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) fills 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) 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.
SPECIAL SENSES

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, 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
  - DUCT
  - LACRIMAL PUNCTA
  - CANAL
  - LACRIMAL SAC
  - NASOLACRIMAL DUCT

INFERIOR MEATUS OF NASAL CAVITY
- TARSAL PLATE/GLAND
- CONJUNCTIVA

Fluid (tears) interlaces the conjunctiva of the eyelid (palpebra) and the cornea facilitating 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 uncellular (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
  - CORNEA
  - CILIARY BODY
  - POSTERIOR CHAMBER
  - ANTERIOR CHAMBER
  - CANAL OF SCHLEMM
  - VEIN

VITREOUS BODY:

INTRAOCULAR PRESSURE (IOP):

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).
SPECIAL SENSES

VISUAL SYSTEM (3)

CN: Use light colors for A-F, H, and I. Use contrasting colors for J and K. (1) After coloring each eye muscle, color its functional arrow in the upper diagram. (2) In the drawing on ciliary action, color only the contracted ciliary muscles. (3) Carefully color the diagram below, noting that only the first titles (visual field) receive J and K colors. The rest of the titles are left uncolored, but use the two colors on the structures to which they refer.

EXTRAOCULAR MUSCLES:
- SUPERIOR RECTUS (ELEV.)
- INFERIOR RECTUS (DEPR.)
- LATERAL RECTUS (ABD.)
- MEDIAL RECTUS (ADD.)
- SUPERIOR OBlique (ROT. A.)
- INFERIOR OBlique (ROT. L.)

The extraocular (extrinsic) muscles of the eye provide for a remarkable tracking capacity of the eye. CNS mechanisms permit conjugate (binocular) movement of both eyes. Slowed, incomplete, or absent movement of one eye during tracking movements suggests cranial nerve dysfunction or muscle/tendon incarceration, as might occur in an orbital plate fracture. The true function of these muscles is more complex than shown, one reason being eye rotation and torsion requiring multiple muscle action. Deviation from co-equal alignment of the eyes is called strabismus.

INTRINSIC MUSCLES:
- CILIARY
- SPHINCTER PUPILLAE
- DILATOR PUPILLAE

The intrinsic muscles are located in the ciliary body (ciliary muscle) and the iris (pupillary dilator and sphincter). Contraction of the ciliary muscles (1) wrinkles the ciliary body tissue and puts slack in the processes, giving laxity to the suspensory ligaments (2) and permitting the lens to round up on its own accord (tension in lens fibers) (3). These muscles function by parasympathetic innervation during near vision in which greater refractivity is desired. The dilator pupillae consists of myoepithelial cells that pull the iris toward the ciliary body, dilating the pupil (sympathetic innervation). The sphincter pupillae circumscribes the inner iris; its contraction constricts the iris, narrowing the pupil (parasympathetic innervation). See the uppermost drawing.

VISUAL PATHWAYS:
- VISUAL FIELD / VISUAL FIELD
- LIGHT WAVE
- OPTIC NERVE
- CHIASMA
- TRACT
- LATERAL GENICULATE BODY
- SUPERIOR COLliculus
- OPTIC RADIATION
- VISUAL CORTEX

As you color the lower diagram, note that the axons (K) from the retinas on the temporal side of the optic axis do not cross at the chiasma. Note further that an expanding tumor of the hypophysis is likely to impair visual acuity in the temporal visual fields only ("tunnel vision"). The thalamus functions as a visual relay center, informing multiple memory areas and other centers of the stimulus. The superior colliculi are visual reflex centers, making possible rapid head and body movements in response to a visual threat. Finally, note that the image of the stimulus impinging on the visual cortex (K/J) is the reverse of that which was actually seen (J/K). Integration of visual and memory centers at the visual cortex makes possible perception of the image as actually seen.