Part I. Clinical Applications

1. An infant girl with strabismus is brought into the clinic. Describe what the condition is and what therapy should be tried before surgery?

2. A man in his early 60’s come into the clinic complaining of fuzzy vision. An eye examination reveals clouding of his lenses. What is his problem and what factors might have contributed to it?

3. Albinism is a condition in which melanin pigment is not made. How does albinism affect vision and why?

4. A child is brought to the speech therapist because she does not pronounce high-pitched sounds (like “s”). If it is determined that the spiral organ of Corti is the source of the problem, which region of the organ would be defective?

5. Brian is brought to the clinic by his parents, who noticed that his right eye does not rotate laterally very well. The doctor explains that the nerve serving the lateral rectus muscle is not functioning properly. To what nerve is he referring?
6. When Mrs. Martinez visits her ophthalmologist, she complains of vision loss in her right eye. The intraocular pressure of that eye is found to be abnormally elevated. What is the name of Mrs. Martinez’s probable condition? What causes it? What might be the outcome if the problem is not corrected?

7. A child is brought into the clinic complaining of an earache. Examination reveals the child has a fever and a reddening and outward bulging of the eardrum, which may rupture unless prompt treatment is received. What is the condition, what might be the cause, and what is the treatment?
The following words are to be used for questions 1-24 and may be used more than once or not at all. There may be times when none of the words fit and you will need to refer to notes or book.

Absence
Aqueous humor
Auricle
Bipolar cell
Central fovea
Ceruminous
Ciliary
Ciliary muscle
Ciliary processes
Choroid
Cones
Conjunctiva (bulbar)
Cornea
Crystallins
External auditory canal
Fovea centralis
Fibrous
Ganglion cell
Glaucoma
Iris
Incus
Malleus
Nervous (retinal)
Non visual
Occipital
Optic chiasma
Optic disc
Oval window
Palpebral fissure
Photoreceptor,
Pupil
Sclera
Scleral venous
Sebaceous ciliary glands
Stapes
Stapedius
Suspensory
Tarsal (Meibomian)
Tensor tympani
Transparent
Tympanic membrane
Vascular
Visual
Vitreous body
Vitreous chamber

1. The space between the upper and lower eyelids that exposes the eyeball is called the _______________________.

2. The elongated glands embedded in each tarsal plate are known as ____________________ glands.

3. Dilation and congestion of the blood vessels in this structure give an individual “bloodshot” eyes: _______________________________.

4. Sebaceous glands located at the base of the hair follicles of the eyelashes are called ________________________.

5. Briefly explain why your nose “runs” when you cry.

6. The three tunics (layers) of the eyeball are the _________________________.

   ________________________, and ________________________ tunics.

Test your understanding of the structure of the eyeball by answering these questions.

7. The “white of the eye” is called the ________________________.

8. The anterior portion of the fibrous tunic is called the ________________________.

9. This membrane contains numerous blood vessels and a large amount of dark, brown-black pigment and is part of the vascular tunic. Name this membrane: ________________________.

10. Secretion of aqueous humor is the function of the _________________________.

    ________________________, while alteration of the lens shape occurs via the ________________________, _________________________. Together, these structures form the ________________________ body.
The colored portion of the vascular tunic, suspended between the cornea and the lens, is called the _________. The hole in the center of this structure is the _________.

The retina consists of a pigmented epithelium (_________) portion and a neural (_________) portion.

The three layers of the neural portion of the retina are the ________, ________, and ________ layers.

(Rods? Cones?) are responsible for color vision in bright light. The ________ is a small depression in the center of the macula lutea which contains only cone photoreceptors.

The axons of the ganglion cells extend posteriorly to the ________ or blind spot. This second name is due to the (absence? presence?) of rods and cones here.

Answer these questions about the lens.

Proteins called _________, arranged like the layers of an onion, make up the lens.

The lens is normally (opaque? transparent?) and is held in place by encircling _________ ligaments.

Check your understanding of the interior of the eyeball.

The watery fluid located in the anterior cavity is the ________, whereas the jellylike substance in the posterior cavity is called the ________.

Another name for the posterior cavity is the ________.

The fluid in the anterior cavity is secreted by the ________ and drains through the ________ sinus.

Excessive intraocular pressure is called ________.

Complete these questions pertaining to the visual pathways.

The crossing point of the optic nerves (CN II) is the ________.

The final destination of visual impulses is the (temporal? occipital?) lobes of the cerebral cortex.
The following questions relate to the external and middle ear.

24. The ____________________________ is an elastic cartilage flap which is shaped like the flared end of a trumpet and is covered by thick skin.

25. The ____________________________ leads from the auricle to the eardrum. This tube contains specialized sebaceous glands called ____________________________ glands.

26. The thin, semitransparent partition of fibrous connective tissue between the external auditory canal and the middle ear is the ____________________________.

27. Name the three auditory ossicles: ____________________________, ____________________________, and ____________________________.

28. The stapes fits into a membrane-covered opening called the ____________________________.

29. Two skeletal muscles associated with the auditory ossicles are the ____________________________ and ____________________________ muscles.

Answer these questions about the internal ear:

<table>
<thead>
<tr>
<th>ampulla</th>
<th>perilymph</th>
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<tbody>
<tr>
<td>bony labyrinth</td>
<td>semicircular canals</td>
</tr>
<tr>
<td>endolymph</td>
<td>utricle and saccule</td>
</tr>
<tr>
<td>membranous labyrinth</td>
<td>vestibule</td>
</tr>
</tbody>
</table>

30. Three bony passages, each arranged at approximately right angles to the other two.

31. A series of cavities in the petrous portion of the temporal bone.

32. Fluid found in the membranous labyrinth.

33. Fluid similar to cerebrospinal fluid that surrounds the membranous labyrinth.

34. A series of sacs and tubes lying inside, and having the same general form as, the bony labyrinth.

35. The oval, central portion of the bony labyrinth.

36. Two sacs of the membranous labyrinth in the vestibule.

37. A swelling at the end of each of the semicircular canals.

Answer these questions about the auditory pathway.

38. Sound waves striking the tympanic membrane cause the (incus? malleus?) to vibrate.

39. The movement of the stapes pushes the membrane of the (round? oval?) window in and out.

40. The (perilymph? endolymph?) of the scala vestibuli is pushed by the bulging of the oval window.

41. The hair cells of the spiral organ move against the (basilar? tectorial?) membrane.

42. Auditory nerve impulses travel over the (vestibular? cochlear?) portion of CN (VII? VIII? IX?).
Part III

Check your knowledge of the mechanism of equilibrium by answering these questions.

1. The receptors for static equilibrium are the ________________, which are located in the ________________ and ________________.

2. Hair cells have long extensions of the cell membrane consisting of 70 or more ________________, and one ________________ anchored firmly to its basal body and extending beyond the longest microvilli.

3. The thick, gelatinous glycoprotein layer floating directly over the hair cells of the macula is called the ________________ ________________.

4. The nerve impulses for equilibrium are carried on the ________________ branch of CN (VII? VIII?).

5. The receptors for dynamic equilibrium, which are located in the ampullae of the semicircular ducts, are called the ________________. This positioning permits the detection of rotational ________________ or ________________.

6. The gelatinous mass covering the hair cells of each crista is called the ________________.

Test your knowledge of these visual, auditory, and vestibular disorders.

<table>
<thead>
<tr>
<th>conduction deafness</th>
<th>otitis media</th>
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</thead>
<tbody>
<tr>
<td>motion sickness</td>
<td>senile macular degeneration</td>
</tr>
<tr>
<td>Ménière's syndrome</td>
<td>sensorineural deafness</td>
</tr>
</tbody>
</table>

7. Nausea and vomiting brought on by repetitive angular, linear, or vertical motion. The cause is excessive stimulation of the vestibular apparatus by motion.

8. The growth of new blood vessels or hard mass under the retina, leading to distorted vision or blindness.

9. An acute infection of the middle ear, caused primarily by bacteria.

10. Lack of the sense of hearing caused by impairment of the cochlea or cochlear branch of cranial nerve VIII.

11. An increased amount of endolymph that enlarges the membranous labyrinth, causing fluctuating hearing loss, attacks of vertigo, and roaring tinnitus.

12. Lack of the sense of hearing caused by an impairment of the external and middle ear mechanisms for transmitting sounds to the cochlea.

Answer (T) True or (F) False to the following questions.

13. _______ The thick, gelatinous glycoprotein layer that rests on the hair cells of the macula is called the otolithic membrane.

14. _______ The maculae are the receptors for static equilibrium.

15. _______ Static equilibrium is the maintenance of body position in response to sudden movements.

Fill in the blank

16. The movement of the stapes pushes on the membrane covering the ________________ window.

17. The receptors for color vision and sharpness of vision are the ________________

18. ________________ is secreted into the posterior chamber and reabsorbed through the scleral venous sinus.
BODY TREK:

Using the terms below, fill in the blanks to complete the trek through the outer, middle, and inner ear.

- pharyngotympanic (Eustachian or Auditory) Tube
- oval window
- stereocilia
- endolymph
- scala vestibuli
- scala tympani
- incus
- organ of Corti
- round window
- pinna (auricle)
- cochlear
- middle ear
- tympanic membrane
- malleus
- external ear
- ceruminous
- vestibular duct
- nasopharynx
- ossicles
- tectorial
- basilar membrane
- external auditory meatus
- stapes

Robo’s programming for this trek involves following sound waves through the outer and middle ear until the sound (mechanical) waves are converted into nerve (electrical) impulses in the inner ear.

Robo’s trek begins as sound waves are funnelled by the (1) _______________ into the (2) _______________. The robot’s progress is slowed in this area because of the presence of a “waxy” material secreted by (3) _______________ glands along the canal. All of a sudden Robo is thrust against the (4) _______________, or eardrum, causing a tremendous vibration that pushes the robot from the (5) _______________ into the (6) _______________, or tympanic cavity. This compartment is an air-filled space containing three bones, the auditory (7) _______________. One of the bones looks like a “hammer,” the (8) _______________, while another one looks like an “anvil,” the (9) _______________, and the third has an appearance like a “stirrup,” or (10) _______________. Robo’s trek is momentarily halted because of an opening that leads into an elongated channel, the (11) _______________ tube, which allows for communication between the tympanic cavity and the (12) _______________. After trekking around the opening Robo is “waved” through an ovoid “pane-like” covering, the (13) _______________, which is waving back and forth creating vibrations that set up pressure waves in a clear fluid, the (14) _______________ of the (15) _______________. These pressure waves distort the (16) _______________ on their way to the (17) _______________ of the tympanic duct. As Robo treks into the duct, it senses a distorted membrane forcing hair cells of the (18) _______________ toward or away from the (19) _______________ membrane. This movement moves Robo along, and leads to displacement of (20) _______________ and stimulation of sensory neurons of the (21) _______________.

MISSION CONTROL orders Robo to use the programmed exit route by picking up a pressure wave as it “rolls” back toward the entrance to the vestibular duct. Robo’s handlers are happy to retrieve their robot, which is covered with wax and needs recharging because of a run-down battery.

MATCHING:

Match the terms in column B with the terms in column A.

<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
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<tbody>
<tr>
<td>24. eyelids</td>
<td>24. neural tunic</td>
</tr>
<tr>
<td>25. lacrimal glands</td>
<td>25. otitis media</td>
</tr>
<tr>
<td>26. sharp vision</td>
<td>26. three-dimensional relationships</td>
</tr>
<tr>
<td>27. retina</td>
<td>27. inner ear</td>
</tr>
<tr>
<td>28. Apex of Cochlea</td>
<td>28. palpebral</td>
</tr>
<tr>
<td>29. depth perception</td>
<td>29. ear wax</td>
</tr>
<tr>
<td>30. middle ear infection</td>
<td>30. equilibrium</td>
</tr>
<tr>
<td>31. ceruminous glands</td>
<td>31. tears</td>
</tr>
<tr>
<td>32. membranous labyrinth</td>
<td>32. heliostema</td>
</tr>
<tr>
<td>33. utricle, saccule</td>
<td>33. fovea centralis</td>
</tr>
</tbody>
</table>
34. A lipid-rich product that helps to keep the eyelids from sticking together is produced by the:
   a. gland of Zeis
   b. meibomian gland
   c. lacrimal glands
   d. conjunctiva

35. The fibrous tunic, the outermost layer covering the eye, consists of the:
   a. iris and choroid
   b. pupil and ciliary body
   c. sclera and cornea
   d. lacrimal sac and orbital fat

36. The vascular tunic consists of three distinct structures that include:
   a. sclera, cornea, iris
   b. choroid, pupil, lacrimal sac
   c. retina, cornea, iris
   d. iris, ciliary body, choroid

37. The function of the vitreous body in the eye is to:
   a. provide a fluid cushion for protection of the eye
   b. serve as a route for nutrient and waste transport
   c. stabilize the shape of the eye and give physical support to the retina
   d. serve as a medium for cleansing the inner eye

38. The primary function of the lens of the eye is to:
   a. absorb light after it passes through the retina
   b. biochemically interact with the photoreceptors of the retina
   c. focus the visual image on retinal receptors
   d. integrate visual information for the retina

39. When looking directly at an object, its image falls upon the portion of the retina called the:
   a. fovea centralis
   b. choroid layer
   c. sclera
   d. focal point

40. The bony labyrinth of the ear is subdivided into the:
   a. auditory meatus, auditory canal, ceruminous glands
   b. saccule, utricle, vestibule
   c. vestibule, semicircular canals, and the cochlea
   d. ampulla, crista, cupula

41. The dividing line between the external ear and the middle ear is the:
   a. pharyngotympanic tube
   b. tympanic membrane
   c. sacculus
   d. utricle

42. Sebaceous glands at the base of the hair follicles of the eyelashes are called
   A. tarsal glands
   B. lacrimal glands
   C. ciliary glands
   D. ceruminous gland
   E. none of the above are correct

43. This nonvascular structure is a part of the fibrous tunic.
   A. sclera
   B. ciliary body
   C. iris
   D. cornea
   E. conjunctiva

44. The white portion of the eyeball is called the
   A. conjunctiva
   B. sclera
   C. choroid
   D. uvea
   E. cornea

45. The ciliary body is part of the
   A. fibrous tunic
   B. vascular tunic
   C. nervous tunic
   D. retinal tunic
   E. none of the above are correct

46. Which of the following is NOT part of the hearing mechanism?
   A. malleus
   B. tectorial membrane
   C. scala vestibuli
   D. tympanic membrane
   E. macula lutea

47. Information about equilibrium is transmitted by which cranial nerve?
   A. I
   B. II
   C. VII
   D. VIII
   E. IX

48. The gelatinous mass called the cupula is associated with the
   A. muscle spindle
   B. macula
   C. crista
   D. nociceptor
   E. joint kinesthetic receptor
58. The auditory ossicles of the middle ear include the:
   a. sacculus, utriculus, ampulla
   b. vestibule, cochlea, organ of Corti
   c. malleus, stapes, incus
   d. otoliths, maculae, otoconia

49. The structure in the cochlea of the inner ear that provides information to the CNS is the:
   a. scala tympani
   b. organ of Corti
   c. tectorial membrane
   d. basilar membrane

50. The receptors that provide the sensation of hearing are located in the:
   a. vestibule
   b. ampulla
   c. tympanic membrane
   d. cochlea

51. The senses of equilibrium and hearing are provided by receptors in the:
   a. external ear
   b. middle ear
   c. inner ear
   d. a, b, and c are correct

52. Ascending auditory sensations synapse in the thalamus and then are delivered by projection fibers to the:
   a. auditory cortex of the parietal lobe
   b. auditory cortex of the temporal lobe
   c. auditory cortex of the occipital lobe
   d. auditory cortex of the frontal lobe

53. The waxy material that slows the growth of microorganisms in the external acoustic canal and reduces the chances of infection is:
   a. gustducin
   b. phenylthiourges
   c. cerumen
   d. umami

54. The receptors in the inner ear that provide sensations of gravity and linear acceleration are the:
   a. ampulla and capula
   b. otolith and statoconia
   c. semicircular and chochlear ducts
   d. saccule and utricle

55. The intensity (volume) of a perceived sound is determined by:
   a. which part of the cochlear duct is stimulated
   b. how many of the hair cells in the cochlear duct are stimulated
   c. pressure fluctuations in the endolymph of the vestibular complex
   d. tectorial membrane vibrations

56. The scleral venous sinus drains aqueous humor from the _____________.
   A. vitreous chamber
   C. anterior chamber
   B. posterior chamber
   D. posterior cavity
   E. none of the above are correct

57. Some axons of cranial nerve II cross over at the _____________.
   A. optic nerve
   B. optic tract
   C. optic chiasma
   D. optic bulb
   E. A and D are both correct

58. The ____________ is the site where the optic nerve exits the eyeball.
   A. central fovea
   B. macula lutea
   C. optic disc
   D. ora serrata
   E. both A and C are correct