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Sensory Organs

Answers and Explanations

I. Overview of Sensory Perception

A. Multiple Choice Questions

1. (c) – Perception refers to a conscious awareness that occurs as a sensation reaches the cerebral cortex of the brain.
2. (e) – An effector, such as a muscle, is necessary for a motor response, but not for a sensation to be perceived.
3. (a) – The cranial nerves and other structures of the brain arise from specific nuclei.
4. (b) – Specific tracts, or neural pathways, are located throughout the body.

B. True–False Questions

1. False – Perception of sensations is not a function of sensory organs, but rather of the cerebrum of the brain.
2. True – Sensory tracts conduct impulses from the receptor organs to the cerebral cortex.
3. True – The only energy wavelengths that activate human photoreceptors are from 400 to 700 nm—the visible light spectrum.

II. Classification of the Senses

A. Multiple Choice Questions

1. (e) – The hair cells within the spiral organ respond to tactile stimuli and transform a sound wave into a nerve impulse.
2. (d) – If sufficiently stimulated, all types of receptor cells will send sensations that are perceived as pain.
3. (a) – The visceroreceptors are located within the visceral organs of the trunk.
4. (b) – Proprioceptors relay sensations regarding the position of the joints and muscles of the body relative to a person's surroundings.
5. (a) – A tonic receptor is a type of proprioceptor that continuously sends information as long as a stimulus is present.

B. True–False Questions

1. True – Among the receptor organs are the eyes, spiral organ, and vestibular organs.
2. False – Photoreceptors occur only in the eye, and they do not respond to UV light.
3. True – Excessive stimulation of any type of receptor may be a source of pain.
4. False – Exteroceptors are located near the surface of the body, where they respond to changes in the environment.

III. Somatic Senses

A. Multiple Choice Questions

1. (a) – Corpuscles of touch are located near the surface of skin that is relatively hairless, such as that of the lips, eyelids, fingertips, palms, nipples, and external genital organs. They respond to very light touching or caressing.
2. (b) – Free nerve endings extend into the lower layers of the epidermis and are important pain receptors.
3. (b) – Relatively speaking, the skin of the back has few cutaneous receptors.
4. (b) – The organs of Ruffini and bulbs of Krause are both mechanoreceptors. They generate nerve impulses when they, or nearby tissues, are distorted by mechanical forces.
5. (c) – Referred pain is of immense clinical importance because the pain sensations arising from specific visceral organs may be perceived consistently as coming from another site.
6. (a) – Located within the belly of a muscle, neuromuscular spindles respond to an increase in muscle tension.

B. True–False Questions

1. False – Tactile and mechanoreceptors are common in the skin, muscles, and joints.
2. True – Root hair plexuses wrap around hair follicles and respond to movement of the hair.
3. False – Lamellated corpuscles respond to heavy pressure that is consistently applied.
4. False – Thermoreceptors are free nerve endings that respond to external stimuli, not to internal stimuli.
5. False – The referred pain sites for liver or gallbladder problems are the upper right shoulder and neck regions.
6. True – The thalamus is a relay center for pain, and the cerebrum is the perception center.

IV. Olfactory Sense

A. Multiple Choice Questions

1. (a) – None of the cranial nerves are myelinated.
2. (b) – The olfactory epithelium is in the nasal cavity, and the portion of the brain where perception occurs is in the cerebral cortex. The neural pathway between them is precise.
3. (b) – It is a special sense because the receptors are confined to a specific area and have an extensive neural pathway to the cerebral cortex.

B. True–False Questions

1. True – Olfactory hairs are chemoreceptors.
2. True – Since they are chemoreceptors, the olfactory hairs must be kept moist in order to function effectively.
3. False – Because the olfactory epithelium is positioned above the normal airflow, only about 2% of the inspired air comes in contact with it during normal breathing.

V. Gustatory Sense

A. Multiple Choice Questions

1. (d) – Each taste bud is a sensory organ, composed of many cells and heavily innervated with sensory receptors.
2. (a) – Fungiform papillae are present on the tip and sides of the tongue, filiform papillae are present on the anterior two-thirds of the tongue, and vallate papillae are present on the back of the tongue in the shape of an inverted V.
3. (d) – A salty sensation of taste arises over most of the tongue, but especially along the sides.
4. (c) – The facial nerves serve the anterior two-thirds of the tongue, and the glossopharyngeal nerves serve the posterior one-third of the tongue.

B. True–False Questions

1. False – Filiform papillae are located on the anterior two-thirds of the tongue.
2. False – A few taste buds are located on the roof and sides of the oropharynx.
3. True – Taste receptors for acids respond to the presence of hydrogen ions.
4. True – The taste buds that respond to sweet stimuli are on the tip of the tongue.

VI. Visual Sense

A. Multiple Choice Questions

1. (a) – The photoreceptors within the eyes respond to light rays and transmit the visual sensations to the occipital cerebral lobes of the brain, where perception occurs.
2. (c) – The optic nerves are components of the peripheral nervous system, not accessory structures of the eyes.
3. (e) – The nasal bone forms the bridge of the nasal cavity and does not enter into the bony orbit.
4. (e) – The lacrimal caruncle is located at the medial corner of the eye, where the upper and lower eyelids come together. Tears of the eye are secreted by the lacrimal gland, located laterally under the upper eyelid.
5. (b) – The secretion from the tarsal glands of the eyelids helps to keep the eyelids from adhering to each other.
6. (a) – Located in the inner surfaces of the eyelids, the tarsal glands secrete directly onto the conjunctiva.
7. (c) – Lysozyme is a protective disinfectant of the eye.

8. (d) – The superior oblique eye muscle attaches obliquely onto the sclera of the eye such that, when contracted, the eye rotates laterally and inferiorly.
9. (b) – The superior rectus eye muscle is innervated by the oculomotor nerve.
10. (e) – The lens of the eye derives from ectoderm and is generally not considered a part of any tunic.
11. (e) – Contraction of the smooth muscle fibers in the iris determines the diameter of the pupil, and contraction of the smooth muscle fibers in the ciliary body determines the shape of the lens.
12. (e) – The ratio of rods to bipolar cells is higher than the ratio of cones to bipolar cells.
13. (e) – When the eyes are focusing on a close object, the image is viewed from two different angles, permitting depth perception.

B. True–False Questions

1. False – Lacrimal glands are located laterally below the upper eyelid.
2. True – The four recti muscles are responsible for eye movement on either horizontal or vertical planes, and the two oblique muscles are responsible for lateral eye movement on oblique angles.
3. True – The tautness of the zonular fibers of the suspensory ligament determines the shape of the lens,
4. False – The lens is flattened for distance vision when the ciliary muscles fibers are relaxed and the suspensory ligament is taut.
5. False – Contraction of the smooth muscles within the iris determines the amount of light entering the pupil, not the amount of refraction.
6. False – Rods number over 100 million per eye, and cones number about 7 million per eye.
7. True – The blind spot can be demonstrated by following the instructions presented in figure 15.23 of the fifth edition of *Human Anatomy*.
8. True – Aqueous humor flows continuously through the posterior chamber to the anterior chamber through the connection at the pupil.
9. False – The highly vascular retina is served by branches of the central artery. The vitreous humor is formed during prenatal development.
10. False – Slight refraction occurs as light passes through the aqueous humor and the vitreous humor.
11. True – An inverted visual image is transmitted to the occipital portion of the cerebrum, where it is perceived as being right-side up.
12. False – Only the visual impulses for hand-eye coordination pass through the superior colliculus.

VII. Developmental Exposition of the Eye

A. Multiple Choice Questions

1. (c) – Derived from ectoderm, the developing lens invaginates and completes its development within the center of the eye.
2. (a) – The vitreous humor develops from mesoderm.
3. (d) – If a person has a congenital defect of the eyes, it would have been established by the fifth month of prenatal development.

B. True–False Questions

1. False – The endoderm is not instrumental in eye formation.
2. False – The optic nerve forms from the optic stalk, which is a structure of the developing eye.
3. False – The photoreceptors (rods and cones) also form from ectoderm.

VIII. Senses of Hearing and Balance

A. Multiple Choice Questions

1. (d) – The helicotrema is the connection between the scala vestibuli and the scala tympani within the cochlea of the inner ear.
2. (b) – The vibrating tympanic membrane simply sets the auditory ossicles into motion. The auditory ossicles transfer the vibrations and amplify the mechanical force of vibration approximately twentyfold.
3. (c) – The cochlear window is not an opening, but rather a membrane that dampens excessive fluid vibration within the cochlea.
4. (d) – By moving in response to sound waves, the tympanic membrane sets the auditory ossicles into motion.
5. (e) – The vestibular window is located at the footplate of the stapes, and the cochlear window is directly below the vestibular window between the cochlea and the cavity of the middle ear.

6. (a) – It is through the connections of the nasopharynx and the mastoidal air cells that infections can spread from one area to another.
7. (b) – Mastoidal air cells are thought to lighten the skull while providing a strong, lightweight support for the mastoid process to which the sternocleidomastoid muscle attaches.
8. (a) – The positions of the semicircular canals facilitate a response to angular acceleration.
9. (a) – Considering only those structures given as alternatives, the vestibular window is the third to come in contact with sound waves.
10. (b) – The helicotrema connects the scala vestibuli and scala tympani.
11. (e) – The basilar membrane supports the hair cells of the spiral organ.
12. (a) – At zero decibels, sound waves can barely be heard.
13. (b) – High-frequency sound waves cause displacement of the basilar membrane near the vestibular window.
14. (a) – The temporal lobe of the cerebrum functions in language skills and sound perception.

B. True–False Questions

1. True – The protective cerumen (ear wax) is secreted by cerumenous glands within the external auditory canal.
2. True – It is through the connection of the auditory tube that pressure is equalized on both sides of the tympanic membrane.
3. False – Amplification occurs as sound waves pass through the auditory ossicles.
4. False – Contraction of the auditory muscles inhibits the movement of the auditory ossicles.
5. False – The bony labyrinth is located within the inner ear and does not involve the auditory ossicles.
6. True – These two fluids enable movements within the cochlea.
7. True – The vestibular organs are important in maintaining equilibrium and balance.
8. False – The pitch of a sound is directly related to its frequency.
9. False – Sound frequency is measured in hertz (Hz), and sound intensity is measured in decibels (dB).
10. True – Air is a gaseous medium, auditory ossicles are a solid medium, and perilymph is a fluid medium.
11. False – The cochlear window is displaced as loud sounds pass through the cochlea.
12. False – Low-pitch sounds displace the basilar membrane near the vestibular window.
13. True – The kinocilia are specialized receptors that respond to the placement of the head relative to gravity.
14. False – Statoconia are located in the macula of the utricle and are not found in the semicircular canals.

IX. Developmental Exposition of the Ear

A. Multiple Choice Questions

1. (c) – The development of the ears begins just 2 weeks after the completion of implantation.
2. (b) – Invagination of the otic placode positions it to give rise to the structures of the inner ear.

B. True–False Questions

1. True – The chamber of the middle ear derives as an outpouching of the developing pharynx.
2. False – The auditory ossicles derive from the first and second pharyngeal arch cartilages.
3. False – The auditory tube remains open to equalize pressure on both sides of the tympanic membrane.

X. Clinical Considerations

A. Multiple Choice Questions

1. (e) – Hyperopia, commonly called farsightedness, is characterized by difficulty in clearly seeing very close or distant objects.
2. (b) – A person with presbyopia may have to hold a printed page farther from the eyes in order to read it without difficulty.
3. (d) – A cataract is a clouding of the lens, which is the leading cause of blindness throughout the world.
4. (a) – Although rare in the United States, untreated trachoma is a major cause of blindness throughout the world.
5. (c) – Glaucoma is an increase in intraocular pressure resulting from excessive buildup of aqueous humor. Aqueous humor does not drain through the scleral venous sinus as fast as it is produced by the ciliary body.

B. True–False Questions

1. True – Dilation of the pupils during an eye exam is important to facilitate viewing of the retina.
2. True – Certain types of congenital deafness have been thoroughly documented.
3. False – Congenital deafness is linked to genetics. Atresia of the external auditory canal is failure of this portion of the external ear to develop.
4. True – Sight can usually be restored by removing the clouded lens and replacing it with an artificial one.
5. False – Certain types of nerve, or perception, deafness cannot be treated.

XI. Chapter Review

A. Completion Questions

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|-------------------------|-----------------------------|
| 1. sensation/perception | 11. gustation |
| 2. nuclei | 12. lysozyme |
| 3. hyaloid | 13. fovea centralis |
| 4. ectodermal | 14. Aqueous humor |
| 5. otic placode | 15. fovea centralis |
| 6. General, special | 16. superior colliculus |
| 7. tonic | 17. auditory tube |
| 8. Lamellated | 18. spiral organ/cochlear |
| 9. referred pain | 19. Ophthalmology |
| 10. Phantom | 20. ophthalmoscope/otoscope |

B. Matching Questions

- | | |
|--------|---------|
| 1. (j) | 6. (a) |
| 2. (h) | 7. (f) |
| 3. (i) | 8. (d) |
| 4. (e) | 9. (b) |
| 5. (g) | 10. (c) |