

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
<i>lacrimal glands</i>	<i>saline solution; (lysozyme)</i>
<i>conjunctiva</i>	<i>mucus</i>
<i>tarsal or meibomian glands</i>	<i>oily secretion</i>
<i>caruncle</i>	<i>whitish, oily secretion</i>
<i>ciliary glands</i>	<i>sweat</i>

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.

What seven bones form the bony orbit? (Think! If you can't remember, check a skull or your text.)

sphenoid _____ *ethmoid* _____ *palatine* _____
zygomatic _____ *maxillary* _____
frontal _____ *lacrimal* _____

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

nasolacrimal ducts.

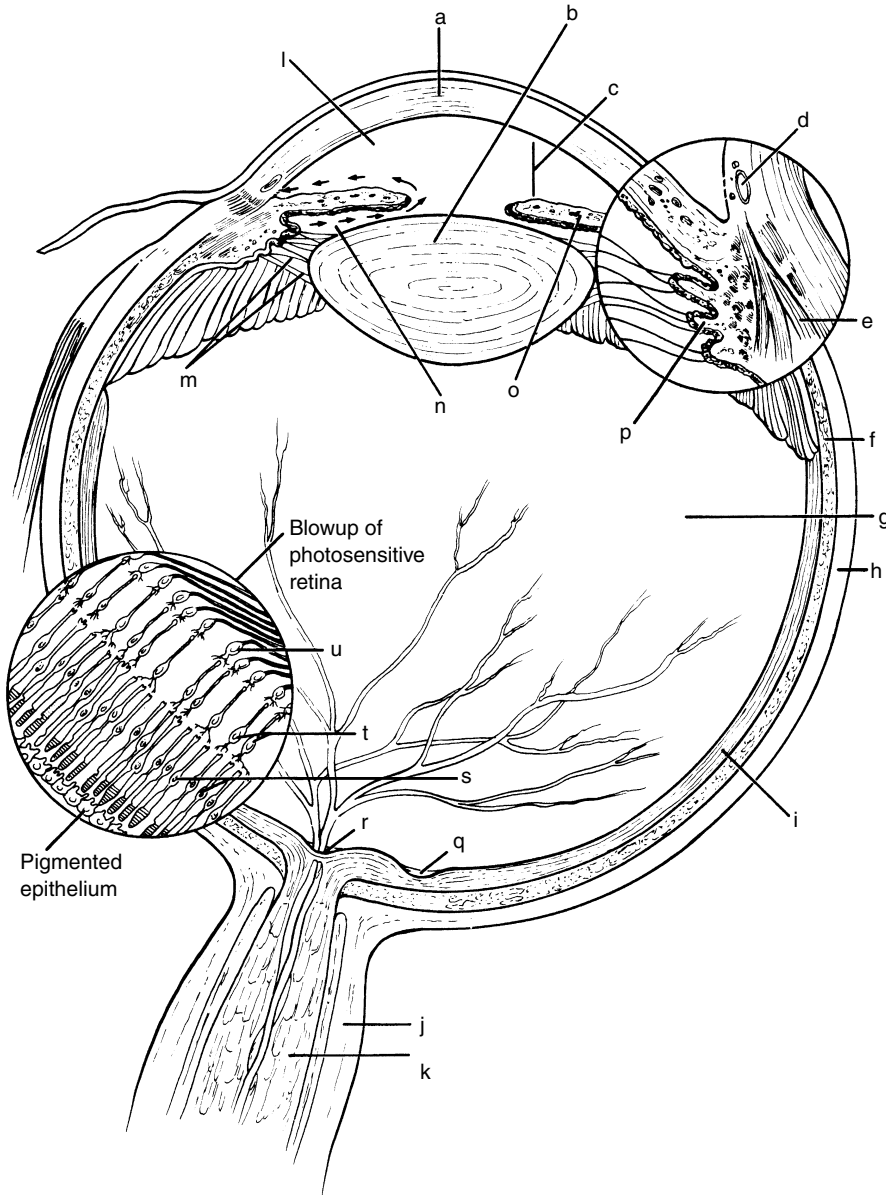
4. Identify the extrinsic eye muscle predominantly responsible for the actions described below.

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
superior rectus _____ 5. turns the eye superiorly
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. Using the terms listed on the right, correctly identify all structures provided with leader lines in the diagram.



- c 1. anterior chamber
- l 2. anterior segment containing aqueous humor
- t 3. bipolar neurons
- p 4. ciliary body and processes
- e 5. ciliary muscle
- f 6. choroid
- 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
- g 21. vitreous body in posterior segment

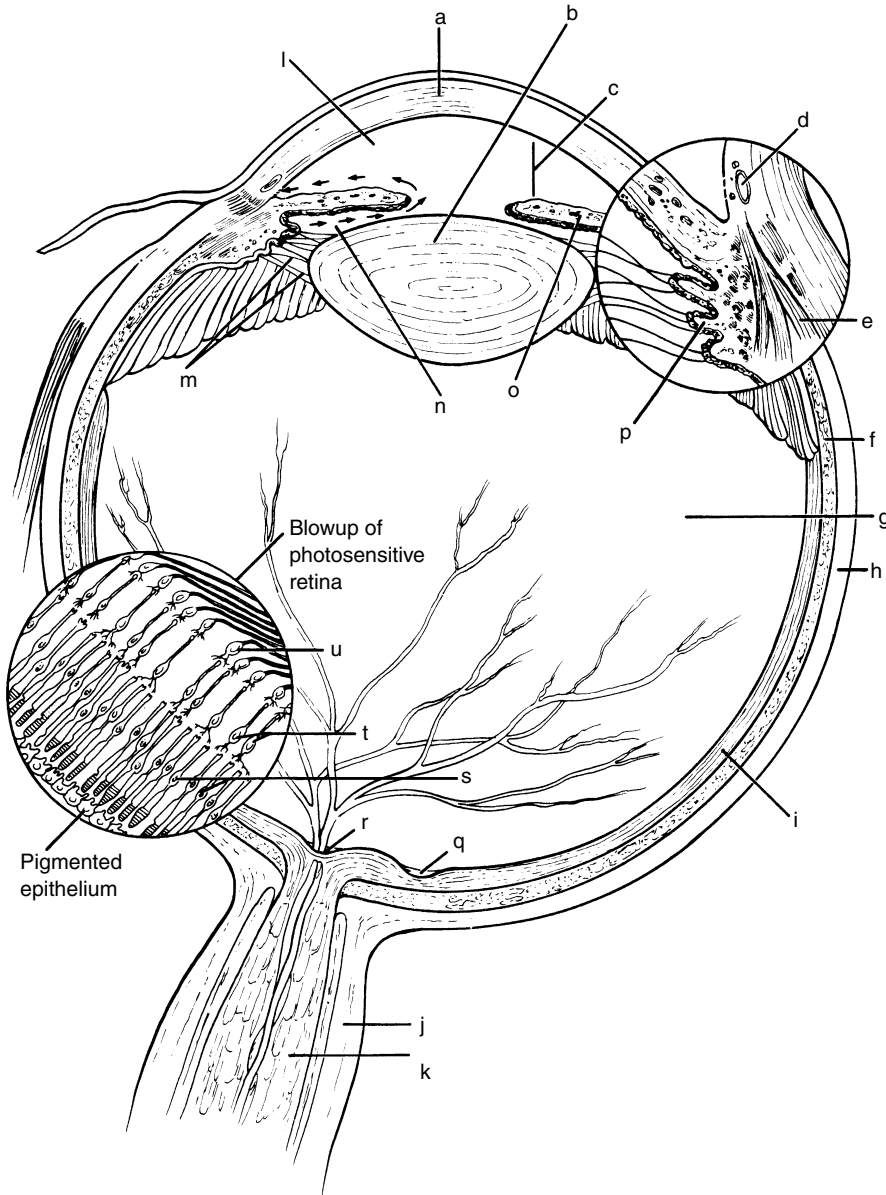
Notice the arrows drawn close to the left side of the iris in the diagram above. What do they indicate?

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

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

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

- m; suspensory ligament 1. attaches the lens to the ciliary body
- a; aqueous humor 2. fluid filling the anterior segment of the eye
- k; sclera 3. the “white” of the eye
- i; optic disc 4. part of the retina that lacks photoreceptors
- c; ciliary body 5. modification of the choroid that controls the shape of the crystalline lens
- c; ciliary body 6. contains the ciliary muscle
- l; scleral venous sinus 7. drains the aqueous humor from the eye
- j; retina 8. tunic containing the rods and cones
- n; vitreous humor 9. substance occupying the posterior segment of the eyeball
- b; choroid 10. forms the bulk of the heavily pigmented vascular tunic
- c; ciliary body, g; iris 11. smooth muscle structures
- f; fovea centralis 12. area of critical focusing and discriminatory vision
- d; ciliary processes of the ciliary body 13. form (by filtration) the aqueous humor
- a; aqueous humor, e; cornea, h; lens
- n; vitreous humor 14. light-bending media of the eye
- e; cornea 15. anterior continuation of the sclera—your “window on the world”
- k; sclera 16. composed of tough, white, opaque, fibrous connective tissue

8. 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

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

- | | |
|-------------------------------------|--|
| a. in brightly lit surroundings | c. during focusing for near vision |
| <u>b. in dimly lit surroundings</u> | <u>d. in observing distant objects</u> |

10. The intrinsic eye muscles are under the control of which of the following? (Circle the correct response.)

- autonomic nervous system somatic nervous system

Microscopic Anatomy of the Retina

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

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.

Visual Pathways to the Brain

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

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

15. 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 optic cortex)

16. 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.

Dissection of the Cow (Sheep) Eye

17. 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.

24. Record your Snellen eye test results below:

Left eye (without glasses) _____ (with glasses) _____

Right eye (without glasses) _____ (with glasses) _____

Is your visual acuity normal, less than normal, or better than normal? _____

Explain. _____

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.*

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

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

26. Record the distance of your near point of accommodation as tested in the laboratory:

right eye _____ left eye _____

Is your near point within the normal range for your age? _____

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

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

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

red _____, *blue* _____, and *green* _____

29. 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.

30. What is the usual cause of color blindness? *Malfunction or absence of one or more of the three cone types.*

31. 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.

32. 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.

What would be the visual result of an inability of these muscles to function? Diplopia (double vision)

33. 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 coordinate (i.e. consensual) and prevents overillumination of the delicate retinal cells.

34. Why is the ophthalmoscopic examination an important diagnostic tool? Allows noninvasive examination of the retinal condition and vasulature.

35. 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.

NAME _____ LAB TIME/DATE _____

REVIEW SHEET
exercise

Special Senses: Hearing and Equilibrium

25

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.

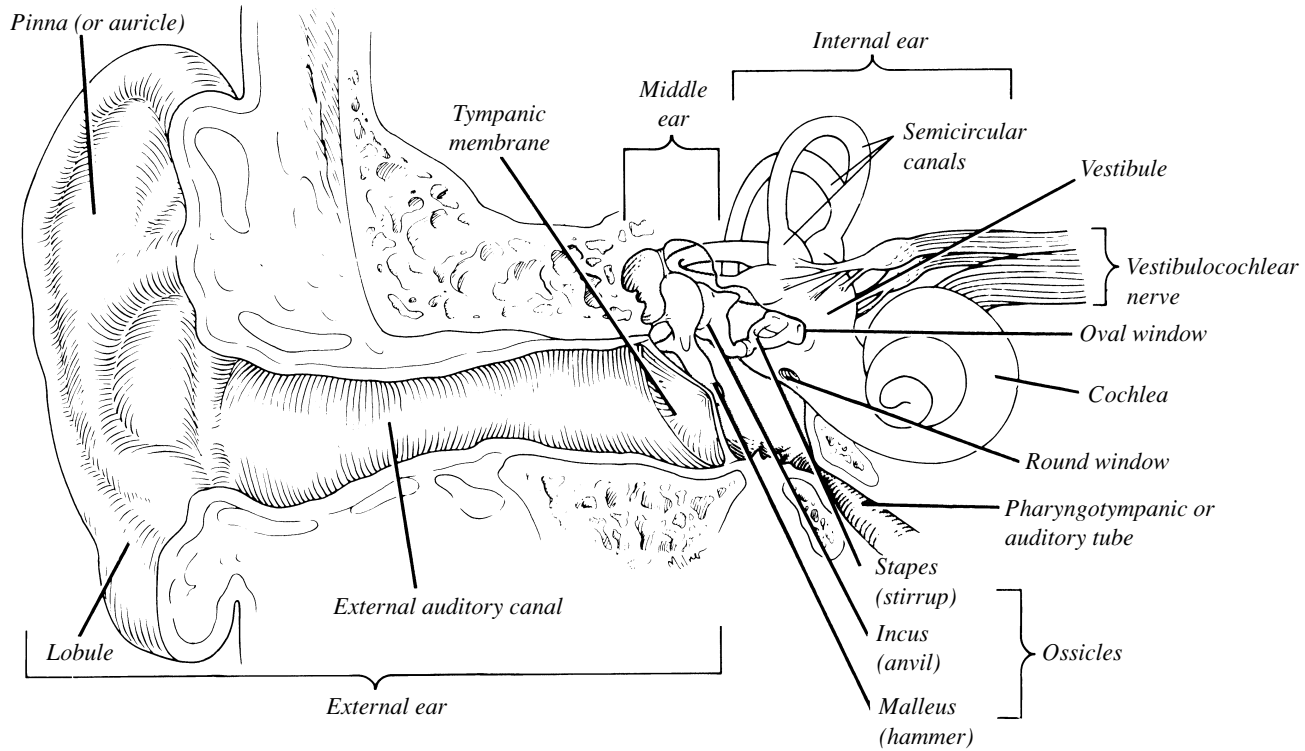
Column A

- d , i , m 1. structures composing the outer or external ear
- b , k , n 2. structures composing the inner ear
- e , f , l 3. collectively called the ossicles
- i , k 4. ear structures not involved with audition
- a 5. involved in equalizing the pressure in the middle ear with atmospheric pressure
- m 6. vibrates at the same frequency as sound waves hitting it; transmits the vibrations to the ossicles
- k , n 7. contain receptors for the sense of balance
- g 8. transmits the vibratory motion of the stirrup to the fluid in the scala vestibuli of the inner ear
- j 9. acts as a pressure relief valve for the increased fluid pressure in the scala tympani; bulges into the tympanic cavity
- a 10. passage between the throat and the tympanic cavity
- c 11. fluid contained within the membranous labyrinth
- h 12. fluid contained within the osseous labyrinth and bathing the membranous labyrinth

Column B

- a. auditory (pharyngotympanic) tube
- b. cochlea
- c. endolymph
- d. external auditory canal
- e. incus (anvil)
- f. malleus (hammer)
- g. oval window
- h. perilymph
- i. pinna
- 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
<u>g</u> _____, <u>j</u> _____ 1. sacs found within the vestibule	a. ampulla
<u>c</u> _____ 2. contains the organ of Corti	b. basilar membrane
<u>g</u> _____, <u>j</u> _____ 3. sites of the maculae	c. cochlear duct
<u>h</u> _____ 4. positioned in all spatial planes	d. cochlear nerve
<u>b</u> _____ 5. hair cells of organ of Corti rest on this membrane	e. cupula
<u>i</u> _____ 6. gelatinous membrane overlying the hair cells of the organ of Corti	f. otoliths
<u>a</u> _____ 7. contains the crista ampullaris	g. saccule
<u>f</u> _____, <u>g</u> _____, <u>j</u> _____, <u>k</u> _____ 8. function in static equilibrium	h. semicircular ducts
<u>a</u> _____, <u>e</u> _____, <u>h</u> _____, <u>k</u> _____ 9. function in dynamic equilibrium	i. tectorial membrane
<u>d</u> _____ 10. carries auditory information to the brain	j. utricle
<u>e</u> _____ 11. gelatinous cap overlying hair cells of the crista ampullaris	k. vestibular nerve
<u>f</u> _____ 12. grains of calcium carbonate in the maculae	

4. Sound waves hitting the eardrum initiate its vibratory motion. Trace the pathway through which vibrations and fluid currents are transmitted to finally stimulate the hair cells in the organ of Corti. (Name the appropriate ear structures in their correct sequence.) Eardrum → 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 "roll" in gelatinous material (responding 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 282 the same or different for both ears? (student response) What factors might account for a difference in the acuity of the two ears? Ear wax, middle/outer 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 282, in which position(s) was the sound least easily located? When the sound was exactly in midline of the head and out of vision.
 How can this phenomenon be explained? The usual cues which 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 282, which tuning fork was the most difficult to hear? (stu obs) Hz
 What conclusion can you draw? High-frequency sounds are heard less well at low intensity.

