The Special Senses

The Eye and Vision: Anatomy

1. Several accessory eye structures contribute to the formation of tears and/or help lubricate the eyeball. Match the described accessory structures with their secretion by choosing answers from the key.

   Key: conjunctiva lacrimal glands tarsal glands

   CONJUNCTIVA
   1. mucus

   TARSAL GLANDS
   2. oil

   LACRIMAL GLANDS
   3. salt solution

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

   TO ACT AS A CUSHION

3. Why may it be necessary to blow one's nose after crying?

   BECAUSE THE TEARS DRAIN INTO THE NASAL CAVITY

4. What is a sty?

   AN INFLAMMATION OF A TARSAL GLAND

   What is conjunctivitis?

   INFLAMMATION OF THE CONJUNCTIVA

5. Which seven bones form the bony orbit? (If you can't remember, check a skull or your textbook.)

   FRONTAL ETHMOID LACRIMAL
   ZYGOMATIC SPHENOID MAXILLA
   PALATINE
6. Identify the lettered structures on the diagram by matching each letter with one of the terms to the right.

- **B**: anterior segment containing aqueous humor
- **F**: bipolar cells
- **C**: scleral venous sinus
- **D**: ciliary body
- **L**: choroid
- **A**: cornea
- **Q**: fovea centralis
- **E**: ganglion cells
- **I**: iris
- **K**: lens
- **P**: optic disc
- **R**: optic nerve
- **G**: photoreceptors
- **H**: pupil
- **O**: retina
- **N**: sclera
- **J**: ciliary zonule (suspensory ligaments)
- **M**: 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?

**PRODUCTION AND DRAINAGE OF THE AQUEOUS HUMOR INTO THE CANAL OF SCHLEMM**

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

**Key:**
- aqueous humor
- scleral venous sinus
- choroid
- ciliary body
- cornea
- fovea centralis
- lens
- optic disc
- retina
- sclera
- ciliary zonule (suspensory ligament)
- vitreous humor

**CILIARY ZONULE**: attaches the lens to the ciliary body
2. Fluid filling the anterior segment of the eye
3. the blind spot
4. contains muscle that controls the size of the pupil
5. drains the aqueous humor from the eye
6. “sensory” layer
7. substance occupying the posterior segment of the eyeball
8. forms most of the pigmented vascular tunic
9. tiny pit in the macula lutea; contains only cones
10. important light-bending structure of the eye; shape can be modified
11. anterior transparent part of the fibrous tunic—your “window on the world”
12. the white of the eye

8. The intrinsic eye muscles are under the control of which of the following? (Circle the correct response.)
   - autonomic nervous system
   - somatic nervous system

Dissection of the Cow (Sheep) Eye

9. 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 to allow cow to see better in low light conditions

10. Describe the appearance of the retina.
    - delicate, white crumpled
    - membrane-like

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

Visual Tests and Experiments

11. Use terms from the key to complete the statements concerning near and distance vision. (Some terms may be used more than once.)

   Key: contracted decreased increased relaxed taut lax

   During distance vision: The ciliary muscle is relaxed, the ciliary zonule (suspensory ligament) is taut, the convexity of the lens is decreased and light refraction is decreased. During close vision: The ciliary muscle is contracted, the ciliary zonule (suspensory ligament) is lax, lens convexity is increased, and light refraction is increased.
12. Explain why the part of the image hitting the blind spot is not seen. **NO PHOTORECEPTORS**

13. Match the terms in column B with the descriptions in column A:

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABERRATION</strong></td>
<td>1. light bending</td>
</tr>
<tr>
<td><strong>ACCOMMODATION</strong></td>
<td>2. ability to focus for close (under 20 ft) vision</td>
</tr>
<tr>
<td><strong>EMMETROPIA</strong></td>
<td>3. normal vision</td>
</tr>
<tr>
<td><strong>HYPEROPIA</strong></td>
<td>4. inability to focus well on close objects (farsightedness)</td>
</tr>
<tr>
<td><strong>MYOPIA</strong></td>
<td>5. nearsightedness</td>
</tr>
<tr>
<td><strong>ASTIGMATISM</strong></td>
<td>6. blurred vision due to unequal curvatures of the lens or cornea</td>
</tr>
<tr>
<td><strong>CONVERGENCE</strong></td>
<td>7. medial movement of the eyes during focusing on close objects</td>
</tr>
<tr>
<td>accommodation</td>
<td>astigmatism</td>
</tr>
<tr>
<td>convergence</td>
<td>emmetropia</td>
</tr>
<tr>
<td>hyperopia</td>
<td>myopia</td>
</tr>
<tr>
<td>refraction</td>
<td></td>
</tr>
</tbody>
</table>

14. 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 the Snellen eye chart is used. **TO UNDERSTAND THE ACUITY OF EACH EYE**

Explain 20/40 vision.  **MEANS LESS THAN NORMAL VISION + SPECIFICALLY THAT THEY SEE BETTER CLOSE UP; MYOPIC**

Explain 20/10 vision. **MEANS BETTER THAN NORMAL VISION + SPECIFICALLY THAT THEY SEE BETTER FAR AWAY; HYPEROPIE**

15. Define astigmatism: **BLURRED VISION DUE TO UNEQUAL CURVATURES OF THE CORNEA**

16. 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? ____________________________

17. How can you explain the fact that we see a great range of colors even though only three cone types exist?  **RANGE OF COLOR COMES FROM WEIGHTED AVERAGE OF OVERLAPPING WAVELENGTH SENSITIVITIES OF THE THREE CONE TYPES**
18. 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? ____________________________

What extrinsic eye muscles control the movement of the eyes during this reflex? ____________________________

What is the value of this reflex? ____________________________

If these muscles were unable to function, what would be the visual result?

19. Many college students struggling through mountainous reading assignments are told that they need glasses for “eye strain.” Why does looking at close objects cause more strain on the extrinsic and intrinsic eye muscles than does looking at far objects?

LOOKING AT CLOSE OBJECTS MAKES BOTH TYPES OF MUSCLES CONTRACT FOR LONG PERIODS OF TIME; MUSCLE FATIGUE

The Ear and Hearing and Balance: Anatomy

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

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANVIL</td>
<td>auditory (pharyngotympanic) tube</td>
</tr>
<tr>
<td>HAMMER</td>
<td>anvil (incus)</td>
</tr>
<tr>
<td>STIRUP</td>
<td>cochlea</td>
</tr>
<tr>
<td>VESTIBULE</td>
<td>endolymph</td>
</tr>
<tr>
<td>SEMICIRCULAR CANALS</td>
<td>external acoustic meatus</td>
</tr>
<tr>
<td></td>
<td>hammer (malleus)</td>
</tr>
<tr>
<td>TYPANIC MEMBRANE</td>
<td>oval window</td>
</tr>
<tr>
<td>SEMICIRCULAR CANALS</td>
<td>perilymph</td>
</tr>
<tr>
<td>OVAL WINDOW</td>
<td>pinna</td>
</tr>
<tr>
<td>AUDITORY TUBE</td>
<td>round window</td>
</tr>
<tr>
<td></td>
<td>semicircular canals</td>
</tr>
<tr>
<td></td>
<td>tympanic membrane</td>
</tr>
<tr>
<td>ENDOLYMPH</td>
<td>vestibule</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. collectively called the auditory ossicles
2. ear structures involved with balance
3. transmits sound vibrations to the ossicles
4. three circular passages, each in a different plane of space
5. transmits the vibratory motion of the stirrup to the fluid in the inner ear
6. passage between the throat and the tympanic cavity
7. fluid contained within the membranous labyrinth
8. involved in equalizing pressure in the middle ear with atmospheric pressure
21. Identify all indicated structures and ear regions that are provided with leader lines or brackets in the following diagram.

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

**Column A**

1. contains the spiral organ of Corti
2. sites of the maculae
3. hair cells of the spiral organ of Corti rest on this membrane
4. gel-like membrane overlying the hair cells of the spiral organ of Corti
5. contains the crista ampullaris
6. function in static equilibrium
7. function in dynamic equilibrium
8. carries auditory information to the brain
9. gelatinous cap overlying hair cells of the crista ampullaris
10. grains of calcium carbonate in the maculae

**Column B**

1. ampulla
2. basilar membrane
3. cochlear duct
4. cochlear nerve
5. cupula
6. otoliths
7. saccule
8. semicircular ducts
9. tectorial membrane
10. utricle
11. vestibular nerve
23. Describe how sounds of different frequency (pitch) are differentiated in the cochlea. Different pitch sounds stimulate different areas of the spiral organ.

24. Explain the role of the endolymph of the semicircular canals in activating the receptors during angular motion. The endolymph moves more slowly than the cupula and thus causes it to bend which activates the receptors.

25. Explain the role of the otoliths in perception of static equilibrium (head position). Otoliths provide weight and under the influence of gravity pull on the otolith membrane which than moves the hair cells hair causing action potentials.

Hearing and Balance Tests

26. Was the auditory acuity measurement made during the experiment on page 209 the same or different for both ears? ____________________________ What factors might account for a difference in the acuity of the two ears? ____________________________

27. During the sound localization experiment on page 209, in which position(s) was the sound least easily located? ____________________________ How can this observation be explained? ____________________________

28. When the tuning fork handle was pressed to your forehead during the Weber test, where did the sound seem to originate? ____________________________ Where did it seem to originate when one ear was plugged with cotton? ____________________________ How do sound waves reach the cochlea when conduction deafness is present? ____________________________

29. The Rinne test evaluates an individual’s ability to hear sounds conducted by air or bone. Which is typical of normal hearing? ____________________________

30. Define nystagmus: It is the involuntary rolling of the eyes in any direction or the trailing of the eyes slowly in one direction.