24 EXERCISE

Special Senses: Vision

Time Allotment: 2 hours.

Multimedia Resources: See Appendix B for Guide to Multimedia Resource Distributors. See Exercise 6 for histology listings.

The Eye: Structure, Function, and Control of Movement (FHS: 54 minutes, VHS, DVD)
Eyes and Ears (FHS: 28 minutes, VHS, DVD, 3-year streaming webcast)
Practice Anatomy Lab™ 3.0 (*PAL*) (BC: CD-ROM, Website)
The Senses (FHS: 20 minutes, VHS, DVD, 3-year streaming webcast)
Sheep Eye Dissection (WNS: 15 minutes, VHS, DVD)
Vision (part of the NOVA Mystery of the Senses series) (IM: 60 minutes each, 5-piece DVD set)

Solutions:

Bleach Solution, 10%
Measure out 100 milliliters of bleach. Add water (undistilled) to a final volume of 1 liter.

Laboratory Materials

Ordering information is based on a lab size of 24 students, working in groups of 4. A list of supply house addresses appears in Appendix A.

Dissectible eye model and/or chart of eye anatomy
12–24 preserved cow or sheep eyes
12–24 dissecting pans and dissecting kits
6 laboratory lamps, penlights, or flashlights
Snellen eye chart and chalk
6–12 Ishihara's color plates
Opthalmoscope (if available)
6 metric rulers/meter sticks
6 test tubes
6 common (straight) pins
24 compound microscopes, lens paper, lens cleaning solution
24 slides (longitudinal section) of eye showing retinal layers
Disposable gloves
24 pairs of safety glasses
Soap, sponges, and disinfectant
6 pencils

Advance Preparation

1. Make arrangements for appropriate storage and disposal of dissection materials. Check with the Department of Health or the Department of Environmental Protection for state regulations.
2. Designate a disposal container for organic debris and a dishwashing area with hot soapy water and sponges. Provide lab disinfectant such as Wavicide-01 (biology supply company) or 10% bleach solution for washing down the lab benches.
3. Set out disposable gloves and safety glasses.
4. Set out dissecting kits, dissecting pans, and preserved cow or sheep eyes. Plan for groups of two or individual dissections.
5. Set out dissectible eye models and/or eye anatomy charts.

6. Set out slides of the eye showing retinal layers, lens paper, and lens cleaning solution. Have compound microscopes available. As an alternative, set up a demonstration slide of the retina.
7. Hang up a Snellen eye chart in a well-lit part of the room. Measure back 20 feet from the chart and mark the distance on the floor with masking tape.
8. Set out Ishihara's color plates.
9. Set out a box of common pins.
10. Set out test tubes, pencils, metric rulers, and meter sticks (one each per group).
11. Set out several laboratory lamps, penlights, or bright flashlights.
12. Set out the ophthalmoscopes (check to be sure ophthalmoscope batteries are working).

Comments and Pitfalls

1. Preserved cow eyes are often misshapen, and inexperienced students may need help locating and identifying the cornea at the beginning of the dissection.
2. Some students will have difficulty with the ophthalmoscope. Remind the subject to look straight ahead at a fixed object while the examiner looks through the pupil at a slight angle. Caution the examiner to limit illuminating the retina to *one minute or less*. Switch to the other eye if necessary. *Do not examine the macula for more than one second at a time.*
3. For demonstration of the blind spot, emphasize that the dot disappears when the right eye is tested, and the X disappears when the left eye is tested. Some student is sure to claim that he/she has no blind spot in the left eye as the dot never disappeared!

Answers to Pre-Lab Quiz (pp. 363–364)

1. c, palpebrae
2. conjunctiva
3. d, six
4. c, cornea
5. optic disc
6. aqueous humor
7. cones
8. b, bipolar
9. true
10. a, accommodation

Answers to Activity Questions

Activity 1: Identifying Accessory Eye Structures (p. 365)

Right eye: medial rectus

Left eye: lateral rectus (and on occasion the superior or inferior oblique)

Dissection: The Cow (Sheep) Eye (pp. 368–369)

6. The optic disc.

Activity 4: Predicting the Effects of Visual Pathway Lesions (pp. 370–371)

A lesion in the right optic nerve affects medial and lateral vision of the right eye. (The person is blind in the right eye.)

A sagittal lesion through the optic chiasma affects medial vision in both eyes. (The lateral peripheral vision is diminished.) Sagittal lesions also eliminate binocular vision.

A lesion in the left optic tract affects left lateral and right medial vision. (While looking straight ahead, nothing is seen in the far right visual field.)

A lesion in the visual area of the right cerebral cortex affects right lateral and left medial vision. (While looking straight ahead, nothing is seen in the far left visual field.)

Activity 10: Tests for Binocular Vision (p. 374)

It is much easier to put the pencil in the test tube with both eyes open.

Activity 11: Demonstrating Reflex Activity of Intrinsic and Extrinsic Eye Muscles (pp. 374–375)

Photopupillary Reflex

When exposed to bright light, the pupil constricts. The pupil of the opposite eye will also be slightly constricted.

Accommodation Pupillary Reflex

As the eye focuses on printed material, the pupil constricts. This reduces divergent light rays and aids in formation of a sharper image. It also restricts the amount of light entering the eye.

Convergence Reflex

The eyeballs will both move medially to focus on the object. This reflex keeps the image focused on the fovea.

NAME _____

LAB TIME/DATE _____

REVIEW SHEET EXERCISE 24

Special Senses: Vision

Anatomy of the Eye

1. Name five accessory eye structures that contribute to the formation of tears and/or aid in lubrication of the eyeball, and then name the major secretory product of each. Indicate which has antibacterial properties by circling the correct secretory product.

Accessory structures	Product
lacrimal glands	*saline solution; (lysozyme)*
conjunctiva	*mucus*
tarsal or meibomian glands	*oily secretion*
caruncle	*whitish, oily secretion*
ciliary glands	*sweat*

2. The eyeball is wrapped in adipose tissue within the orbit. What is the function of the adipose tissue?

To package, protect, and cushion the eyeball in the bony orbit

3. Why does one often have to blow one's nose after crying? *Because tears drain into the nasal cavities via the nasolacrimal ducts.*

4. Identify the extrinsic eye muscle predominantly responsible for each action described below.

lateral rectus 1. turns the eye laterally

medial rectus 2. turns the eye medially

inferior oblique 3. turns the eye up and laterally

inferior rectus 4. turns the eye inferiorly and medially

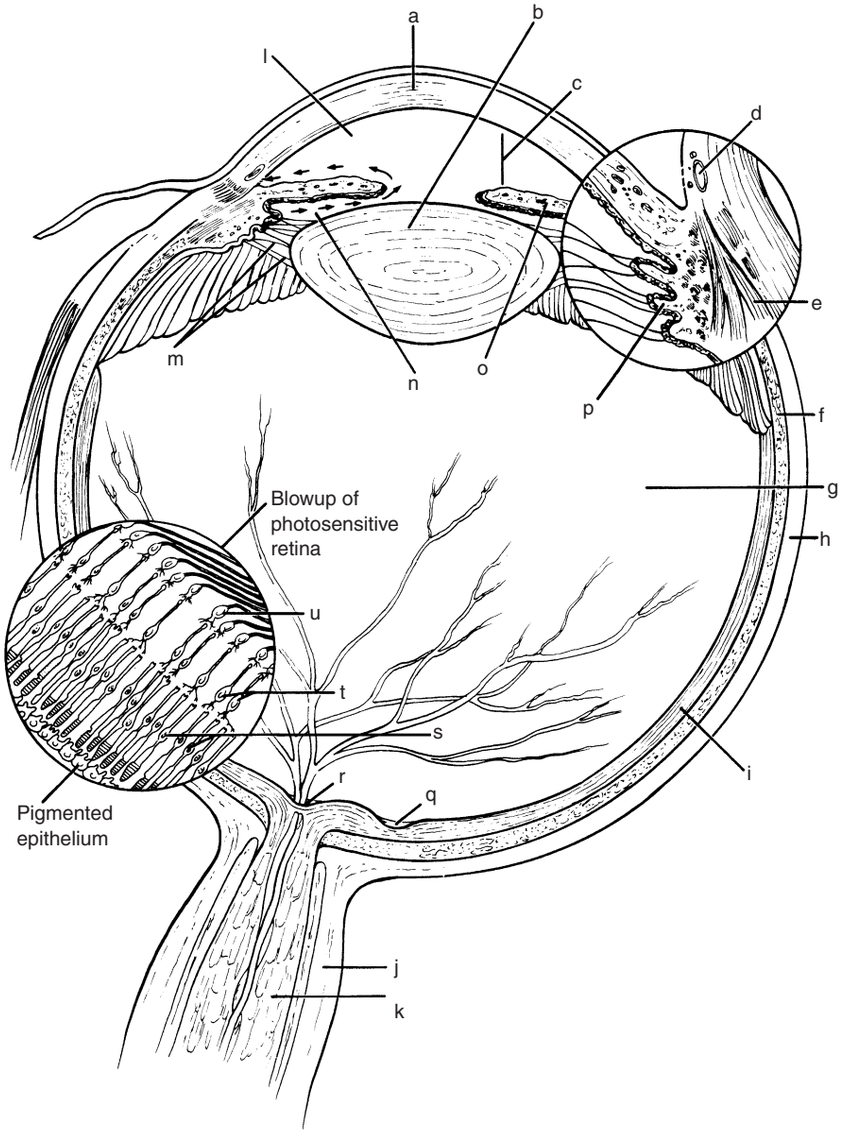
superior rectus 5. turns the eye superiorly and medially

superior oblique 6. turns the eye down and laterally

5. What is a sty? *Inflammation of a small oil or sweat gland associated with the eye exterior*

Conjunctivitis? *Inflammation of the conjunctiva*

6. Correctly identify each lettered structure in the diagram by writing the letter next to its name in the numbered list.



_c_ 1. anterior chamber

_l_ 2. anterior segment

_t_ 3. bipolar neurons

_f_ 4. choroid

_p_ 5. ciliary body and processes

_e_ 6. ciliary muscle

_a_ 7. cornea

_j_ 8. dura mater

_q_ 9. fovea centralis

_u_ 10. ganglion cells

_o_ 11. iris

_b_ 12. lens

_r_ 13. optic disc

_k_ 14. optic nerve

_s_ 15. photoreceptors

_n_ 16. posterior chamber

_i_ 17. retina

_h_ 18. sclera

_d_ 19. scleral venous sinus

_m_ 20. suspensory ligaments (ciliary zonule)

_g_ 21. posterior segment

Notice the arrows drawn close to the left side of the iris in the diagram above. What do they indicate?

The flow of aqueous humor from the ciliary processes of the ciliary body to the scleral venous sinus (canal of Schlemm).

7. The iris is composed primarily of two smooth muscle layers, one arranged radially and the other circularly.

Which of these dilates the pupil? *The radial layer*

8. You would expect the pupil to be dilated in which of the following circumstances? Circle the correct response(s).

a. in bright light (b. in dim light) c. focusing for near vision (d. observing distant objects)

9. The intrinsic eye muscles are controlled by the (circle the correct response):

(autonomic nervous system) somatic nervous system

10. Match the key responses with the descriptive statements that follow.

Key:
a. aqueous humor
b. choroid
c. ciliary body
d. ciliary processes of the ciliary body
e. cornea
f. fovea centralis
g. iris
h. lens
i. optic disc
j. retina
k. sclera
l. scleral venous sinus
m. vitreous humor

a; aqueous humor	1. fluid filling the anterior segment of the eye
k; sclera	2. the "white" of the eye
i; optic disc	3. part of the retina that lacks photoreceptors
c; ciliary body	4. modification of the choroid that controls the shape of the crystalline lens and contains the ciliary muscle
l; scleral venous sinus	5. drains the aqueous humor from the eye
j; retina	6. layer containing the rods and cones
m; vitreous humor	7. substance occupying the posterior segment of the eyeball
b; choroid	8. forms the bulk of the heavily pigmented vascular layer
c; ciliary body , *g; iris*	9. smooth muscle structures (2)
f; fovea centralis	10. area of critical focusing and discriminatory vision
d; ciliary processes of the ciliary body	11. form (by filtration) the aqueous humor
a; aqueous humor , *e; cornea*	12. light-bending media of the eye (4)
m; vitreous humor , *h; lens*	
e; cornea	13. anterior continuation of the sclera—your "window on the world"
k; sclera	14. composed of tough, white, opaque, fibrous connective tissue

Microscopic Anatomy of the Retina

11. The two major layers of the retina are the epithelial and neural layers. In the neural layer, the neuron populations are arranged as follows from the pigmented epithelial layer to the vitreous humor. (Circle the proper response.)

bipolar cells, ganglion cells, photoreceptors

photoreceptors, ganglion cells, bipolar cells

ganglion cells, bipolar cells, photoreceptors

(photoreceptors, bipolar cells, ganglion cells)

12. The axons of the *ganglion* cells form the optic nerve, which exits from the eyeball.

13. Complete the following statements by writing either *rods* or *cones* on each blank.

The dim light receptors are the *rods*. Only *cones* are found in the fovea centralis, whereas mostly *rods* are found in the periphery of the retina. *Cones* are the photoreceptors that operate best in bright light and allow for color vision.

Dissection of the Cow (Sheep) Eye

14. What modification of the choroid that is not present in humans is found in the cow eye? *Tapetum lucidum*

What is its function? *To reflect light that enters the eye, thus increasing light stimulation of the retina under dim light conditions.*

15. What does the retina look like? *Thin yellowish-white or tan membrane. (Often becomes crumpled during dissection of the eye.)*

At what point is it attached to the posterior aspect of the eyeball? *At the optic disc*

Visual Pathways to the Brain

16. The visual pathway to the occipital lobe of the brain consists most simply of a chain of five cells. Beginning with the photoreceptor cell of the retina, name them and note their location in the pathway.

1. *photoreceptor cell; retina*
2. *bipolar cell; retina*
3. *ganglion cell; retina*
4. *neuron; lateral geniculate nucleus of the thalamus*
5. *cortical neuron; visual cortex of the cerebral hemisphere(s)*

17. Visual field tests are done to reveal destruction along the visual pathway from the retina to the optic region of the brain. Note where the lesion is likely to be in the following cases.

Normal vision in left eye visual field; absence of vision in right eye visual field: *Right optic nerve*

Normal vision in both eyes for right half of the visual field; absence of vision in both eyes for left half of the visual field:

Right optic tract (or right visual cortex)

18. How is the right optic *tract* anatomically different from the right optic *nerve*? *The right optic nerve contains fibers from the right eye only. The right optic tract contains fibers from the lateral aspect of the right eye and the medial aspect of the left eye.*

Visual Tests and Experiments

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

	Column A		Column B
g; refraction	1. light bending	a.	accommodation
a; accommodation	2. ability to focus for close (less than 20 feet) vision	b.	astigmatism
d; emmetropia	3. normal vision	c.	convergence
e; hyperopia	4. inability to focus well on close objects (farsightedness)	d.	emmetropia
f; myopia	5. nearsightedness	e.	hyperopia
b; astigmatism	6. blurred vision due to unequal curvatures of the lens or cornea	f.	myopia
c; convergence	7. medial movement of the eyes during focusing on close objects	g.	refraction

20. Complete the following statements:

In farsightedness, the light is focused __1__ the retina. The lens required to treat myopia is a __2__ lens. The "near point" increases with age because the __3__ of the lens decreases as we get older. A convex lens, like that of the eye, produces an image that is upside down and reversed from left to right. Such an image is called a __4__ image.

1. *behind*
2. *concave*
3. *elasticity*
4. *real*

21. Use terms from the key to complete the statements concerning near and distance vision.

Key: a. contracted b. decreased c. increased d. relaxed e. taut

During distance vision, the ciliary muscle is *d*, the suspensory ligament is *e*, the convexity of the lens is *b*, and light refraction is *b*. During close vision, the ciliary muscle is *a*, the suspensory ligament is *d*, lens convexity is *c*, and light refraction is *c*.

22. Explain why vision is lost when light hits the blind spot. *This area lacks photoreceptors.*

23. Using your Snellen eye test results, answer the following questions.

Is your visual acuity normal, less than normal, or better than normal? *The answers may vary.*

Explain your answer. _____

Explain why each eye is tested separately when using the Snellen eye chart. *There is usually a slight difference in the visual acuity of the two eyes.*

Explain 20/40 vision. *Poorer than normal vision. Able to read #40 letters at 20 feet. The normal eye reads these letters at 40 feet.*

Explain 20/10 vision. *Better than normal vision. Can read #10 letters at 20 feet. The normal eye would have to be 10 feet away to read these letters.*

24. Define *astigmatism.* *Blurred vision due to unequal curvatures of the lens or cornea.*

How can it be corrected? *With specially ground (circularly ground) lenses.*

25. Define *presbyopia.* *"Old vision." A hyperopia resulting from decreasing lens elasticity with advancing age.*

What causes it? *Decreased function of an increasingly inelastic lens.*

26. To which wavelengths of light do the three cone types of the retina respond maximally?

red, *blue*, and *green*

27. How can you explain the fact that we see a great range of colors even though only three cone types exist?

When more than one cone type is stimulated simultaneously, intermediate colors (of the visible spectrum) are seen.

28. Explain the difference between binocular and panoramic vision. *Binocular—visual fields overlap considerably but not completely; therefore, slightly different views are received by each eye. Panoramic—little or no overlap of visual fields; therefore, each eye "sees" a different view.*

What is the advantage of binocular vision? *Allows for depth perception.*

What factor(s) are responsible for binocular vision? *The slight difference between the visual fields of the two eyes and the partial crossover at the optic chiasma.*

29. In the experiment on the convergence reflex, what happened to the position of the eyeballs as the object was moved closer to the subject's eyes? *Eyeballs turned medially.*

What extrinsic eye muscles control the movement of the eyes during this reflex? *Medial recti*

What is the value of this reflex? *Allows the image to be precisely focused on the fovea of each eye.*

30. In the experiment on the photopupillary reflex, what happened to the pupil of the eye exposed to light? *It constricted.* What happened to the pupil of the nonilluminated eye? *It constricted.*

Explanation? *Regulation of pupil constriction by the parasympathetic division of the autonomic nervous system is coordinated (i.e., consensual) and prevents overillumination of the delicate retinal cells.*

31. Why is the ophthalmoscopic examination an important diagnostic tool? *Allows noninvasive examination of the retinal condition and vasculature.*

32. Many college students struggling through mountainous reading assignments are told that they need glasses for "eyestrain." Why is it more of a strain on the extrinsic and intrinsic eye muscles to look at close objects than at far objects?

No accommodation or convergence is required for distant vision.

EXERCISE 25

Special Senses: Hearing and Equilibrium

Time Allotment: 1 hour.

Multimedia Resources: See Appendix B for Guide to Multimedia Resource Distributors.
See Exercise 6 for histology listings.

The Ear: Hearing and Balance (IM: 29 minutes, DVD)
Eyes and Ears (FHS: 28 minutes, VHS, DVD, 3-year streaming webcast)
Hearing (FHS: 30 minutes, VHS, DVD, 3-year streaming webcast)
Hearing (part of the NOVA Mystery of the Senses series) (IM: 60 minutes each, 5-piece DVD set)
Practice Anatomy Lab™ 3.0 (*PAL*) (BC: CD-ROM, Website)
The Senses (FHS: 20 minutes, VHS, DVD, 3-year streaming webcast)

Laboratory Materials

Ordering information is based on a lab size of 24 students, working in groups of 4. A list of supply house addresses appears in Appendix A.

3-D dissectible ear models and/or chart of ear anatomy
24 compound microscopes, lens paper, lens cleaning solution
24 slides of the cochlea
1 slide of crista ampullaris receptor of a semicircular canal
6 sets of tuning forks (range of frequencies)
6 rubber mallets
Absorbent cotton
Otoscope (if available), disposable otoscope tips, and alcohol swabs
Disposable autoclave bag
6 metric rulers
6 pocket watches or clocks that tick
White chalk and blackboard or markers and whiteboard
Audiometer (if available)
Red and blue pencils
Rotating stool or chair
Three coins of different sizes

Advance Preparation

1. Set out dissectible ear models and/or chart of ear anatomy.
2. Set out slides of the cochlea, lens paper, and lens cleaning solution. Have compound microscopes available. Set up a demonstration slide of the crista ampullaris receptor of a semicircular canal.
3. For each group, set out tuning forks, rubber mallet, absorbent cotton, a pocket watch or small clock that ticks, a piece of white chalk or a whiteboard marker, and a metric ruler.
4. If an audiometer is available it can be used instead of the tuning forks to test frequency range of hearing. If necessary, prepare instructions for the use of the audiometer. Set out red and blue pencils.
5. Set out otoscopes (if available), disposable otoscope tips, alcohol swabs, and an autoclave bag.
6. Have a sturdy rotating chair or stool available for the Barany test.

Comments and Pitfalls

1. It is often difficult to find an area quiet enough to get good results with the acuity and sound localization tests. An empty lab or a quiet corner of the hallway might be used.
2. Students should be reminded to simulate conductive deafness while performing the Weber test. Although it is not a specific assignment, they'll be asked for results in the Review Sheets.
3. Remind the students to strike the tuning forks with the rubber mallet and not against the lab bench.
4. Be sure the students understand how to evaluate the direction of nystagmus before the subject spins. Also remind the subject to keep his or her eyes open! Instruct students who are standing around the stool to place their foot firmly against the stool leg to prevent the stool from tipping over.

Answers to Pre-Lab Quiz (pp. 383–384)

1. three
2. a, auricle
3. tympanic membrane
4. d, stapes
5. a, cochlea
6. otoscope
7. b, Rinne
8. b, inner ear
9. macula/vestibule
10. c, involuntary trailing of eyes in one direction, then rapid movement in the other

Answers to Activity Questions

Activity 4: Conducting Laboratory Tests of Hearing (pp. 387–388)

Acuity Test

The threshold is indefinite.

Sound Localization

No, the sound is less easily located if the source is equidistant from both ears. Sound arriving from spots equidistant from both ears arrives at each ear at the same time and with equal loudness. This does not provide enough information to adequately locate the position of the source.

Frequency Range of Hearing

Generally, high-frequency sounds are heard less clearly, but results depend on the loudness of each of the tuning forks.

Activity 7: Conducting Laboratory Tests on Equilibrium (pp. 391–392)

Balance Test

1. Nystagmus should not be present.
2. The cerebellum integrates input from receptors in the vestibule and semicircular canals, the eyes and somatic receptors, and coordinates skeletal muscle activity and regulates muscle tone.

Barany Test

4. When rotation stops, the direction of nystagmus reverses. If the chair is rotated clockwise, the nystagmus will be counterclockwise. For a few seconds after the chair is stopped, the subject reports a feeling of movement in the same direction and the same speed in which the chair was spun.

Romberg Test

2. Gross swaying movements are not usually observed when the eyes are open.
3. Side-to-side movement increases.
4. Front-to-back swaying occurs.

   The equilibrium apparatus and proprioceptors are probably functioning normally.

   Visual information is lacking and the result is increased swaying.

   Equilibrium and balance require input from a number of receptors, including proprioceptors, the vestibular apparatus, and the eyes.

25 REVIEW SHEET EXERCISE

NAME _____

LAB TIME/DATE _____

Special Senses: Hearing and Equilibrium

Anatomy of the Ear

1. Select the terms from column B that apply to the column A descriptions. Some terms are used more than once.

Column A

d, *i*, *m* 1. structure composing the external ear

b, *k*, *n* 2. structures composing the internal ear

e, *f*, *l* 3. collectively called the ossicles

a 4. involved in equalizing the pressure in the middle ear with atmospheric pressure

m 5. vibrates at the same frequency as sound waves hitting it; transmits the vibrations to the ossicles

k, *n* 6. contain receptors for the sense of balance

g 7. transmits the vibratory motion of the stirrup to the fluid in the scala vestibuli of the inner ear

j 8. acts as a pressure relief valve for the increased fluid pressure in the scala tympani; bulges into the tympanic cavity

a 9. passage between the throat and the tympanic cavity

c 10. fluid contained within the membranous labyrinth

h 11. fluid contained within the osseous labyrinth and bathing the membranous labyrinth

Column B

a. pharyngotympanic (auditory) tube

b. cochlea

c. endolymph

d. external auditory canal

e. incus (anvil)

f. malleus (hammer)

g. oval window

h. perilymph

i. pinna (auricle)

j. round window

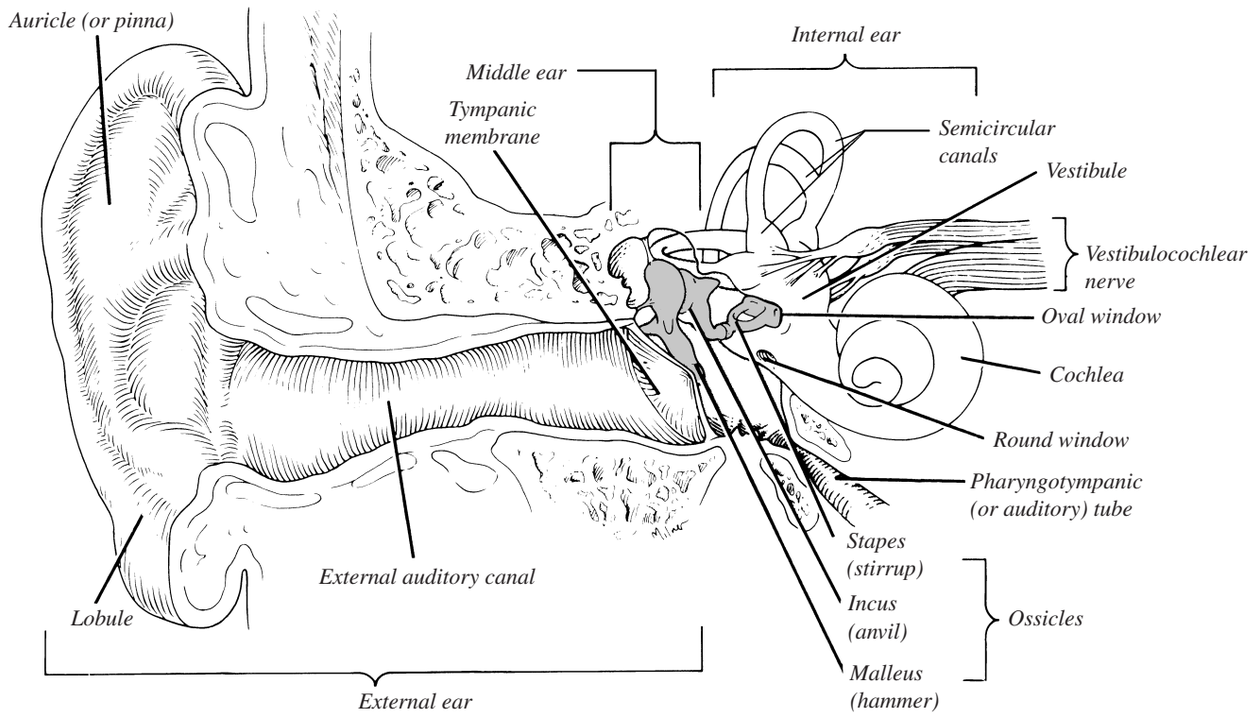
k. semicircular canals

l. stapes (stirrup)

m. tympanic membrane

n. vestibule

2. Identify all indicated structures and ear regions in the following diagram.



3. Match the membranous labyrinth structures listed in column B with the descriptive statements in column A.

Column A	Column B
g, j 1. sacs found within the vestibule	a. ampulla
c 2. contains the spiral organ (of Corti)	b. basilar membrane
g, j 3. sites of the maculae	c. cochlear duct
h 4. positioned in all spatial planes	d. cochlear nerve
b 5. hair cells of spiral organ (of Corti) rest on this membrane	e. cupula
i 6. gelatinous membrane overlying the hair cells of the spiral organ (of Corti)	f. otoliths
a 7. contains the crista ampullaris	g. saccule
f, g, j, k 8. function in static equilibrium	h. semicircular ducts
a, e, h, k 9. function in dynamic equilibrium	i. tectorial membrane
d 10. carries auditory information to the brain	j. utricle
e 11. gelatinous cap overlying hair cells of the crista ampullaris	k. vestibular nerve
f 12. grains of calcium carbonate in the maculae	

4. Sound waves hitting the tympanic membrane (eardrum) initiate its vibratory motion. Trace the pathway through which vibrations and fluid currents are transmitted to finally stimulate the hair cells in the spiral organ (of Corti). (Name the appropriate ear structures in their correct sequence.)

Tympanic membrane → *malleus → incus → stapes → oval window → perilymph → cochlear duct → endolymph → basilar membrane with hair cells*

5. Describe how sounds of different frequency (pitch) are differentiated in the cochlea. *It is believed that high-frequency (high-pitched) sounds peak close to the oval window while low-frequency (low-pitched) sounds peak near the cochlear apex, disturbing hair cells there (the "Place Principle").*

6. Explain the role of the endolymph of the semicircular canals in activating the receptors during angular motion.

When angular motion occurs in one direction, the endolymph in a semicircular canal lags behind, pushing the cupula in a direction opposite to that of the angular motion. Depending on the ear, this depolarizes or hyperpolarizes the hair cells, resulting in enhanced or reduced impulses to the brain.

7. Explain the role of the otoliths in perception of static equilibrium (head position). *When the head position changes, the otoliths move in gelatinous material in response to gravitational pull. This triggers hyperpolarization or depolarization of the hair cells and modifies the rate of impulse transmission along the vestibular nerve.*

Laboratory Tests

8. Was the auditory acuity measurement made during the experiment on page 387 the same or different for both ears? *(student response)* What factors might account for a difference in the acuity of the two ears?

Earwax, middle/external ear infection, cochlear nerve damage, etc.—anything that affects sound conduction or nervous system structures associated with hearing.

9. During the sound localization experiment on page 387, note the position(s) in which the sound was least easily located. How can this phenomenon be explained? *The usual cues that allow sound to be localized (slight differences in loudness in the two ears and in the time the sound reaches each ear) are missing.*

10. In the frequency experiment on page 388, note which tuning fork was the most difficult to hear. *Answers may vary.*

What conclusion can you draw? *High-frequency sounds are heard less well at low intensity.*

11. When the tuning fork handle was pressed to your forehead during the Weber test, where did the sound seem to originate? *From the ears.*

Where did it seem to originate when one ear was plugged with cotton? *From the plugged ear.*

How do sound waves reach the cochlea when conduction deafness is present? *By vibration through bones of the skull.*

12. Indicate whether the following conditions relate to conduction deafness (C) or sensorineural deafness (S).

c 1. can result from the fusion of the ossicles

s 2. can result from a lesion on the cochlear nerve

s 3. sound heard in one ear but not in the other during bone and air conduction

c, s 4. can result from otitis media

c 5. can result from impacted cerumen or a perforated eardrum

s 6. can result from a blood clot in the auditory cortex

13. The Rinne test evaluates an individual's ability to hear sounds conducted by air or bone. Which is more indicative of normal hearing? *Air-conducted sound*

14. Define *nystagmus.* *Involuntary rolling or trailing of the eyes in one direction and then rapid movement in the opposite direction*

Define *vertigo.* *Sensation of dizziness and rotational movement when such movement is not occurring*

15. The Barany test investigated the effect that rotatory acceleration had on the semicircular canals. Explain *why* the subject still had the sensation of rotation immediately after being stopped. *The fluids of the inner ear had not yet stopped moving.*

16. What is the usual reason for conducting the Romberg test? *To determine if proprioceptive impulses are being transmitted up the spinal cord to the brain properly*

Was the degree of sway greater with the eyes open or closed? Why? *Closed. Visual cues (input) were lacking.*

17. Normal balance, or equilibrium, depends on input from a number of sensory receptors. Name them.

Proprioceptors of the muscles and tendons, vestibular apparatus of the ears, retina of the eye (photoreceptors)

18. What effect does alcohol consumption have on balance and equilibrium? Explain. *Alcohol depresses the nervous system and enhances inhibition of reflex and coordination centers, causing a loss of balance and equilibrium.*

26 EXERCISE

Special Senses: Olfaction and Taste

Time Allotment: 1 hour.

Multimedia Resources: See Appendix B for Guide to Multimedia Resource Distributors. See Exercise 6 for histology listings.

The Senses of Smell and Taste (NIMCO: 28 minutes, VHS, DVD)
The Senses: Skin Deep (FHS: 28 minutes, VHS, DVD, 3-year streaming webcast)
Smell (part of the NOVA Mystery of the Senses series) (IM: 60 minutes each, 5-piece DVD set)
Smell and Taste (FHS: 30 minutes, VHS, DVD)
Taste (part of the NOVA Mystery of the Senses series) (IM: 60 minutes each, 5-piece DVD set)
Taste (FHS: 30 minutes, VHS, DVD, 3-year streaming webcast)

Laboratory Materials

Ordering information is based on a lab size of 24 students, working in groups of 4. A list of supply house addresses appears in Appendix A.

24 compound microscopes, lens paper, lens cleaning solution
24 slides of nasal olfactory epithelium (longitudinal section)
24 slides of tongue showing taste buds (cross section)
Paper towels
6 small mirrors
6 small packets of granulated sugar
Disposable autoclave bag
18 cotton-tipped swabs
6 dropper bottles of oil of cloves, oil of wintergreen, and oil of peppermint (or corresponding condiment flavors)
Absorbent cotton
Toothpicks
Disposable gloves
6 sets of 5 numbered vials containing common household substances with strong odors (herbs, spices, etc.)
6 flasks of distilled or tap water
6 paper plates
Chipped ice
6 opaque containers of equal-sized food cubes of cheese, apple, raw potato, dried prunes, banana, raw carrot, and hard-cooked egg white (at least 6 of each)
6 nose clips
6 paper cups

Advance Preparation

1. Set out slides of the tongue and the nasal epithelium, lens paper, and lens cleaning solution. Have compound microscopes available. (Or set up demonstration slides of the tongue and nasal epithelium.)
2. Set out for each group paper towels, a small mirror, a packet of granulated sugar, absorbent cotton, dropper bottles of oil of cloves and oil of wintergreen and oil of peppermint (or corresponding flavors from the condiment section of the supermarket), a flask of distilled water, a paper plate, and chipped ice.
3. Set out a disposable autoclave bag, toothpicks, and disposable gloves.
4. Prepare a plate of cubed food items such as cheese, apple, raw potato, dried prunes, banana, raw carrot, and hard-cooked egg white. These foods should be in an opaque container (a foil-lined egg carton works well). Keep covered and refrigerated until used.

5. Set out nose clips and five numbered vials containing common household substances with strong odors (such as cinnamon, garlic, ginger, rosemary, lemon peel, etc.).
6. Prepare an answer key for the five vials and have it available.

Comments and Pitfalls

1. Some students dislike putting cotton in their noses. Substitute good nose clips.
2. Some students may have difficulty getting their noses to adapt to the aromatic oil. Be sure they are following directions carefully and are patient.
3. Subjects for the food tests should not be allowed to see the food.
4. Remind students to use toothpicks to select food cubes. Caution students to alert the instructor and group members about food allergies.

Answers to Pre-Lab Quiz (p. 397)

1. true
2. c, olfactory epithelium
3. bipolar
4. c, papillae
5. two
6. sweet, sour, bitter, salty, and umami
7. false
8. b, olfactory adaptation

Answers to Activity Questions

Location and Anatomy of Taste Buds (p. 399)

It is easiest to identify fungiform and circumvallate papillae.

Activity 3: Stimulating Taste Buds (p. 400)

Substances must be in aqueous solution to stimulate the taste buds.

Activity 4: Examining the Combined Effects of Smell, Texture, and Temperature on Taste (pp. 400–401)

Effects of Smell and Texture

3. No, some foods can be identified fairly easily by texture. The sense of smell is most important when foods do not have an easily recognizable and unique texture. For example, it is hard to differentiate between raw apple and raw potato.

Effect of Olfactory Stimulation

2. It is hard to distinguish the flavor with the nostrils closed.
3. With the nostrils open it is easy to identify the oil.
6. The subject usually identifies the oil held at the nostrils.
7. Smell seems to be more important for identification in this experiment.

Effect of Temperature

Identification is more difficult by a chilled tongue.

Activity 5: Assessing the Importance of Taste and Olfaction in Odor Identification (p. 402)

4. It is much easier to identify odors without the nose clips. There are only five basic tastes. Other taste sensations depend on olfaction.

Activity 6: Demonstrating Olfactory Adaptation (p. 402)

The adapted nostril should be able to detect the new oil. Adaptation is to the particular scent and not to aromatic oils in general.