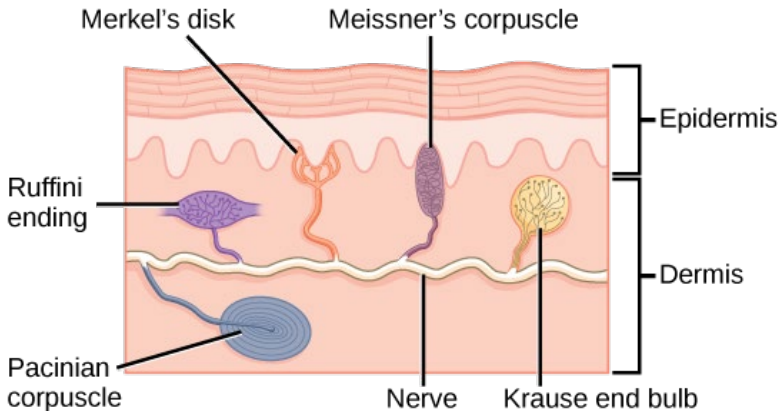
Biology 2e
Unit 7: Animal Structure and Function
Chapter 36: Sensory Systems

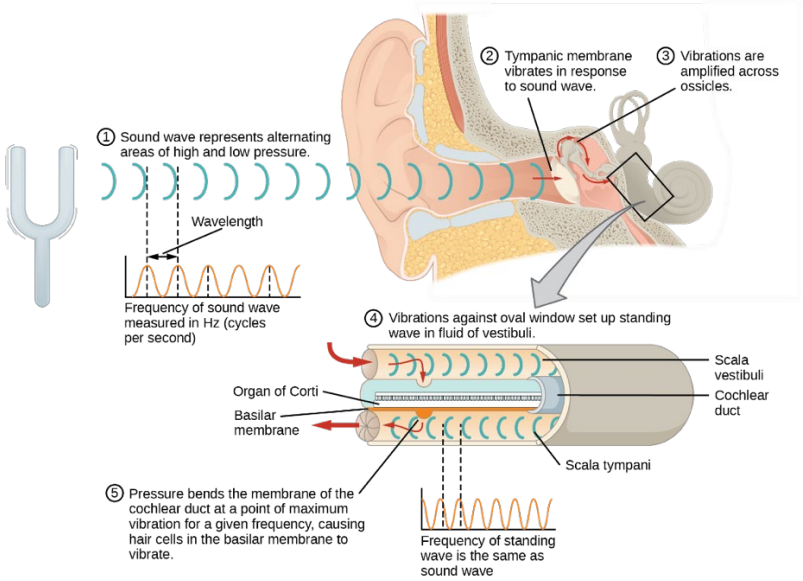
Visual Connection Questions

1. Which of the following statements about mechanoreceptors is false?



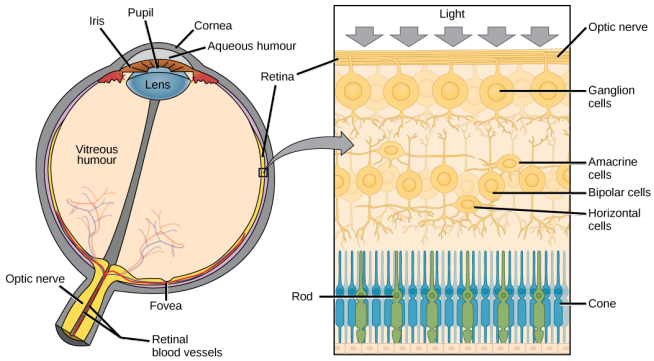
d. Meissner's corpuscles extend into the lower dermis.

2. Cochlear implants can restore hearing in people who have a nonfunctional cochlear. The implant consists of a microphone that picks up sound. A speech processor selects sounds in the range of human speech, and a transmitter converts these sounds to electrical impulses, which are then sent to the auditory nerve. Which of the following types of hearing loss would not be restored by a cochlear implant?



B. Hearing loss resulting from an abnormal auditory nerve.

3. Which of the following statements about the human eye is false?



a. Rods detect color, while cones detect only shades of gray.

Review Questions

4. Where does perception occur?

b. cerebral cortex

5. If a person's cold receptors no longer convert cold stimuli into sensory signals, that person has a problem with the process of _____.

d. transduction

6. After somatosensory transduction, the sensory signal travels through the brain as a(n) _____ signal.

a. electrical

7. Many people experience motion sickness while traveling in a car. This sensation results from contradictory inputs arising from which senses?

d. Vision and Vestibular System

8. _____ are found only in _____ skin, and detect skin deflection.

b. Merkel's disks: glabrous

9. If you were to burn your epidermis, what receptor type would you most likely burn?

a. free nerve endings

10. Many diabetic patients are warned by their doctors to test their glucose levels by pricking the sides of their fingers rather than the pads. Pricking the sides avoids stimulating which receptor?

b. Meissner's corpuscles

11. Which of the following has the fewest taste receptors?

d. filiform papillae

12. How many different taste molecules do taste cells each detect?
a. one

13. Salty foods activate the taste cells by _____.
a. exciting the taste cell directly

14. All sensory signals except _____ travel to the _____ in the brain before the cerebral cortex
b. olfaction; thalamus

15. How is the ability to recognize the umami taste an evolutionary advantage?
c. Umami identifies foods that might contain essential amino acids.

16. In sound, pitch is measured in _____, and volume is measured in _____.
d. hertz (Hz); decibels (dB)

17. Auditory hair cells are indirectly anchored to the _____.
a. basilar membrane

18. Which of the following are found both in the auditory system and the vestibular system?
b. hair cells

19. Benign Paroxysmal Positional Vertigo is a disorder where some of the calcium carbonate crystals in the utricle migrate into the semicircular canals. Why does this condition cause periods of dizziness?
b. The hair cells in the semicircular canals will now be stimulated by gravity.

20. Why do people over 55 often need reading glasses?
b. Their lens no longer focuses correctly.

21. Why is it easier to see images at night using peripheral, rather than the central, vision?
c. Rods are denser in the periphery of the retina.

22. A person catching a ball must coordinate her head and eyes. What part of the brain is helping to do this?
d. superior colliculus

23. A satellite is launched into space, but explodes after exiting the Earth's atmosphere. Which statement accurately reflects the observations made by an astronaut on a space walk outside the International Space Station during the explosion?
a. The astronaut would see the explosion, but would not hear a boom.

Critical Thinking Questions

24. If a person sustains damage to axons leading from sensory receptors to the central nervous system, which step or steps of sensory perception will be affected?

Transmission of sensory information from the receptor to the central nervous system will be impaired, and thus, perception of stimuli, which occurs in the brain, will be halted.

25. In what way does the overall magnitude of a stimulus affect the just-noticeable difference in the perception of that stimulus?

The just-noticeable difference is a fraction of the overall magnitude of the stimulus and seems to be a relatively fixed proportion (such as 10 percent) whether the stimulus is large (such as a very heavy object) or small (such as a very light object).

26. Describe the difference in the localization of the sensory receptors for general and special senses in humans.

General sensory receptors are located throughout the body in the skin and internal organs. Conversely, special senses are all located in the head region, and require specialized organs.

27. What can be inferred about the relative sizes of the areas of cortex that process signals from skin not densely innervated with sensory receptors and skin that is densely innervated with sensory receptors?

The cortical areas serving skin that is densely innervated likely are larger than those serving skin that is less densely innervated.

28. Many studies have demonstrated that women are able to tolerate the same painful stimuli for longer than men. Why don't all people experience pain the same way?

Pain is a subjective sensation that relies on the brain interpreting the nociception signals received by the sensory receptors (perception). Therefore, even though two people experience identical stimuli, their brains can perceive them as very different sensory experiences.

29. From the perspective of the recipient of the signal, in what ways do pheromones differ from other odorants?

Pheromones may not be consciously perceived, and pheromones can have direct physiological and behavioral effects on their recipients.

30. What might be the effect on an animal of not being able to perceive taste?

The animal might not be able to recognize the differences in food sources and thus might not be able to discriminate between spoiled food and safe food or between foods that contain necessary nutrients, such as proteins, and foods that do not.

31. A few recent cancer detection studies have used trained dogs to detect lung cancer in urine samples. What is the hypothesis behind this study? Why are dogs a better choice of detectors in this study than humans?

These studies rely on the dogs' olfactory senses. The hypothesis behind the study is that the dogs are capable of detecting volatile compounds (evaporating scent molecules) that are only

produced in people with cancer. The dogs are a better choice because their sense of smell is more sensitive due to the increased number of olfactory receptors.

32. How would a rise in altitude likely affect the speed of a sound transmitted through air? Why?

The sound would slow down, because it is transmitted through the particles (gas) and there are fewer particles (lower density) at higher altitudes.

33. How might being in a place with less gravity than Earth has (such as Earth's moon) affect vestibular sensation, and why?

Because vestibular sensation relies on gravity's effects on tiny crystals in the inner ear, a situation of reduced gravity would likely impair vestibular sensation.

34. How does the structure of the ear allow a person to determine where a sound originates?

The first step in processing a sound in humans is the collection of sound by the pinna. When a person encounters a sound, the pinna on both sides of the head will collect the vibrations. Since the waves originate from a single site, the two pinnae will not collect the sound at the exact same time. When the sound is processed by the auditory system, the brain is able to use this slight difference in timing to determine the location of the sound.

35. How could the pineal gland, the brain structure that plays a role in annual cycles, use visual information from the suprachiasmatic nucleus of the hypothalamus?

The pineal gland could use length-of-day information to determine the time of year, for example. Day length is shorter in the winter than it is in the summer. For many animals and plants, photoperiod cues them to reproduce at a certain time of year.

36. How is the relationship between photoreceptors and bipolar cells different from other sensory receptors and adjacent cells?

The photoreceptors tonically inhibit the bipolar cells, and stimulation of the receptors turns this inhibition off, activating the bipolar cells.

37. Cataracts, the medical condition where the lens of the eye becomes cloudy, are a leading cause of blindness. Describe how developing a cataract would change the path of light through the eye.

The purpose of the lens in the eye is to focus the light beams on the retina so that the image seen by the eye can be transmitted to the optic nerve and interpreted. When the lens becomes cloudy instead of clear, it scatters the light over the back of the retina. The vision system cannot interpret the image then.