

# VISUAL SYSTEM (1)

**CN:** Use orange for E, yellow for G, red for M, blue for N, and very light colors for C, H, I, J, and K. (1) Color the sagittal section of the eyeball and the uppermost illustrations simultaneously. Arteries (M) and veins (N) are too narrow to be colored on the surface of the retina in the sagittal section. (2) When coloring the retinal layers, color gray the arrows (in dark outlines) representing the nerve impulse.

## EYE LAYERS:

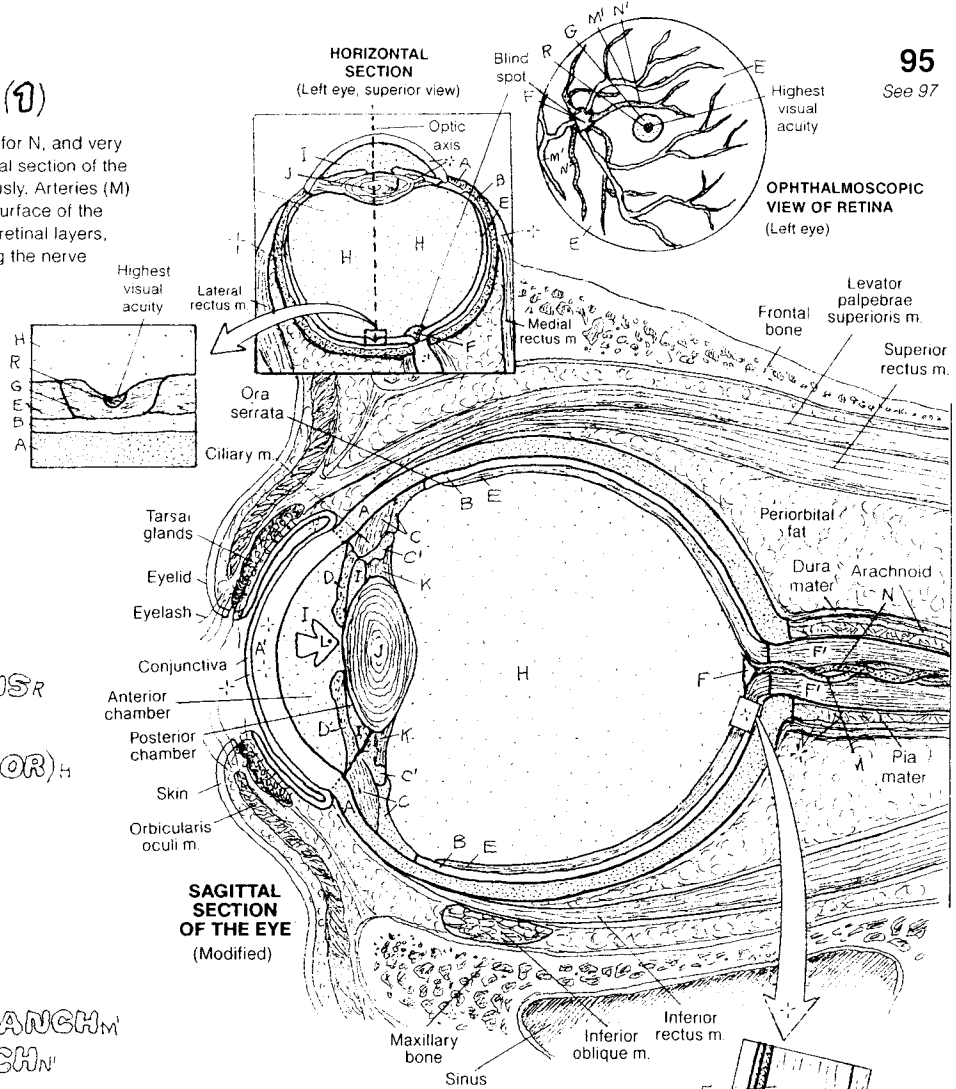
- SCLERA<sub>A</sub> /
- CORNEA<sub>A'</sub> /
- CHOROID<sub>B</sub>
- CILIARY BODY<sub>C</sub>
- PROCESS<sub>C'</sub>
- IRIS<sub>D</sub>
- RETINA<sub>E</sub>
- OPTIC DISC<sub>F</sub>
- MACULA LUTEA<sub>G</sub>
- FOVEA CENTRALIS<sub>R</sub>

## FLUIDS:

- VITREOUS BODY (HUMOR)<sub>H</sub>
- AQUEOUS HUMOR<sub>I</sub>

## OTHER STRUCTURES:

- LENS<sub>J</sub>
- SUSPENSORY LIG<sub>D,K</sub>
- PUPIL<sub>L</sub>
- OPTIC NERVE<sub>F'</sub>
- RETINAL ARTERY<sub>M</sub> / BRANCH<sub>M'</sub>
- RETINAL VEIN<sub>N</sub> / BRANCH<sub>N'</sub>

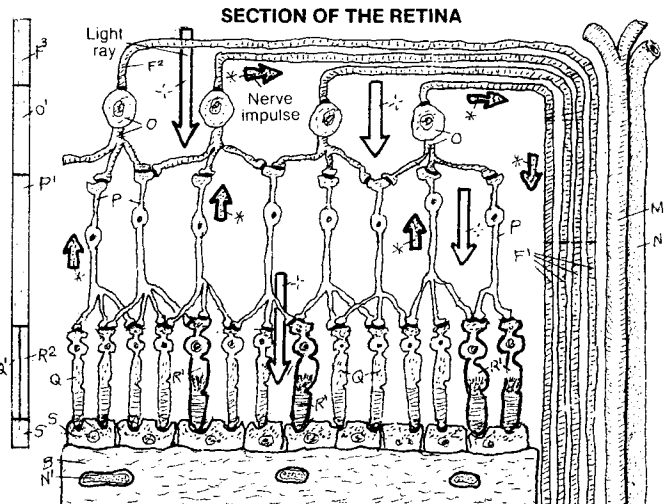


The eye is a layer of photoreceptor cells and associated neurons (retina) packaged within a white, fibrous, rubberlike protective globe (*sclera*) that is transparent in front (*cornea*). The cornea, composed of five layers of epithelia and fibrous tissue, is the chief refractive medium of the eye, focusing light rays onto the retina. The *lens* (tightly packed, encapsulated non-elastic lens fibers derived from epithelial cells) also refracts light, and up to middle age, it can vary its shape (and refractive index). The *aqueous humor* (extracellular fluid) filling the anterior and posterior chambers of the eye, and the more gelatinous (99% water) *vitreous humor* taking up 80% of the globe's volume, function as refractive media. The inner surface of the posterior two-thirds of the sclera is lined with a vascular, highly pigmented layer (*choroid*) that absorbs and prevents scattering of light. The choroid thickens anteriorly as the pigmented, fibromuscular *ciliary body* that surrounds the lens. The ciliary body projects outpocketings (*processes*) to which *suspensory ligaments* from the lens attach. On the anterior aspect of the ciliary body, a thin, pigmented, epithelial and fibromuscular layer (*iris*) circumscribes the hole (*pupil*) in front of the lens.

The retina lines the posterior half of the interior of the globe, and a bit more, ending anteriorly at the ora serrata. At the retinal end of the optic axis, there is a yellow pigmented area (*macula lutea*) within which is a depressed area called the *fovea centralis*. Under lighted conditions, this is the center of greatest visual acuity (clarity of form and color), reflecting a dense accumulation of color-sensitive cells (cones). About 3 mm to the nose side of the macula, axons of the nerve fiber layer stream out through the optic disc to become the *optic nerve*. The *optic disc* is devoid of light-sensitive cells and is therefore a blind spot. The *pigmented layer* of the retina (refreshing pigment to the adjacent rods/cones) is closest to the choroid. The photoreceptor layer consists of *cone cells* (sensitive to form and color) and color-insensitive *rod cells* possessing great sensitivity to light. *Bipolar cells* receive and mediate input from rod and cone cells and conduct resultant impulses to the *ganglion cell layer*. Among these two more-peripheral layers are interwoven numerous horizontal cells (not shown for visual clarity) that influence neuronal activity. The axons of the ganglion cells, the final common pathway of retinal activity, form the fibers of the optic nerve.

## LAYERS OF RETINA

- AXON<sub>F2</sub> / NERVE FIBER LAYER<sub>F3</sub>
- GANGLION CELL<sub>F</sub> / LAYER<sub>F'</sub>
- BIPOLAR CELL<sub>P</sub> / LAYER<sub>P'</sub>
- ROD CELL<sub>Q</sub> / LAYER<sub>Q'</sub>
- CONE CELL<sub>R</sub> / LAYER<sub>R'</sub>
- PIGMENTED EPITHELIAL LAYER<sub>R</sub>



# VISUAL SYSTEM (2)

CN: Use the same colors as were used on the previous plate (with different subscripts) for structures J, K, L, M, N<sup>1</sup>, and O. Use light colors for A, G, H, and I. Note that various structures in the central illustration also appear in the illustration below it.

## ACCESSORY STRUCTURES:

### LACRIMAL APPARATUS

LACRIMAL GLAND<sub>A</sub>

TEAR<sub>A'</sub>

DUCT<sub>A'</sub>

LACRIMAL PUNCTA<sub>C</sub>

CANAL<sub>D</sub>

LACRIMAL SAC<sub>E</sub>

NASOLACRIMAL DUCT<sub>F</sub>

INFERIOR MEATUS OF NASAL CAVITY<sub>G</sub>

TARSAL PLATE/GLAND<sub>H</sub>

CONJUNCTIVA<sub>I</sub>

Fluid (tears) interfacing the conjunctivae of the eyelid (palpebra) and the cornea facilitate easy movement of the lids over the cornea without inducing irritation. Tears also function as a vehicle for moving epithelial debris and microorganisms from the corneal surface and undersurface of the eyelids into the nasal cavity via the lacrimal apparatus. Thus, there is an anatomic basis for blowing your nose after a good cry. The absence of tears can cause remarkable pain and even blindness. The principal gland for tears is the *lacrimal gland*, located in the anterior, superior and lateral (temporal) aspect of the orbit. Other glands and sources of tears include unicellular (goblet) glands of the conjunctiva and *tarsal glands* of the lids. Episodic blinking (rapid cycle of lid approximation and retraction) maintains a film of tears on the conjunctiva and resists "dry eye." Routine closing of the lids occurs with muscle relaxation; energetic closure requires the orbicularis oculi muscle. Retraction of the eyelids is accomplished by smooth muscle fibers (tarsal muscle of Müller; sympathetic innervation) and the levator palpebrae muscle in the upper lid.

## SECRETION/DRAINAGE OF AQUEOUS HUMOR:

### FLOW OF AQUEOUS HUMOR:

SCLERA<sub>K</sub>

CORNEA<sub>K'</sub>

CILIARY BODY<sub>L</sub>

PROCESS<sub>L'</sub>

POSTERIOR CHAMBER<sub>J'</sub>

IRIS<sub>M</sub>

ANTERIOR CHAMBER<sub>J<sup>2</sup></sub>

CANAL OF SCHLEMM<sub>N</sub>

VEIN<sub>N'</sub>

### VITREOUS BODY.

### INTRAOCULAR PRESSURE (IOP)<sub>P</sub>

Aqueous humor is a fluid in the anterior and posterior chambers of the eye, secreted by cells of the *ciliary processes* (see lowest drawing). Fluid and electrolytes also enter by diffusion from the *ciliary body*. Aqueous humor is a clear, plasma-like fluid (but constituted differently). It is filtered into the *canal of Schlemm* (scleral venous sinus), a modified vein filled with fibrous trabeculae, located at the sclero-corneal junction. Fluid in the canal drains into nearby *veins*. Obstruction to drainage is one of several causes of increased *intraocular pressure*, in which the increasing pressure in the anterior/posterior chambers presses on the lens, which presses on the *vitreous* (99% water) body. As water cannot be compressed, pressure is applied to the contiguous retina. Unrelenting pressure compresses vessels to the axons and neurons of the retina, damages neurons, and can result in blindness (glaucoma).

