

SPECIAL SENSES

The body's sensory receptors react to stimuli or changes occurring both within the body and in the external environment. When triggered, these receptors send nerve impulses along afferent pathways to the brain for interpretation, thus allowing the body to assess and adjust to changing conditions so that homeostasis may be maintained.

The minute receptors of general sensation that react to touch—pressure, pain, temperature changes, and muscle tension—are widely distributed in the body. These are considered in Chapter 7. In contrast, receptors of the special senses—sight, hearing, equilibrium, smell, and taste—tend to be localized and in many cases are quite complex. The structure and function of the special sense organs are the subjects of the student activities in this chapter.

THE EYE AND VISION

1. Complete the following statements by inserting your responses in the answer blanks.

- _____ 1. Attached to the eyes are the (1) muscles that allow us to direct our eyes toward a moving object. The anterior aspect of each eye is protected by the (2), which have eyelashes projecting from their edges. Closely associated with the lashes are oil-secreting glands called (3) that help to lubricate the eyes. Inflammation of the mucosa lining the eyelids and covering the anterior part of the eyeball is called (4).

2. Trace the pathway that the secretion of the lacrimal glands takes from the surface of the eye by assigning a number to each structure. (Note that #1 will be *closest* to the lacrimal gland.)

- | | |
|-----------------------|----------------------------|
| _____ 1. Lacrimal sac | _____ 3. Nasolacrimal duct |
| _____ 2. Nasal cavity | _____ 4. Lacrimal canals |

3. Identify each of the eye muscles indicated by leader lines in Figure 8-1. Color code and color each muscle a different color. Then, in the blanks below, indicate the eye movement caused by each muscle.

- 1. Superior rectus _____
- 2. Inferior rectus _____
- 3. Superior oblique _____
- 4. Lateral rectus _____
- 5. Medial rectus _____
- 6. Inferior oblique _____

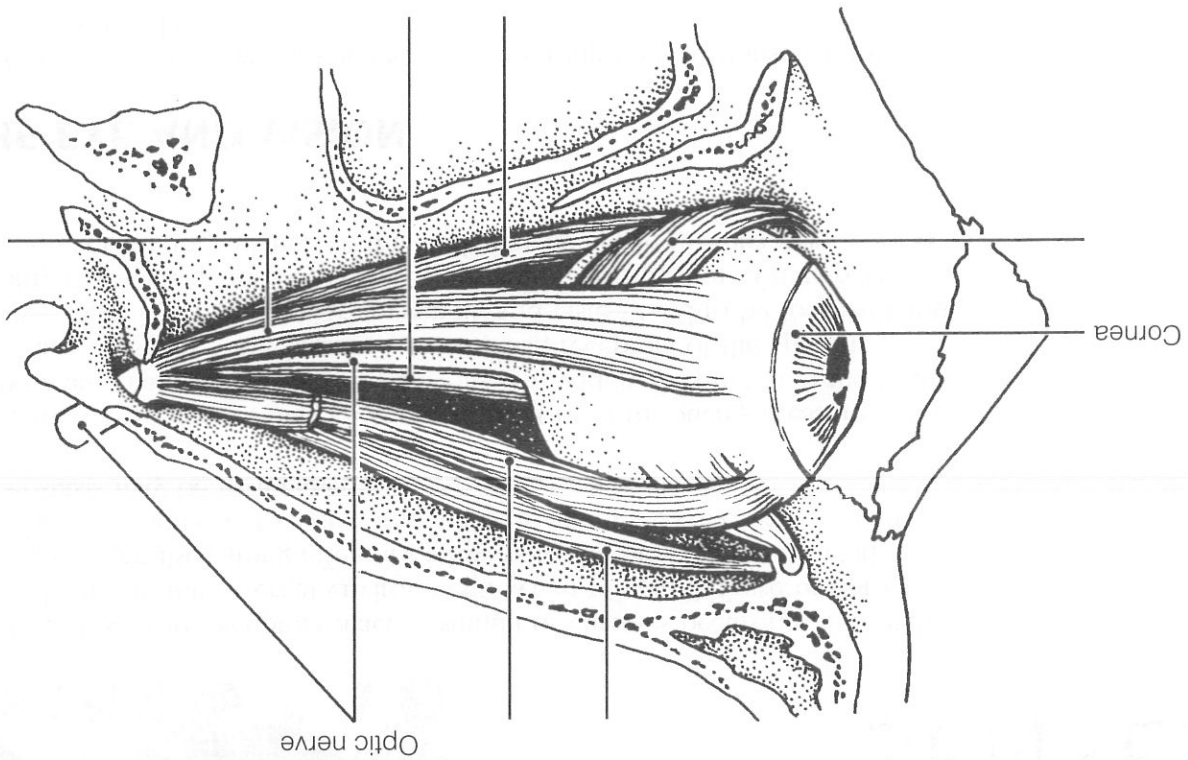


Figure 8-1

4. Three main accessory eye structures contribute to the formation of tears and/or aid in lubricating the eyeball. In the table, name each structure and then name its major secretory product. Indicate which of the secretions has antibacterial properties by circling that response.

	1.
	2.
	3.

Accessory eye structures **Secretory product**

5. Match the terms provided in Column B with the appropriate descriptions in Column A. Insert the correct letter response or corresponding term in the answer blanks.

Column A**Column B**

- | | | |
|-------|--|-----------------------------------|
| _____ | 1. Light bending | A. Accommodation |
| _____ | 2. Ability to focus for close vision (under 20 feet) | B. Accommodation pupillary reflex |
| _____ | 3. Normal vision | C. Astigmatism |
| _____ | 4. Inability to focus well on close objects; farsightedness | D. Cataract |
| _____ | 5. Reflex constriction of pupils when they are exposed to bright light | E. Convergence |
| _____ | 6. Clouding of the lens, resulting in loss of sight | F. Emmetropia |
| _____ | 7. Nearsightedness | G. Glaucoma |
| _____ | 8. Blurred vision, resulting from unequal curvatures of the lens or cornea | H. Hyperopia |
| _____ | 9. Condition of increasing pressure inside the eye, resulting from blocked drainage of aqueous humor | I. Myopia |
| _____ | 10. Medial movement of the eyes during focusing on close objects | J. Night blindness |
| _____ | 11. Reflex constriction of the pupils when viewing close objects | K. Photopupillary reflex |
| _____ | 12. Inability to see well in the dark; often a result of vitamin A deficiency | L. Refraction |
6. The intrinsic eye muscles are under the control of which division of the nervous system? Circle the correct response.

1. Autonomic nervous system 2. Somatic nervous system

7. Complete the following statements by inserting your responses in the answer blanks.

- _____ 1. A (1) lens, like that of the eye, produces an image that is upside down and reversed from left to right. Such an image is
 _____ 2. called a (2) image. In farsightedness, the light is focused
 _____ 3. (3) the retina. The lens used to treat farsightedness is a
 _____ 4. (4) lens. In nearsightedness, the light is focused (5) the
 _____ 5. retina; it is corrected with a (6) lens. _____ 6.

8. Using the key choices, identify the parts of the eye described in the following statements. Insert the correct term or letter response in the answer blanks.

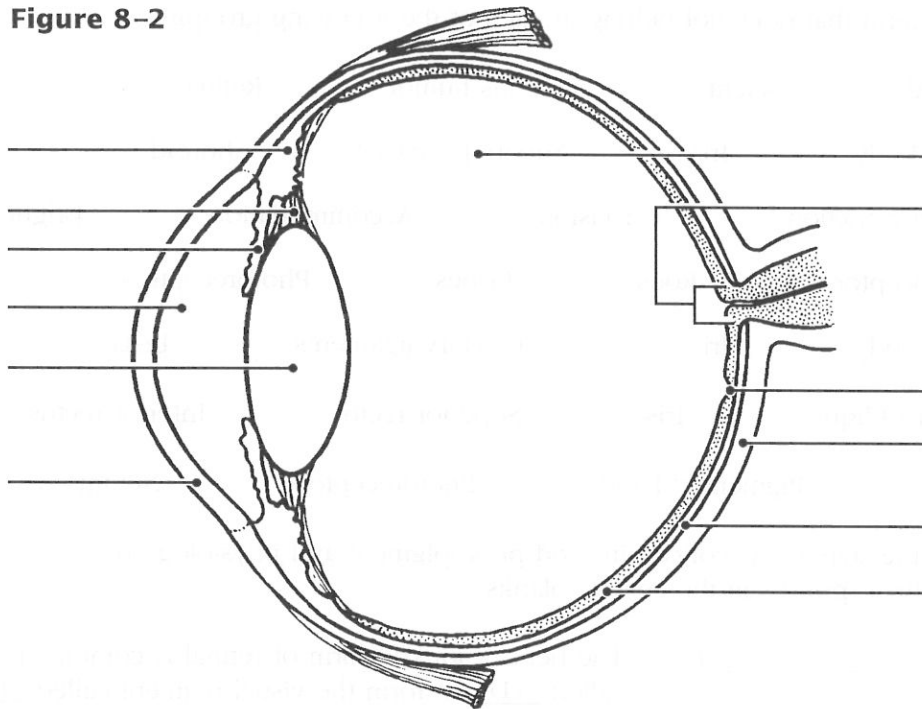
Key Choices

- | | | |
|---|--|---|
| A. <input type="radio"/> Aqueous humor | F. <input type="radio"/> Cornea | K. <input type="radio"/> Retina |
| B. <input type="radio"/> Canal of Schlemm | G. <input type="radio"/> Fovea centralis | L. <input type="radio"/> Sclera |
| C. <input type="radio"/> Choroid | H. <input type="radio"/> Iris | M. <input type="radio"/> Vitreous humor |
| D. <input type="radio"/> Ciliary body | I. <input type="radio"/> Lens | |
| E. <input type="radio"/> Ciliary zonule | J. <input type="radio"/> Optic disk | |

1. Attaches the lens to the ciliary body _____
2. Fluid in the anterior segment that provides nutrients to the lens and cornea _____
3. The "white" of the eye _____
4. Area of retina that lacks photoreceptors _____
5. Contains muscle that controls the shape of the lens _____
6. Nutritive (vascular) layer of the eye _____
7. Drains the aqueous humor of the eye _____
8. Layer containing the rods and cones _____
9. Gel-like substance that helps to reinforce the eyeball _____
10. Heavily pigmented layer that prevents light scattering within the eye _____
11. _____ 12. Smooth muscle structures (intrinsic eye muscles)
13. Area of acute or discriminatory vision _____
14. _____ 15. Refractory media of the eye (#14-17)
16. _____ 17. _____
18. Most anterior part of the sclera—your "window on the world" _____
19. Pigmented "diaphragm" of the eye _____

9. Using the key choice terms given in Exercise 8, identify the structures indicated by leader lines on the diagram of the eye in Figure 8-2. Select different colors for all structures provided with a color-coding circle in Exercise 8, and then use them to color the coding circles and corresponding structures in the figure.

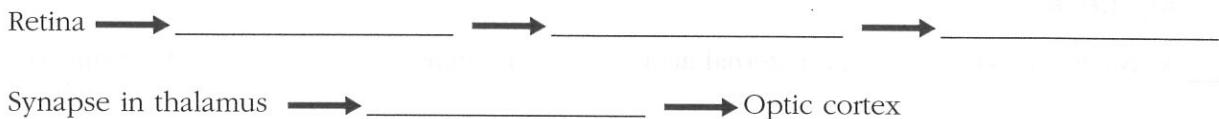
Figure 8-2



10. In the following table, circle the correct word under the vertical headings that describes events occurring within the eye during close and distant vision.

Vision	Ciliary muscle		Lens convexity		Degree of light refraction	
1. Distant	Relaxed	Contracted	Increased	Decreased	Increased	Decreased
2. Close	Relaxed	Contracted	Increased	Decreased	Increased	Decreased

11. Name in sequence the neural elements of the visual pathway, beginning with the retina and ending with the optic cortex.



12. Complete the following statements by inserting your responses in the answer blanks.

- _____ 1. There are (1) varieties of cones. One type responds most vigorously to (2) light, another to (3) light, and still another to (4) light. The ability to see intermediate colors such as purple results from the fact that more than one cone type is being stimulated (5). Lack of all color receptors results in (6). Because this condition is sex linked, it occurs more commonly in (7). Black and white, or dim light, vision is a function of the (8).
- _____ 2.
- _____ 3.
- _____ 4.
- _____ 5.
- _____ 6. _____ 7. _____ 8.

13. Circle the term that does not belong in each of the following groupings.

- | | | | |
|-----------------------|-----------------|----------------------|-----------------|
| 1. Choroid | Sclera | Vitreous humor | Retina |
| 2. Ciliary body | Iris | Superior rectus | Choroid |
| 3. Pupil constriction | Far vision | Accommodation | Bright light |
| 4. Proprioceptors | Rods | Cones | Photoreceptors |
| 5. Ciliary body | Iris | Suspensory ligaments | Lens |
| 6. Inferior oblique | Iris | Superior rectus | Inferior rectus |
| 7. Retina | Pigmented layer | Photoreceptors | Neural layer |

14. Complete the statements concerning rod photopigment and physiology by writing your responses in the answer blanks.

1. _____
 2. _____
 3. _____
 4. _____
 5. _____
 6. _____
- The bent or kinked form of retinal is combined with a protein called (1) _____ to form the visual pigment called (2) _____. When light strikes the visual pigment, it straightens out and breaks down into its two components. This event is called (3) _____ because the purple color of the visual pigment changes to (4) _____ and finally becomes (5) _____ as retinal is converted all the way back to vitamin (6) _____.

THE EAR: HEARING AND BALANCE

15. Using the key choices, select the terms that apply to the following descriptions. Place the correct letter in the answer blanks.

Key Choices

- | | | | |
|--------------------------|--|---|----------------------|
| A. Anvil (incus) | E. External acoustic meatus | I. Pinna | M. Tympanic membrane |
| B. Pharyngotympanic tube | F. Hammer (malleus) | J. Round window | N. Vestibule |
| C. Cochlea | G. Oval window | K. Semicircular canals | |
| D. Endolymph | H. Perilymph | L. Stirrup (stapes) | |
| _____ 1. _____ | _____ 2. _____ | _____ 3. Structures composing the outer ear | |
| _____ 4. _____ | _____ 5. _____ | _____ 6. Structures composing the bony or osseous labyrinth | |
| _____ 7. _____ | _____ 8. _____ | _____ 9. Collectively called the ossicles | |
| _____ 10. _____ | _____ 11. Ear structures not involved with hearing | | |

- ___ 12. Allows pressure in the middle ear to be equalized with the atmospheric pressure
- ___ 13. Vibrates as sound waves hit it; transmits the vibrations to the ossicles
- ___ 14. Contains the organ of Corti
- ___ 15. Connects the nasopharynx and the middle ear
- ___ 16. ___ 17. Contain receptors for the sense of equilibrium
- ___ 18. Transmits the vibrations from the stirrup to the fluid in the inner ear
- ___ 19. Fluid that bathes the sensory receptors of the inner ear
- ___ 20. Fluid contained within the osseous labyrinth, which bathes the membranous labyrinth

16. Figure 8–3 is a diagram of the ear. Use anatomical terms (as needed) from the key choices in Exercise 15 to correctly identify all structures in the figure provided with leader lines. Color all external ear structures yellow; color the ossicles red; color the equilibrium areas of the inner ear green; and color the internal ear structures involved with hearing blue.

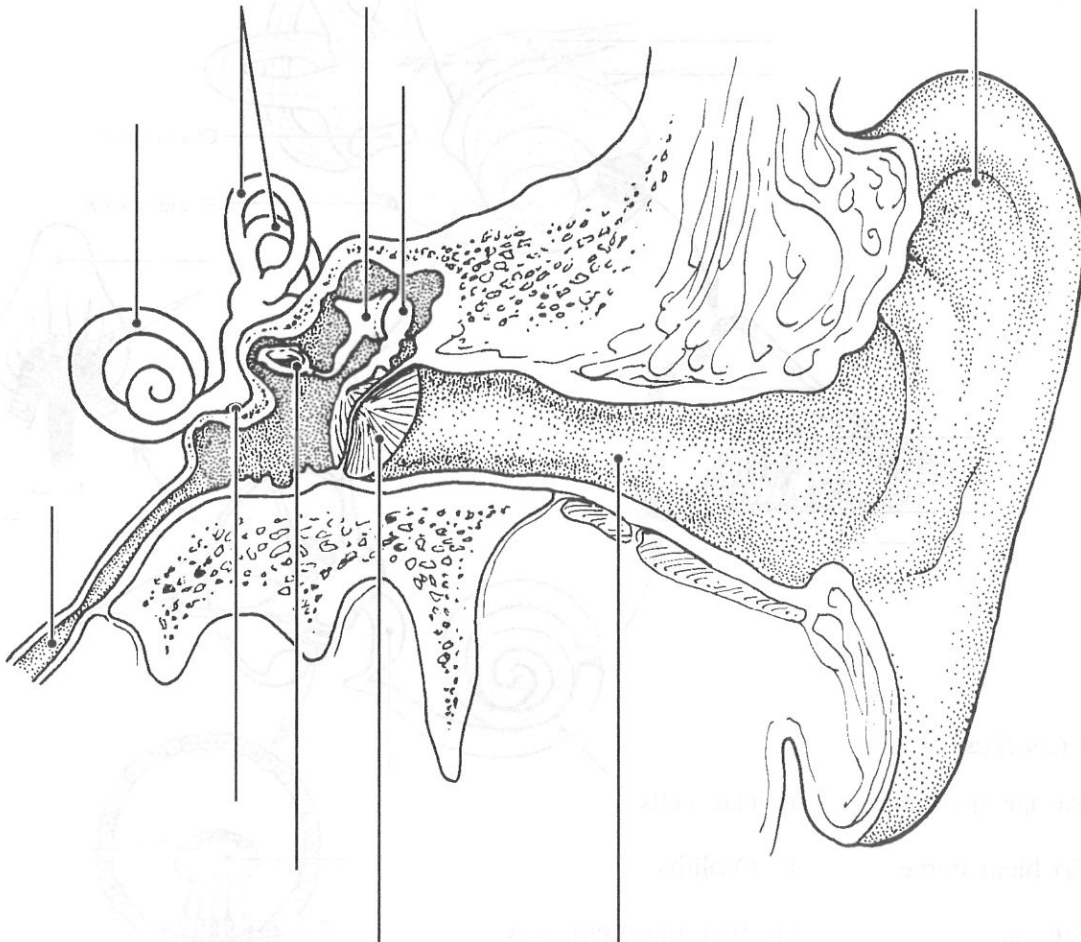
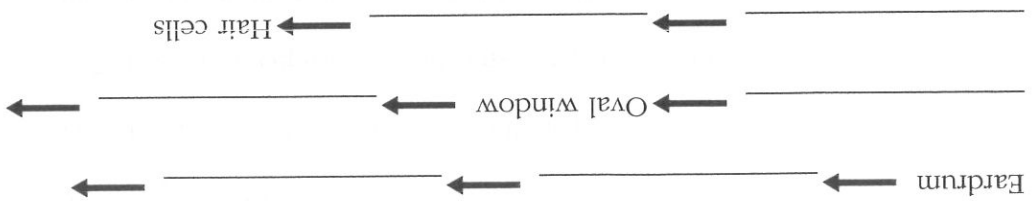


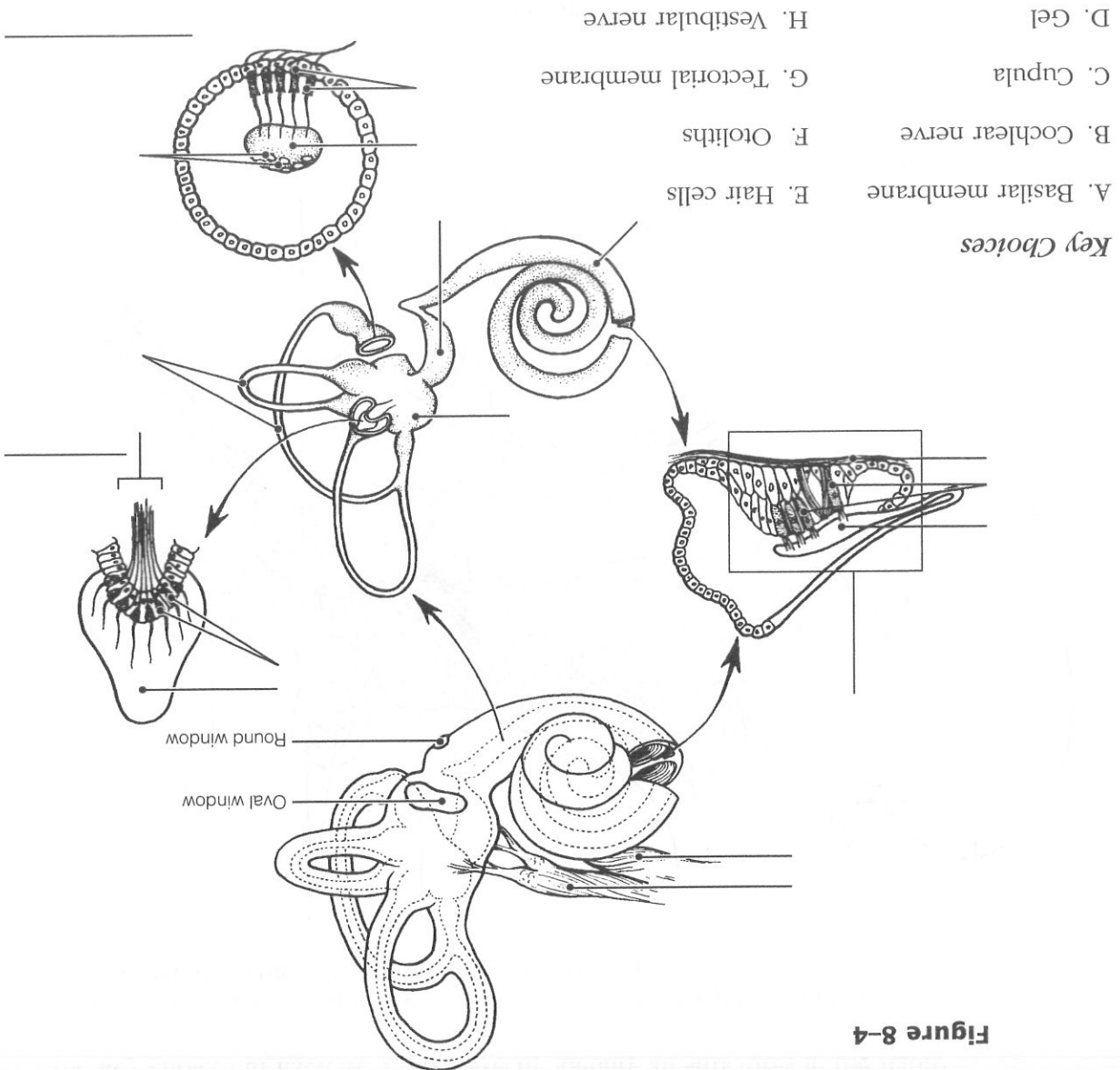
Figure 8–3

17. Sound waves hitting the eardrum set it into vibration. Trace the pathway through which vibrations and fluid currents travel to finally stimulate the hair cells in the organ of Corti. Name the appropriate ear structures in their correct sequence and insert your responses in the answer blanks.



18. Figure 8-4 is a view of the structures of the membranous labyrinth. Correctly identify the following major areas of the labyrinth on the figure: *membranous semicircular canals*, *sacule* and *utricle*, and the *cochlear duct*. Next, correctly identify each of the receptor types shown in enlarged views (organ of Corti, crista ampullaris, and macula). Finally, using terms from the key choices below, identify all receptor structures provided with leader lines. (Some of these terms may need to be used more than once.)

Figure 8-4



Key Choices

- A. Basilar membrane
- B. Cochlear nerve
- C. Cupula
- D. Gel
- E. Hair cells
- F. Otoliths
- G. Tectorial membrane
- H. Vestibular nerve

19. Complete the following statements on the functioning of the static and dynamic equilibrium receptors by inserting the letter or term from the key choices in the answer blanks.

Key Choices

- | | | |
|---------------------|-------------------|------------------------|
| A. Angular/rotatory | E. Gravity | I. Semicircular canals |
| B. Cupula | F. Perilymph | J. Static |
| C. Dynamic | G. Proprioception | K. Utricle |
| D. Endolymph | H. Sacculle | L. Vision |

- _____ 1. The receptors for (1) equilibrium are found in the crista ampullaris of the (2). These receptors respond to changes in (3) motion. When motion begins, the (4) fluid lags behind and the (5) is bent, which excites the hair cells.
- _____ 2. _____ 3. When the motion stops suddenly, the fluid flows in the opposite direction and again stimulates the hair cells. The receptors for (6) equilibrium are found in the maculae of the (7) and (8). These receptors report the position of the head in space. Tiny stones found in a gel overlying the hair cells roll in response to the pull of (9). As they roll, the gel moves and tugs on the hair cells, exciting them. Besides the equilibrium receptors of the inner ear, the senses of (10) and (11) are also important in helping to maintain equilibrium.
- _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____ 11.

20. Indicate whether the following conditions relate to conduction deafness (C) or sensorineural (central) deafness (S). Place the correct letter choice in each answer blank.

- _____ 1. Can result from a bug wedged in the external auditory meatus
- _____ 2. Can result from damage to the cochlear nerve
- _____ 3. Sound is heard in one ear but not in the other, during both bone and air conduction
- _____ 4. Often improved by a hearing aid
- _____ 5. Can result from otitis media
- _____ 6. Can result from otosclerosis, excessive earwax, or a perforated eardrum
- _____ 7. Can result from a blood clot in the auditory cortex of the brain

21. List three things about which a person with equilibrium problems might complain. Place your responses in the answer blanks.

_____ , _____ , and _____

22. Circle the term that does not belong in each of the following groupings.

- | | | | |
|-----------------------|-------------------|---------------------|-------------------------|
| 1. Hammer | Anvil | Pinna | Stirrup |
| 2. Tectorial membrane | Crista ampullaris | Semicircular canals | Cupula |
| 3. Gravity | Angular motion | Sound waves | Rotation |
| 4. Utricle | Sacculle | Auditory tube | Vestibule |
| 5. Vestibular nerve | Optic nerve | Cochlear nerve | Vestibulocochlear nerve |

CHEMICAL SENSES: SMELL AND TASTE

23. Complete the following statements by inserting your responses in the answer blanks.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

Three cranial nerves involved in transmitting impulses for the sense of taste are the (1) _____, (2) _____, and (3) _____. Impulses for the sense of smell are transmitted by the (4) _____ nerve. The receptors for smell are located in the (5) _____ of the nasal passages; the act of (6) _____ increases the sensation because it brings more air into contact with the receptors. The receptors for taste are found in clusterlike areas called (7) _____, most of which are located on the sides of (8) _____ or (9) _____ papillae. The five basic taste sensations are (10) _____, (11) _____, (12) _____, (13) _____, and (14) _____. The most protective receptors are thought to be those that respond to (15) _____ substances. When nasal passages are congested, the sense of taste is decreased. This indicates that much of what is considered taste actually depends on the sense of (16) _____. It is impossible to taste substances with a (17) _____ tongue because foods must be dissolved (or in solution) to excite the taste receptors. The sense of smell is closely tied to the emotional centers of the brain (limbic region), and many odors bring back (18) _____.

15. _____
16. _____
17. _____
18. _____