Vocabulary Related to the Special Senses

Terms marked with the ❖ symbol are pronounced on the Student Activity CD-ROM that accompanies this text.

KEY WORD PARTS

- ☐ **blephar/o**
- ☐ **-cusis**
- ☐ **dacryocyst/o**
- ☐ **irid/o**
- ☐ **kerat/o**
- ☐ **-metry**
- ☐ **ophthalm/o**
- ☐ **-opia**
- ☐ **ot/o**
- ☐ **presby/o**
- ☐ **pseud/o**
- ☐ **retin/o**
- ☐ **scler/o**
- ☐ **trop/o**
- ☐ **tympan/o**

KEY MEDICAL TERMS

- ☐ **accommodation** (ah-**kom**-oh-**DAY**-shun) ❖
- ☐ **adnexa** (ad-**NECK**-sah) ❖
- ☐ **amblyopia** (**am**-blee-**OH**-pee-ah) ❖
- ☐ **ametropia** (**am**-eh-**TROH**-pee-ah) ❖
- ☐ **anisocoria** (**an**-ih-so-**KOH**-ree-ah) ❖
- ☐ **astigmatism** (ah-**STIG**-mah-tizm) ❖
- ☐ **audiologist** (**aw**-dee-**OL**-oh-jist)
- ☐ **blepharoptosis** (**blef**-ah-roh-**TOH**-sis *or* **blef**-ah-rop-**TOH**-sis) ❖
- ☐ **cataract** (**KAT**-ah-rakt) ❖
- ☐ **chalazion** (kah-**LAY**-zee-on) ❖
- ☐ **conjunctivitis** (kon-**junk**-tih-**VYE**-tis) ❖
- ☐ **conjunctivoplasty** (**kon**-junk-**TYE**-voh-**plas**-tee)
- ☐ **convergence** (kon-**VER**-jens)
- ☐ **dacryocystitis** (**dack**-ree-oh-sis-**TYE**-tis) ❖
- ☐ **diplopia** (dih-**PLOH**-pee-ah) ❖
- ☐ **ectropion** (eck-**TROH**-pee-on) ❖
- ☐ **emmetropia** (em-eh-**TROH**-pee-ah) ❖
- ☐ **entropion** (en-**TROH**-pee-on) ❖
- ☐ **esotropia** (**es**-oh-**TROH**-pee-ah) ❖
- ☐ **eustachitis** (**you**-stay-**KYE**-tis) ❖
- ☐ **exotropia** (**eck**-soh-**TROH**-pee-ah) ❖
- ☐ **fenestration** (**fen**-es-**TRAY**-shun) ❖
- ☐ **glaucoma** (glaw-**KOH**-mah) ❖
- ☐ **hemianopia** (**hem**-ee-ah-**NOH**-pee-ah) ❖
- ☐ **hordeolum** (hor-**DEE**-oh-lum) ❖
- ☐ **hyperopia** (**high**-per-**OH**-pee-ah) ❖
- ☐ **intravenous fluorescein angiography** (**flew**-oh-**RES**-ee-in) ❖
- ☐ **iridectomy** (**ir**-ih-**DECK**-toh-mee) ❖
- ☐ **iritis** (eye-**RYE**-tis) ❖
- ☐ **keratitis** (**ker**-ah-**TYE**-tis) ❖
- ☐ **keratotomy** (**ker**-ah-**TOT**-oh-mee) ❖
- ☐ **labyrinthectomy** (**lab**-ih-rin-**THECK**-toh-mee) ❖
- ☐ **labyrinthitis** (**lab**-ih-rin-**THIGH**-tis) ❖
- ☐ **mastoidectomy** (**mas**-toy-**DECK**-toh-mee)
- ☐ **mastoiditis** (**mas**-toy-**DYE**-tis)
- ☐ **Ménière's syndrome** (**men**-ee-**AYRZ** *or* men-**YEHRS**) ❖
- ☐ **monochromatism** (**mon**-oh-**KROH**-mah-tizm) ❖
- ☐ **myopia** (my-**OH**-pee-ah) ❖
- ☐ **myringectomy** (**mir**-in-**JECK**-toh-mee) ❖
- ☐ **myringitis** (**mir**-in-**JIGH**-tis) ❖
- ☐ **myringotomy** (**mir**-in-**GOT**-oh-mee) ❖
- ☐ **nyctalopia** (**nick**-tah-**LOH**-pee-ah) ❖
- ☐ **nystagmus** (nis-**TAG**-mus) ❖
- ☐ **ophthalmologist** (ahf-thal-**MOL**-oh-jist) ❖
- ☐ **optometrist** (op-**TOM**-eh-trist) ❖
- ☐ **otitis media** (oh-**TYE**-tis **MEE**-dee-ah) ❖
- ☐ **otomycosis** (**oh**-toh-my-**KOH**-sis) ❖
- ☐ **otoplasty** (**OH**-toh-**plas**-tee) ❖
- ☐ **otopyorrhea** (**oh**-toh-**pye**-oh-**REE**-ah) ❖
- ☐ **otorrhagia** (**oh**-toh-**RAY**-jee-ah) ❖
- ☐ **otosclerosis** (**oh**-toh-skleh-**ROH**-sis)
- ☐ **papilledema** (**pap**-ill-eh-**DEE**-mah) ❖
- ☐ **patulous** (**PAT**-you-lus)
- ☐ **phacoemulsification** (**fay**-koh-ee-**mul**-sih-fih-**KAY**-shun *or* **fack**-koh-ee-**mul**-sih-fih-**KAY**-shun) ❖
- ☐ **presbycusis** (**pres**-beh-**KOO**-sis) ❖
- ☐ **presbyopia** (**pres**-bee-**OH**-pee-ah) ❖
- ☐ **purulent otitis media** (**PYOU**-roo-lent oh-**TYE**-tis **MEE**-dee-ah)
- ☐ **retinopexy** (**RET**-ih-noh-**peck**-see)
- ☐ **scleritis** (skleh-**RYE**-tis)
- ☐ **scotoma** (skoh-**TOH**-mah) ❖
- ☐ **stapedectomy** (**stay**-peh-**DECK**-toh-mee)
- ☐ **strabismus** (strah-**BIZ**-mus) ❖
- ☐ **synechia** (sigh-**NECK**-ee-ah) ❖
- ☐ **tarsectomy** (tahr-**SECK**-toh-mee) ❖
- ☐ **tarsorrhaphy** (tahr-**SOR**-ah-fee) ❖
- ☐ **tinnitus** (tih-**NIGH**-tus) ❖
- ☐ **tonometry** (toh-**NOM**-eh-tree) ❖
- ☐ **trabeculoplasty** (trah-**BECK**-you-loh-**plas**-tee) ❖
- ☐ **tympanectomy** (**tim**-pah-**NECK**-toh-mee) ❖
- ☐ **tympanocentesis** (**tim**-pah-noh-sen-**TEE**-sis)
- ☐ **tympanometry** (**tim**-pah-**NOM**-eh-tree) ❖
- ☐ **tympanoplasty** (**tim**-pah-noh-**PLAS**-tee)
- ☐ **tympanostomy tubes** (**tim**-pan-**OSS**-toh-mee)
- ☐ **vertigo** (**VER**-tih-go)
- ☐ **xerophthalmia** (**zeer**-ahf-**THAL**-mee-ah) ❖

Objectives

Upon completion of this chapter, you should be able to:

1. Describe the functions and structures of the eyes and adnexa.
2. Recognize, define, spell, and pronounce terms related to the pathology and diagnostic and treatment procedures of eye disorders.
3. Describe the functions and structures of the ears.
4. Recognize, define, spell, and pronounce terms related to the pathology and diagnostic and treatment procedures of ear disorders.

MEDICAL SPECIALTIES RELATED TO THE EYES AND EARS

- An **audiologist** (**aw**-dee-**OL**-oh-jist) specializes in the measurement of hearing function and the rehabilitation of persons with hearing impairments (**audi** means hearing and **-ologist** means specialist).
- An **ophthalmologist** (ahf-thal-**MOL**-oh-jist) specializes in diagnosing and treating diseases and disorders of the eye (**ophthalm** means eye and **-ologist** means specialist).
- An **optometrist** (op-**TOM**-eh-trist) holds a Doctor of Optometry (OD) degree and specializes in measuring the accuracy of vision to determine whether corrective lenses or eyeglasses are needed (**opt/o** means vision and **-metrist** means one who measures).
- An **otolaryngologist** (**oh**-toh-**lar**-in-**GOL**-oh-jist) is a physician who specializes in the care of the ears, nose, and throat (**ot/o** means ear, **laryng** means larynx, and **-ologist** means specialist).

FUNCTIONS OF THE EYES AND EARS

The eyes and ears are sensory receptor organs. Abbreviations used to describe these sensory organs are listed in Table 11.1.

FUNCTIONS OF THE EYES

The functions of the eyes are to receive images and transmit them to the brain.

- The term **optic** means pertaining to the eye or sight (**opt** means sight and **-ic** means pertaining to).
- **Ocular** (**OCK**-you-lar) means pertaining to the eye (**ocul** means eye and **-ar** means pertaining to).
- **Extraocular** (**eck**-strah-**OCK**-you-lar) means outside the eyeball (**extra-** means on the outside, **ocul** means eye, and **-ar** means pertaining to).
- **Intraocular** (**in**-trah-**OCK**-you-lar) means within the eyeball (**intra-** means within, **ocul** means eye, and **-ar** means pertaining to).

FUNCTIONS OF THE EARS

The functions of the ears are to receive sound impulses and transmit them to the brain. The inner ear also helps to maintain balance.

- The term **auditory** (**AW**-dih-**tor**-ee) means pertaining to the sense of hearing (**audit** means hearing or sense of hearing and **-ory** means pertaining to).
- **Acoustic** (ah-**KOOS**-tick) means relating to sound or hearing (**acous** means hearing or sound and **-tic** means pertaining to).

Table 11.1

COMPARISON OF ABBREVIATIONS RELATING TO THE EYES AND EARS

Eyes		Ears	
OD	Right eye	**AD**	Right ear
OS	Left eye	**AS**	Left ear
OU	Each eye or both eyes	**AU**	Each ear or both ears

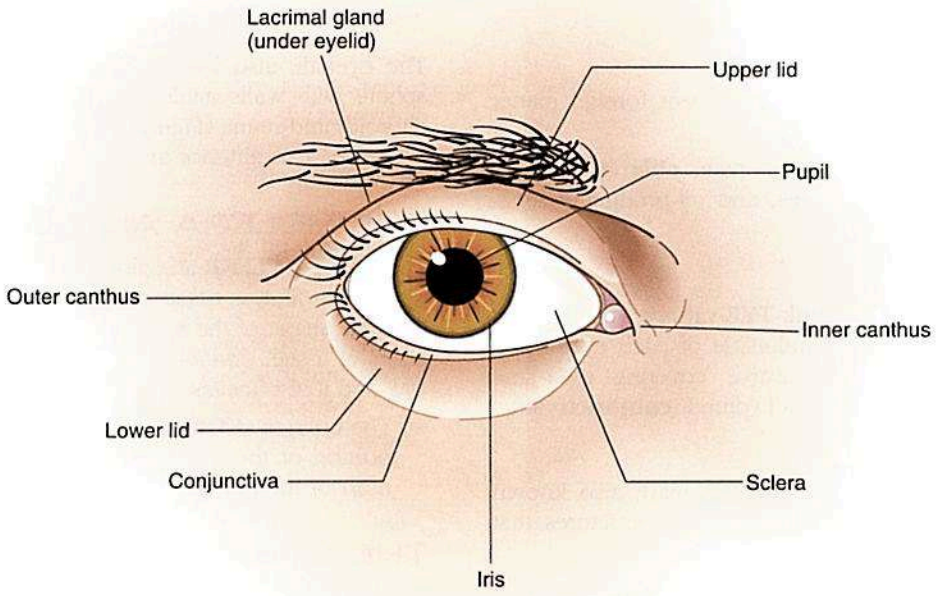


FIGURE 11.1 Major structures and adnexa of the right eye.

STRUCTURES OF THE EYES

ADNEXA OF THE EYES

The **adnexa** (ad-**NECK**-sah) of the eyes, also known as **adnexa oculi,** include the orbit, eye muscles, eyelids, eyelashes, conjunctiva, and lacrimal apparatus (Figure 11.1). *Adnexa* means the appendages or accessory structures of an organ.

The Orbit

The **orbit,** also known as the **eye socket,** is the bony cavity of the skull that contains and protects the eyeball and its associated muscles, blood vessels, and nerves.

The Eye Muscles

The six major muscles attached to each eye make possible a wide range of movement (Figure 11.2).

- The muscles of both eyes work together in coordinated movements that enable normal binocular vision. *Binocular* refers to the use of both eyes working together.

The Eyelids

The **upper** and **lower eyelids** of each eye protect the eyeball from foreign matter, excessive light, and impact.

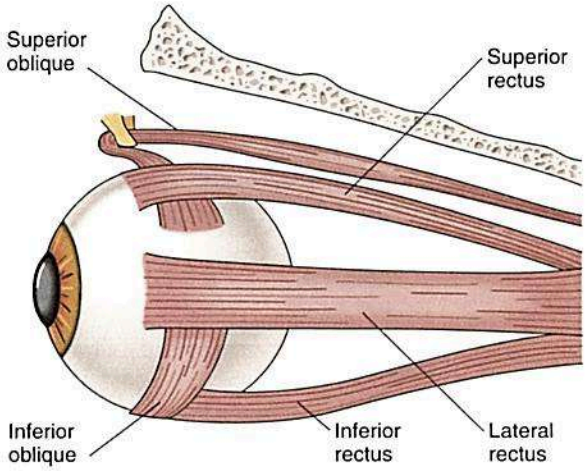


FIGURE 11.2 Six muscles, arranged in three pairs, make major eye movement possible. These are the superior and inferior rectus, superior and inferior oblique, and lateral and medial rectus (not visible here).

- The **canthus** (**KAN**-thus) is the angle where the upper and lower eyelids meet (plural, **canthi**).
- The **inner canthus** is where the eyelids meet nearest the nose. The **epicanthus** (**ep**-ih-**KAN**-thus) is a vertical fold of skin on either side of the nose. In some people, this covers the inner canthus.

- The **tarsus** (**TAHR**-suhs), also known as the **tarsal plate,** is the platelike framework within the upper and lower eyelids that provides stiffness and shape. *Caution: Tarsus* also refers to the seven tarsal bones of the instep (plural, **tarsi**).

The Eyebrows and Eyelashes

The **eyebrows** and **eyelashes** prevent foreign matter from reaching the eyes.

- The edges of the eyelids contain **cilia** (**SIL**-ee-ah), also known as **eyelashes,** and oil-producing sebaceous glands.

The Conjunctiva

The **conjunctiva** (**kon**-junk-**TYE**-vah) is the mucous membrane that lines the underside of each eyelid and continues to form a protective covering over the exposed surface of the eyeball (plural, **conjunctivae**).

The Lacrimal Apparatus

The **lacrimal apparatus** (**LACK**-rih-mal), also known as the **tear apparatus,** consists of the structures that produce, store, and remove tears.

- The **lacrimal glands** are located above the outer corner of each eye. These glands secrete **lacrimal fluid,** also known as **tears,** that maintains moisture on the anterior surface of the eyeball.
- **Lacrimation** (**lack**-rih-**MAY**-shun) is the normal continuous secretion of tears by the lacrimal glands.
- The **lacrimal canaliculi** (**LACK**-rih-mal **kan**-ah-**LICK**-you-lye) are the ducts at the inner corner of each eye. These ducts collect tears and drain them into the lacrimal sac (singular, **canaliculus**).
- The **lacrimal sac,** also known as the **dacryocyst** (**DACK**-ree-oh-sist) or **tear sac,** is an enlargement of the upper portion of the lacrimal duct.
- The **lacrimal duct,** also known as the **nasolacrimal duct,** is the passageway that drains lacrimal fluid into the nose.

THE EYEBALL

The eyeball, also known as the **globe,** is a one-inch sphere with walls made up of three layers: the sclera, choroid, and retina (Figure 11.3). The interior of the eye is divided into anterior and posterior segments.

THE SCLERA AND CORNEA

The **sclera** (**SKLEHR**-ah), also known as the **white of the eye,** is the fibrous tissue outer layer of the eye. It maintains the shape of the eye and protects the delicate inner layers of tissue. *Caution:* **scler/o** means the white of the eye, and it also means hard.

- The **cornea** (**KOR**-nee-ah) is the transparent anterior portion of the sclera. It is the cornea that provides most of the optical power of the eye.

THE UVEAL TRACT

The **uveal tract** (**YOU**-vee-ahl), also known as the **uvea** (**YOU**-vee-ah), is the vascular layer of the eye. It includes the choroid, iris, and ciliary body (Figure 11.4).

The Choroid

The **choroid** (**KOH**-roid), also known as the **choroid layer** or **choroid coat,** is the opaque middle layer of the eyeball. *Opaque* (oh-**PAYK**) means that light cannot pass through this substance.

- The choroid contains many blood vessels and provides the blood supply for the entire eye.

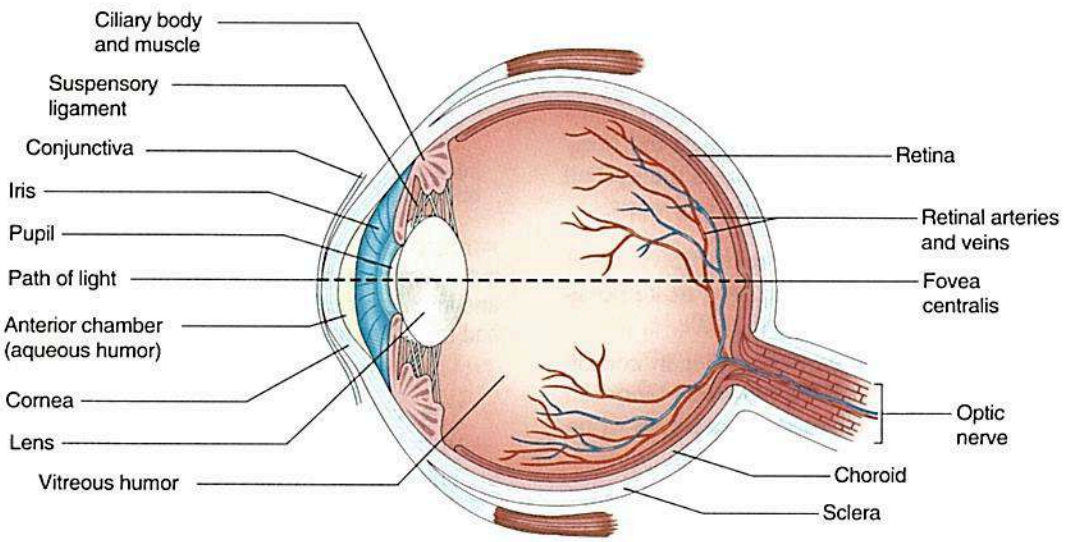


FIGURE 11.3 Structures of the eyeball shown in cross section.

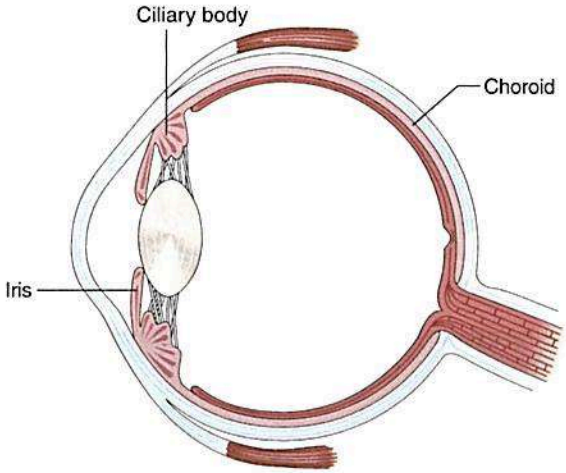


FIGURE 11.4 The uveal tract includes the choroid, iris, and ciliary body.

The Iris, Pupil, and Lens

- The **iris** is the pigmented (colored) muscular layer that surrounds the pupil.
- The **pupil** is the black circular opening in the center of the iris that permits light to enter the eye.
- Muscles within the iris control the amount of light that is allowed to enter. To *decrease* the amount of light, these circular muscles contract and make the opening smaller. To *increase* the amount of light, the muscles dilate (relax) and make the opening larger.
- The **lens,** also known as the **crystalline lens,** is the clear, flexible, curved structure that focuses images on the retina. It is held in place by the suspensory ligaments from the ciliary body. It is contained within a clear capsule and is located behind the iris and pupil.

The Ciliary Body

The **ciliary body** (**SIL**-ee-ehr-ee), which is located within the choroid, is a set of muscles and suspensory ligaments that adjust the lens to refine the focus of light rays on the retina (see Figure 11.4).

- To focus on nearby objects, these muscles adjust the lens to make it *thicker.*
- To focus on distant objects, these muscles stretch the lens so it is *thinner.*

THE RETINA

The **retina** (**RET**-ih-nah) is the sensitive inner nerve layer of the eye located between the posterior chamber and the choroid layer at the back of the eye.

- The retina contains specialized light-sensitive cells called **rods** (black and white receptors) and **cones** (color receptors).
- These rods and cones receive images and convert them into nerve impulses.

The Macula Lutea and Fovea Centralis

- The **macula lutea** (**MACK**-you-lah **LOO**-tee-ah) is a clearly defined yellow area in the center of the retina (**macula** means spot and **lutea** means yellow). This is the area of sharpest central vision.
- The **fovea centralis** (**FOH**-vee-ah sen-**TRAH**-lis) is a pit in the middle of the macula lutea. Color vision is best in this area because it contains a high concentration of cones.

The Optic Disk and Nerve

- The **optic disk,** also known as the **blind spot,** is the region in the eye where the nerve endings of the retina gather to form the optic nerve. It is called the blind spot because it does not contain any rods or cones.
- The **optic nerve,** also known as the **second cranial nerve (CN II),** transmits the nerve impulses from the retina to the brain.

SEGMENTS OF THE EYE

The eye is divided into anterior and posterior segments.

Anterior Segment of the Eye

The front one-third of the eyeball, known as the **anterior segment,** is divided into anterior and posterior chambers (Figure 11.5).

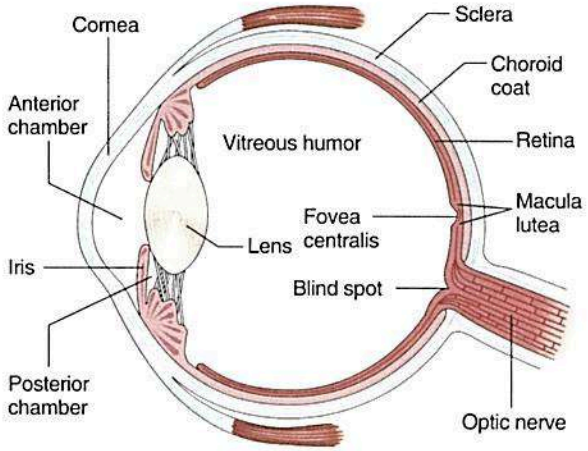


FIGURE 11.5 The anterior portion of the eye (in front of the lens) contains aqueous humor. The posterior portion (behind the lens capsule) is filled with vitreous humor.

- The **anterior chamber** is located behind the inner surface of the cornea and in front of the iris. The **posterior chamber** is located between the back of the iris and the front of the lens.
- These chambers are filled with **aqueous fluid,** also known as **aqueous humor.** A *humor* is any clear body liquid or semifluid substance.

- This fluid nourishes the intraocular structures and is constantly filtered and drained through the **trabecular meshwork** and the **canal of Schlemm** (Figure 11.6).

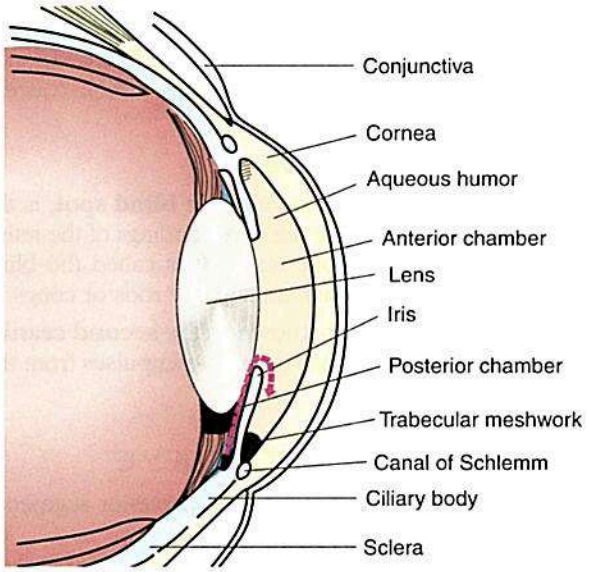


FIGURE 11.6 The flow of aqueous humor.

- This constant drainage regulates **intraocular pressure (IOP),** which normally is between 12 and 21 mm Hg (see Diagnostic Procedures of the Eye).

Posterior Segment of the Eye

- The **posterior** two-thirds of the eyeball is filled with **vitreous humor** (**VIT**-ree-us), which is also known as **vitreous gel.** This soft, clear, jellylike mass aids the eye in maintaining its shape.
- The posterior portion of the eye is lined with the retina and its related structures.

NORMAL ACTION OF THE EYES

- **Accommodation** (ah-**kom**-oh-**DAY**-shun) is the process whereby the eyes make adjustments for seeing objects at various distances. These adjustments include constriction (narrowing) and dilation (widening) of the pupil, movement of the eyes, and changes in the shape of the lens.
- **Convergence** (kon-**VER**-jens) is the simultaneous inward movement of the two eyes (toward each other), usually in an effort to maintain single binocular vision as an object comes nearer.
- **Emmetropia** (em-eh-**TROH**-pee-ah) **(EM)** is the normal relationship between the refractive power of the eye and the shape of the eye that enables light rays to focus correctly on the retina (**emmetr** means in proper measure and **-opia** means vision condition). Compare this with *hyperopia* and *myopia*.
- **Refraction** is the ability of the lens to bend the light rays to help them focus on the retina (see Figure 11.11A)

Visual Acuity

Visual acuity is the ability to distinguish object details and shape at a distance. Normal vision is stated as 20/20.

- A **Snellen chart** is used to measure visual acuity. The results are recorded as two numbers in fraction form (Figure 11.7).

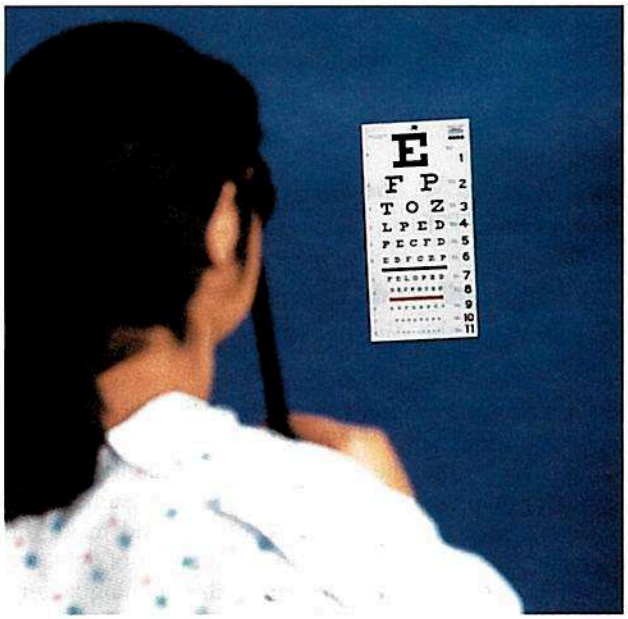


FIGURE 11.7 A Snellen chart is used to measure visual acuity.

- The **first number** indicates the distance from the chart, which is standardized at 20 feet. The **second number** indicates the deviation from the norm based on the ability to read lines of letters on the chart.
- For example, a person with 20/40 vision can read at 20 feet what someone with normal vision could read at 40 feet.

PATHOLOGY OF THE EYES

EYELIDS

- **Blepharoptosis** (**blef**-ah-roh-**TOH**-sis *or* **blef**-ah-rop-**TOH**-sis) is drooping of the upper eyelid (**blephar/o** means eyelid and **-ptosis** means drooping or sagging), see Figure 11.8A.
- **Ectropion** (eck-**TROH**-pee-on) is the eversion (turning outward) of the edge of the eyelid (**ec-** mean out, **trop** means turn, and **-ion** means condition), see Figure 11.8B.

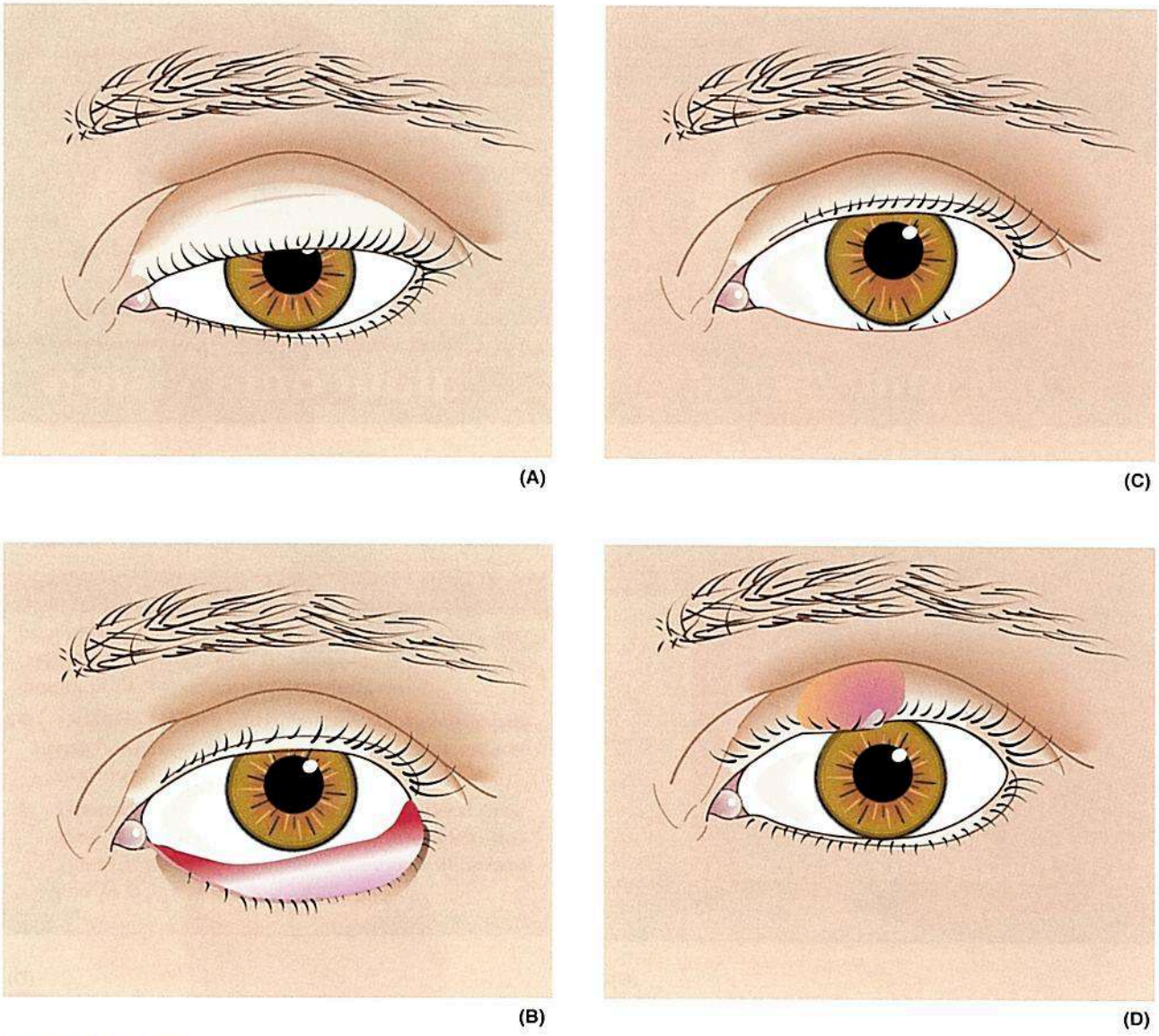


FIGURE 11.8 Disorders of the eyelid. (A) Blepharoptosis. (B) Ectropion. (C) Entropion. (D) Hordeolum.

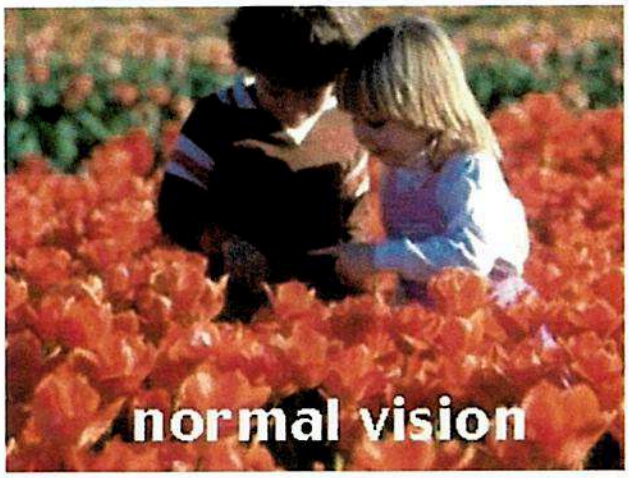
- **Entropion** (en-**TROH**-pee-on) is the inversion (turning inward) of the edge of the eyelid (**en-** means in, **trop** means turn, and **-ion** means condition), see Figure 11.8C.
- A **hordeolum** (hor-**DEE**-oh-lum), also known as a **stye,** is an infection of one or more glands at the border of the eyelid, see Figure 11.8D.
- A **chalazion** (kah-**LAY**-zee-on), also known as an **internal hordeolum,** is a localized swelling of the eyelid resulting from obstruction of one of the sebaceous (oil-producing) glands of the eyelid.

ADDITIONAL ADNEXA PATHOLOGY

- **Dacryocystitis** (**dack**-ree-oh-sis-**TYE**-tis) is an inflammation of the lacrimal sac and is associated with faulty tear drainage (**dacryocyst** means tear sac and **-itis** means inflammation).
- **Conjunctivitis** (kon-**junk**-tih-**VYE**-tis), also known as **pinkeye,** is an inflammation of the conjunctiva (**conjunctiv** means conjunctiva and **-itis** means inflammation).
- **Xerophthalmia** (**zeer**-ahf-**THAL**-mee-ah), also known as **dry eye,** is drying of eye surfaces characterized by the loss of luster of the conjunctiva and cornea (**xer-** means dry, **ophthalm** means eye, and **-ia** means abnormal condition).

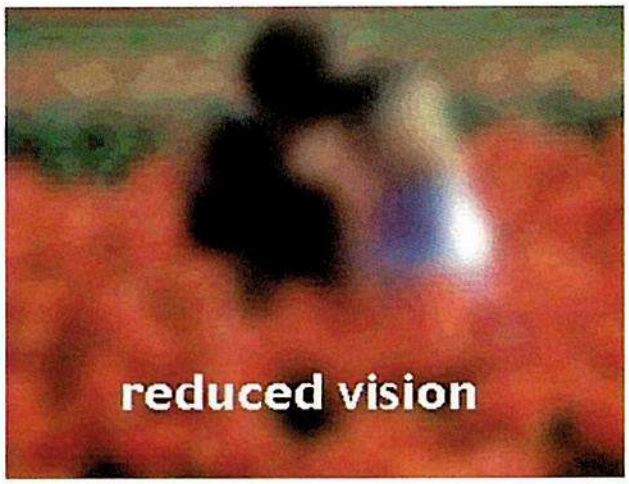
SCLERA, CORNEA, AND IRIS

- **Scleritis** (skleh-**RYE**-tis) is an inflammation of the sclera (**scler** means white of eye and **-itis** means inflammation). *Note*: **scler/o** also means hard.
- **Keratitis** (**ker**-ah-**TYE**-tis) is an inflammation of the cornea (**kerat** means cornea and **-itis** means inflammation). *Note*: **kerat/o** also means hard.



(A)

(C)



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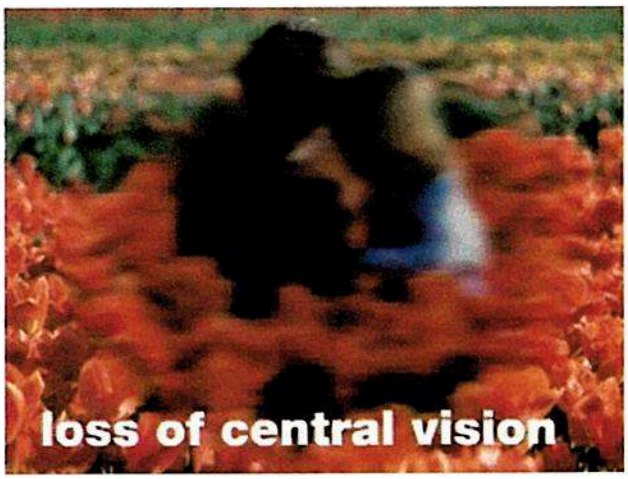


(D)

FIGURE 11.9 Normal vision and pathologic vision changes. (A) Normal vision. (B) Vision reduced by cataracts. (C) The loss of peripheral vision caused by untreated glaucoma. (D) The loss of central vision due to macular degeneration.

- A **corneal abrasion** is an injury, such as a scratch or irritation, to the outer layers of the cornea.
- A **corneal ulcer** is a pitting of the cornea caused by an infection or injury. Although these ulcers heal with treatment, they may leave a cloudy scar that impairs vision.
- **Iritis** (eye-**RYE**-tis) is an inflammation of the iris (**irit** means iris, and **-itis** means inflammation).
- **Synechia** (sigh-**NECK**-ee-ah) is an adhesion that binds the iris to any adjacent structure (plural, **synechiae**). An *adhesion* (ad-**HE**-zhun) holds structures together abnormally.

THE EYE

- **Anisocoria** (**an**-ih-so-**KOH**-ree-ah) is a condition in which the pupils are unequal in size (**anis/o** means unequal, **cor** means pupil, and **-ia** means abnormal condition). This may be congenital (present at birth) or caused by a head injury, aneurysm, or pathology of the central nervous system.
- A **cataract** (**KAT**-ah-rakt) is the loss of transparency of the lens. This may be congenital (present at birth) or caused by trauma (injury) or disease. However, the formation of most cataracts is associated with aging (see Figure 11.9B).
- **Choked disk,** also known as **papilledema** (**pap**-ill-eh-**DEE**-mah), is swelling and inflammation of the optic nerve at the point of entrance through the optic disk. This swelling is caused by increased intracranial pressure and may be due to a tumor pressing on the optic nerve.
- **Floaters,** also known as **vitreous floaters,** are particles that float in the vitreous fluid and cast shadows

on the retina. Floaters occur normally with aging or in association with vitreous detachments, retinal tears, or intraocular inflammations.

- **Nystagmus** (nis-**TAG**-mus) is an involuntary, constant, rhythmic movement of the eyeball.
- In a **retinal detachment,** also known as a **detached retina,** the retina is pulled away from its normal position of being attached to the choroid in the back of the eye. A **retinal tear** occurs when the retina tears (develops a hole) as it is pulled away from its normal position.
- **Uveitis** (**you**-vee-**EYE**-tis) is an inflammation anywhere in the uveal tract (**uve** means uveal tract and **-itis** means inflammation). It may affect the choroid, iris, or ciliary body and has many possible causes, including diseases elsewhere in the body. Uveitis can rapidly damage the eye and produce complications including cataracts, detached retina, and glaucoma.

Glaucoma

Glaucoma (glaw-**KOH**-mah) is a group of diseases characterized by increased intraocular pressure (IOP), resulting in damage to the optic nerve and retinal nerve fibers. If left untreated, this pressure damages the optic nerve and causes the loss of peripheral vision and eventually blindness (see Figure 11.9C).

- In **open-angle glaucoma,** which is the most common form of glaucoma, the trabecular meshwork becomes blocked.
- In **closed-angle glaucoma,** the opening between the cornea and iris narrows so that fluid cannot reach the trabecular meshwork. This narrowing may cause a sudden increase in pressure and produce severe pain, nausea, redness of the eye, and blurred vision. Without immediate treatment, blindness may occur in as little as two days.
- Glaucoma does not produce symptoms noticed by the patient until the optic nerve has been damaged. However, it can be detected before damage occurs through regular eye examinations including tonometry and visual field testing (see Diagnostic Procedures of the Eyes).

Macular Degeneration

Macular degeneration (**MACK**-you-lar) is a gradually progressive condition that results in the loss of central vision but not in total blindness (Figure 11.9D). This condition, which most frequently affects older people, is also known as **age-related macular degeneration (AMD).**

- **Dry type macular degeneration,** which accounts for 90 percent of cases, is caused by the atrophy (deterioration) of the macula.
- **Wet type macular degeneration** is associated with the formation of new blood vessels that produce small hemorrhages.

FUNCTIONAL DEFECTS

- **Diplopia** (dih-**PLOH**-pee-ah), also known as **double vision,** is the perception of two images of a single object (**dipl** means double and **-opia** means vision condition).
- **Hemianopia** (**hem**-ee-ah-**NOH**-pee-ah) is blindness in one half of the visual field.
- **Monochromatism** (**mon**-oh-**KROH**-mah-tizm), also known as **color blindness,** is the lack of the ability to distinguish colors (**mon/o** means one, **chromat** means color, and **-ism** means condition).
- **Nyctalopia** (**nick**-tah-**LOH**-pee-ah), also known as **night blindness,** is a condition in which the individual has difficulty seeing at night (**nyctal** means night and **-opia** means vision condition).
- **Presbyopia** (**pres**-bee-**OH**-pee-ah) describes the changes in the eyes that occur with aging (**presby** means old age and **-opia** means vision condition). With aging, the lens becomes less flexible, and the muscles of the ciliary body become weaker. The result is that the eyes are no longer able to focus the image properly on the retina.

Strabismus

- **Strabismus** (strah-**BIZ**-mus), also known as a **squint,** is a disorder in which the eyes cannot be directed in a parallel manner toward the same object (Figure 11.10).

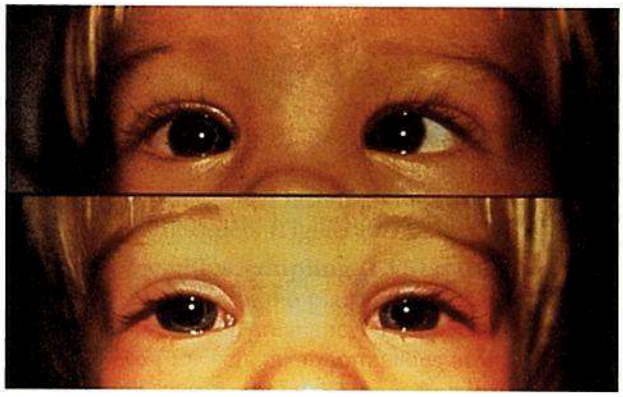
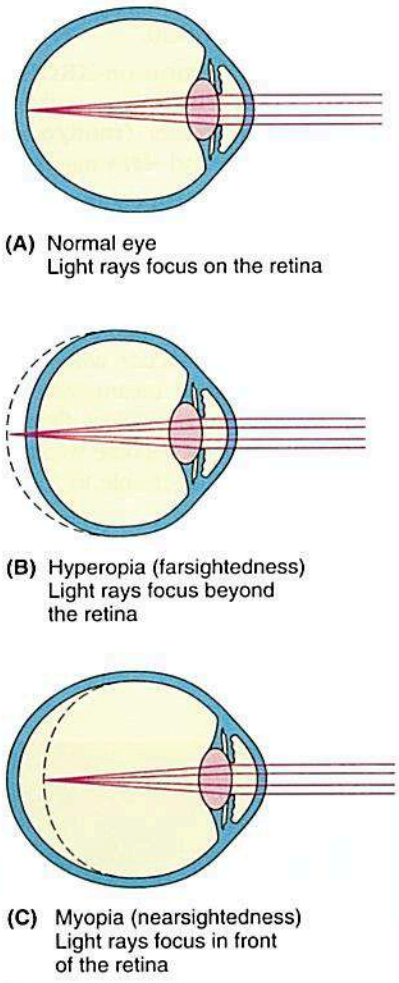


FIGURE 11.10 A child with strabismus before and after corrective treatment. (Courtesy of the National Eye Institute.)

- **Esotropia** (**es**-oh-**TROH**-pee-ah), also known as **cross-eyes,** is strabismus characterized by an inward deviation of one eye in relation to the other (**eso-** means inward, **trop** means turn, and **-ia** means abnormal condition).
- **Exotropia** (**eck**-soh-**TROH**-pee-ah), also known as **walleye,** is strabismus characterized by the outward deviation of one eye relative to the other (**exo-** means outward, **trop** means turn, and **-ia** means abnormal condition).

REFRACTIVE DISORDERS

A **refractive disorder** is a condition in which the lens and cornea do not bend light so that it focuses properly on the retina. (Normal refraction is shown in Figure 11.11A.)



(A) Normal eye
Light rays focus on the retina

(B) Hyperopia (farsightedness)
Light rays focus beyond the retina

(C) Myopia (nearsightedness)
Light rays focus in front of the retina

FIGURE 11.11 Refraction. (A) Normal eye. (B) Hyperopia (farsightedness). (C) Myopia (nearsightedness).

- **Ametropia** (**am**-eh-**TROH**-pee-ah) is any error of refraction in which images do not focus properly on the retina (**ametr** means out of proportion and **-opia** means vision condition). Astigmatism, hyperopia, and myopia are all froms of ametropia.
- **Astigmatism** (ah-**STIG**-mah-tizm) is a condition in which the eye does not focus properly because of uneven curvatures of the cornea.
- **Hyperopia** (**high**-per-**OH**-pee-ah), also known as **farsightedness,** is a defect in which light rays focus beyond the retina (**hyper-** means excessive and **-opia** means vision condition). This condition occurs most commonly after age 40 (see Figure 11.11B).
- **Myopia** (my-**OH**-pee-ah), also known as **nearsightedness,** is a defect in which light rays focus in front of the retina. This condition occurs most commonly in school-aged children (see Figure 11.11C).

BLINDNESS

- **Amblyopia** (**am**-blee-**OH**-pee-ah) is a dimness of vision or the partial loss of sight without detectable disease of the eye (**ambly** means dim or dull and **-opia** means vision condition).
- **Blindness** is the inability to see. Although some sight remains, **legal blindness** is the point at which, under law, an individual is considered to be blind. A commonly used standard is that a person is legally blind when his or her best-corrected vision is reduced to 20/200 or less (see Normal Action of the Eyes).
- **Scotoma** (skoh-**TOH**-mah), also known as a **blind spot,** is an abnormal area of absent or depressed vision surrounded by an area of normal vision.

DIAGNOSTIC PROCEDURES OF THE EYES

- **Visual acuity measurement** (ah-**KYOU**-ih-tee) is an evaluation of the eye's ability to distinguish object details and shape (see Normal Action of the Eyes.)
- **Refraction** is an examination procedure to determine an eye's refractive error and the best corrective lenses to be prescribed. A **diopter** (dye-**AHP**-tur) is a unit of measurement of lens refractive power.
- **Tonometry** (toh-**NOM**-eh-tree) measures **intraocular pressure (IOP).** Abnormally high pressure may be an indication of glaucoma.
- In preparation for an examination of the interior of the eye, it is necessary to **dilate** (**DYE**-layt) the pupils. Dilation is accomplished by administering **mydriatic drops** (**mid**-ree-**AT**-ick) that produce temporary paralysis, which forces the pupils to remain wide open even in the presence of bright light. (*Dilation* is the artificial enlargement of an opening.)

SPECIALIZED DIAGNOSTIC PROCEDURES

- **Fluorescein staining** (**flew**-oh-**RES**-ee-in) is used to visualize a corneal abrasion (injury). When the stain is applied, corneal abrasions are stained bright green.
- In **intravenous fluorescein angiography** (**flew**-oh-**RES**-ee-in **an**-jee-**OG**-rah-fee) **(IVFA),** a dye is injected into a vein in the arm, and pictures are taken as the dye passes through the blood vessels in the retina. This test allows the examiner to detect leaking blood vessels within the eye.
- A **visual field test** is used to determine losses in peripheral vision. Such a loss is characteristic of glaucoma.

TREATMENT PROCEDURES OF THE EYES

THE ORBIT AND EYELIDS

- **Orbitotomy** (**or**-bih-**TOT**-oh-mee) is a surgical incision into the orbit for biopsy, abscess drainage, or the removal of a tumor mass or foreign object (**orbit** means bony socket and **-otomy** means surgical incision).
- A **tarsectomy** (tahr-**SECK**-toh-mee) is the surgical removal of a segment of the tarsal plate of the upper or lower eyelid (**tars** means eyelid and **-ectomy** means surgical removal).
- **Tarsorrhaphy** (tahr-**SOR**-ah-fee) is the partial or complete suturing together of the upper and lower eyelids (**tars/o** means eyelid and **-rrhaphy** means to suture). This procedure is performed to provide protection to the eye when the lids are paralyzed and unable to close normally.
- Cosmetic procedures relating to the eyelids are discussed further in Chapter 12.

CONJUNCTIVA, CORNEA, AND IRIS

- **Conjunctivoplasty** (**kon**-junk-**TYE**-voh-**plas**-tee) is the surgical repair of the conjunctiva (**conjunctiv** means conjunctiva and **-plasty** means surgical repair).
- A **corneal transplant,** also known as **keratoplasty** (**KER**-ah-toh-**plas**-tee), is the surgical replacement of scarred or diseased cornea with clear corneal tissue from a donor (**kerat/o** means cornea and **-plasty** means surgical repair).
- An **iridectomy** (**ir**-ih-**DECK**-toh-mee) is the surgical removal of a portion of the iris tissue (**irid** means iris and **-ectomy** means surgical removal).
- **Radial keratotomy** (**ker**-ah-**TOT**-oh-mee) **(RK)** is used to correct myopia (**kerat** means cornea, and **-otomy** means surgical incision). During the surgery, incisions made partially through the cornea cause it to flatten.

CATARACT SURGERY

- **Lensectomy** (len-**SECK**-toh-mee) is the general term used to describe the surgical removal of a cataract-clouded lens.
- **Extracapsular cataract extraction (ECCE)** is the removal of a cloudy lens that leaves the posterior lens capsule intact (Figure 11.12).
- **Intracapsular cataract extraction (ICCE)** is the removal of a cloudy lens including the surrounding capsule.
- **Phacoemulsification** (**fay**-koh-ee-**mul**-sih-fih-**KAY**-shun *or* **fack**-koh-ee-**mul**-sih-fih-**KAY**-shun) is the use of ultrasonic vibration to shatter and break up a cataract making it easier to remove.
- An **intraocular lens (IOL)** is a plastic lens that is surgically implanted to replace the natural lens.
- **Aphakia** (ah-**FAY**-kee-ah) is the absence of the lens of an eye after cataract extraction (**a-** means without, **phak** means lens, and **-ia** means abnormal condition).
- **Pseudophakia** (**soo**-doh-**FAY**-kee-ah) is an eye in which the natural lens is replaced with an IOL (**pseudo/o** means false, **phak** means lens, and **-ia** means abnormal condition).

Lens Implant Surgery for Cataracts

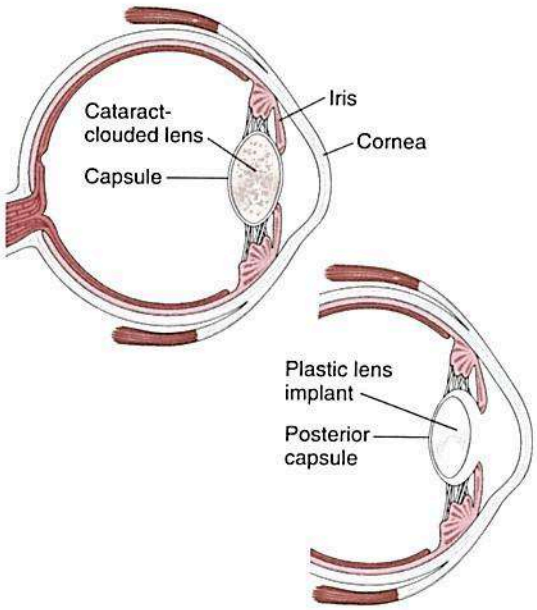


FIGURE 11.12 In an extracapsular extraction, the lens is removed, the posterior lens capsule is left intact, and an intraocular lens (IOL) is placed.

LASER TREATMENTS

Lasers have a wide range of applications in the treatment of eye disorders. (For more details on how lasers work, see Chapter 12.) In the treatment of eye disorders, lasers are used for the following reasons:

- To treat **open-angle glaucoma** by creating an opening that allows fluid to drain properly to prevent pressure buildup within the eye. This procedure is known as **laser trabeculoplasty** (trah-**BECK**-you-loh-**plas**-tee).
- To treat **closed-angle glaucoma** by creating an opening in the iris to allow proper drainage. This procedure is known as **laser iridotomy** (**ir**-ih-**DOT**-oh-mee).

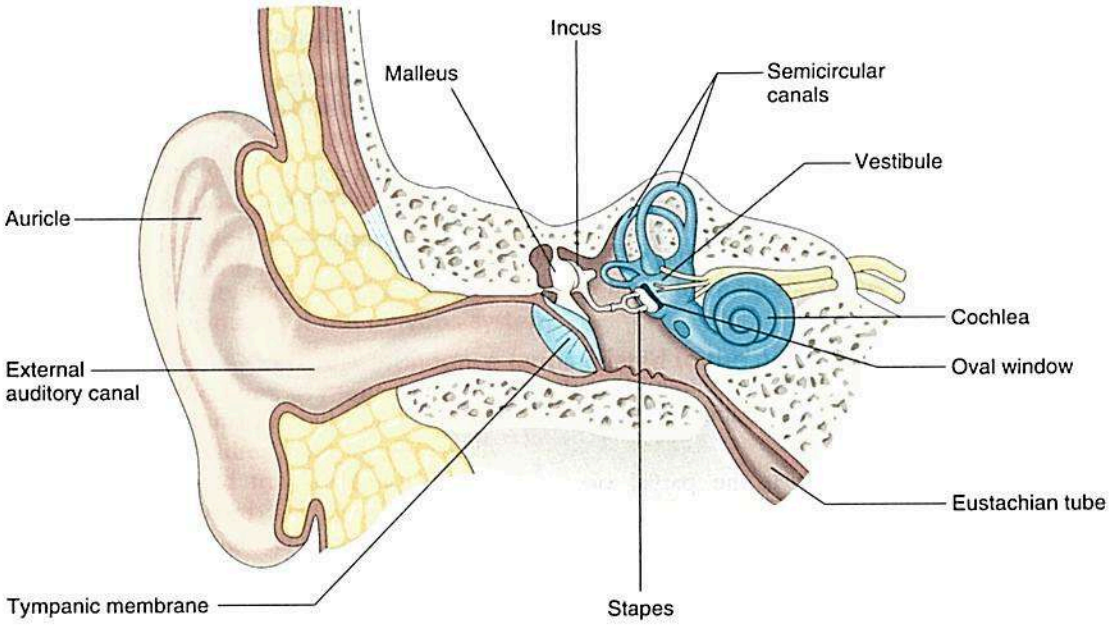


FIGURE 11.13 Structures of the ear shown in cross section.

- To treat some forms of **macular degeneration** by sealing leaking or damaged blood vessels.
- To treat **retinal tears** by sealing the torn portion.
- To reattach a **detached retina.** This procedure is also known as **retinopexy** (**RET**-ih-noh-**peck**-see).
- To correct **refraction disorders** by reshaping of the top layer of the cornea. This procedure is known as **photo refractive keratectomy** (**ker**-ah-**TECK**-toh-mee) or **PRK.**
- To remove **clouded tissue** that may form in the posterior portion of the lens capsule after cataract extraction.

STRUCTURES OF THE EARS

The ear is divided into three separate regions: the outer ear, middle ear, and inner ear (Figure 11.13).

THE OUTER EAR

- The **pinna** (**PIN**-nah), also known as the **auricle,** is the external portion of the ear. This structure catches sound waves and transmits them into the external auditory canal.
- The **external auditory canal** transmits sound waves from the pinna to the middle ear.
- **Cerumen** (seh-**ROO**-men), also known as **earwax,** is secreted by ceruminous glands that line the auditory canal. This sticky yellow-brown substance has protective functions as it traps small insects, dust, debris, and certain bacteria to prevent them from entering the middle ear.

THE MIDDLE EAR

- The **tympanic membrane** (tim-**PAN**-ick) **(TM),** also known as the **eardrum,** is located between the outer and middle ear (Figure 11.14). (The word parts **myring/o** and **tympan/o** both mean tympanic membrane.)

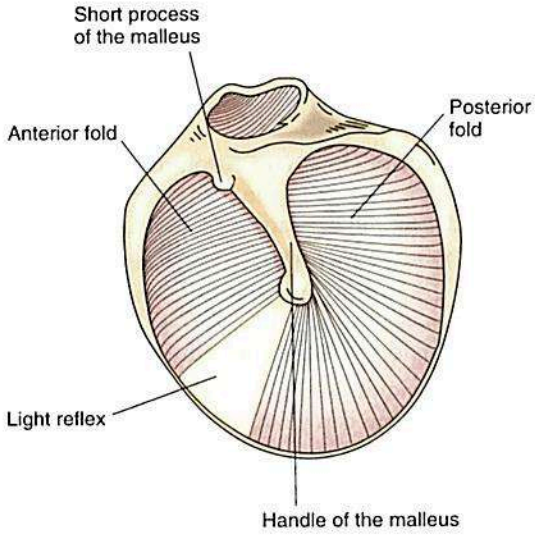


FIGURE 11.14 Schematic of the normal tympanic membrane as viewed from the auditory canal.

- When sound waves reach it, this membrane transmits the sound by vibrating.
- The middle ear is surrounded by the **mastoid cells,** which are hollow air spaces located in the mastoid process of the temporal bone. An infection in the middle ear can rapidly spread to these cells.

The Auditory Ossicles

The **auditory ossicles** (**OSS**-ih-kulz) are three small bones found in the middle ear. These bones transmit the sound waves from the eardrum to the inner ear by vibration. These bones, which are named for their shapes, are the

- **Malleus** (**MAL**-ee-us), also known as the **hammer**
- **Incus** (**ING**-kus), also known as the **anvil**
- **Stapes** (**STAY**-peez), also known as the **stirrup**

The Eustachian Tubes

The **eustachian tubes** (you-**STAY**-shun *or* you-**STAY**-kee-an) are also known as the **auditory tubes.** These narrow tubes, which lead from the middle ear to the nasopharynx, equalize the air pressure in the middle ear with that of the outside atmosphere.

THE INNER EAR

The **inner ear,** also known as the **labyrinth** (**LAB**-ih-rinth), contains the sensory receptors for hearing and balance.

- The **oval window,** located under the base of the stapes, is the membrane that separates the middle ear from the inner ear.
- The **cochlea** (**KOCK**-lee-ah) is the spiral passage that leads from the oval window.
- The **cochlear duct,** located within the cochlea, is filled with fluid that vibrates when the sound waves strike it.
- The **organ of Corti,** also located within the cochlea, is the receptor site that receives these vibrations and relays them to the **auditory nerve fibers,** which transmit them to the auditory center of the cerebral cortex, where they are interpreted and heard.
- The three **semicircular canals,** also located within the inner ear, contain **endolymph** (a liquid) and sensitive hairlike cells. The bending of these hairlike cells in response to the movements of the head sets up impulses in nerve fibers to help maintain equilibrium. *Equilibrium* is the state of balance.
- The **acoustic nerves** (cranial nerve VIII) transmit this information to the brain, and the brain sends messages to muscles in all parts of the body to ensure that equilibrium is maintained.

NORMAL ACTION OF THE EARS

- Sound waves enter the ear through the pinna, travel down the auditory canal, and strike the tympanic membrane between the outer and middle ear. This process is called **air conduction.**
- As the eardrum vibrates, it moves the auditory ossicles, and these conduct sound waves through the middle ear. This process is called **bone conduction.**
- Sound vibrations reach the inner ear via the oval window. The structures of the inner ear receive the sound waves and relay them to the brain. This process is called **sensorineural conduction.**

PATHOLOGY OF THE EARS

THE OUTER EAR

- **Impacted cerumen** is an accumulation of cerumen that forms a solid mass adhering to the walls of the external auditory canal. *Impacted* means lodged or wedged firmly in place.
- **Otalgia** (oh-**TAL**-gee-ah), also known as an **earache,** is pain in the ear (**ot** means ear and **-algia** means pain).
- **Otitis** (oh-**TYE**-tis) means any inflammation of the ear (**ot** means ear and **-itis** means inflammation). The second term gives the location of the inflammation.
- **Otitis externa** is an inflammation of the outer ear.
- **Otomycosis** (**oh**-toh-my-**KOH**-sis), also known as **swimmer's ear**, is a fungal infection of the external auditory canal (**ot/o** means ear, **myc** means fungus, and **-osis** means abnormal condition).
- **Otopyorrhea** (**oh**-toh-**pye**-oh-**REE**-ah) is the flow of pus from the ear (**ot/o** means ear, **py/o** means pus, and **-rrhea** means abnormal flow).
- **Otorrhagia** (**oh**-toh-**RAY**-jee-ah) is bleeding from the ear (**ot/o** means ear and **-rrhagia** means bleeding).

THE MIDDLE EAR

- **Eustachitis** (**you**-stay-**KYE**-tis) is an inflammation of the eustachian tube (**eustach** means eustachian tube and **-itis** means inflammation).
- **Mastoiditis** (**mas**-toy-**DYE**-tis) is an inflammation of any part of the mastoid process (**mastoid** means mastoid process and **-itis** means inflammation).
- **Myringitis** (**mir**-in-**JIGH**-tis) is an inflammation of the tympanic membrane (**myring** means eardrum and **-itis** means inflammation).
- **Otosclerosis** (**oh**-toh-skleh-**ROH**-sis) is ankylosis of the bones of the middle ear resulting in a conductive hearing loss (**ot/o** means ear, and **-sclerosis** means abnormal hardening). *Ankylosis* (**ang**-kih-**LOH**-sis) means fused together.
- **Patulous eustachian tube** (**PAT**-you-lus) is distention of the eustachian tube. *Patulous* means extended, spread wide open.

Otitis Media

- **Acute otitis media** (oh-**TYE**-tis **MEE**-dee-ah) **(AOM)** is an inflammation of the middle ear usually associated with an upper respiratory infection that is most commonly seen in young children.

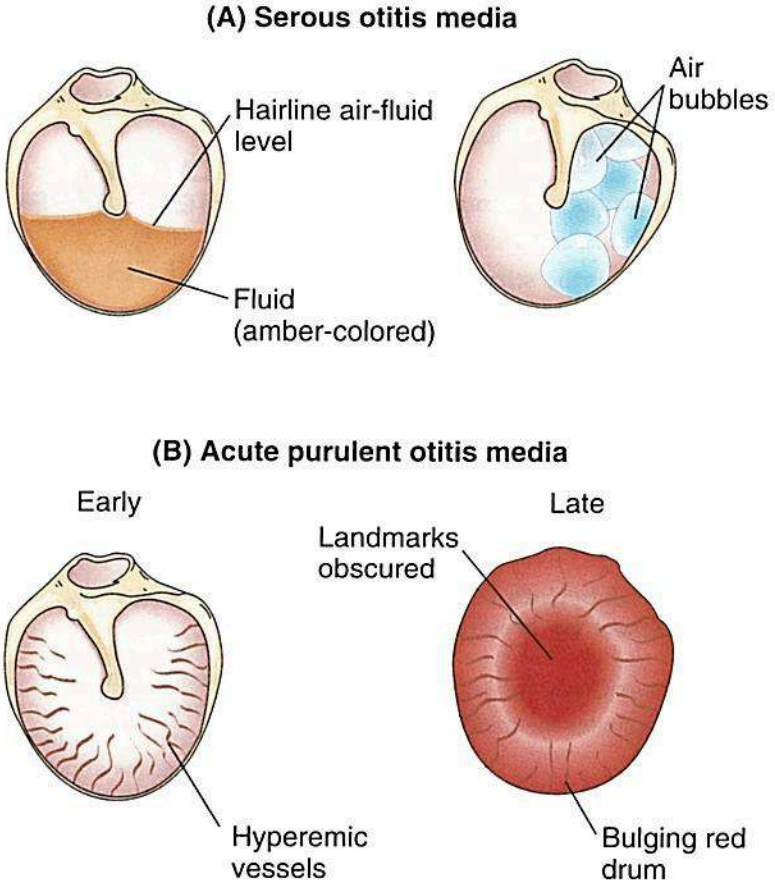


FIGURE 11.15 The tympanic membrane in the presence of otitis media. (A) Serious otitis media. (B) Acute purulent otitis media. *Hyperemic* means increased blood within these vessels.

- **Serous otitis media** (**SEER**-us oh-**TYE**-tis **MEE**-dee-ah) **(SOM)** is a fluid buildup in the middle ear that may follow acute otitis media or be caused by an obstruction of the eustachian tube (Figure 11.15A).
- SOM is also known as **otitis media with effusion**. *Effusion* (eh-**FEW**-zhun) is the escape of fluid from blood or lymphatic vessels into the tissues or a cavity.
- **Purulent otitis media** (**PYOU**-roo-lent oh-**TYE**-tis **MEE**-dee-ah) is a buildup of pus within the middle ear (Figure 11.15B).

THE INNER EAR

- **Labyrinthitis** (**lab**-ih-rin-**THIGH**-tis) is an inflammation of the labyrinth that may result in vertigo and deafness.
- **Vertigo** (**VER**-tih-goh), which is a symptom of several conditions, is described as a sense of whirling, dizziness, and the loss of balance.
- **Ménière's syndrome** (**men**-ee-**AYRZ** *or* men-**YEHRS**) is a chronic disease of the inner ear characterized by three main symptoms: attacks of vertigo, a fluctuating hearing loss (usually in one ear), and tinnitus.
- **Tinnitus** (tih-**NIGH**-tus) is a ringing, buzzing, or roaring sound in the ears.

HEARING LOSS

- **Deafness** is the complete or partial loss of the ability to hear. It may range from the inability to hear sounds of a certain pitch or intensity to a complete loss of hearing.
- A **conductive hearing loss** is one in which the outer or middle ear does not conduct sound vibrations to the inner ear normally.
- A **noise-induced hearing loss** is the result of the loss of sensitive hairlike cells of the inner ear. This damage is most commonly caused by repeated expo-

sure to very intense noise such as aircraft engines, noisy equipment, and loud music.

- A **sensorineural hearing loss,** also known as **nerve deafness,** is a symptom of problems affecting the inner ear.
- **Presbycusis** (**pres**-beh-**KOO**-sis) is a progressive hearing loss occurring in old age (**presby** means old age and **-cusis** means hearing).

DIAGNOSTIC PROCEDURES OF THE EARS

- **Audiometry** (**aw**-dee-**OM**-eh-tree) is the use of an audiometer to measure hearing (**audio** means hearing and **-metry** means to measure).
- An **audiometer** (**aw**-dee-**OM**-eh-ter) is an electronic device that produces acoustic stimuli of a known frequency and intensity (**audi/o** means hearing and **-meter** means to measure).
- **Speech audiometry** measures the threshold of speech reception (hearing speech sounds) and speech discrimination (understanding speech sounds).
- An **evoked potential audiometer** is an instrument that detects response to sound stimuli by changes in the electroencephalogram (record of brain wave activity).
- **Tympanometry** (**tim**-pah-**NOM**-eh-tree) is the indirect measurement of acoustical energy absorbed or reflected by the middle ear (**tympan/o** means eardrum and **-metry** means to measure). In a conductive hearing loss, the middle ear absorbs relatively less sound and reflects relatively more sound. This test is used to test for middle ear effusion (fluid buildup) or eustachian tube obstruction. The resulting record is a **tympanogram.**
- **Monaural** (mon-**AW**-rahl) testing involves one ear (**mon-** means one, **aur** means hearing, and **-al** means pertaining to).
- **Binaural** (bye-**NAW**-rul *or* bin-**AW**-rahl) testing involves both ears (**bi-** means two, **aur** means hearing, and **-al** means pertaining to).

TREATMENT PROCEDURES OF THE EARS

THE OUTER EAR

- **Otoplasty** (**OH**-toh-**plas**-tee) is the surgical repair of the pinna of the ear (**ot/o** means ear and **-plasty** means surgical repair).

THE MIDDLE EAR

- A **mastoidectomy** (**mas**-toy-**DECK**-toh-mee) is the surgical removal of mastoid cells (**mastoid** means mastoid process and **-ectomy** means surgical removal).
- A **myringectomy** (**mir**-in-**JECK**-toh-mee), also known as a **tympanectomy** (**tim**-pah-**NECK**-toh-me), is the surgical removal of all or part of the tympanic membrane (**myring** means eardrum and **-ectomy** means surgical removal).
- A **myringotomy** (**mir**-in-**GOT**-oh-mee) is the surgical incision of the eardrum to create an opening for the placement of tympanostomy tubes (**myring** means eardrum and **-otomy** means surgical incision).
- **Tympanostomy tubes** (**tim**-pan-**OSS**-toh-mee), also known as **pediatric ear tubes,** are tiny ventilating tubes placed through the eardrum to provide ongoing drainage for fluids and to relieve pressure that can build up after ear infections.
- **Tympanocentesis** (**tim**-pah-noh-sen-**TEE**-sis) is the surgical puncture of the tympanic membrane with a needle to remove fluid from the middle ear (**tympan/o** means eardrum and **-centesis** means a surgical puncture to remove fluid).
- **Tympanoplasty** (**tim**-pah-noh-**PLAS**-tee) is the surgical correction of a damaged middle ear (**tympan/o** means eardrum and **-plasty** means a surgical repair).
- A **stapedectomy** (**stay**-peh-**DECK**-toh-mee) is the surgical removal of the stapes.

The Inner Ear

- A **fenestration** (**fen**-es-**TRAY**-shun) is a surgical procedure in which a new opening is made in the labyrinth of the inner ear to restore hearing.
- A **labyrinthectomy** (**lab**-ih-rin-**THECK**-toh-mee) is the surgical removal of the labyrinth (**labyrinth** means labyrinth and **-ectomy** means surgical removal).
- A **labyrinthotomy** (**lab**-ih-rin-**THOT**-oh-mee) is a surgical incision into the labyrinth (**labyrinth** means labyrinth and **-otomy** means a surgical incision).

Career Opportunities

In addition to the medical specialties already discussed, some of the health occupations involving the treatment of the eyes and ears include

- **Ophthalmic dispenser** or **dispensing optician:** places orders for prescribed ophthalmic laboratory work, helps patients select frames, adjusts finished glasses, and may fit patients for contact lenses
- **Ocularist:** a dispensing optician who specializes in fitting artificial eyes
- **Ophthalmic laboratory technician:** grinds, finishes, polishes, and mounts lenses for eyeglasses and contact lenses
- **Optometric technician (OpT)** or **paraoptometric:** works under the supervision of an ophthalmologist (or optometrist) preparing patients for examinations, performing receptionist duties, helping patients with frame selection, and instructing patients in the care and use of their contact lenses. An OpT also administers basic vision tests and teaches eye exercises.
- **Optometric assistant:** performs the same duties as an OpT, with the exception of administering vision testing and teaching eye exercises
- **Orientation and mobility instructor:** teaches visually challenged individuals how to move about safely in a variety of environments
- **Audiologist:** provides care to individuals with hearing problems, testing, diagnosing, and prescribing treatment. Audiologists also conduct noise-level testing in workplaces and work to prevent hearing loss.
- **Speech/language therapist** or **pathologist:** identifies, evaluates, and treats patients with speech and language disorders; may work with elementary or preschool children or in the rehabilitation of stroke patients

Health Occupation Profile: Audiologist

Perry C. Hanavan is an audiologist in Sioux Falls, South Dakota. "As an audiologist, I identify, diagnose, treat, and manage individuals with communication disorders resulting from hearing loss. From diagnosing hearing problems in newborns to providing audiologic services to elderly persons who suffer a hearing loss, this profession provides challenging and stimulating career experiences across the life span."

"Audiologists select, dispense, and fit hearing aids and assistive listening devices and are a part of the cochlear implant team. Increasingly, audiologists rely on a variety of technologies to fit programmable and digital hearing aids, to assess auditory brain activity, and to assess middle ear and inner ear function."

"I was in search of a profession that included psychology, science, and technology when I discovered the fascinating field of audiology while in college. I am now an assistant professor, teaching audiology courses and supervising students providing audiologic services."

STUDY BREAK

Images seen through the *rods* and *cones* of the eye's *retina* are converted into nerve impulses to be interpreted by the brain. Sometimes, the brain gets confused by the images it receives, as is the case of an optical illusion. Try this famous Floating Finger optical illusion:

- Hold your hands in front of you at eye level. Point your index fingers toward each other. Leave a little space (an inch or so) between your two index fingers. With your fingers at eye level, focus on a wall or an object a few feet away.
- You should see a finger with two ends floating in between your two index fingers. If you have trouble seeing it, try moving your fingers closer to your eyes (still at eye level).
- For a different illusion, try this with your two index fingers actually touching each other.

Optical illusions are part of our everyday vision. Newspaper illustrations and computer screens, for example, are made up of small colored dots that our brain merges into solid images. If the optic nerve could transmit only literal impulses to the brain, we would not be able to enjoy television, animation, and many other wonderful optical illusions.

Review Time

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

1. **Written assignment:** Using terms a physician would understand, describe the differences between **open-angle glaucoma** and **closed-angle glaucoma.**

   Discussion assignment: What test is performed to detect glaucoma?

2. **Written assignment:** Describe the differences between a **conductive hearing loss** and a **noise-induced hearing loss.**

   Discussion assignment: What steps can be taken to prevent a noise-induced hearing loss, and at what age should one begin taking these precautions?

3. **Written assignment:** Using terms a patient would understand, describe the difference in the vision loss between a patient with **glaucoma** and one with **macular degeneration.**

   Discussion assignment: How would each of these vision losses affect the patient's quality of life?

4. **Written assignment:** Describe the difference between **tinnitus** and **vertigo.**

   Discussion assignment: How would each of these conditions affect the patient?

5. **Written assignment:** Describe the difference between **hyperopia** and **myopia.**

   Discussion assignment: How would you explain each of these conditions to a young patient and her family?

Optional Internet Activity

The goal of this activity is to help you learn more about medical terminology while improving your Internet skills. Select ***one*** *of these two options and follow the instructions.*

1. **Internet Search:** Search for information about **glaucoma.** Write a brief (one- or two-paragraph) report on something new you learned here and include the address of the web site where you found this information.

2. **Web Site:** To learn more about **tinnitus,** go to this web address: **http://www.ata.org/**. Explore the site and then write a brief (one- or two-paragraph) report on something new you learned here.

The Human Touch: Critical Thinking Exercise

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

William Davis is 62 years old. He was employed as a postal worker until his declining eyesight forced him into early retirement a few months ago. His wife, Mildred, died last year of complications from diabetes after a prolonged and expensive hospitalization. Mr. Davis does not trust the medical community and, because of this distrust, he has not been to a doctor since his wife's death.

Mr. Davis is not considered legally blind, but his presbyopia and the advancing cataract in his right eye are starting to interfere with his ability to take care of himself. He still drives to the market once a week, but angry drivers honk and yell at him. He pays for his groceries with a credit card because he is afraid the checker will cheat him if he accidentally gives her the wrong bill. He complains that the cleaning lady hides things from him and deliberately leaves the furniture out of place. When she leaves, he can't find his slippers or an ashtray. Yesterday, he put his lit pipe down in a wooden bowl by accident.

His son insists on taking him to see the ophthalmologist who treated his wife's diabetic retinopathy. Dr. Hsing believes Mr. Davis's sight can be improved in the right eye by performing cataract surgery. Mr. Davis listens in fear as the doctor explains. "Without this procedure your sight will only get worse."

Mr. Davis thinks about all the medical procedures that were tried on Mildred, and she died anyway. He doesn't want to go into the hospital, and he doesn't want any operations. But his son is talking about taking away his car if he doesn't do something about his failing sight. "What more can be taken away from me?" he thinks bitterly. "First my wife, then my job, and now my independence."

Suggested Discussion Topics

1. Discuss how Mr. Davis's loss of sight is affecting the way he treats others and is treated by them.
2. Mr. Davis is a patient at the clinic where you work. Discuss the ways you would adjust your usual routine to accommodate his needs.
3. Close your eyes and keep them closed for 15 minutes while a classmate or friend leads you around. Discuss how you felt and what could have been done to make the experience less stressful.
4. Discuss why cataract surgery would be scary to Mr. Davis and what Dr. Hsing and his staff could do to ease his apprehension.
5. If Mr. Davis does not go ahead with the surgery, available support groups can help him cope with his vision loss. What groups might help him deal with his grief and depression?

Student Workbook and Student Activity CD-ROM

1. Go to your **Student Workbook** and complete the Learning Exercises for this chapter.
2. Go to the **Student Activity CD-ROM** and have fun with the exercises and games for this chapter.

CHAPTER

12 Skin: The Integumentary System

Overview of Structures, Word Parts, and Functions of the Integumentary System

Major Structures	Related Word Parts	Primary Functions
Skin	**cutane/o, dermat/o, derm/o**	Intact skin is the first line of defense for the immune system. Skin also waterproofs the body and is the major receptor for the sense of touch.
Sebaceous glands	**seb/o**	Secrete sebum (oil) to lubricate the skin and discourage the growth of bacteria on the skin.
Sweat glands	**hidr/o**	Secrete sweat to regulate body temperature and water content and excrete some metabolic waste.
Hair	**pil/i, pil/o**	Aids in controlling the loss of body heat.
Nails	**onych/o, ungu/o**	Protect the dorsal surface of the last bone of each finger and toe.