Talking Point:</b> Mention that the brain only interprets pain from other regions of the body. The brain itself cannot “feel” pain. The brain does not have any pain receptors like other tissues of the body.</p>	<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>MS: 2</li> <li>Matching: 6</li> </ul>
8.6 Describe the sensory receptors for taste.	<p>III. Taste</p> <p>A. Anatomy of receptors for taste</p> <ol style="list-style-type: none"> <li>Taste cells</li> <li>Basal cells</li> </ol>	<p><b>Talking Point:</b> Stress that the bumps on the tongue are not taste buds. They are papillae. The papillae consists of taste buds. The taste buds consists of gustatory cells. The gustatory cells send signals to the brain for the interpretation of taste.</p>	<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>MS: 3</li> <li>Completion: 2</li> </ul>

	3. Support cells		
	<b>Chapter Figure:</b> 8.5 (The tongue)		
8.7 Describe the different tastes and explain how flavor is perceived.	B. Physiology of taste 1. Salt 2. Sweet 3. Sour 4. Bitter 5. Umami	<b>WkBk Concept Maps:</b> <ul style="list-style-type: none"><li>Taste</li></ul> Figure 8.5 (Taste concept map)	<b>Spot check:</b> 3 <b>WkBk Review Questions:</b> <ul style="list-style-type: none"><li>MS: 3</li><li>Completion: 3</li></ul>
8.8 Describe the pathway for taste.	i. Pathway for taste		<b>WkBk Review Questions:</b> <ul style="list-style-type: none"><li>MS: 8</li></ul>
8.9 Describe the sensory receptors for smell.	IV. Smell A. Anatomy of receptors for smell  <b>Chapter Figure:</b> 8.6 (Olfactory receptors)	<b>WkBk Concept Maps:</b> <ul style="list-style-type: none"><li>Smell</li></ul> Figure 8.6 (Smell concept map)	<b>WkBk Review Questions:</b> <ul style="list-style-type: none"><li>MS: 8</li></ul>
8.10 Explain how odors are perceived.	B. Physiology for smell		<b>Spot check:</b> 4 <b>WkBk Review Questions:</b> <ul style="list-style-type: none"><li>MS: 8</li></ul>
8.11 Describe the pathway for smell.	1. Pathway for olfaction		<b>WkBk Review Questions:</b> <ul style="list-style-type: none"><li>Critical Thinking: 2</li></ul>
8.12 Describe the anatomy of the ear.	V. Hearing	<b>WkBk Coloring Book:</b>	<b>WkBk Review Questions:</b>

	<p>A. Anatomy of the ear</p> <p><b>Chapter Figures:</b></p> <p>8.7 (The range of human hearing)</p> <p>8.8 (The internal anatomy of the ear)</p> <p>8.9 (A tube inserted in the tympanic membrane to drain fluid)</p> <p>8.10 (The cochlea unwound)</p> <p>8.11 (Anatomy of the cochlea)</p>	<ul style="list-style-type: none"> <li>The ear</li> </ul> <p>Figure: 8.1 (The ear)</p> <p><b>WkBk Lab Exercises and Activities:</b></p> <ul style="list-style-type: none"> <li>The ear</li> </ul> <p>Figure: 8.1 (the ear)</p> <p><b>WkBk Concept Maps:</b></p> <ul style="list-style-type: none"> <li>Hearing</li> </ul> <p>Figure 8.7 (Hearing concept map)</p> <p><b>Talking Point:</b> The ossicles are the 3 smallest bones of the body with the stapes being the smallest of all the ossicles. The ossicles vibrate in this sequence: Malleus, Incus, and Stapes. You can remember this sequence by remembering the first letter of each bone: MIS.</p>	<ul style="list-style-type: none"> <li>Matching: 1-5</li> </ul>
8.13 Explain how sound is perceived.	<p>B. Physiology of hearing</p> <p><b>Chapter Figures:</b></p> <p>8.12 (The effects of sound waves on the cochlea)</p> <p>8.13 (Frequency response of the basilar membrane in the cochlea)</p>	<p><b>WkBk Concept Maps:</b></p> <ul style="list-style-type: none"> <li>Hearing</li> </ul> <p>Figure 8.7 (Hearing concept map)</p>	<p><b>Spot check:</b> 5</p> <p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>Completion: 4, 5</li> </ul>
8.14 Describe the pathway for hearing.	<p>1. Pathway for hearing</p>		<p><b>WkBk Review Questions:</b></p>

			<ul style="list-style-type: none"> <li>• Matching: 10</li> <li>• Critical Thinking: 3</li> </ul>
8.15 Describe the anatomy of the vestibular apparatus.	<p>VI. Equilibrium</p> <p>A. Anatomy of the vestibular apparatus</p> <p><b>Chapter Figure:</b></p> <p>8.14 (Dynamic equilibrium)</p> <p>8.15 (The saccule and utricle)</p> <p>8.16 (The effect of gravity on the macula)</p> <p>8.17 (Semicircular canals)</p>	<p><b>WkBk Coloring Book:</b></p> <ul style="list-style-type: none"> <li>• The ear</li> </ul> <p>Figure: 8.1 (The ear)</p>	<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• Matching: 1-5</li> </ul>
8.16 Explain how equilibrium is perceived.	B. Physiology of equilibrium		<p><b>Spot check:</b> 6</p> <p><b>Quiz:</b> 1</p> <p>(Covers LOs 8.12, 8.13, 8.15, 8.16 See Individual Outcome 8.16)</p> <p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• Critical Thinking: 1</li> </ul>
8.17 Describe the pathway for equilibrium.	<p>1. Pathway for equilibrium</p> <p>a. Spinal cord</p> <p>b. Cerebellum</p> <p>c. Neurons in CN III, IV, and VI</p>		<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• Matching: 9</li> </ul>

	d. Thalamus		
8.18 Describe the anatomy of the eye.	<p>VII. Vision</p> <p>A. Anatomy of the eye</p> <ol style="list-style-type: none"> <li>1. The orbital region</li> <li>2. Muscles of the eye</li> <li>3. The eyeball <ol style="list-style-type: none"> <li>a. Sclera</li> <li>b. Uvea</li> <li>c. Retina <ol style="list-style-type: none"> <li>i. Optic disc</li> <li>ii. Macula lutea</li> <li>iii. Fovea centralis</li> </ol> </li> </ol> </li> </ol> <p><b>Chapter Figure:</b></p> <p>8.18 (Orbital region)</p> <p>8.19 (Lacrimal gland and ducts)</p> <p>8.20 (Accessory structures of the eye)</p> <p>8.21 (Muscles of the eye)</p> <p>8.22 (Sagittal view of the eye)</p> <p>8.23 (Neurons of the retina)</p> <p>8.24 (The retina as seen through an ophthalmoscope)</p>	<p><b>WkBk Coloring Book:</b></p> <ul style="list-style-type: none"> <li>• The eye</li> </ul> <p>Figure: 8.2 (The eye)</p> <p><b>WkBk Lab exercises and Activities:</b></p> <ul style="list-style-type: none"> <li>• Paths of the stimulus—light in the eye</li> </ul> <p><b>WkBk Concept Maps:</b></p> <ul style="list-style-type: none"> <li>• Retina</li> </ul> <p>Figure 8.9 (Retina concept map)</p>	<p><b>Spot check:</b> 7, 10</p> <p><b>Quiz:</b> 2</p> <p>(Covers LO 8.18 See Individual Outcome 8.18)</p> <p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• MS: 7</li> </ul>
8.19 Explain how vision is perceived.	B. Physiology of vision	<p><b>Talking Point:</b></p> <p>What does 20/20 vision mean? The first number</p>	<p><b>Spot check:</b> 11</p> <p><b>WkBk Review Questions:</b></p>



	<p><b>Chapter Figure:</b> 8.25 (Focus and accommodation by the eye)</p>	<p>always refers to the person tested. The second number refers to people with normal vision. 20/20= I can see at 20 feet what normal people can see at 20 feet.</p> <p>Here are other examples:</p> <p>A patient has vision of 20/30. This means the patient is viewing something at a distance of 20 feet that others can see the same thing at a distance of 30 feet.</p> <p>A patient has vision of 20/15. This means the patient is viewing something at a distance of 20 feet that others have to be 5 feet closer to see the same thing.</p> <p><b>WkBk Concept Maps:</b></p> <ul style="list-style-type: none"> <li>• Retina</li> </ul> <p>Figure 8.9 (Retina concept map)</p> <ul style="list-style-type: none"> <li>• Vision</li> </ul> <p>Figure 8.10 (Vision concept map)</p> <p><b>WkBk Lab exercises and Activities:</b></p> <ul style="list-style-type: none"> <li>• Blind spot</li> </ul> <p>Figure: 8.3 (Blind spot test)</p>	<ul style="list-style-type: none"> <li>• MS: 6</li> </ul>
8.20 Describe the pathway for vision.	<p>1. Pathway for vision</p> <p><b>Chapter Figure:</b></p>	<p><b>Talking Point:</b> Stress that vision is interpreted in the occipital lobe of the brain. This is why, if a person is hit real hard in the back of the head, they</p>	<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• MS: 7</li> </ul>

	8.26 (Pathway for vision)	<p>may actually see stars. The nerves of the occipital lobe have been activated.</p> <p><b>Talking Point:</b> Many people either have been taught or have the impression that since the optic nerves cross in the area of the tuberculum sella, whatever the right eye “sees” is interpreted by the left hemisphere and whatever the left eye “sees” is interpreted in the right hemisphere. Actually, even though the nerves cross each other, part of the optic nerve from the right eye will actually go to the right hemisphere and part of the optic nerve of the left eye will go the left hemisphere.</p>	
8.21 Describe the effects of aging on the senses.	<p>VIII. Effects of aging on the senses</p> <p>A. Changes in the general senses</p> <p>B. Changes in taste</p> <p>C. Changes in smell</p> <p>D. Changes in hearing</p> <p>E. Changes in equilibrium</p> <p>F. Changes in vision</p>		<p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• MS: 4</li> </ul>
8.22 Describe common diagnostic tests used to diagnose disorders of the senses.	<p>IX, Diagnostic tests for disorders of the sense</p> <p>A. Ishihara test</p> <p>B. Rinne test</p>		<p><b>Spot Check:</b> 12</p> <p><b>WkBk Case Study:</b> 2</p>

	<p>C. Weber test D. Snellen test E. Tonometry</p> <p><b>Table:</b> 8.2 (Common diagnostic tests for disorders of senses of the nervous system)</p>		
8.23 Describe disorders of the senses and relate abnormal function to the pathology.	<p>X. Disorders of the senses</p> <p>A. Hearing loss</p> <ol style="list-style-type: none"> <li>1. Conductive hearing loss</li> <li>2. Sensorineural hearing loss</li> </ol> <p>B. Cataracts</p> <p><b>Chapter figure:</b> 8.27 (Cataract)</p> <p><b>Table:</b> 8.3 (Summary of diseases and disorders of the senses in the nervous system)</p>		<p><i>Spot Check: 12, 13</i></p> <p><b>WkBk Review Questions:</b></p> <ul style="list-style-type: none"> <li>• MS: 5</li> </ul> <p><b>Case Study: 1, 3, 4</b></p>

## INDIVIDUAL OUTCOMES

### OUTCOME 8.2

**Spot Check 2:** In Chapter 6 you learned about four things that could stimulate a dendrite of a neuron. Which of the four is not used for general senses?

*Answer: Light.*

**Group Activity:** Divide the class into six groups—one group per sense (general senses, taste, smell, hearing, equilibrium, hearing, and vision). Each group is to answer the question of how could this sense be lost, and if so, how can one compensate for the loss in carrying out daily activities. Each group presents their findings at the end of the unit.

### OUTCOME 8.3

**Spot Check 1:** In what layer of the skin are most of the general-sense receptors located?

*Answer: Dermis.*

### OUTCOME 8.7

**Spot Check 3:** How might a cold affect your ability to taste your food?

*Answer: You would still be able to detect the taste but probably not the flavor of the food due to the impaired sense of smell because of the cold.*

**OUTCOME 8.10**

**Spot Check 4:** Some people cannot smell garlic. How does their anatomy differ from those who can smell garlic?

*Answer: The people who cannot smell garlic are missing a receptor for garlic.*

**OUTCOME 8.13**

**Spot Check 5:** It is possible to have arthritis in the joints between ossicles. How might that affect hearing?

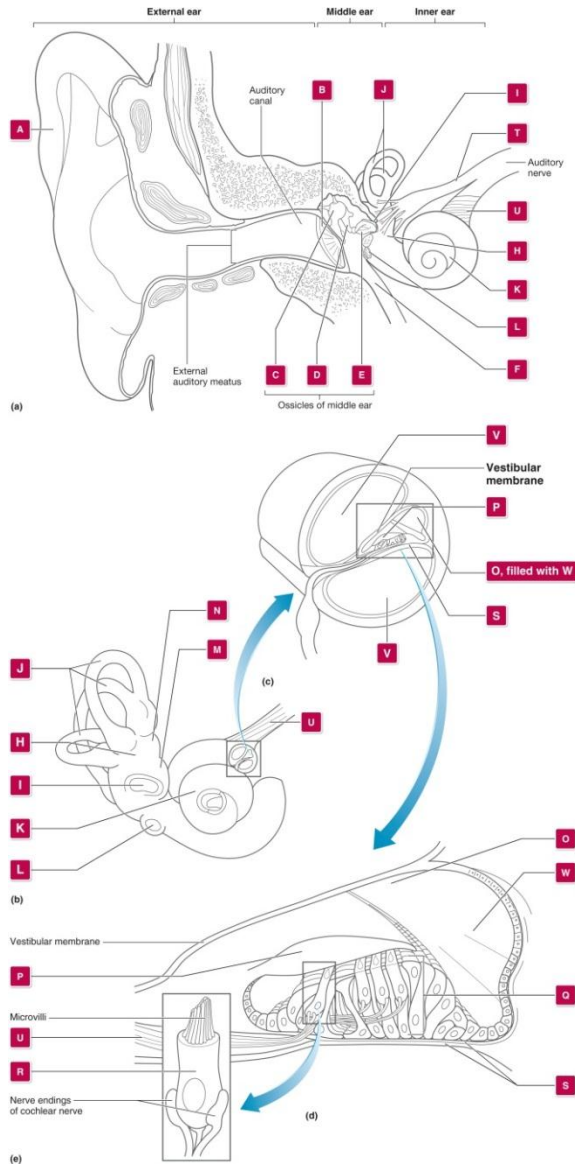
*Answer: The ossicles are used to amplify the vibration 20 times by the time they reach the oval window. The arthritis may dampen the size of the vibrations reaching the oval window and therefore, decrease hearing.*

**OUTCOME 8.16**

**Spot Check 6:** What type of equilibrium is involved if a roller coaster has a complete vertical loop? What anatomy is used to sense the equilibrium while you are making the loop?

*Answer: Dynamic equilibrium, semicircular canals.*

Quiz 1



## IM Ch 8

Use this figure for the following questions.

- |   |  |
|---|--|
| 1. Identify B.  | <i>Tympanic membrane</i>   |
| 2. Identify F.  | <i>Auditory tube</i>   |
| 3. What is the function of F?   | <i>Equalize the pressure on the tympanic membrane</i>                |
| 4. Identify J.  | <i>Semicircular canals</i>   |
| 5. For which sense is J important?  | <i>Dynamic equilibrium</i>   |
| 6. The auditory nerve is shown in this figure. For which sense(s) does this nerve carry messages? | <i>Hearing and equilibrium</i>                                       |
| 7. Identify C, D, and E (in that order).  | <i>Malleus, incus, stapes</i>  |
| 8. What is the function(s) of C, D, and E?  | <i>Transfer vibrations from tympanic membrane to the oval window</i> |
| 9. Identify K.  | <i>Cochlea</i>   |
| 10. Identify I.   | <i>Oval window</i>   |

### OUTCOME 8.18

**Spot Check 7:** Which would be the best place to administer eye drops to a patient to treat an eye infection: the lateral corner of the eye, the middle of the eye, or the medial corner of the eye?

*Answer: The lateral corner of the eye so that the drops will wash over the entire surface of the eye before being drained at the lacrimal punctum.*

**Spot Check 8:** Why does your nose run when you cry?

*Answer: Excess tears are being drained to the nose.*

**Spot Check 9:** The muscles of the eye and the cranial nerves that stimulate these muscles can be tested by having the subject move the eye in an “H” pattern. Which eye muscles move the eye in a transverse, side-to-side motion for the bar of the “H”? Which cranial nerves stimulate each of these muscles?

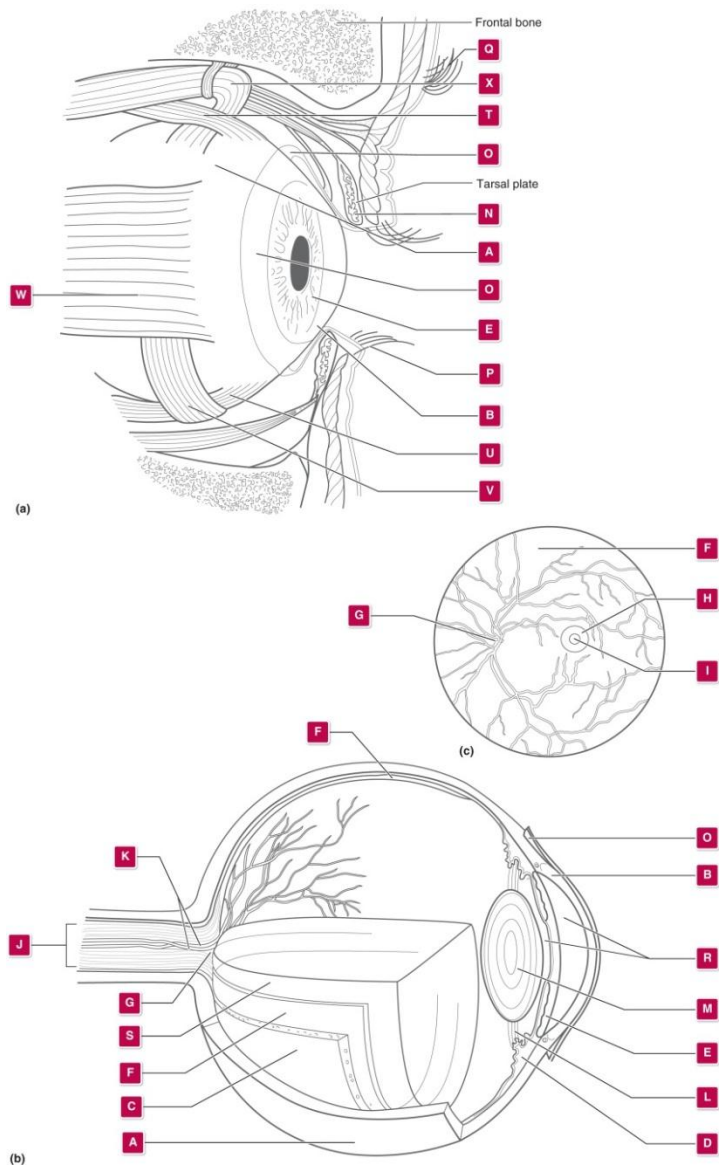
*Answer: The medial and lateral rectus muscles move the eye side-to-side. The medial rectus muscle is stimulated by the oculomotor nerve (CN III), and the lateral rectus muscle is stimulated by the abducens nerve (CN VI).*

**Spot Check 10:** You are sitting outside in the evening as it is getting dark. Predict what would be easier: determining the shape of a car driving by or determining whether the color of the car is dark blue or black. Explain in terms of the photoreceptors involved.

*Answer: It would be easier to determine the shape. Rods can be used in low light conditions to determine shape. Cones are used to determine color, but they require more light.*



Quiz: 2



## IM Ch 8

Use this figure to answer the following questions.

1. Identify O.                *Conjunctiva*
2. Identify B.                *Cornea*
3. Identify M.                *Lens*
4. Identify A.                *Sclera*
5. Identify C.                *Choroid layer*
6. Identify F.                *Retina*
7. Identify G.                *Optic disk, Blind spot*
8. Identify I.                *Fovea centralis*
9. Identify H.                *Macula lutea*
10. Identify E.               *Iris*

### OUTCOME 8.19

**Spot Check 11:** You have injured your eye and now need to wear a patch over it while it heals. What activities should you avoid while wearing the patch because of the loss of vision in that eye?

*Answer: Answers will vary, but activities mentioned should require depth perception.*

**OUTCOME 8.22**

**Spot Check 12:** Explain the differences in how a Rinne test and a Weber test are performed. What do the results of these tests indicate?

*Answer: Rinne test: places a tuning fork near the ear canal.*

*Weber test: Places the base of the tuning fork near the mastoid process of the skull.*

*Rinne test: Sound waves produced by the tuning fork will pass through air, enter into the ear canal and set up vibrations of the ossicles.*

*Weber test: This causes the inner ear to vibrate. If the patient cannot hear the sound produced by the tuning fork through the air but can hear sound from the tuning fork on the mastoid process, the problem is not sensorineural. It is conductive.*

**Case Study 2:** What diagnostic test could be used to help determine his diagnosis? How does the test work to determine hearing loss?

*Answer: Conduct both the Rinne test and the Weber test.*

*Rinne test: places a tuning fork near the ear canal.*

*Weber test: Places the base of the tuning fork near the mastoid process of the skull.*

*Rinne test: Sound waves produced by the tuning fork will pass through air, enter into the ear canal and set up vibrations of the ossicles.*

*Weber test: This causes the inner ear to vibrate. If the patient cannot hear the sound produced by the tuning fork through the air but can hear sound from the tuning fork on the mastoid process, the problem is not sensorineural. It is conductive.*

## OUTCOME 8.23

**Spot Check 13:** Compare and contrast hyperopia and presbyopia.

*Answer: Both are termed “farsightedness.” However, the cause is different. Hyperopia is due to the inaccuracy of the ability to focus on near objects due to a misshaped eye. The eye is too short. Presbyopia is a case of “farsightedness” due to age. The lens is becoming less elastic.*

### Case Study

**1:** What are the two types of hearing loss? What type is Michael most likely suffering from?

*Answer: Conductive and sensorineural. Michael most likely has conductive hearing loss. This type of loss is due to damage to the hearing structures and since Michael is exposed to loud noises, the tympanic membrane or ossicles could be damaged. Diagnostic tests need to be performed in order to develop a definitive answer.*

**3:** Is there anything Michael could have done to prevent damaging his hearing?

*Answer: Michael should have been wearing ear plugs.*

**4:** What, if anything, can be done to improve Michael’s hearing?

*Answer: If there is damage to the ossicles, surgery will be necessary. If there is damage to the cochlea, surgery will be needed. If surgery is not an option, the use of a variety of hearing aids will be necessary. There are hearing aids that are designed to vibrate the skull bones and there are hearing aids that amplify sound.*

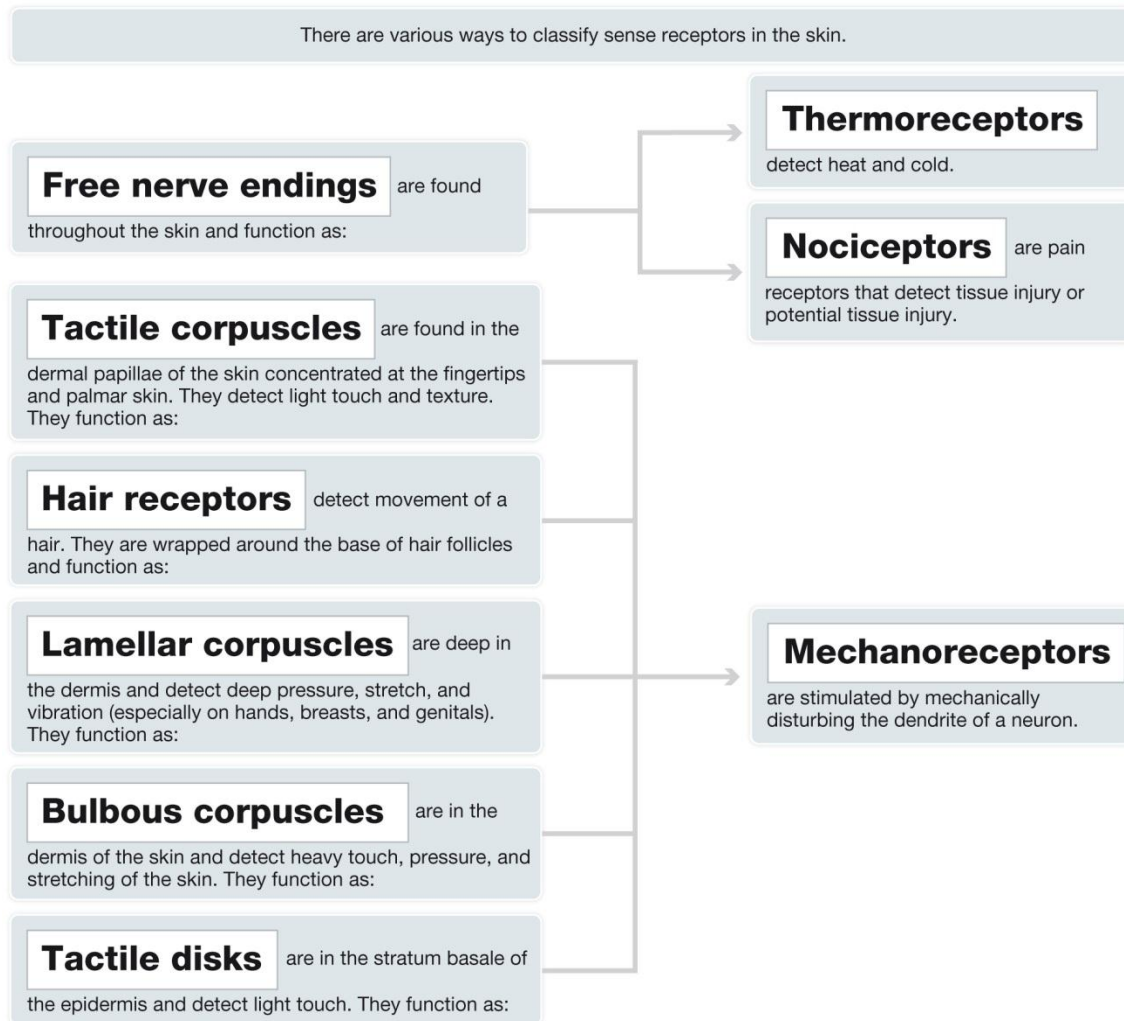
**ANSWER KEY**

**Chapter Review Questions**

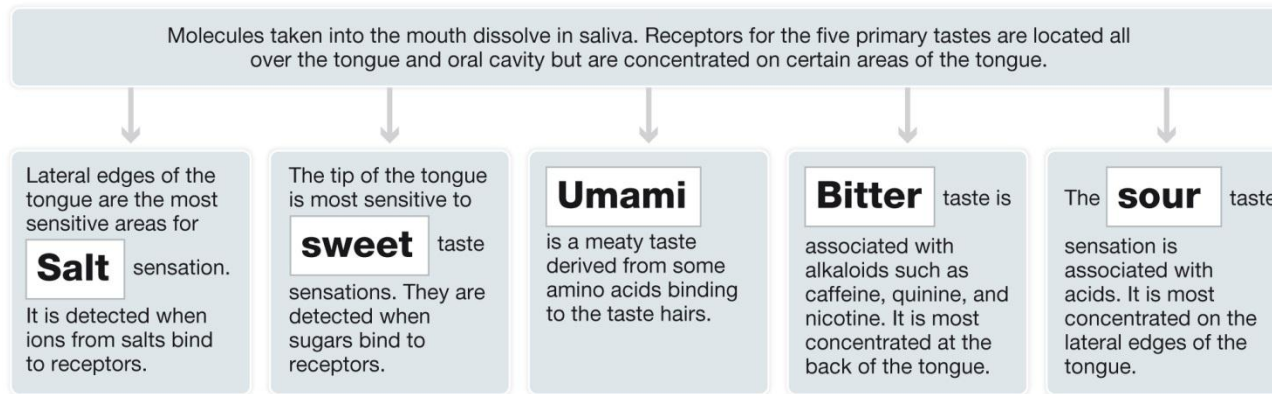
1. B
2. D
3. A
4. B
5. C
6. A
7. A
8. D
9. B
10. A
11. C
12. D
13. D
14. C
15. A
16. A
17. C
18. B
19. B
20. C
21. C
22. D
23. B

## WORKBOOK CONCEPT MAPS:

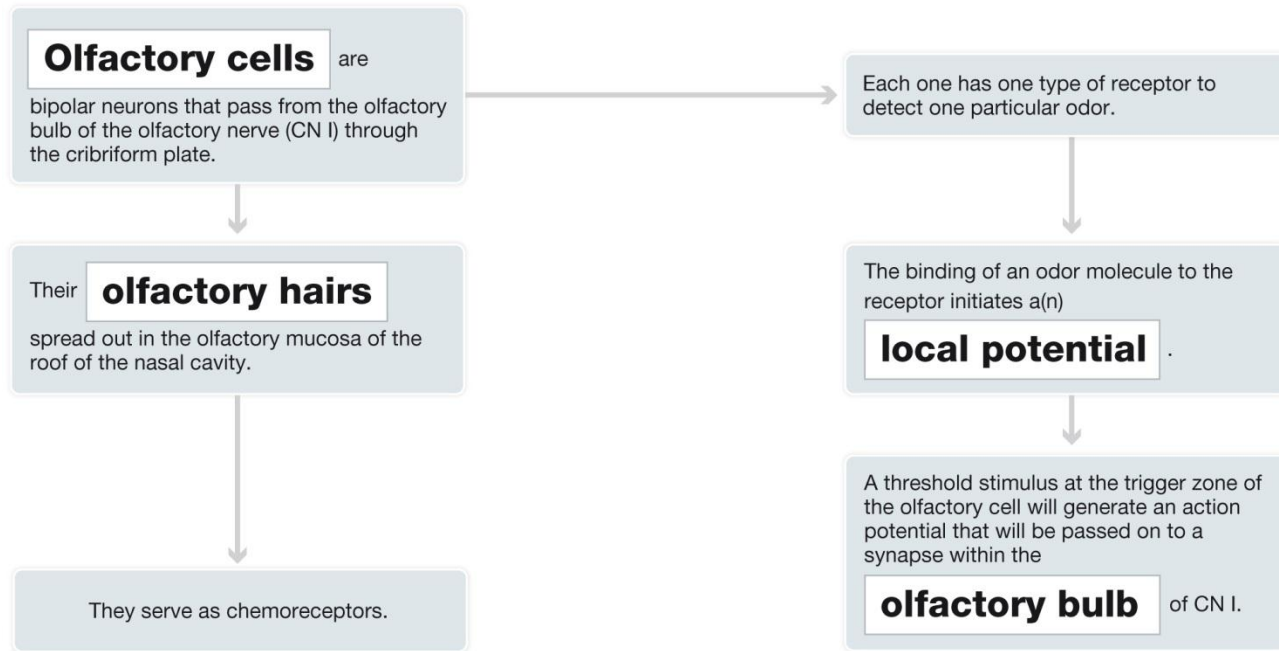
## General Senses



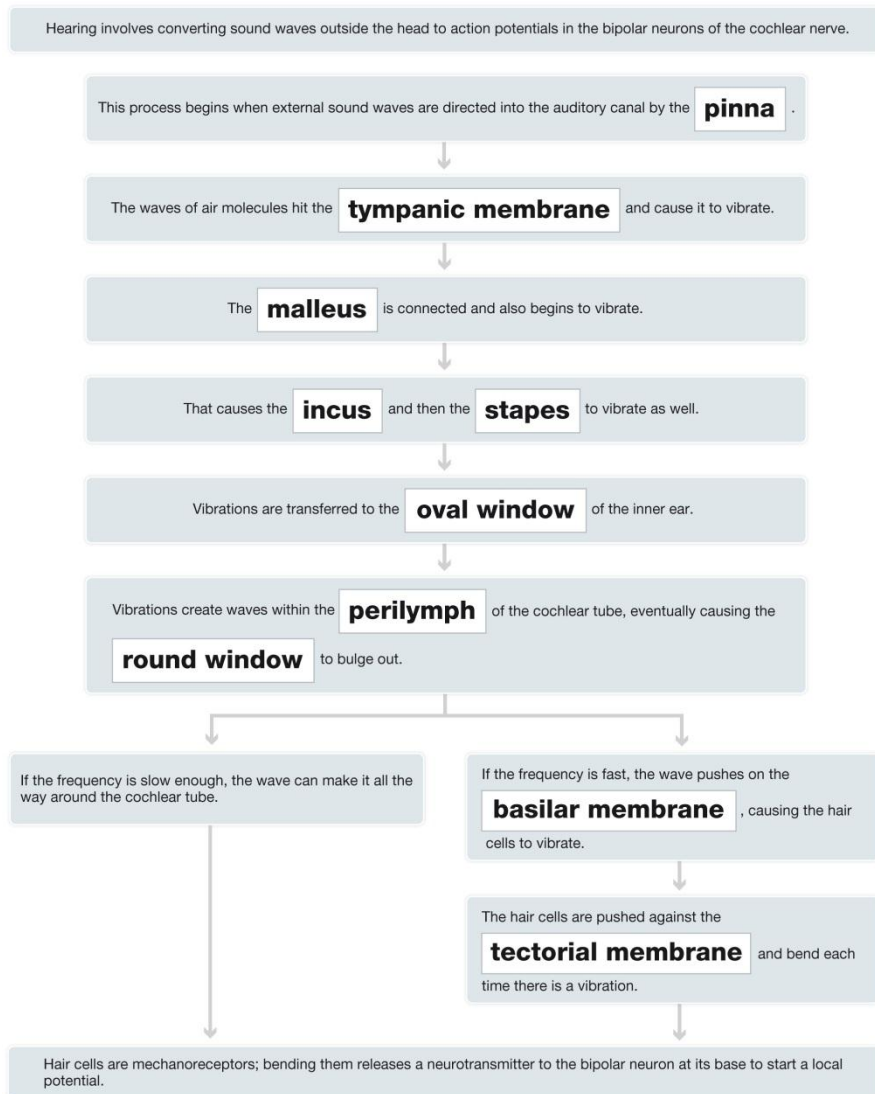
## Taste



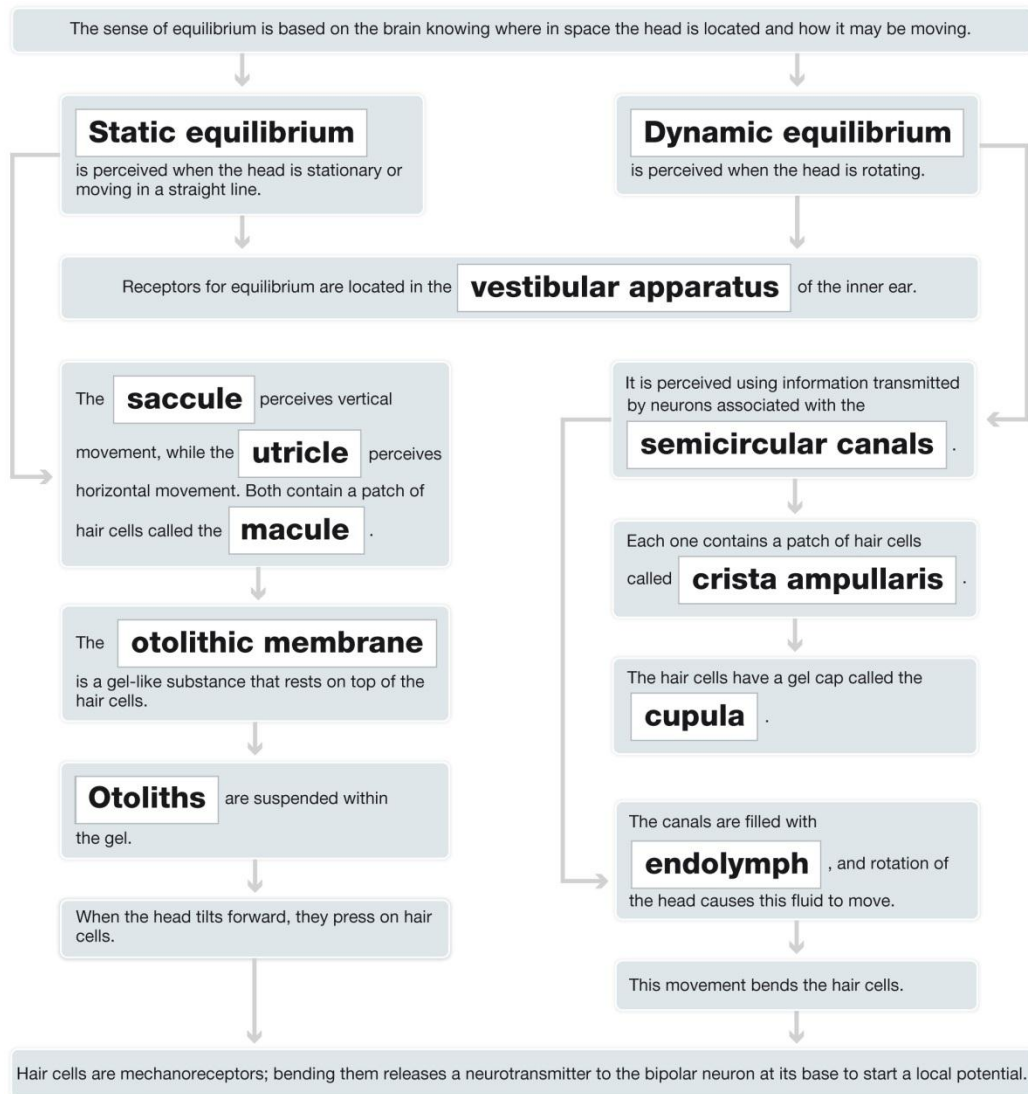
Smell

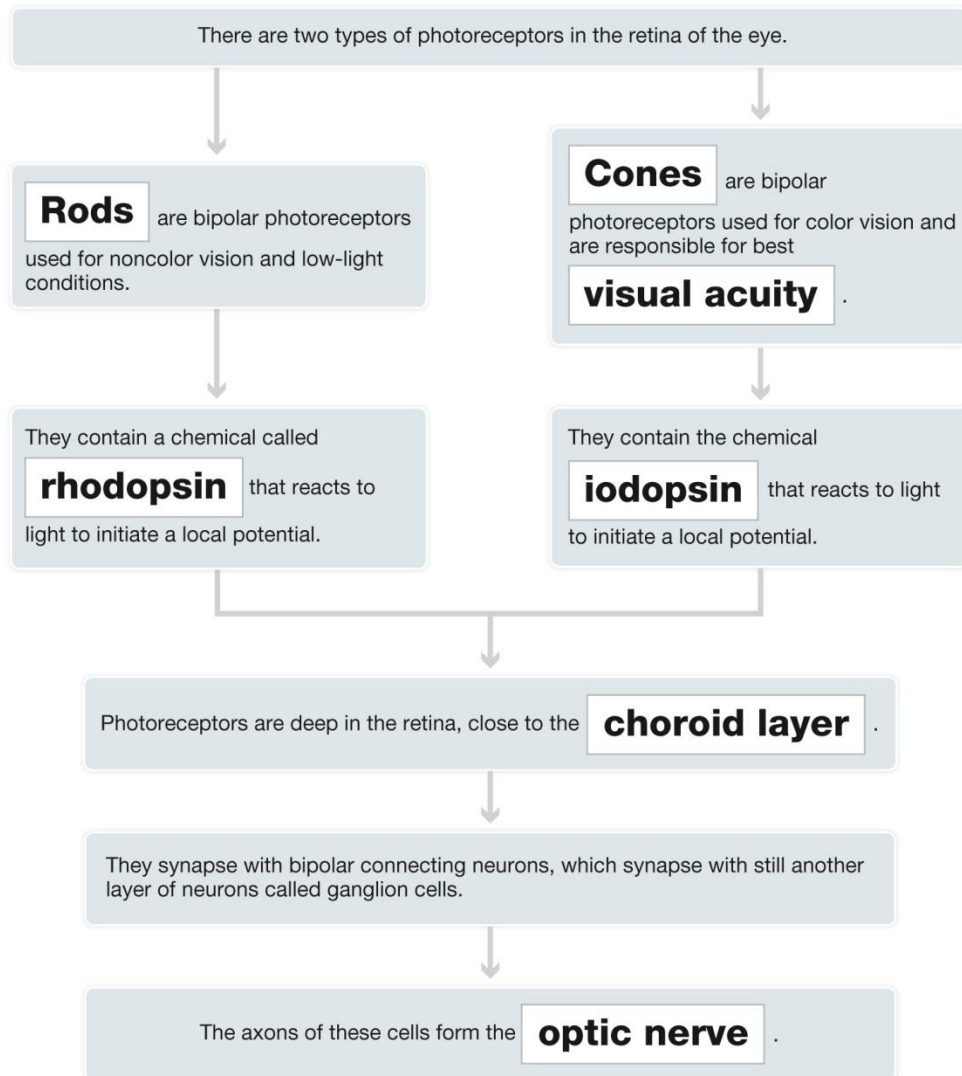




**Hearing**

## Equilibrium



**Retina**

## Vision



**Workbook Chapter Review Questions**

**Word Deconstruction:**

In the textbook, you built words to fit a definition using combining forms, prefixes, and suffixes. Here you are to break down the term into its parts (prefixes, roots, and suffixes) and give a definition. Prefixes and suffixes can be found inside the back cover of the textbook.

FOR EXAMPLE: Dermatitis: dermat/ it is-inflammation of the skin

1. Proprioceptors: Proprio/ ceptor, a receptor that supplies information about your own body
2. Retinopathy: Retino/ pathy, disease of the retina
3. Corneal: Corne/ al, pertaining to the cornea
4. Otosopic: Oto/ scopic, pertaining to an instrument used to examine the ear
5. Intraocular: Intra/ ocul/ ar, pertaining to within the eye

**Multiple Select:**

Select the correct choices for each statement. The choices may be all correct, all incorrect, or any combination of correct and incorrect.

1. How are senses classified?

- a. Special senses include taste, touch, smell, vision, and hearing.
- b. General senses include pain.*
- c. Special senses are detected by organs in the head.*
- d. General senses are detected throughout the body.*
- e. Equilibrium is a general sense.

2. What is the pathway for pain?

- a. Damaged tissues release chemicals to stimulate local potentials on the dendrites of nociceptors.*
- b. If the pain is in the head, the sensory message is carried on cranial nerves.*
- c. If the pain is below the neck, the sensory messages go to the spinal cord.*
- d. The sensory messages for pain may go to the hypothalamus and amygdala.*
- e. The pathway for pain begins with a bipolar neuron.

3. How do the receptors for taste work?

- a. Taste cells have taste hairs that have receptors for chemicals.*

*b. The chemicals detected are dissolved in saliva.*

c. There are six primary tastes.

d. Salt taste sensations are concentrated at the back of the tongue.

*e. Flavor is derived from multiple sensory inputs.*

4. What happens to our senses as we age?

*a. The number of receptors in olfaction and gustation decrease.*

*b. It gets harder to accommodate.*

*c. The iris is not as responsive to changes in the amount of light.*

*d. Pain sensitivity diminishes starting about age 50.*

*e. Light touch is usually increased in the elderly.*

5. Which of the following is (are) true about the forms of hearing loss?

*a. Sensorineural loss is a problem of the organ of Corti or the vestibular nerve.*

*b. Conductive hearing loss can be caused by a ruptured tympanic membrane.*

c. Sensorineural hearing loss can be caused by arthritis in the ossicles of the middle ear.

*d. The type of hearing loss can be determined by comparing air conduction and bone conduction using a tuning fork.*

*e. Tinnitus is often associated with mild hearing loss.*

6. How is vision perceived?

*a. Rhodopsin and iodopsin react to light to initiate a local potential on a bipolar neuron.*

*b. Images are projected upside down on the retina.*

c. The cornea and lens reflect light.

d. The choroid layer is dark, so more light is reflected within the eye.

*e. Depth perception allows objects to be located in space.*

7. How can the anatomy of the eye be described?

*a. The cornea is perfectly smooth to properly refract light.*

b. The uvea is the outer layer of the back of the eye.

*c. The ciliary body is smooth muscle.*

*d. The diaphragm is smooth muscle.*

*e. The canal of Schlemm drains aqueous humor.*



8. How are odors perceived?

- a. Chemicals bind to hair cells.*
- b. Odors are detected in the mucosa of the nasal cavity.*
- c. Bipolar neurons are used.*
- d. Messages travel through the sella turcica to the olfactory bulb.
- e. Adaptation diminishes the duration of the sense of smell.*

9. Which of the following statements is (are) true concerning receptors for general senses in the skin?

- a. Thermoreceptors detect heat and cold.*
- b. Receptors are distributed evenly over the skin.
- c. Mechanoreceptors detect touch, vibration, stretch, and pressure.*
- d. Free nerve endings detect heat, cold, and pain.*
- e. Tactile disks are the only general sense receptor located in the epidermis.*

10. What type(s) of information is (are) transmitted to the brain from receptors?

*A. The location, based on receptive fields*

*B. The intensity, based on the sensitivity of the receptors*

*C. The type of sensation, based on the pathway*

*D. The intensity of the stimulus, based on the frequency of nerve impulses*

*E. The duration of the stimulus, based on how much the neuron adapts the frequency of action potentials*

**Matching:**

Match the description to the structure. Some answers may be used more than once. Some descriptions may fit more than one structure.

- |  |                         |
|--|-------------------------|
| <u>a</u> 1. Contains the saccule and utricle           | a. Vestibular apparatus |
| <u>c</u> 2. Contains the organ of Corti and endolymph  | b. Semicircular canals  |
| <u>a, b</u> 3. Contains perilymph                      | c. Cochlear duct        |
| <u>b</u> 4. Is found in the bony labyrinth             | d. Ossicles             |
| <u>f</u> 5. Connects the middle ear to the nasopharynx | e. Auditory canal       |
|  | f. Auditory tube        |

**Matching:**

Match the final destination in a pathway to the sense. Some answers may be used more than once. Some senses may have more than one destination.

j, h 6. Pain

g. Occipital lobe

g 7. Vision

h. Temporal lobe

h, j 8. Taste

i. Frontal lobe

j 9. Equilibrium

j. Parietal lobe

h 10. Hearing

k. Hypothalamus and amygdala

**Completion:**

Fill in the blanks to complete the following statements.

1. Each neuron in the skin is responsible for detecting a stimulus in a given area called a receptive field.
2. Taste cells are found in taste buds located in bumps on the tongue called papillae.
3. Unami is a meaty taste.
4. The frequency of sound is measured in hertz.
5. The volume of sound is measured in units called decibels.

**Critical Thinking:**

1. Explain in terms of the physiology of the vestibular apparatus why astronauts may have difficulty with equilibrium in a weightless environment. Static equilibrium is perceived based on otoliths pressing on hair cells in the saccule and utricle based on gravity. There is no gravity in a weightless environment.
2. In terms of anatomy and physiology, why might the smell of your mother's home cooking produce a visceral and an emotional response? The pathway for smell is the hypothalamus and amygdala which are responsible for visceral and emotional responses.
3. Write a pathway for singing along with the radio, starting where sound waves enter the ear and ending where skeletal messages are sent. pinna – auditory canal – tympanic membrane – malleus – incus – stapes – oval window – hair cell – auditory nerve – pons – midbrain (inferior colliculi) – temporal lobe (general sensory area – association area – Wernicke's Area) – frontal lobe (Broca's area -- premotor area -- primary motor area).

**Case Study:**

1. Conductive hearing loss and sensorineural hearing loss. Michael is most likely suffering from sensorineural hearing loss.
2. Conductive and sensorineural hearing loss can be determined by testing hearing by air and bone conduction. A tuning fork is used in both tests. The Rinne test involves placing a vibrating tuning fork close to the ear. Sound waves produced by the fork are received by the ear normally through the air to the outer ear, and then vibrations should be conducted to the middle ear. The Weber test involves placing the base of a vibrating tuning fork on the bone of the skull behind the ear, causing the inner ear to vibrate directly. If the person cannot hear the sound produced by the tuning fork through the air, but can hear it when the tuning fork is placed on bone, it is not a problem with the organ of Corti or the auditory nerve. Instead, this indicates a conduction problem and conductive hearing loss.
3. Michael could have used noise reduction equipment while working with loud machinery.
4. Sensorineural hearing loss is the most common type of permanent hearing loss.