Laboratory Exercise 34

Eye Structure

Materials Needed

Textbook
Dissectible eye model
Compound light microscope
Prepared microscope slide of a mammalian eye (sagittal section)
Sheep or beef eye (fresh or preserved)
Dissecting tray
Dissecting instruments—forceps, sharp scissors, and dissecting needle

For Learning Extension:
Ophthalmoscope

⚠ Safety

- Wear disposable gloves when working on the eye dissection.
- Dispose of tissue remnants and gloves as instructed.
- Wash the dissecting tray and instruments as instructed.
- Wash your laboratory table.
- Wash your hands before leaving the laboratory.

The eye contains photoreceptors, modified neurons located on its inner wall. Other parts of the eye provide protective functions or make it possible to move the eyeball. Still other structures serve to focus light entering the eye so that a sharp image is projected onto the receptor cells. Nerve impulses generated when the receptors are stimulated travel along the optic nerves to the brain, which interprets the impulses and creates the sensation of sight.

Purpose of the Exercise

To review the structure and function of the eye and to dissect a mammalian eye.

LEARNING OUTCOMES

After completing this exercise, you should be able to

1. Locate the major structures of an eye.
2. Describe the functions of the structures of an eye.
3. Trace the structures through which light passes as it travels from the cornea to the retina.
4. Dissect a mammalian eye and locate its major features.

EXPLORE

Procedure A—Structure and Function of the Eye

1. Review the sections entitled "Visual Accessory Organs," "Structure of the Eye," and "Visual Receptors" in chapter 12 of the textbook.
2. As a review activity, label figures 34.1, 34.2, and 34.3.
3. Complete Part A of Laboratory Report 34.
4. Examine the dissectible model of the eye and locate the following features:

eyelid
conjunctiva
orbicularis oculi
levator palpebrae superioris
lacrimal apparatus
- lacrimal gland
- canaliculi
- lacrimal sac
- nasolacrimal duct

extrinsic muscles
- superior rectus
- inferior rectus
- medial rectus

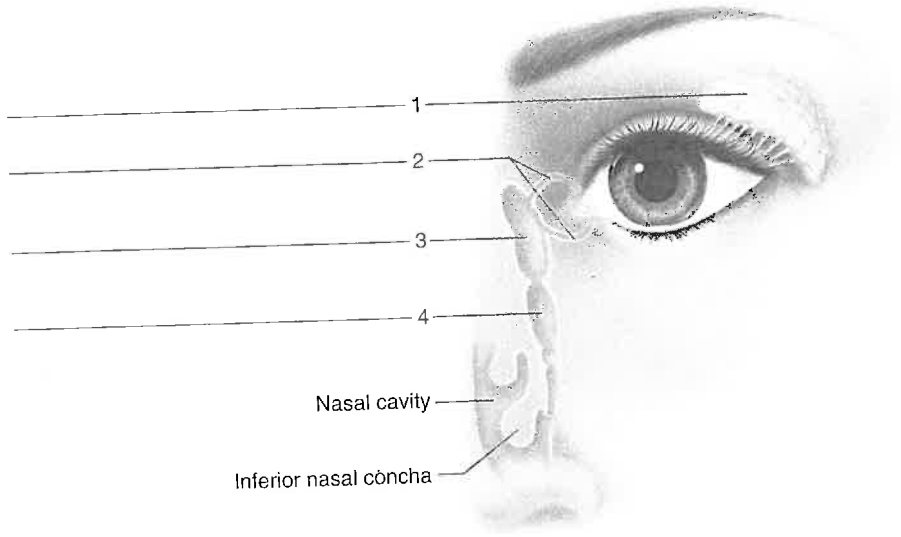

Figure 34.1 Label the structures of the lacrimal apparatus. **1**

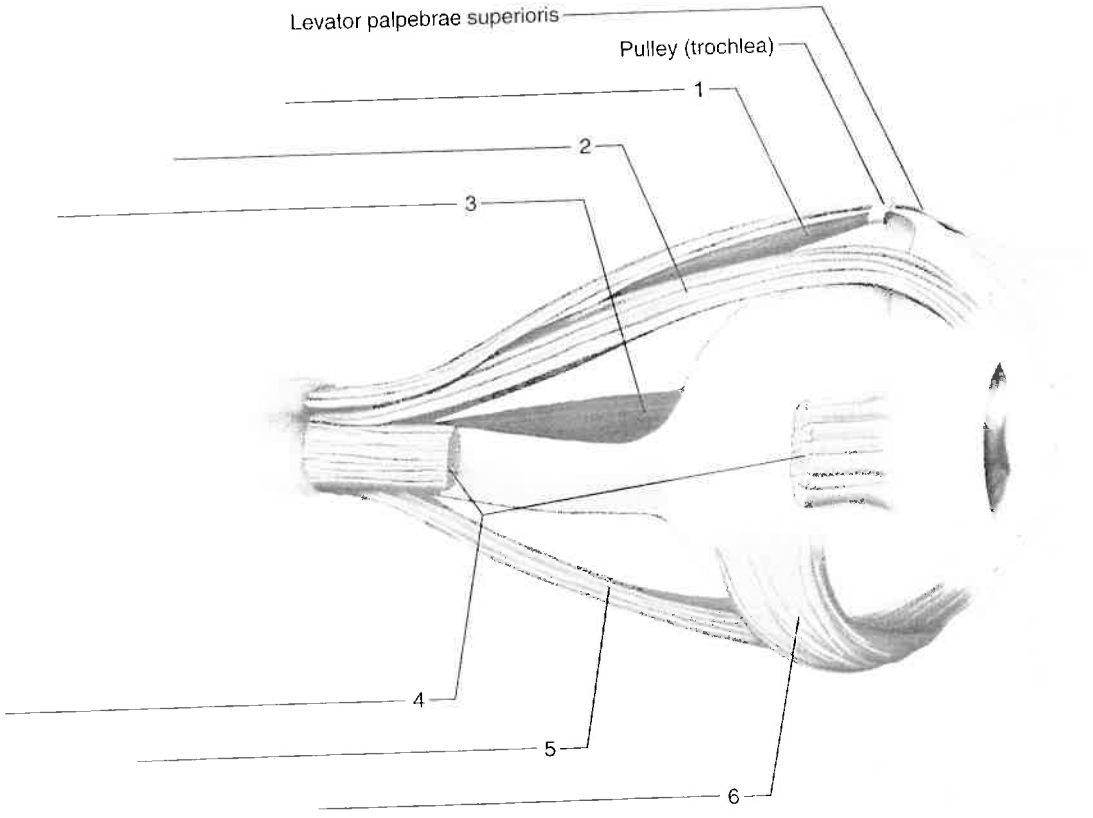

Figure 34.2 Label the extrinsic muscles of the right eye (lateral view). **1**

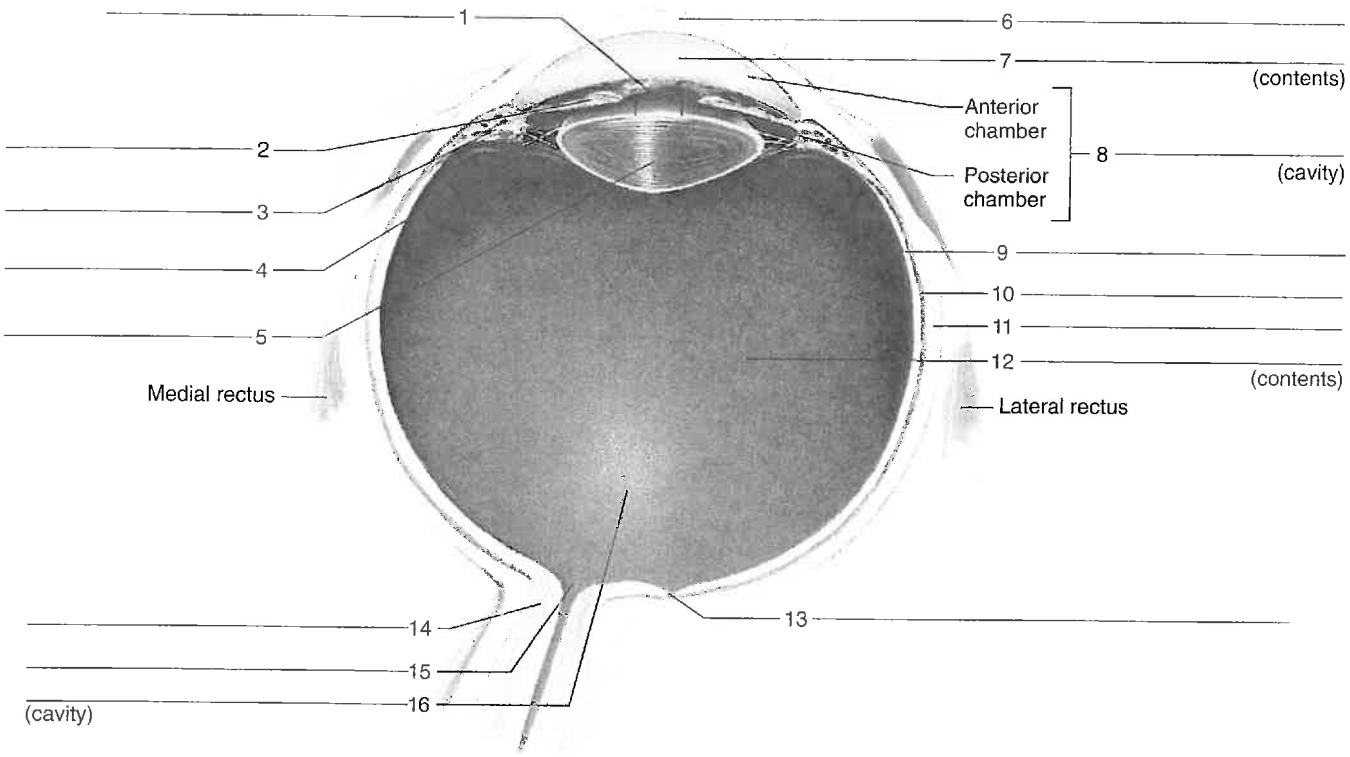

Figure 34.3 Label the structures indicated in this transverse section of the right eye (superior view). 1

lateral rectus
superior oblique
inferior oblique
trochlea (pulley)
outer (fibrous) tunic (layer)
sclera
cornea
middle (vascular) tunic (layer)
choroid coat
ciliary body
ciliary processes
ciliary muscles
suspensory ligaments
iris
pupil (opening in center of iris)
inner (nervous) tunic (layer)
retina
macula lutea
fovea centralis
optic disc
optic nerve
lens
anterior cavity
anterior chamber
posterior chamber
aqueous humor
posterior cavity
vitreous humor

5. Obtain a microscope slide of a mammalian eye section, and locate as many of the features in step 4 as possible.
6. Using high-power magnification, observe the posterior portion of the eye wall, and locate the sclera, choroid coat, and retina.
7. Using high-power magnification, examine the retina, and note its layered structure (fig. 34.4). Locate the following:

nerve fibers leading to the optic nerve (innermost layer of the retina)
layer of ganglion cells
layer of bipolar neurons
nuclei of rods and cones
receptor ends of rods and cones
pigmented epithelium (outermost layer of the retina)

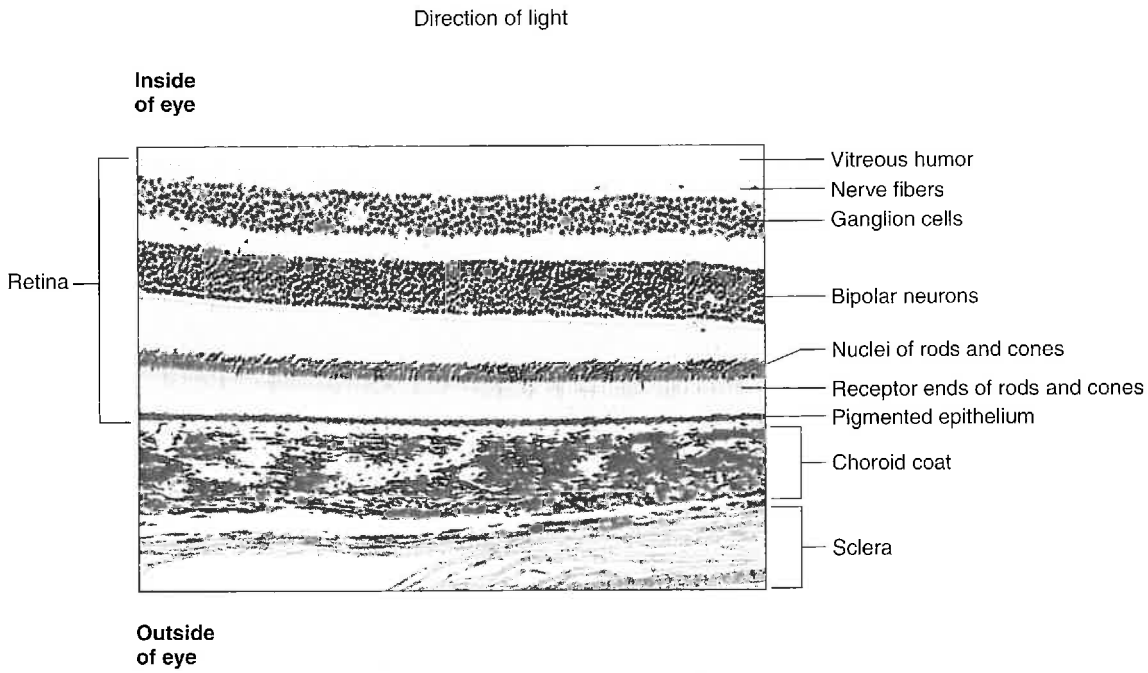

Figure 34.4 The cells of the retina are arranged in distinct layers (75×).

Learning Extension

Use an ophthalmoscope to examine the interior of your laboratory partner's eye. This instrument consists of a set of lenses held in a rotating disc, a light source, and some mirrors that reflect the light into the test subject's eye.

The examination should be conducted in a dimly lit room. Have your partner seated and staring straight ahead at eye level. Move the rotating disc of the ophthalmoscope so that the *0* appears in the lens selection window. Hold the instrument in your right hand with the end of your index finger on the rotating disc (fig. 34.5). Direct the light at a slight angle from a distance of about 15 cm into the subject's right eye. The light beam should pass along the inner edge of the pupil. Look through the instrument, and you should see a reddish, circular area—the interior of the eye. Rotate the disc of lenses to higher values until sharp focus is achieved.

Move the ophthalmoscope to within about 5 cm of the eye being examined *being very careful that the instrument does not touch the eye,* and again rotate the lenses to sharpen the focus (fig. 34.6). Locate the optic disc and the blood vessels that pass through it. Also locate the yellowish macula lutea by having your partner stare directly into the light of the instrument (fig. 34.7).

Examine the subject's iris by viewing it from the side and by using a lens with a +15 or +20 value.

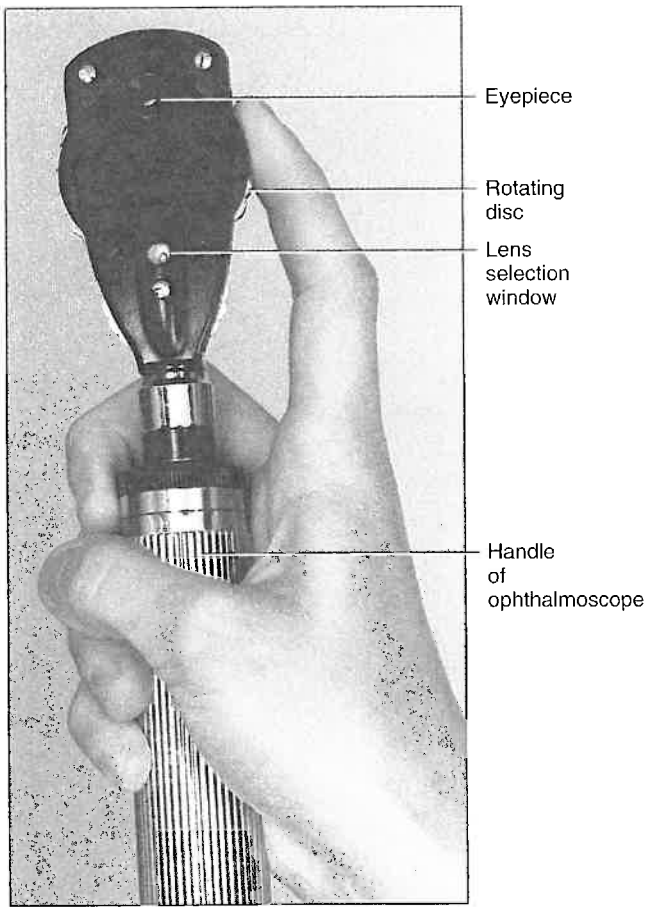

Figure 34.5 The ophthalmoscope is used to examine the interior of the eye.

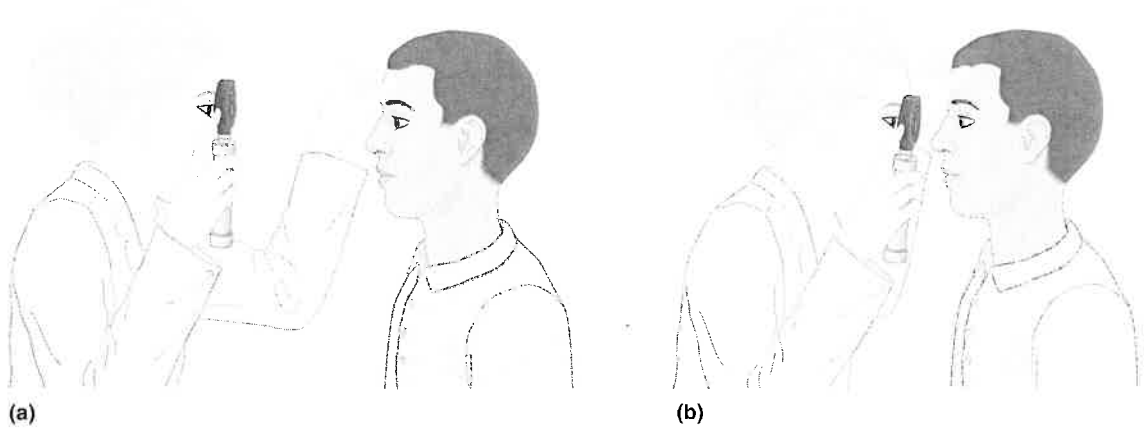

Figure 34.6 (*a*) Rotate the disc of lenses until sharp focus is achieved. (*b*) Move the ophthalmoscope to within 5 cm of the eye to examine the optic disc.

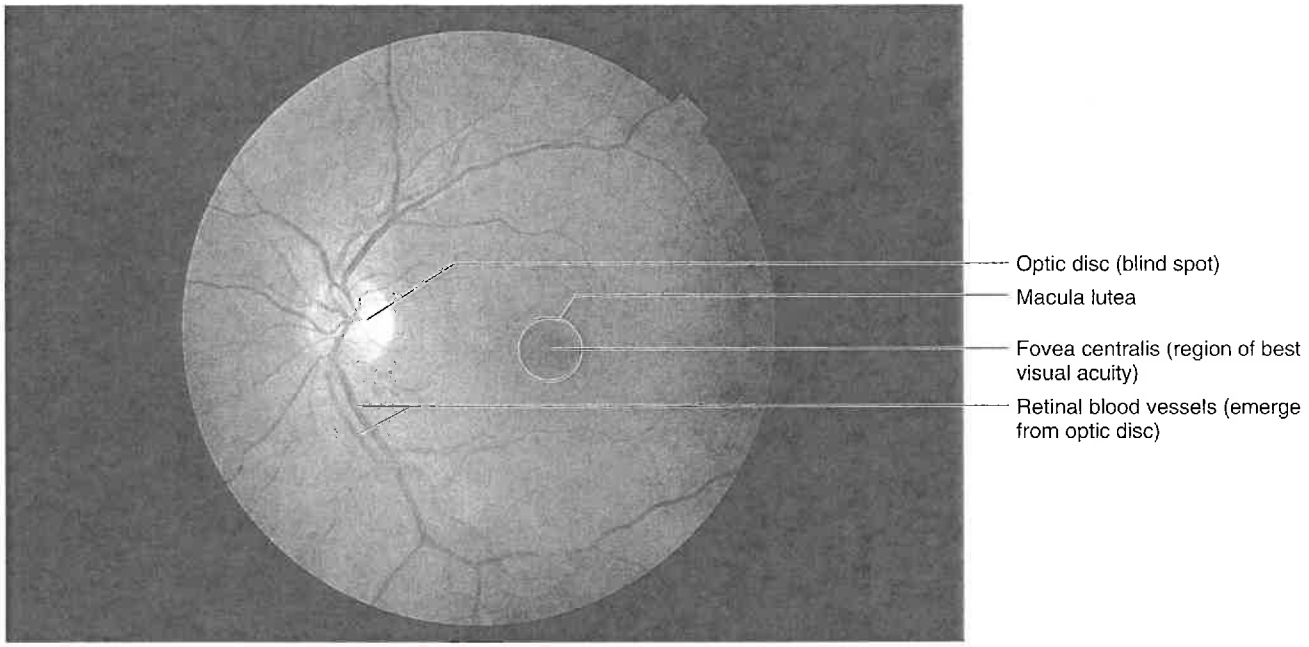

Figure 34.7 Retina of the eye as seen through the pupil using an ophthalmoscope.

EXPLORE

Procedure B—Eye Dissection

1. Obtain a mammalian eye, place it in a dissecting tray, and dissect it as follows:
   - **a.** Trim away the fat and other connective tissues but leave the stubs of the *extrinsic muscles* and of the *optic nerve.* This nerve projects outward from the posterior region of the eyeball.
   - **b.** The *conjunctiva* lines the inside of the eyelid and is reflected over the anterior surface of the eye, except for the cornea. Lift some of this thin membrane away from the eye with forceps and examine it.
   - **c.** Locate and observe the *cornea, sclera,* and *iris.* Also note the *pupil* and its shape. The cornea from a fresh eye will be transparent; when preserved, it becomes opaque.

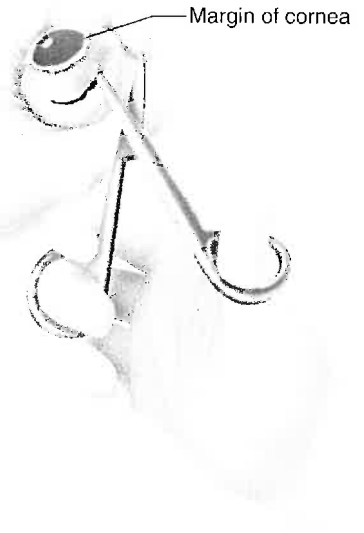

Figure 34.8 Prepare a frontal section of the eye.

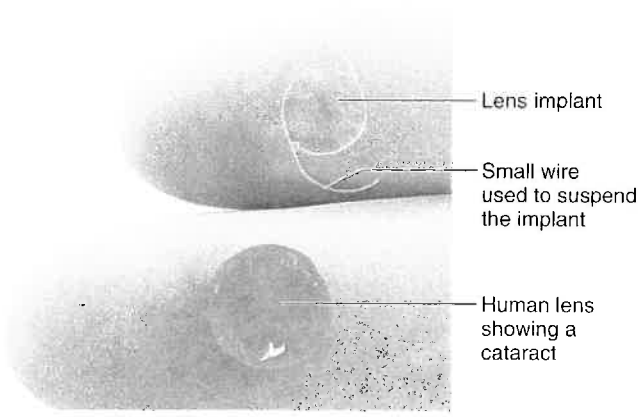

Figure 34.9 Human lens showing a cataract and one type of lens implant (intraocular lens replacement) on tips of fingers to show their relative size. A normal lens is transparent.

d. Use sharp scissors to make a frontal section of the eye. To do this, cut through the wall about 1 cm from the margin of the cornea and continue all the way around the eyeball. Try not to damage the internal structures of the eye (fig. 34.8).

e. Gently separate the eyeball into anterior and posterior portions. Usually the jellylike vitreous humor will remain in the posterior portion, and the lens may adhere to it. Place the parts in the dissecting tray with their contents facing upward.

f. Examine the anterior portion of the eye, and locate the *ciliary body,* which appears as a dark, circular structure. Also note the *iris* and the *lens* if it remained in the anterior portion. The lens is normally attached to the ciliary body by many *suspensory ligaments,* which appear as delicate, transparent threads.

g. Use a dissecting needle to gently remove the lens, and examine it. If the lens is still transparent, hold it up and look through it at something in the distance and note that the lens inverts the image. The lens of a preserved eye is usually too opaque for this experience. If the lens of the human eye becomes opaque, the defect is called a cataract (fig. 34.9).

h. Examine the posterior portion of the eye. Note the *vitreous humor.* This jellylike mass helps to hold the lens in place anteriorly and helps to hold the *retina* against the choroid coat.

i. Carefully remove the vitreous humor and examine the retina. This layer will appear as a thin, nearly colorless to cream-colored membrane that detaches easily from the choroid coat. Compare the structures identified to figure 34.10.

j. Locate the *optic disc*—the point where the retina is attached to the posterior wall of the eyeball and where the optic nerve originates. There are no receptor cells in the optic disc, so this region is also called the "blind spot."

k. Note the iridescent area of the choroid coat beneath the retina. This colored surface in ungulates (mammals having hoofs) is called the *tapetum fibrosum.* It serves to reflect light back through the retina, an action thought to aid the night vision of some animals. The tapetum fibrosum is lacking in the human eye.

2. Discard the tissues of the eye as directed by the laboratory instructor.
3. Complete Parts B and C of the laboratory report.

Critical Thinking Application

A strong blow to the head might cause the retina to detach. From observations made during the eye dissection, explain why this could happen.

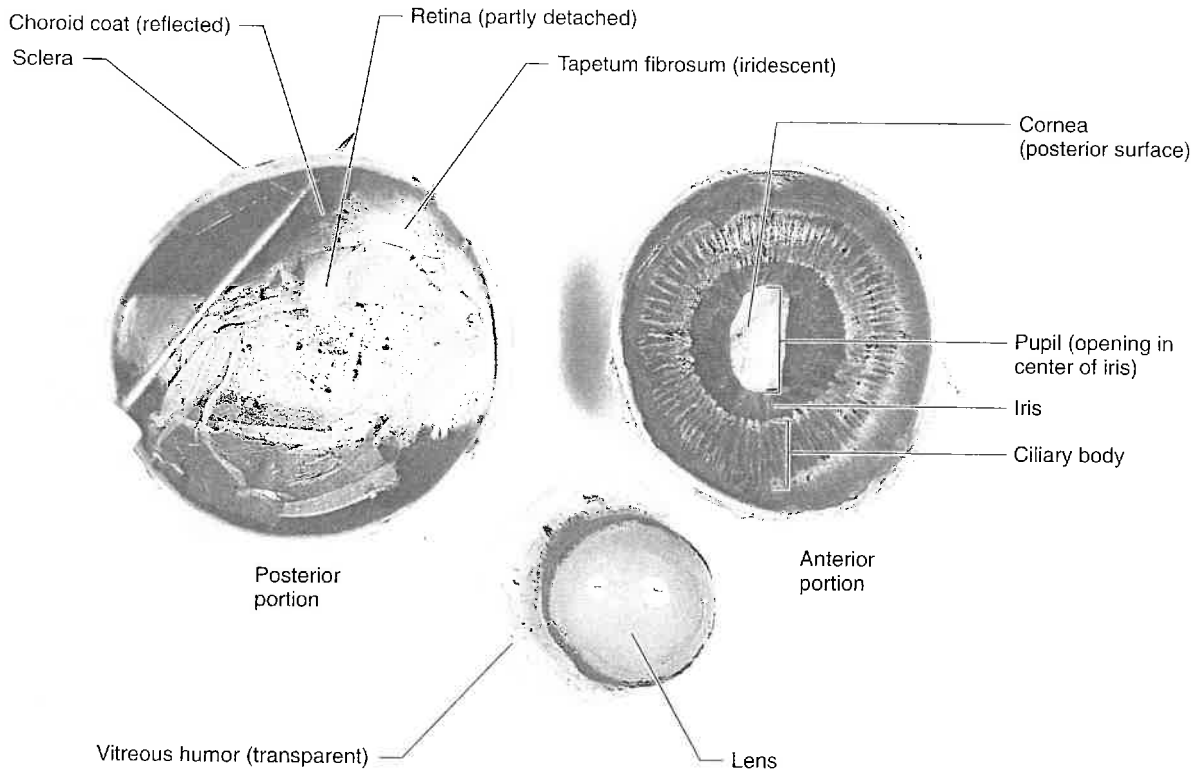

Figure 34.10 Internal structures of the beef eye dissection.