CHAPTER 15

The Special Senses: Part A
Warm Up

• What is the function of the eyeball? List any structures of the eyeball that you already know!
The Eye and Vision

- 70% of all sensory receptors are in the eye
- Nearly half of the cerebral cortex is involved in processing visual information!
- Most of the eye is protected by a cushion of fat and the bony orbit
Accessory Structures of the Eye

- Protect the eye and aid eye function
  - Eyebrows
  - Eyelids (palpebrae)
  - Conjunctiva
  - Lacrimal apparatus
  - Extrinsic eye muscles
(a) Surface anatomy of the right eye

- Eyebrow
- Eyelid
- Eyelashes
- Site where conjunctiva merges with cornea
- Palpebral fissure
- Lateral commissure
- Iris
- Eyelid
- Pupil
- Sclera (covered by conjunctiva)
- Lacrimal caruncle
- Medial commissure
Eyebrows

- Overlie the supraorbital margins
- Function in
  - Shading the eye
  - Preventing perspiration from reaching the eye
Eyelids

• Protect the eye anteriorly
• Palpebral fissure—separates eyelids
• Lacrimal caruncle—elevation at medial commissure; contains oil and sweat glands
• Tarsal plates—internal supporting connective tissue sheet
• Levator palpebrae superioris—gives the upper eyelid mobility
Eyelids

• Eyelashes
  • Nerve endings of follicles initiate reflex blinking
• Lubricating glands associated with the eyelids
  • Tarsal (Meibomian) glands
  • Sebaceous glands associated with follicles
  • Ciliary glands between the hair follicles
(b) Lateral view; some structures shown in sagittal section
Conjunctiva

• Transparent membrane
  • Palpebral conjunctiva lines the eyelids
  • Bulbar conjunctiva covers the white of the eyes
  • Produces a lubricating mucous secretion
Lacrimal Apparatus

- Lacrimal gland and ducts that connect to nasal cavity
- Lacrimal secretion (tears)
  - Dilute saline solution containing mucus, antibodies, and lysozyme
  - Blinking spreads the tears toward the medial commissure
  - Tears enter paired lacrimal canaliculi via the lacrimal puncta
  - Drain into the nasolacrimal duct
Extrinsic Eye Muscles

- Six straplike extrinsic eye muscles
  - Originate from the bony orbit
  - Enable the eye to follow moving objects
  - Maintain the shape of the eyeball
- Four rectus muscles originate from the common tendinous ring; names indicate the movements they promote
- Two oblique muscles move the eye in the vertical plane and rotate the eyeball
Figure 15.3a

(a) Lateral view of the right eye
Figure 15.3b

(b) Superior view of the right eye

Trochlea
Superior oblique muscle
Superior oblique tendon
Superior rectus muscle
Axis at center of eye
Inferior rectus muscle
Medial rectus muscle
Lateral rectus muscle
Common tendinous ring
### (c) Summary of muscle actions and innervating cranial nerves

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Action</th>
<th>Controlling cranial nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral rectus</td>
<td>Moves eye laterally</td>
<td>VI (abducens)</td>
</tr>
<tr>
<td>Medial rectus</td>
<td>Moves eye medially</td>
<td>III (oculomotor)</td>
</tr>
<tr>
<td>Superior rectus</td>
<td>Elevates eye and turns it medially</td>
<td>III (oculomotor)</td>
</tr>
<tr>
<td>Inferior rectus</td>
<td>Depresses eye and turns it medially</td>
<td>III (oculomotor)</td>
</tr>
<tr>
<td>Inferior oblique</td>
<td>medially</td>
<td>III (oculomotor)</td>
</tr>
<tr>
<td>Superior oblique</td>
<td>Elevates eye and turns it laterally</td>
<td>IV (trochlear)</td>
</tr>
<tr>
<td></td>
<td>Depresses eye and turns it laterally</td>
<td></td>
</tr>
</tbody>
</table>
What to be working on…

1. **PreLab** - on my website (answer questions on a sheet of notebook paper… must be completed in order to do the dissection tomorrow!) → **DUE TOMORROW**

2. **Packet Work** - *(DUE THURSDAY)*
   - Optical Illusion Lab,
   - Blind Now See Article Reading Notes/ Questions
   - Unit Guide *(CUT # 7, 8 and 9)*

3. **Project Work** - *(DUE THURSDAY as well!)*

**REMINDER** - gloves are required for tomorrow’s dissection!
Warm Up - Happy Monday!

→ List the names and functions of the 5 accessory structures to the eye.
Structure of the Eyeball

- Wall of eyeball contains three layers
  - Fibrous
  - Vascular
  - Sensory
- Internal cavity is filled with fluids called humors
- The lens separates the internal cavity into anterior and posterior segments (cavities)
(a) **Diagrammatic view.** The vitreous humor is illustrated only in the bottom part of the eyeball.
Fibrous Layer

• Outermost layer; dense avascular connective tissue

• Two regions: sclera and cornea

1. Sclera

• Opaque posterior region
• Protects and shapes eyeball
• Anchors extrinsic eye muscles
2. Cornea:

- Transparent anterior 1/6 of fibrous layer
- Bends light as it enters the eye
- Sodium pumps of the corneal endothelium on the inner face help maintain the clarity of the cornea
- Numerous pain receptors contribute to blinking and tearing reflexes
Vascular Layer (Uvea)

• Middle pigmented layer

• Three regions: choroid, ciliary body, and iris

1. Choroid region

• Posterior portion of the uvea

• Supplies blood to all layers of the eyeball

• Brown pigment absorbs light to prevent visual confusion
2. Ciliary body

- Ring of tissue surrounding the lens
- Smooth muscle bundles (ciliary muscles) control lens shape
- Capillaries of ciliary processes secrete fluid
- Ciliary zonule (suspensory ligament) holds lens in position
Vascular Layer

3. Iris

- The colored part of the eye
- Pupil—central opening that regulates the amount of light entering the eye
  - Close vision and bright light—sphincter papillae (circular muscles) contract; pupils constrict
  - Distant vision and dim light—dilator papillae (radial muscles) contract; pupils dilate
- Changes in emotional state—pupils dilate when the subject matter is appealing or requires problem-solving skills
Figure 15.5

Iris (two muscles)
- Sphincter pupillae muscle contraction decreases pupil size.
- Dilator pupillae muscle contraction increases pupil size.

Parasympathetic +

Sympathetic +
Sensory Layer: Retina

- Delicate two-layered membrane
  - Pigmented layer
    - Outer layer
    - Absorbs light and prevents its scattering
  - Stores vitamin A
Sensory Layer: Retina

- Neural layer
  - Photoreceptor: transduce light energy
  - Cells that transmit and process signals: bipolar cells, ganglion cells, amacrine cells, and horizontal cells
Pathway of light

(a) Posterior aspect of the eyeball

Neural layer of retina
Pigment layer of retina
Optic nerve
Sclera
Choroid
Central artery and vein of retina
Optic disc

Figure 15.6a
The Retina

- Ganglion cell axons
  - Run along the inner surface of the retina
  - Leave the eye as the optic nerve
- Optic disc (blind spot)
  - Site where the optic nerve leaves the eye
  - Lacks photoreceptors
Figure 15.6b

Cells of the neural layer of the retina

- Rod
- Cone
- Bipolar cells
- Ganglion cells

Pathway of light
Pathway of signal output

Amacrine cell
Horizontal cell
Pigmented layer of retina

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Photoreceptors

• Rods
  • More numerous at peripheral region of retina, away from the macula lutea
  • Operate in dim light
  • Provide indistinct, fuzzy, non color peripheral vision
Photoreceptors

• Cones
  • Found in the macula lutea; concentrated in the fovea centralis
  • Operate in bright light
  • Provide high-acuity color vision
Blood Supply to the Retina

• Two sources of blood supply
  • Choroid supplies the outer third (photoreceptors)
  • Central artery and vein of the retina supply the inner two-thirds
Figure 15.7

- Central artery and vein emerging from the optic disc
- Macula lutea
- Optic disc
- Retina
Internal Chambers and Fluids

• The lens and ciliary zonule separate the anterior and posterior segments
Figure 15.4a

(a) Diagrammatic view. The vitreous humor is illustrated only in the bottom part of the eyeball.

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Internal Chambers and Fluids

• Posterior segment contains vitreous humor that:
  • Transmits light
  • Supports the posterior surface of the lens
  • Holds the neural retina firmly against the pigmented layer
  • Contributes to intraocular pressure

• Anterior segment is composed of two chambers
  • Anterior chamber—between the cornea and the iris
  • Posterior chamber—between the iris and the lens
Internal Chambers and Fluids

- Anterior segment contains aqueous humor
  - Plasma like fluid continuously filtered from capillaries of the ciliary processes
  - Drains via the scleral venous sinus (canal of Schlemm) at the sclera-cornea junction
  - Supplies nutrients and oxygen mainly to the lens and cornea but also to the retina, and removes wastes
- Glaucoma: compression of the retina and optic nerve if drainage of aqueous humor is blocked
1 Aqueous humor is formed by filtration from the capillaries in the ciliary processes.
2 Aqueous humor flows from the posterior chamber through the pupil into the anterior chamber. Some also flows through the vitreous humor (not shown).
3 Aqueous humor is reabsorbed into the venous blood by the scleral venous sinus.
Lens

- Biconvex, transparent, flexible, elastic, and avascular
- Allows precise focusing of light on the retina
- Cells of lens epithelium differentiate into lens fibers that form the bulk of the lens
- Lens fibers—cells filled with the transparent protein crystallin
- Lens becomes denser, more convex, and less elastic with age
- Cataracts (clouding of lens) occur as a consequence of aging, diabetes mellitus, heavy smoking, and frequent exposure to intense sunlight
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What to be working on…

→ PROJECT RESEARCH! (please follow the guidelines given to you last class :))

→ PACKET WORK

- Optical Illusion Lab
- “Once Blind Now They See” Article Reading Notes and Questions
- Unit 6 Study Guide!