Basic Ocular Anatomy

Features of the eye

- Cornea
- Iris
- Lens
- Aqueous humor
- Angle
- Sclera
- Choroid
- Pigment epithelium
- Retina
- Macula
- Fovea
- Optic nerve
- Canal of Schlemm
- Ciliary muscle
Horizontal cross section of the human eye.

VA = visual axis
AP = anterior pole
PP = posterior pole
Lam. = lamina
crib. = cribrosa
Med. = medial

Three Ocular Layers

A. Outer layer
   • Sclera
   • Cornea

B. Middle layer (uvea)
   • Iris
   • Ciliary body
   • Choroid

C. Inner layer
   • Retina
Sclera & Cornea

Sclera
• Consists largely of collagen.
• Provides support and protection, and maintains shape of eye.

Cornea
• Transparent anterior part of eye, the most powerful optical component of the eye.
• Lacks blood vessels, gets oxygen directly from the air and the aqueous humor.
• Very sensitive nerve endings, responds rapidly to injury.

Uvea: Iris

Uvea
• Highly vascularized, provides nutrition to various elements of the eye.

Iris
• The colored part of the eye.
• Controls pupil size -> regulates the amount of light entering the eye.
• Influences sharpness of retinal image.
Uvea: Ciliary Body & Choroid

Ciliary body
- Produces aqueous humor (function: nourishes the cornea and lens).
- Ciliary muscle plays a major role in accommodation (change in lens shape to focus at distance or near).

Choroid
- Provides nourishment to the retina.
Other Ocular Structures

- Crystalline lens
- Vitreous humor
- Canal of Schlemm
- Fovea
- Optic Nerve

Crystalline Lens

- Provides ~1/3 of the power of the eye.
- Accommodation: changes its shape to focus at different distances.
- Loses its ability to change shape easily with age -> presbyopia.
- With age, lens becomes less transparent -> cataract.
**Vitreous Humor**

- Consists primarily of collagen and hyaluronic acid and has a gel-like structure.
- Provides structural support to the eye and helps nourishes the retina.
- With age, may liquefy -> floaters.

**Canal of Schlemm**

- Provides drainage for the aqueous humor.
- Located at the angle of the eye (where the iris inserts into the ciliary body).
- Production and drainage of aqueous humor help maintain the intraocular pressure (IOP).
Optic Nerve

- Axons of the ganglion cells (leaving the eye).
- Optic nerve head, or optic disc: the part of the fundus where the bundle of ganglion cells exits the eye.
- No photoreceptors in optic disc, therefore no perception of light -> physiological blind spot.
Fundus Photograph

From Livingston, 1995

Retinal Blood Vessels

Retinal vessels imaged with fluorescein angiography

Note the absence of blood vessels in the fovea.
Retina

- A sheet of neural tissue, ~0.2 to 0.4 mm thick.
- 5 classes of neurons: photoreceptors, bipolar cells, ganglion cells, horizontal cells and amacrine cells. Each of these classes has subtypes, as well.

Anatomic Subdivisions of the Macula

- foveola
- perifovea
- parafovea
- capillary free zone
- Fovea centralis
- umbo

From Gass, 1997
Section through the center of the fovea

The dark regions in blue light that are absent in green light are areas of high macular pigment density -- most dense along the fibers of Henle.
Fovea

- Specialized area of the retina that subserves most acute vision.
- Foveal pit: neural elements of inner retina piled up on the side of pit.
- Part of the macula (area centralis).
- Macula contains a pigment that screens out blue light, thus giving the macula a yellow tinge.
Retinal Wiring

Abbreviations
Rb = rod bipolar
AIIa = AII amacrine
Am = amacrine cell
M = midget
gc = ganglion cell
Pa = parasol gc
on = ON
OFF
F = flat
I = invaginating
d = diffuse
cb = cone bipolar
Hz = horizontal cell

From Livingston, 1995
Photoreceptors

- 2 classes of photoreceptors: rods and cones.
- **Rods**: night-time vision, very sensitive at dim light level, no rods in the fovea.
- **Cones**: daytime vision, not as sensitive as rods but work well in bright light, most densely packed in the fovea. Three cone types provide trichromatic (color) vision.

Simplified Retinal Wiring Diagram

- Photons are absorbed in photoreceptor
- Electrical potential changes in the membrane cause a release of neurotransmitter into “synapse”
- Bipolar cell communicates signals to Ganglion Cell
- Ganglion Cell generates an “Action Potential” that travels up the Optic Nerve to the brain.