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Sensory Organs

I. Overview of Sensory Perception

☞ *Concept:* Sensory organs are highly specialized extensions of the nervous system. They contain sensory neurons adapted to respond to specific stimuli and conduct nerve impulses to the brain for interpretation.

A. Multiple Choice Questions

- ___ 1. The interpretation of a nerve impulse that is transmitted to the brain from the sensory organs is referred to as
- (a) a sensation. (c) a perception.
(b) a response. (d) a recognition.
- ___ 2. Which of the following is *not* essential for the perception of a sensation?
- (a) stimulus (d) interpretation
(b) receptor (e) effector
(c) conduction
- ___ 3. Clusters of neuron cell bodies within the tracts of white matter in the CNS are called
- (a) nuclei. (c) conduction centers.
(b) ganglia. (d) interneurons.
- ___ 4. The correct sequence of nuclei locations that a sensory impulse from the foot would pass through as it traveled to the cerebral cortex would be
- (a) the spinal cord, medulla oblongata, cerebellum, and thalamus.
(b) the spinal cord, medulla oblongata, pons, and thalamus.
(c) the medulla oblongata, cerebellum, pons, and thalamus.
(d) the spinal cord, medulla oblongata, thalamus, and pons.

B. True–False Questions

- ___ 1. The perception of sensations occurs within specialized sensory organs containing receptor cells adapted to respond to specific stimuli.
- ___ 2. Impulses reaching the cerebral cortex travel through nerve fibers composing sensory, or ascending, tracts.
- ___ 3. The sensory receptors in the eye respond only to a limited part of the electromagnetic spectrum.

II. Classification of the Senses

☞ *Concept:* The senses are classified as general or special according to the degree of complexity of the receptors and neural pathways. They are also classified as somatic or visceral according to the location of the receptors.

A. Multiple Choice Questions

- _____ 1. Hair cells in the spiral organ (organ of Corti) within the inner ear are
(a) tactile receptors. (c) thermoreceptors.
(b) chemoreceptors. (d) mechanoreceptors.
- _____ 2. Which of the following statements is *false* regarding pain receptors?
(a) They are stimulated by chemicals released from damaged tissues.
(b) They exist throughout the body.
(c) They are classified as exteroceptors when located within the skin.
(d) They respond only to pressure stimuli..
- _____ 3. Which of the following sensations does *not* involve visceroreceptors?
(a) taste (d) hunger
(b) thirst (e) fullness
(c) nausea
- _____ 4. Body position, equilibrium, and movement are monitored by
(a) enteroceptors. (c) baroreceptors.
(b) proprioceptors. (d) exteroceptors.
- _____ 5. Receptors that produce a relatively constant rate of firing as long as the stimulus is maintained are known as
(a) tonic receptors. (c) sensory receptors.
(b) somatic receptors. (d) phasic receptors.

B. True–False Questions

- _____ 1. The special senses are localized in complex receptor organs and have extensive neural pathways.
- _____ 2. Photoreceptors occur in the eyes, where they respond to visible light waves, and in the skin, where they respond to UV light waves.
- _____ 3. Although there are specific pain receptors, nearly all types of receptors may transmit impulses that are perceived as pain.
- _____ 4. Baroreceptors are exteroceptors that respond to changes in blood pressure.

III. Somatic Senses

☞ *Concept:* The somatic senses arise in cutaneous receptors and proprioceptors. The perception of somatic sensations is determined by the density of the receptors in the stimulated receptive field and the intensity of the sensation.

A. Multiple Choice Questions

- _____ 1. The cutaneous receptors sensitized for fine, or light, touch are
(a) corpuscles of touch (Meissner's corpuscles).
(b) free nerve endings.
(c) root hair plexuses.
(d) lamellated corpuscles.

- _____ 2. The receptors that are closest to the surface of the skin are
 (a) corpuscles of touch.
 (b) free nerve endings.
 (c) lamellated corpuscles.
 (d) bulbs of Krause.
- _____ 3. Lamellated corpuscles are *least* abundant in
 (a) the palms of the hand.
 (b) the skin of the back.
 (c) the external genital organs.
 (d) the synovial joints of the body.
- _____ 4. The organs of Ruffini and the bulbs of Krause are both
 (a) tactile receptors. (d) pain receptors.
 (b) mechanoreceptors. (e) thermoreceptors.
 (c) chemoreceptors.
- _____ 5. The sensation of visceral pain perceived as arising from a somatic location removed from the site of the problem is known as
 (a) related pain. (c) referred pain.
 (b) phantom pain. (d) parietal pain.
- _____ 6. Proprioceptors that are located in skeletal muscles, particularly those of the extremities, are called
 (a) neuromuscular spindles. (d) joint kinesthetic receptors.
 (b) Golgi tendon organs. (e) none of the above.
 (c) fascial receptors.

B. True–False Questions

- _____ 1. Tactile receptors and mechanoreceptors are found only in the skin.
- _____ 2. Root hair plexuses are a specialized type of free nerve ending.
- _____ 3. Lamellated corpuscles respond when a person touches an object to determine its texture.
- _____ 4. Thermoreceptors are located in the dermis of the skin and within the wall of the digestive tract.
- _____ 5. The site of referred pain for liver or gallbladder problems is the lower lumbar region of the trunk.
- _____ 6. All sensory information passes through the thalamus before being carried to the cerebrum, where perception occurs.

IV. Olfactory Sense

☞ *Concept:* Olfactory receptors are the dendritic endings of the olfactory nerve (I) that respond to chemical stimuli and transmit the sensation of olfaction directly to the olfactory portion of the cerebral cortex.

A. Multiple Choice Questions

- _____ 1. Which of the following statements concerning olfaction is *false*?
 (a) The sensory olfactory neurons are myelinated.
 (b) Olfactory reception is not as well developed in humans as it is in other vertebrates.
 (c) Accommodation occurs rapidly with olfaction.
 (d) The olfactory cells are bipolar neurons.
 (e) Thousand of odors can be detected in human olfaction.

- _____ 2. The correct transmission pathway for olfactory sensations is
- (a) the olfactory hairs, olfactory bulb, olfactory nerve, olfactory tract, and cerebral cortex.
 - (b) the olfactory hairs, olfactory nerve, olfactory bulb, olfactory tract, and cerebral cortex.
 - (c) the olfactory bulb, olfactory hairs, olfactory nerve, olfactory tract, and cerebral cortex.
 - (d) the olfactory nerve, olfactory hairs, olfactory tract, olfactory bulb, and cerebral cortex.
- _____ 3. Olfaction is classified as
- (a) a general sense. (c) a somatic sense.
 - (b) a special sense. (d) a tactile sense.

B. True–False Questions

- _____ 1. The olfactory receptors require dissolved substances for stimuli.
- _____ 2. Olfactory hairs are actually specialized dendritic endings that respond to chemical stimuli.
- _____ 3. During relaxed breathing, about 50% of the inspired air comes in contact with the olfactory receptive areas.

V. Gustatory Sense

☞ *Concept:* Taste receptors are specialized epithelial cells, clustered together in taste buds, that respond to chemical stimuli and transmit the sense of taste through the glossopharyngeal nerve (IX) or the facial nerve (VII) to the taste area in the parietal lobe of the cerebral cortex for interpretation.

A. Multiple Choice Questions

- _____ 1. Which term best describes a taste bud?
- (a) gustatory cell (d) sensory organ
 - (b) taste pore (e) papilla
 - (c) gustatory microvillus
- _____ 2. The knoblike papillae located on the tip and sides of the tongue are known as
- (a) fungiform papillae. (c) filiform papillae.
 - (b) vallate papillae. (d) taste buds.
- _____ 3. A salty sensation of taste arises from which part of the tongue?
- (a) the tip (c) the sides
 - (b) the back (d) most areas
- _____ 4. The two cranial nerves that provide the pathway for taste sensations to the brain are
- (a) the vagus and facial nerves.
 - (b) the facial and trigeminal nerves.
 - (c) the facial and glossopharyngeal nerves.
 - (d) the glossopharyngeal and hypoglossal nerves.

B. True–False Questions

- _____ 1. The short, thickened filiform papillae are located on the posterior one-third of the tongue.
- _____ 2. Taste buds are located only on the superior surface of the tongue.
- _____ 3. All acids taste sour because of the presence of H⁺.
- _____ 4. To test the functionality of the facial cranial nerve, a sweet substance would be placed on the tip of the tongue.

VI. Visual Sense

☞ *Concept:* Rod and cone cells are the photoreceptors within the eyeball that are sensitive to light energy. They are stimulated to transmit nerve impulses through the optic nerve and optic tract to the visual cortex of the occipital lobes, where the interpretation of vision occurs. Formation of the sensory components of the eye is complete at 20 weeks, and the accessory structures have been formed by 32 weeks.

A. Multiple Choice Questions

- _____ 1. Which of the following statements concerning vision is *false*?
- (a) The eyes are specialized sensory organs that interpret visual impulses.
 - (b) The position of the eyes permits binocular vision.
 - (c) The photoreceptor cells within the eyes can respond to about 1 billion different stimuli each second.
 - (d) Incoming light rays are refracted within the eyes.
 - (e) The eyes are responsible for approximately 80% of all knowledge that is assimilated.
- _____ 2. Which of the following are *not* accessory structures of the eyes?
- (a) extrinsic ocular muscles
 - (b) eyebrows
 - (c) optic nerves
 - (d) eyelids
 - (e) eyelashes
- _____ 3. A bone that is *not* a part of the bony orbit is
- (a) the frontal bone.
 - (b) the lacrimal bone.
 - (c) the ethmoid bone.
 - (d) the sphenoid bone.
 - (e) the nasal bone.
- _____ 4. Which of the following statements describes the lacrimal caruncle?
- (a) It surrounds the eyeball.
 - (b) It contains sebaceous and sudoriferous glands.
 - (c) It is positioned at the medial commissure of the eye.
 - (d) It secretes tears.
 - (e) Both b and c are correct descriptions.
- _____ 5. Tarsal plates and tarsal glands are located within
- (a) the sclera.
 - (b) the eyelids.
 - (c) the ocular muscles.
 - (d) the retina.
 - (e) the vitreous humor.
- _____ 6. Tarsal glands
- (a) are located in the inner surfaces of the eyelids.
 - (b) are located in the orbit (eye socket) of the eye.
 - (c) secrete aqueous humor.
 - (d) secrete tears.
 - (e) secrete vitreous humor.
- _____ 7. Lacrimal fluid (tears) contains a bactericidal substance called
- (a) lysosome.
 - (b) mucolactase.
 - (c) lysozyme.
 - (d) serotonin.
 - (e) ocular acid.

- _____ 8. Contraction of the superior oblique eye muscle rotates the eye
- (a) upward and toward the midline.
 - (b) downward and toward the midline.
 - (c) laterally and away from the midline.
 - (d) downward and away from the midline.
 - (e) upward and away from the midline.
- _____ 9. Which of the following word combinations relating an ocular muscle and its innervation is *incorrect*?
- (a) lateral rectus muscle/abducens nerve
 - (b) superior rectus muscle/trochlear nerve
 - (c) inferior oblique muscle/oculomotor nerve
 - (d) medial rectus muscle/oculomotor nerve
 - (e) superior oblique muscle/trochlear nerve
- _____ 10. Which of the following is *not* a part of the vascular tunic, or uvea?
- (a) ciliary body
 - (b) choroid
 - (c) ciliary muscle
 - (d) iris
 - (e) lens
- _____ 11. Involuntary smooth muscle is located within
- (a) the coronary.
 - (b) the iris.
 - (c) the ciliary muscle.
 - (d) the choroid.
 - (e) both b and c.
- _____ 12. Which of the following statements concerning rods and cones is *false*?
- (a) Cones are concentrated in the fovea centralis.
 - (b) Rods contain the pigment rhodopsin.
 - (c) Cones provide better visual acuity than rods.
 - (d) Rods are more sensitive to low illumination than cones.
 - (e) The ratio of rods to bipolar cells is lower than the ratio of cones to bipolar cells.
- _____ 13. When the eyes are focusing on a close object, which of the following is *true*?
- (a) The lens becomes more convex.
 - (b) The ciliary muscles contract.
 - (c) The tension in the suspensory ligament decreases.
 - (d) The eyeballs converge so that the light rays focus on the same portions in both retinas.
 - (e) All of the above are true.

B. True–False Questions

- _____ 1. Lacrimal fluid is secreted from the lacrimal (tear) glands located at the medial corner of the eye.
- _____ 2. All of the movements of the eyeball result from the selective contraction of one or more of the six extrinsic ocular muscles.
- _____ 3. The suspensory ligament of the eye is composed of zonular fibers attached to the ciliary body.
- _____ 4. When one views a close object, the ciliary muscles contract and flatten the lens.
- _____ 5. Involuntary contraction of the smooth muscles within the iris aids in the focusing of light rays onto the back of the retina.
- _____ 6. A person can see better during the day than at night because there are more cones within the eye than rods.

- ___ 7. The optic disc is a blind spot because there are no photoreceptors at this location where the optic nerve is attached.
- ___ 8. Aqueous humor, which fills the anterior and posterior chambers of the eye, is secreted from the ciliary body.
- ___ 9. The retina of the eye is nourished by the vitreous humor, which is secreted from specialized cells within the choroid layer.
- ___ 10. The cornea and the lens are the only refractory structures of the eye.
- ___ 11. The refraction of light rays is so extensive within the eyeball that the visual image is inverted on the retina.
- ___ 12. All of the visual impulses pass through the superior colliculus along the neural pathway toward the occipital lobe of the cerebrum.

VII. Developmental Exposition of the Eye

A. Multiple Choice Questions

- ___ 1. Which of the following sequences for the formation of the lens of the eye is correct?
- optic vesicle, lens vesicle, lens placode, and lens
 - lens placode, optic vesicle, lens vesicle, and lens
 - optic vesicle, lens placode, lens vesicle, and lens
 - lens vesicle, optic vesicle, lens placode, and lens
- ___ 2. Which of the following word combinations relating germ layer derivation and eye structure is *incorrect*?
- ectoderm/vitreous humor
 - mesoderm/ extrinsic eye muscles
 - surface ectoderm/ conjunctiva
 - surface ectoderm/lens
 - mesoderm/choroid
- ___ 3. Development of the eyes and their accessory structures is completed during
- | | |
|-----------------------|------------------------|
| (a) the ninth week. | (d) the fifth month. |
| (b) the third month. | (e) the seventh month. |
| (c) the fourth month. | |

B. True–False Questions

- ___ 1. All three germ layers are involved in the formation of the eye.
- ___ 2. The optic stalk, which becomes the optic nerve, arises from the developing brain and attaches to the developing eye.
- ___ 3. The lens is the only structure of the eye that is derived from ectoderm.

VIII. Senses of Hearing and Balance

☞ *Concept:* Structures of the outer, middle, and inner ear are involved in the sense of hearing. The inner ear also contains structures that provide a sense of balance, or equilibrium. The development of the ear begins during the fourth week and is complete by week 32.

A. Multiple Choice Questions

- _____ 1. Which of the following structures is (are) *not* part of the outer ear?
- (a) auricle
 - (b) helix
 - (c) ceruminous glands
 - (d) helicotrema
 - (e) external auditory canal
- _____ 2. Which of the following statements regarding the outer ear is *false*?
- (a) The shape of the auricle is maintained by elastic connective tissue.
 - (b) The vibrating tympanic membrane alone amplifies sound about 20 times.
 - (c) Cerumen keeps the tympanic membrane soft and waterproof.
 - (d) The rim of the auricle is called the helix.
 - (e) The external auditory canal is approximately 2.5 cm long.
- _____ 3. Which of the following statements regarding the middle ear is *false*?
- (a) The tensor tympani and the stapedius contract reflexively to protect the inner ear against loud noises.
 - (b) The middle ear is enclosed within the petrous portion of the temporal bone.
 - (c) The cochlear window and the auditory tube are the two openings into the middle ear.
 - (d) The auditory tube equalizes air pressure on both sides of the tympanic membrane.
 - (e) Sound waves pass through a solid medium within the middle ear.
- _____ 4. The tympanic membrane
- (a) is a single-layered epithelial membrane.
 - (b) is sensitive to pain and is innervated by the vestibulocochlear nerve.
 - (c) heals slowly if ruptured.
 - (d) moves in response to sound waves passing through the external auditory canal.
- _____ 5. Which of the following structures separate(s) the middle ear from the inner ear?
- (a) vestibule
 - (b) cochlear window
 - (c) vestibular window
 - (d) helicotrema
 - (e) both b and c
- _____ 6. The tympanic cavity
- (a) connects to the mastoidal air cells and the nasopharynx.
 - (b) surrounds the cochlea and the semicircular canals.
 - (c) is continuous with the external auditory canal.
 - (d) is also known as the inner ear.
- _____ 7. Which of the word combinations relating auditory structure and function is *incorrect*?
- (a) ceruminous glands/waterproofing
 - (b) mastoidal air cells/sound resonance
 - (c) tympanic membrane/sound vibration
 - (d) auditory tube/equalization of air pressure
 - (e) vestibular window/sound vibration
- _____ 8. The sensation of angular acceleration is associated with
- (a) the semicircular canals.
 - (b) the utricle.
 - (c) the cochlea.
 - (d) the saccule.
- _____ 9. Considering only the structures listed below, which is the third to be passed through by sound waves entering the ear and activating the cochlear nerve?
- (a) vestibular window
 - (b) incus
 - (c) scala vestibuli
 - (d) helicotrema
 - (e) tympanic membrane

- ___ 10. The scala vestibuli and scala tympani contain perilymph and are connected at
 (a) the cochlear duct. (d) the vestibule.
 (b) the helicotrema. (e) the spiral organ.
 (c) the semicircular duct.
- ___ 11. The hair cells of the spiral organ are anchored in
 (a) the tectorial membrane. (d) the vestibule.
 (b) the scala tympani. (e) the basilar membrane.
 (c) the helicotrema.
- ___ 12. A sound intensity at the threshold of hearing has an intensity of
 (a) zero decibels. (d) 1 hertz.
 (b) 1 decibel. (e) 100 hertz.
 (c) 100 decibels.
- ___ 13. As the pitch of a sound gets higher, displacements of the basilar membrane occur
 (a) more toward the apex.
 (b) more toward the base.
 (c) more toward the middle.
 (d) at equal intervals throughout the length of the membrane.
- ___ 14. The portion of the brain that receives and interprets auditory sensations is
 (a) the temporal lobe of the cerebrum.
 (b) the parietal lobe of the cerebrum.
 (c) the cerebellum.
 (d) the medulla oblongata.

B. True–False Questions

- ___ 1. The tympanic membrane is a thin, double-layered epithelial membrane protected by cerumen.
- ___ 2. The auditory tube connects the tympanic cavity to the nasopharynx.
- ___ 3. The tympanic membrane amplifies the sound waves as they pass from the outer ear to the middle ear.
- ___ 4. Contractions of the tensor tympani and the stapedius muscles aid the ear ossicles in amplification of sound.
- ___ 5. The auditory ossicles constitute the bony labyrinth of the middle ear.
- ___ 6. Perilymph fills the scala vestibuli and scala tympani, whereas endolymph fills the cochlear duct.
- ___ 7. The vestibular organs include the utricle, the saccule, and the semicircular canals.
- ___ 8. The higher the frequency of a sound, the lower its pitch.
- ___ 9. The intensity, or loudness, of a sound is measured in hertz (Hz) units.
- ___ 10. Incoming sound waves pass sequentially through gaseous, solid, and fluid media.
- ___ 11. The cochlear window simply seals the cochlea and does not function in hearing.
- ___ 12. Sounds of low pitch (< 50 Hz) cause movements only at the apex of the basilar membrane.
- ___ 13. Displacement of the kinocilia of the vestibular organs causes impulses to be sent to the brain via the vestibular portion of the vestibulocochlear nerve.
- ___ 14. Statoconia are located in each of the vestibular organs.

IX. Developmental Exposition of the Ear

A. Multiple Choice Questions

- ___ 1. The ears begin their development during
- (a) the second week.
 - (b) the third week.
 - (c) the fourth week.
 - (d) the sixth week.
 - (e) the eighth week.
- ___ 2. The otic placode of the developing ear gives rise to
- (a) the auricle.
 - (b) the auditory ossicles.
 - (c) the auditory tube.
 - (d) the semicircular canals and cochlea.
 - (e) the tympanic cavity.

B. True–False Questions

- ___ 1. The chamber of the middle ear is the only portion of the ear that derives from endoderm.
- ___ 2. The auditory ossicles derive from the first, second, and third pharyngeal arch cartilages.
- ___ 3. The auditory tube is important during development but closes before birth to compartmentalize the auditory ossicles.

X. Clinical Considerations

A. Multiple Choice Questions

- ___ 1. The visual impairment characterized by a short eyeball and a focal point behind the retina is
- (a) astigmatism.
 - (b) myopia.
 - (c) presbyopia.
 - (d) diplopia.
 - (e) hyperopia.
- ___ 2. A condition in which the lens loses its elasticity and ability to accommodate is
- (a) atresia.
 - (b) presbyopia.
 - (c) astigmatism.
 - (d) hyperopia.
 - (e) myopia.
- ___ 3. A chemical change in the proteins of the lens of the eye results in
- (a) myopia.
 - (b) presbyopia.
 - (c) astigmatism.
 - (d) cataracts.
- ___ 4. Trachoma is
- (a) a highly contagious bacterial disease of the conjunctiva and cornea.
 - (b) an infection of the follicles of eyelashes.
 - (c) a condition where the eyes do not focus on the same axis.
 - (d) a viral disease of the retina.
- ___ 5. The ciliary body and the scleral venous sinus are directly involved in the visual condition of
- (a) diplopia.
 - (b) keratitis.
 - (c) glaucoma.
 - (d) cataracts.

B. True–False Questions

- ___ 1. A cycloplegic drug is used in an eye examination because it dilates the pupils and inactivates the ciliary muscles.
- ___ 2. Congenital deafness is generally caused by an autosomal recessive gene.
- ___ 3. Atresia is the genetic condition of deafness.
- ___ 4. Cataracts are the leading cause of blindness, but they can be surgically corrected.
- ___ 5. All types of deafness can be treated to a limited extent, either surgically or with hearing aids.

XI. Chapter Review

A. Completion Questions

- 1. A _____ is a feeling or awareness of a bodily state or condition that occurs when a sensory impulse reaches the brain; the interpretation of that sensation is termed _____.
- 2. Clusters of neuron cell bodies called _____ are located throughout the white matter of the CNS.
- 3. During development of the eye, the _____ vessels become the central vessels of the retina.
- 4. The lens of the eye is derived from the _____ germ layer.
- 5. The formation of an _____ during the fourth week is the first indication of ear development.
- 6. _____ senses are widespread throughout the body and are simple in structure, whereas _____ senses are localized in complex receptor organs and have extensive neural pathways.
- 7. Receptors that produce a constant rate of firing as long as the stimulus is maintained are known as _____ receptors.
- 8. _____ corpuscles are located within the hypodermis of the skin, where they respond to deep cutaneous pressures or vibrations.
- 9. The perception of pain as coming from areas of the body other than where the pain is actually arising is called _____.
- 10. _____ pain is frequently experienced by an amputee who continues to feel pain from the body part that was amputated, as if it were still there.
- 11. The technical term for taste perception is _____.
- 12. Lacrimal fluid (tears) contains a bactericidal substance called _____.
- 13. The _____ is the area of keenest vision because cones are concentrated there.

14. _____ fills the anterior and posterior chambers of the eye.
15. The region on the retina having an abundance of cones is the _____.
16. The _____ in the midbrain functions in body-eye coordination.
17. The _____ connects the tympanic cavity with the nasopharynx and equalizes air pressure on both sides of the tympanum.
18. Hearing is made possible by displacement of structures within the _____ and impulses traveling to the brain via the _____ nerve.
19. _____ is the specialty of medicine concerned with diagnosing and treating eye diseases.
20. A(n) _____ is an instrument used to examine the interior structures of the eye. A(n) _____ is an instrument used to examine the tympanic membrane of the ear.

B. Matching Questions

Match each term on the left with its description or function on the right.

- | | |
|--------------------------|--|
| ___ 1. macula lutea | (a) contains sebaceous and sudoriferous glands |
| ___ 2. lacrimal puncta | (b) located under the upper eyelid |
| ___ 3. scala vestibuli | (c) attach to the lens |
| ___ 4. uvea | (d) earwax |
| ___ 5. utricle | (e) vascular tunic containing the choroid |
| ___ 6. lacrimal caruncle | (f) purple pigment in the eye |
| ___ 7. rhodopsin | (g) sensitive to gravity |
| ___ 8. cerumen | (h) drainage site for "tears" |
| ___ 9. lacrimal gland | (i) filled with perilymph |
| ___ 10. zonular fibers | (j) surrounds the fovea centralis |