Chapter 15

Disorders of the Eyes, Ears and Other Sensory Organs

Sensory Receptors

- Classified into two major categories
  - General senses
  - Special senses
    - Include the eye and ear

Sensory Receptors by Location

- Exteroceptors
  - Located close to body surface (cutaneous receptors)
    - Examples—touch, pressure, temperature, pain
- Viscероreceptors
  - Located internally around the viscera
- Proprioceptors
  - Muscle sense

Sensory Receptors by Stimuli

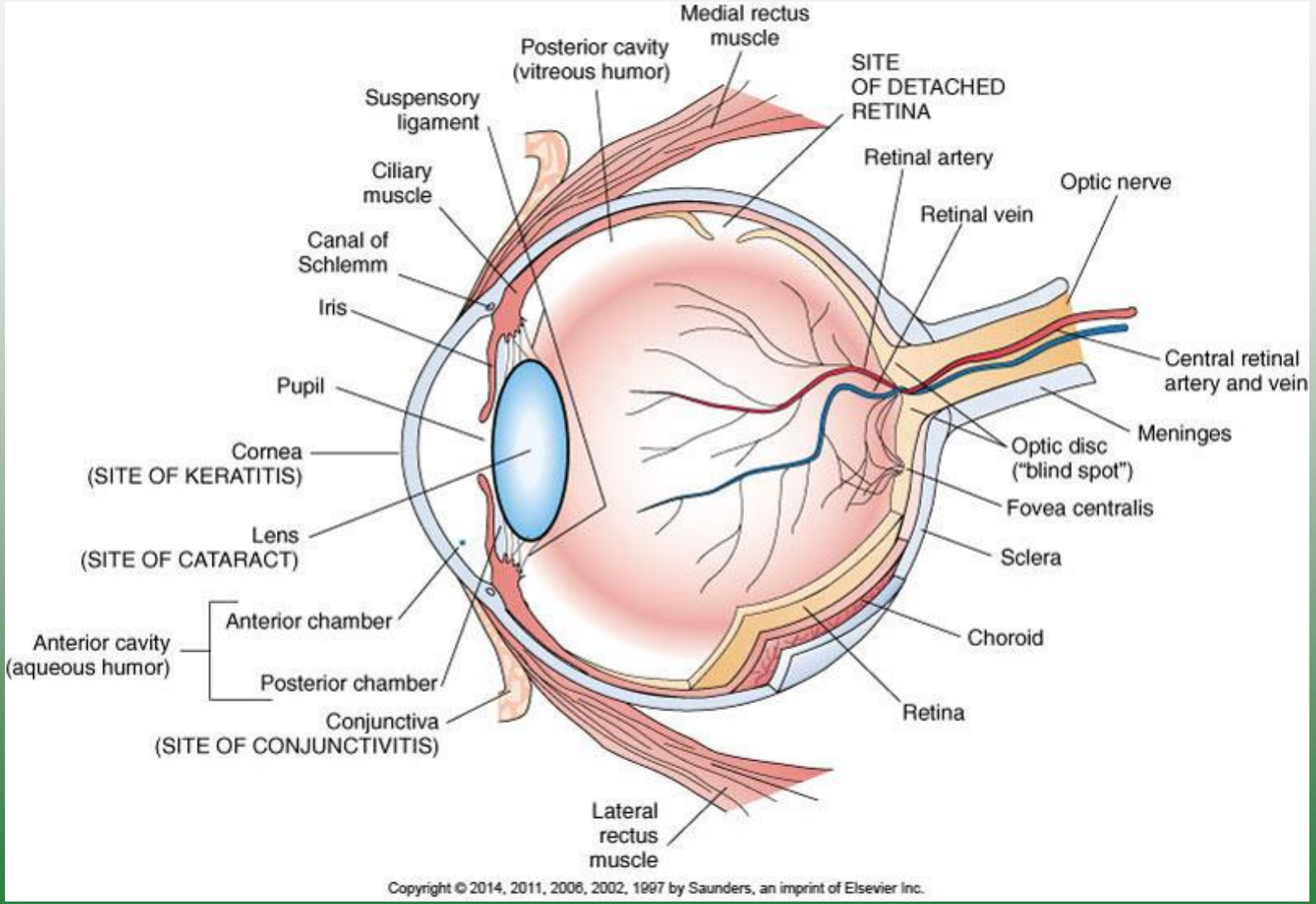
- Mechanoreceptors
  - Stimulated by mechanical force(s)
    - Touch, pressure, ***equilibrium, hearing***
- Chemoreceptors
  - Change in chemical concentration
    - Taste, smell
- Thermoreceptors
  - Stimulated by change in the temperature
    - Warm and cold receptors

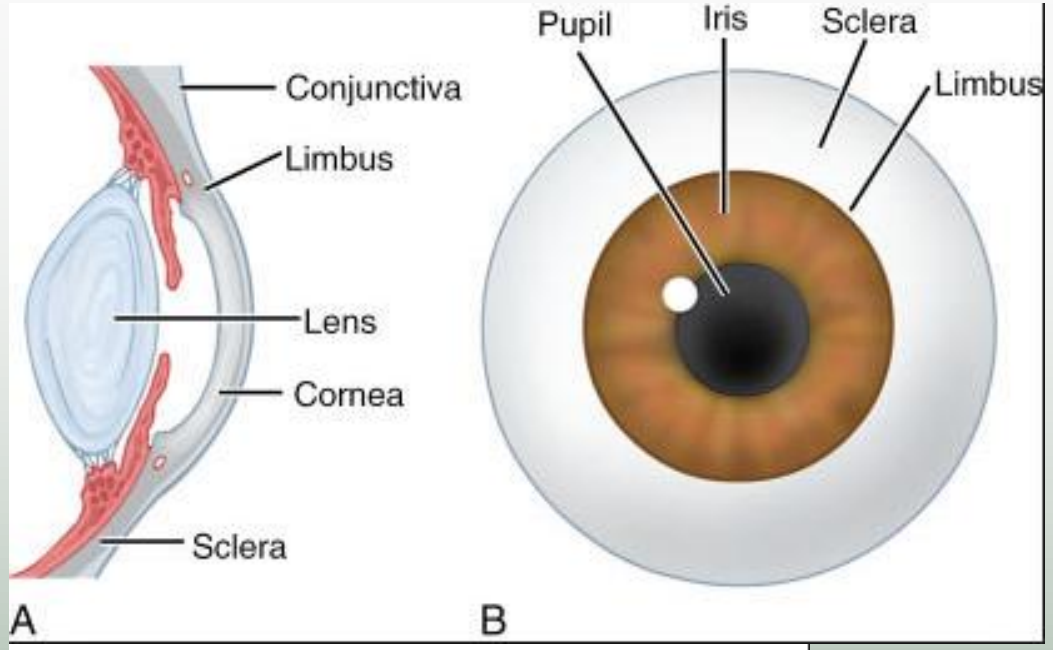
Sensory Receptors by Stimuli (Cont.)

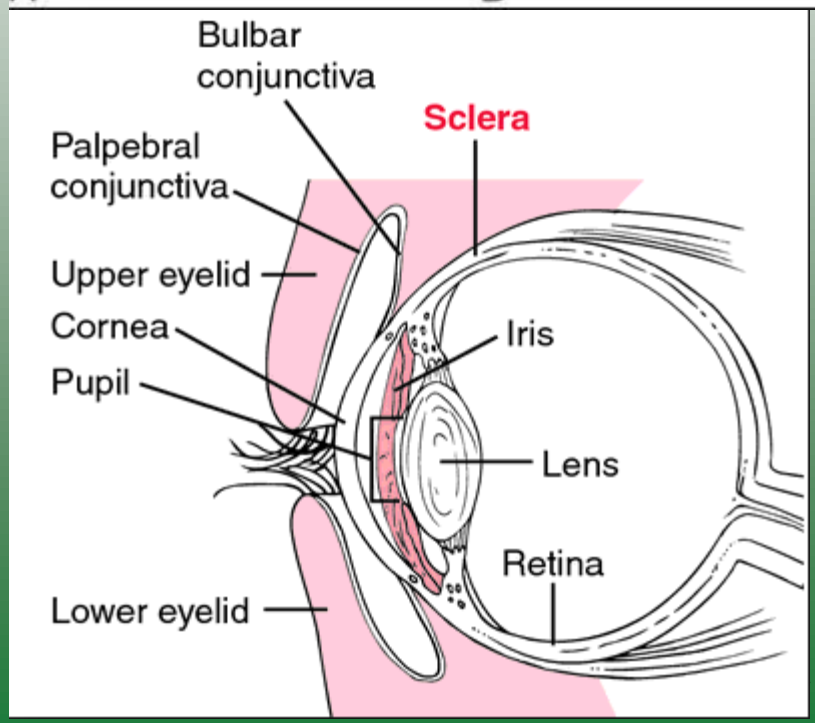
- Photoreceptors
  - Respond to light
    - Rods and cones in the retina (eye)
- Nociceptors
  - Respond to any tissue damage
    - Results in pain
- Osmoreceptors
  - Recognize changes in the osmolarity of body fluids
    - Concentrated in the hypothalamus

Eye: (study diagram before proceeding).

Find: Cornea, pupil, lens, retina, and optic nerve.







Find:

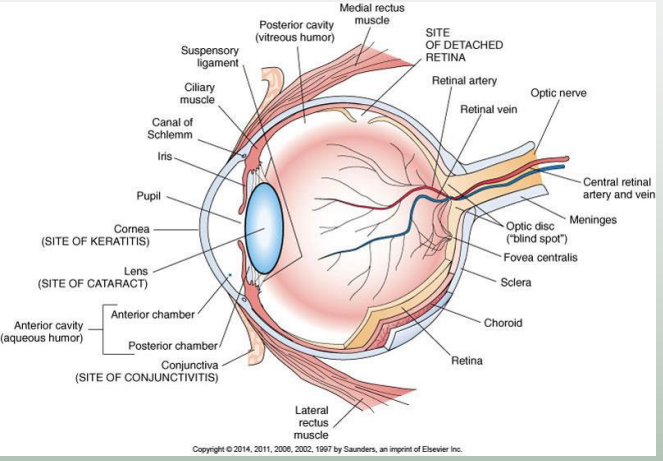
Pupil – hole in iris.

Iris – colored part behind cornea.

Sclera – white of eye continuous with the cornea that is clear.

Conjunctiva – lining of inner eyelid.

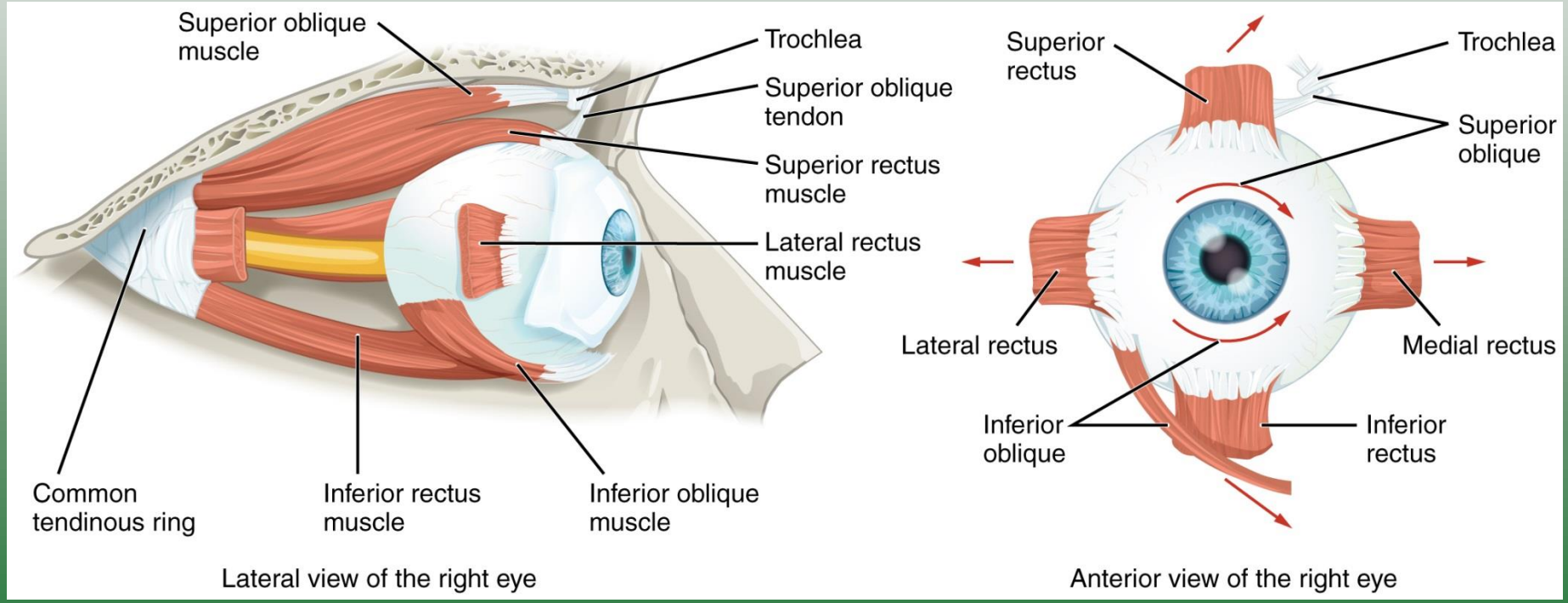
Fluids in the Eye



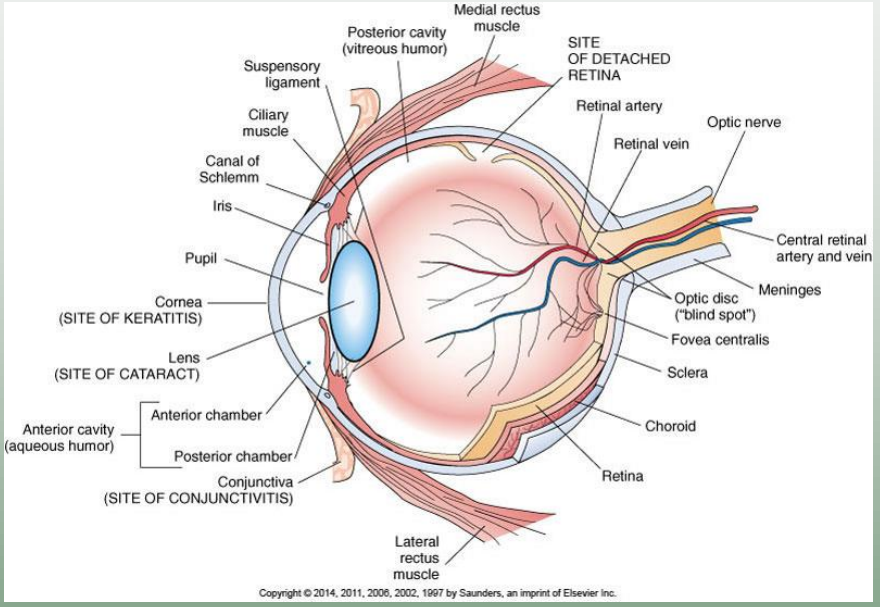
- Posterior cavity
  - Space between lens and retina
  - Contains vitreous humor
    - Formed during embryonic development
- Anterior cavity
  - Between cornea and lens
  - Divided into the anterior chamber and the posterior chamber
  - Filled with aqueous humor
    - Amount formed should be equal to the amount reabsorbed—maintenance of normal intraocular pressure (IOP) below 24 mm Hg

Muscles of the Eyeball

- Six extraocular skeletal muscles for movement of the eyeball
- Muscles controlled by cranial nerves (CNs) III, IV and VI.



Eye

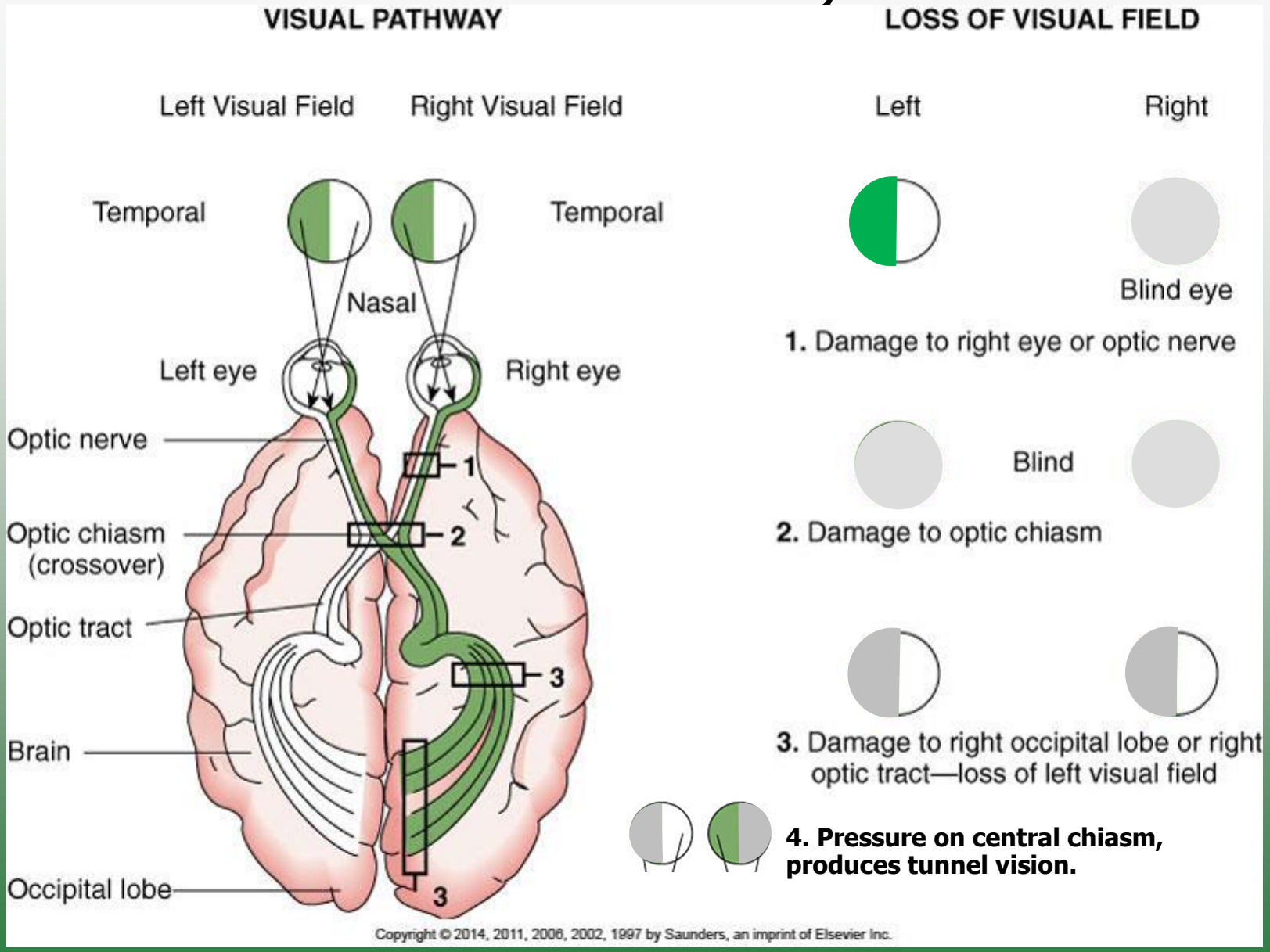


- Light rays enter the eye through the cornea and pass through the lens to the receptor cells of the retina:
  - **Rods—black and white vision**
  - **Cones—color vision**
- Visual stimuli are conducted by the optic nerve to the occipital lobe.

Visual Pathway

- Light rays pass through cornea
  - Refraction of rays
  - Through aqueous humor and pupil
  - To the retina (rods and cones)
- Retinal Nerve fibers form the optic nerve (CN II)
- Optic chiasm
  - Fibers cross (see picture next slide)
  - Left occipital lobes receive images from right visual fields, right occipital lobes from left visual fields
- Perception occurs in visual sensory and association areas of the occipital lobes of the cortex.

Visual Pathway



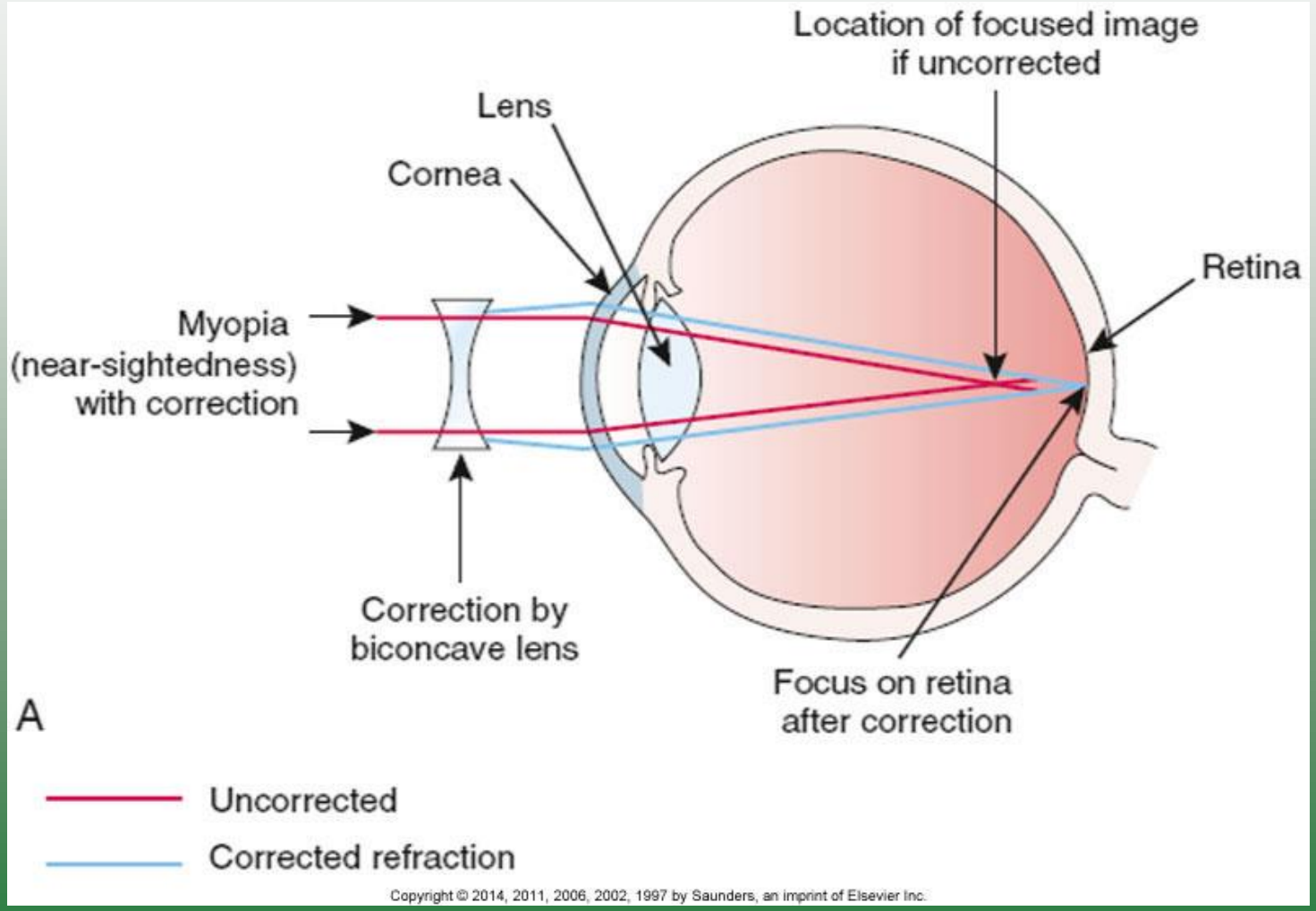
Diagnostic Tests

- Snellen chart (or similar test)
  - Measures visual acuity
- Visual field test
  - Checks for central and peripheral vision
- Tonometry
  - Assessment of Intraocular pressure.
- Ophthalmoscope
  - Visually examines internal structures, lets you look at the retina through the cornea.

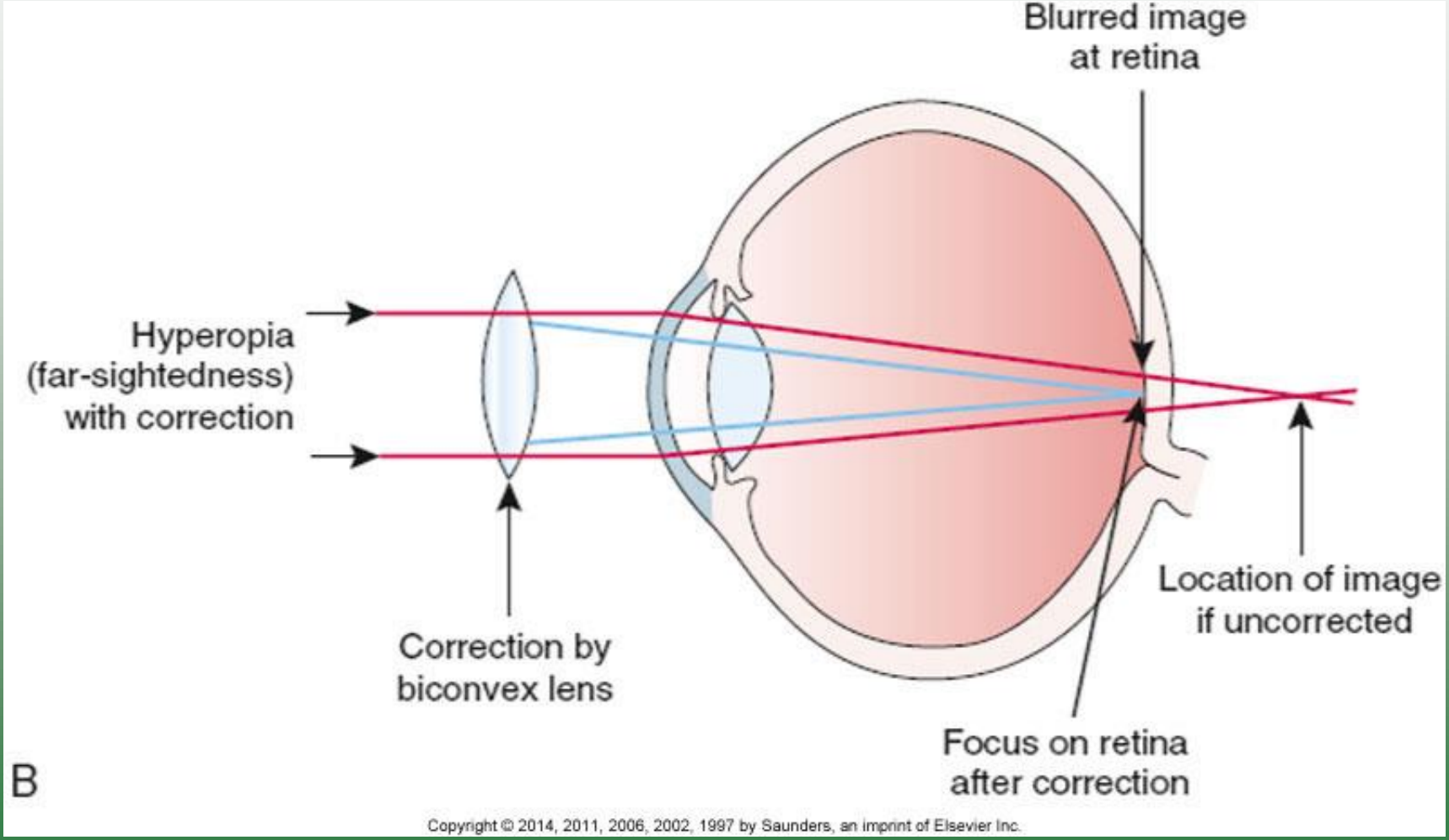
Structural Defects of the Eye

- Myopia
  - Nearsightedness
  - Image focused in front of the lens
- Hyperopia
  - Farsightedness
  - Eyeball is too short
  - Image focused behind the retina
- Presbyopia
  - Farsightedness associated with aging
  - Loss of elasticity reduces accommodation

Refraction Defects in the Eye: Myopia also known as “near-sightedness”



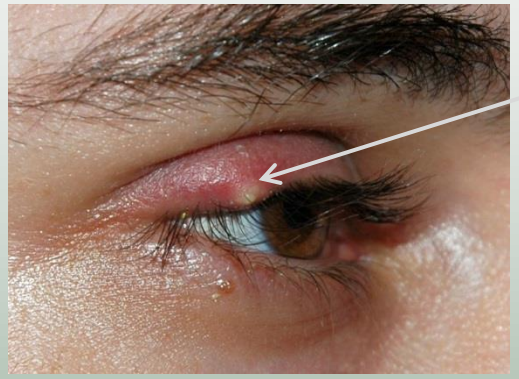
Refraction Defects in the Eye: Hyperopia also known as “far-sightedness”



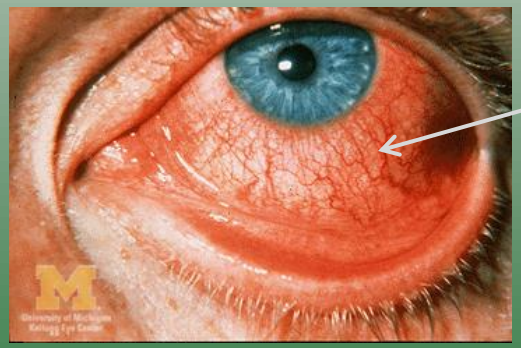
Structural Defects of the Eye (Cont.)

- Astigmatism
  - Irregular curvature in the cornea or lens
- **Strabismus** (squint or **cross-eyed)**
  - Results from deviation of one eye
  - **Double vision (diplopia)**
  - May be caused by weak or hypertonic muscle, short muscle, neurological defect
  - In children
    - Must be treated immediately to prevent development of amblyopia

Infections and Trauma



- Stye
  - Infection involving a hair follicle on the eyelid
  - Usually caused by staphylococci
  - Swollen, red mass forms on eyelid
  - Purulent exudate



- Other infections
  - Conjunctivitis, or “pink eye”

Conjunctivitis

- Superficial inflammation or infection caused by:
  - Allergens, irritating chemicals, bacteria, viruses

- Etiologies:
  - Virus is common in adults.
  - Bacteria include: *Staph., Strep. , H. Flu B*
  - Spread by fingers or contaminated towels
    - Occurs with contact lens use, contaminated makeup, contaminated medication
  - Antibiotic treatment to prevent damage to cornea

Conjunctivitis (Cont.)

- Other causes
  - *Chlamydia trachomatis* and *Neisseria gonorrheae*
  - Both cause infections in the reproductive tract.
  - May infect eyes of newborns
  - May be transferred by self-inoculation

Keratitis

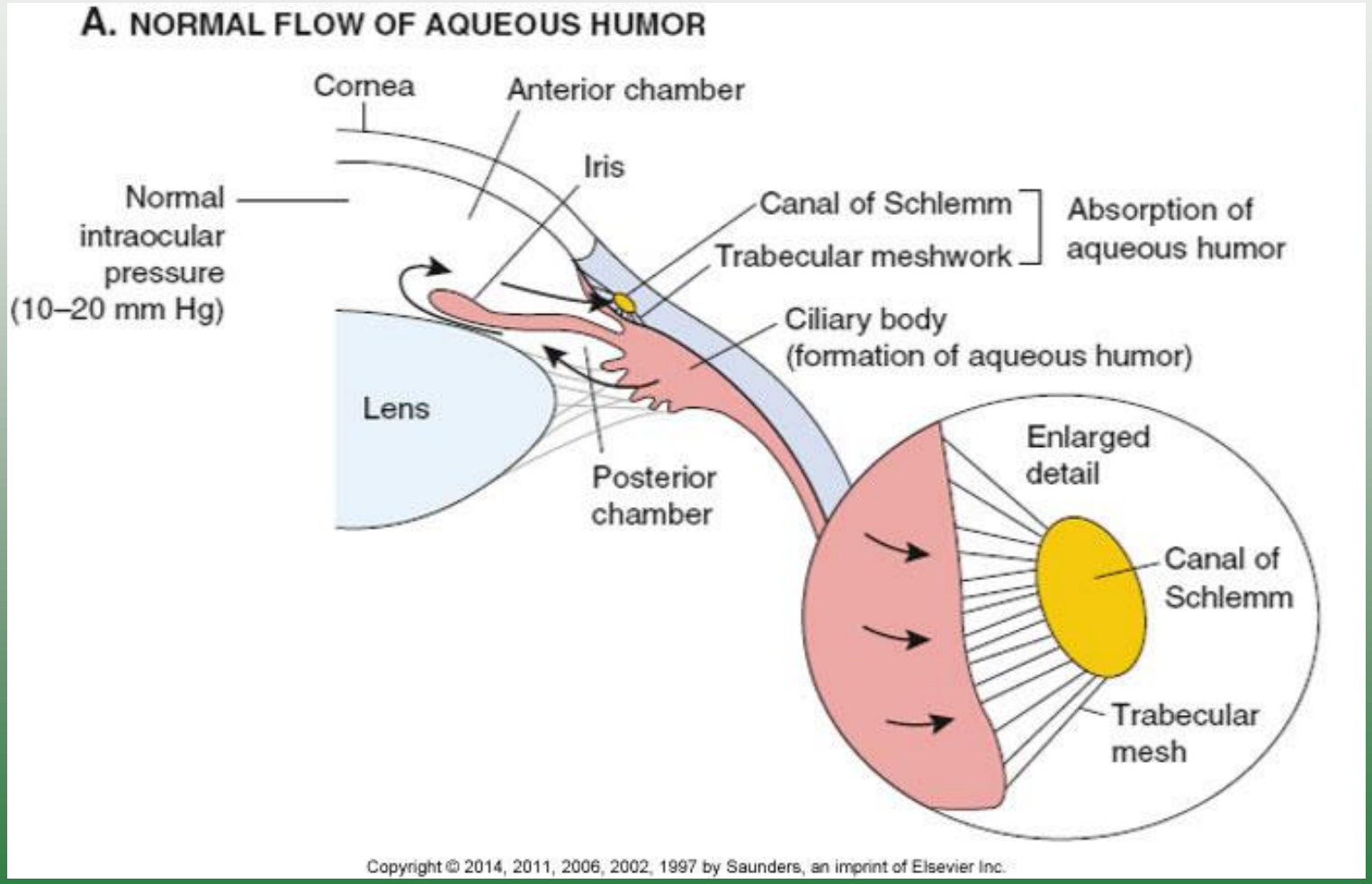
- Develops when cornea is infected or irritated
  - Herpes simplex can be cause
    - Transfer from herpes lesion around mouth
    - Transfer by fingers, dental office, spray of contaminated saliva
  - Severe pain and photophobia
  - Increased risk of ulceration eroding the cornea
  - Scar tissue formation interferes with vision.

- Trauma is another etiology:
  - Damage from chemicals, splashes, fumes.

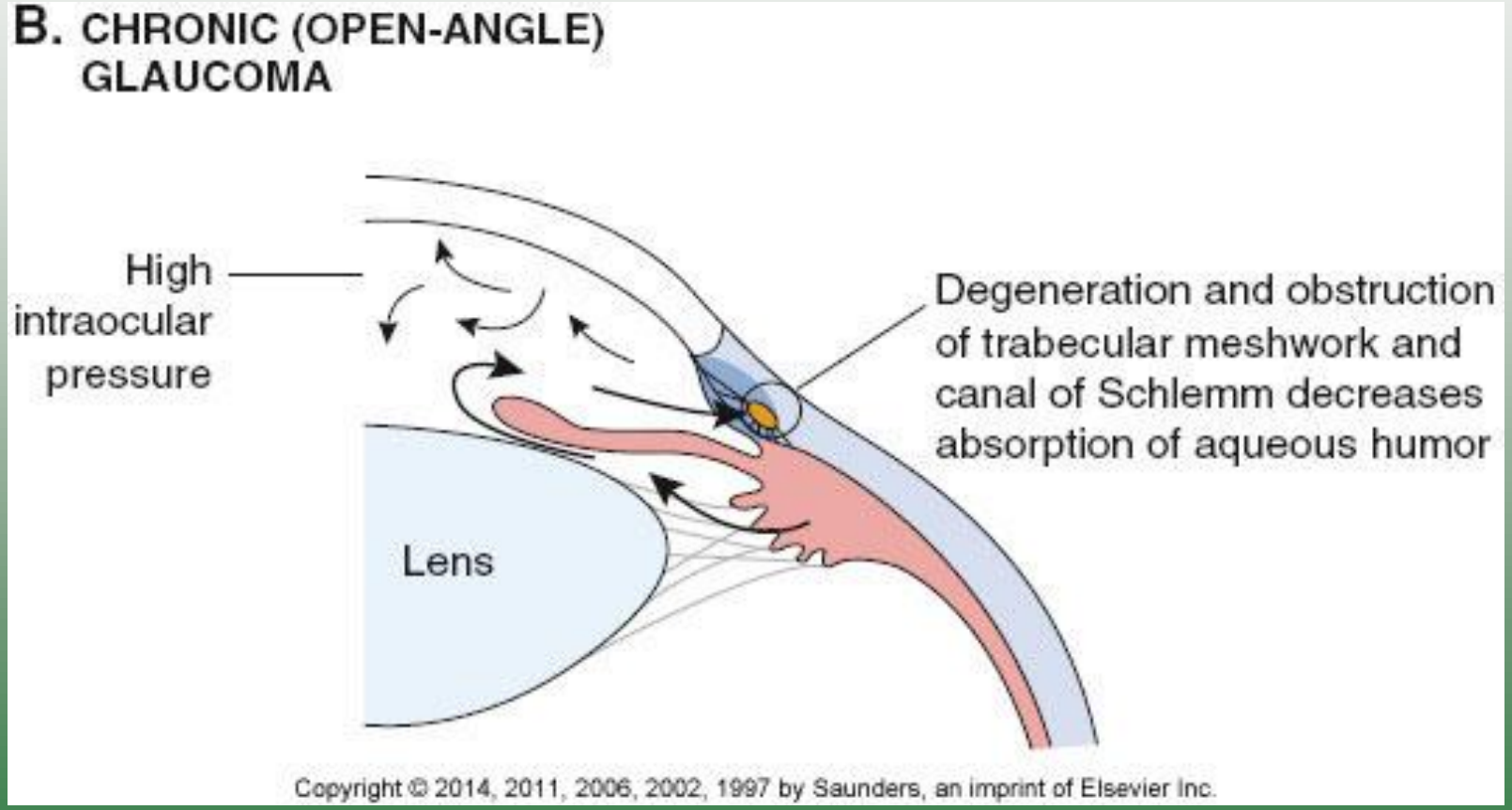
Glaucoma

- Result of increased IOP caused by excessive accumulation of aqueous humor
- Most common and preventable loss of vision in developed countries
- May be acute or chronic
- Signs and symptoms
  - Halos around lights at night
  - Loss of peripheral vision
  - Pain may occur if IOP is greatly increased, as in acute form

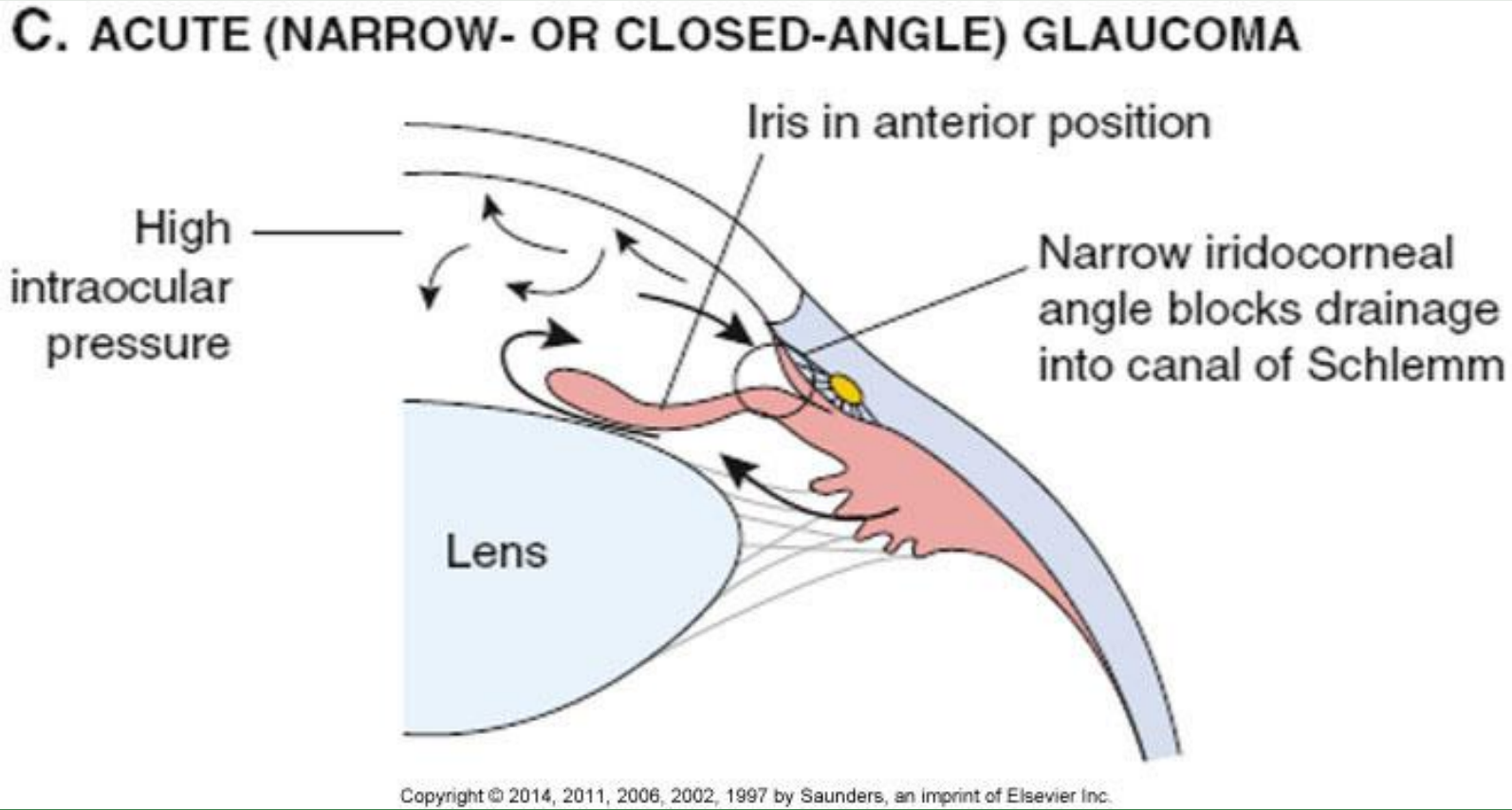
Glaucoma: Normal Flow of Aqueous Humor



Chronic Glaucoma



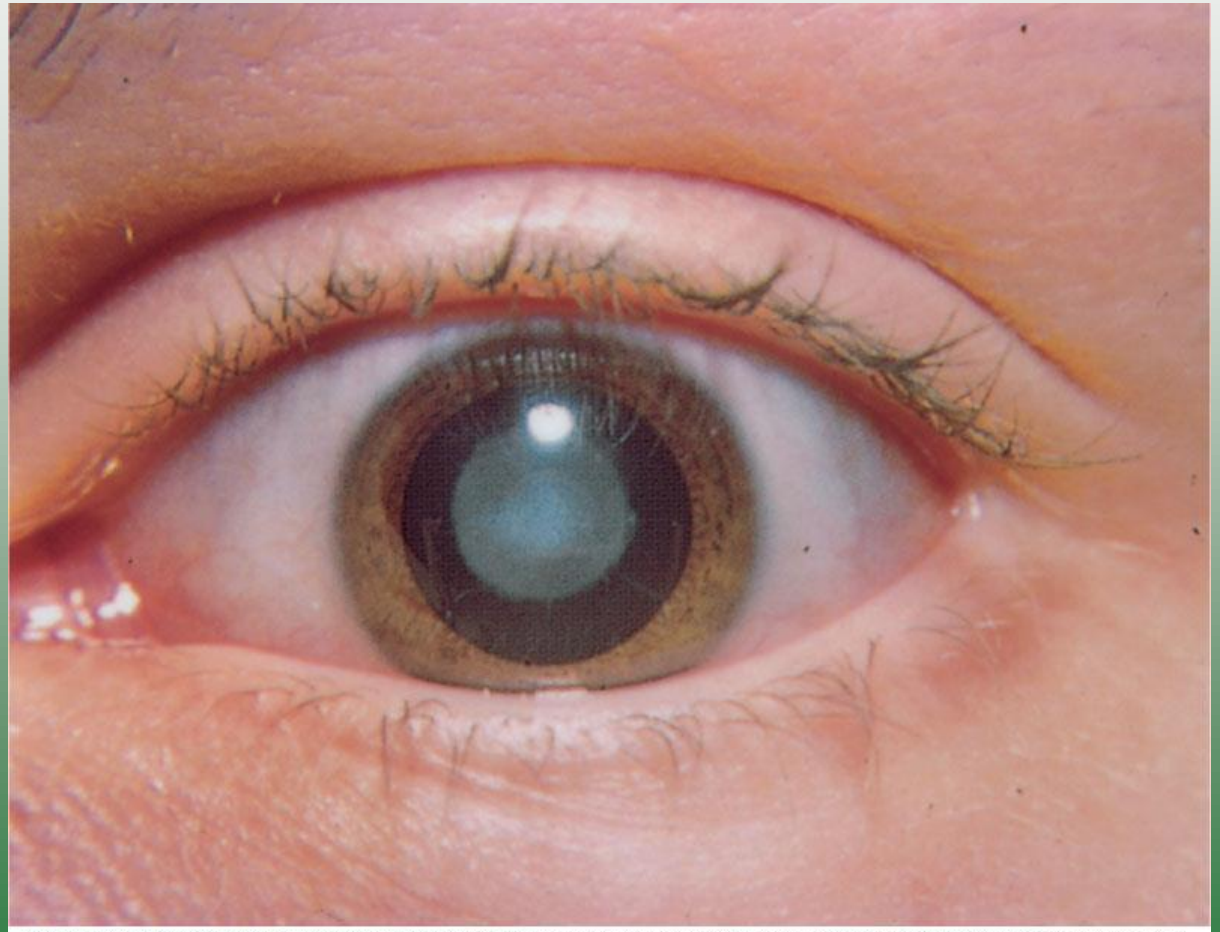
Acute Glaucoma



Cataracts

- Progressive opacity or clouding of the lens
  - Interferes with light transmission
- Size, site, and density of clouding vary among individuals.
  - May be different in individual's two eyes
- Changes may be
  - Age-related or caused by metabolic abnormalities
  - Excessive exposure to sunlight
  - Congenital
  - Traumatic

Appearance of Eye with Cataract



Courtesy of Ophthalmic Photography at the University of Michigan W.K. Kellogg Eye Center, Ann Arbor, from Black JM, Hawks JH: Medical-Surgical Nursing: Management for Positive Outcomes, ed 7, Philadelphia, 2005, Saunders.

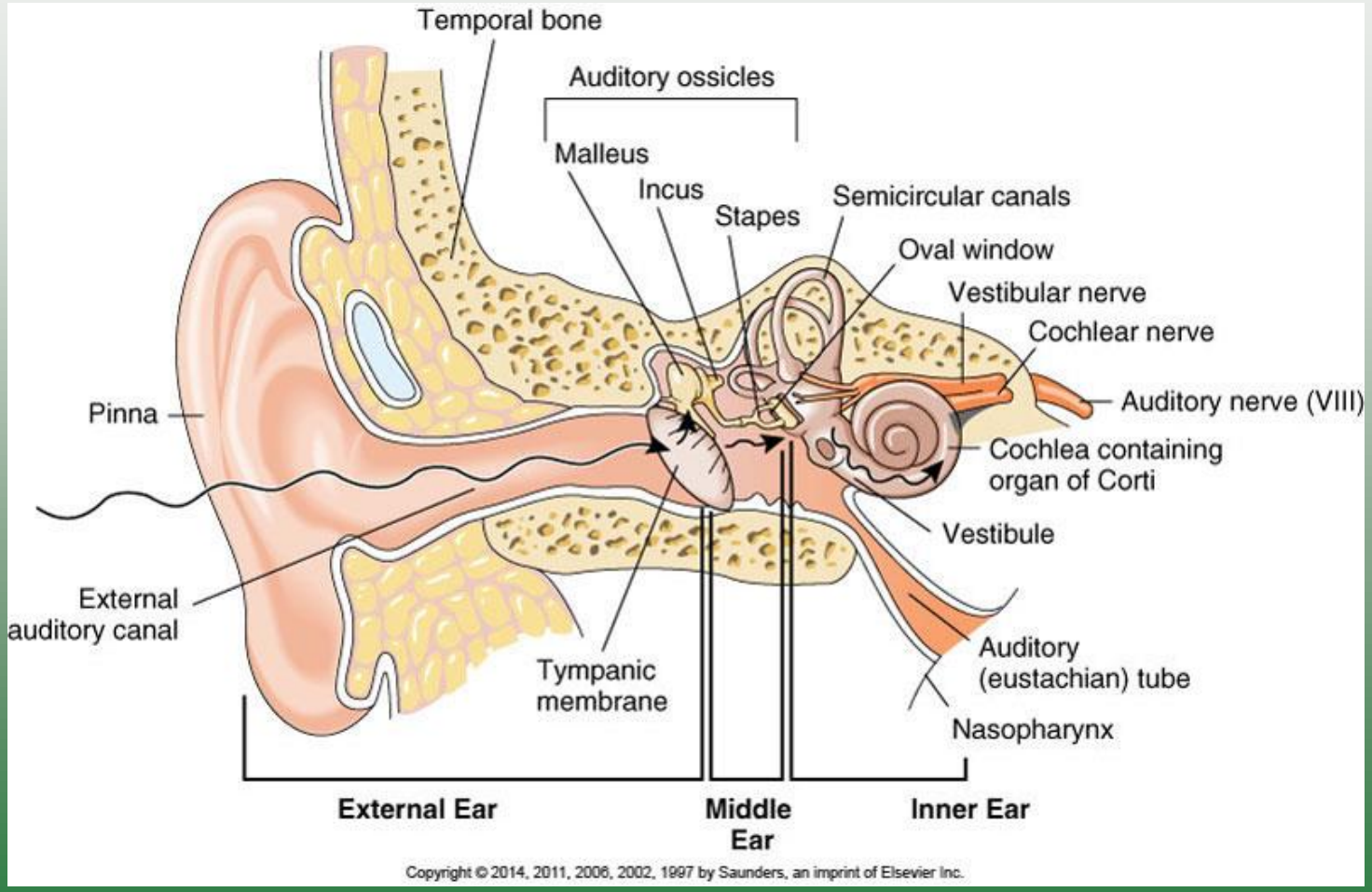
Detached Retina

- Acute emergency
  - Retina tears away from underlying choroid
  - Retinal ischemia can lead to irreversible loss of receptors.
  - No pain or discomfort
  - Visual field contains areas of blackness (scotomas), as if a curtain has fallen over the eye.

Parts of the Ear

- External ear
  - Pinna and external auditory meatus (canal)
- Middle ear
  - Tympanic membrane
  - Bony ossicles
  - Auditory tube connects to upper respiratory tract
- Inner ear
  - Cochlea
    - Organ of Corti—hearing
  - Semicircular canals
    - Balance and equilibrium

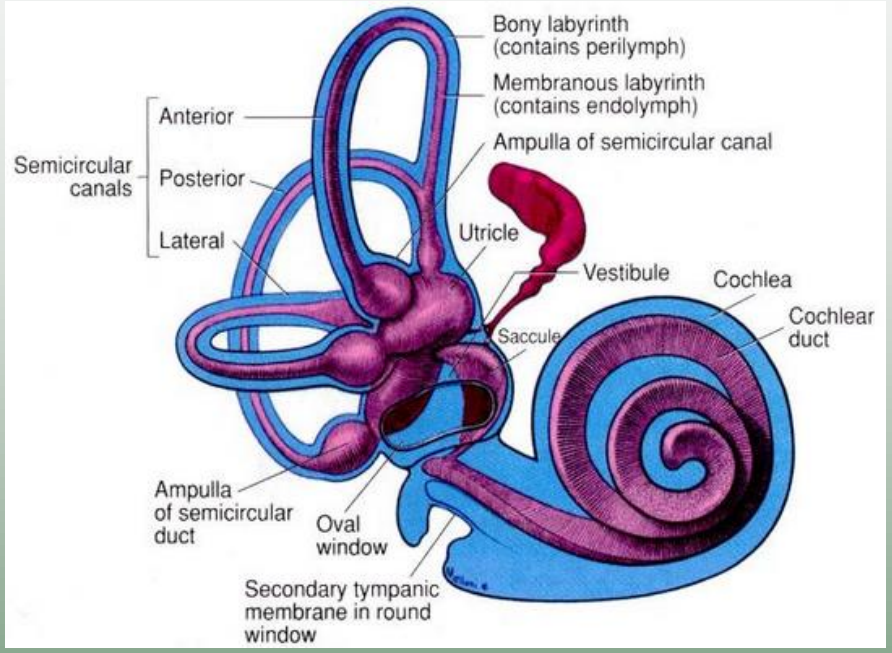
Structure of the Ear



Pathway of Sound

- Sound waves enter the external ear canals.
- Vibration of the tympanic membrane causes the ossicles to vibrate.
- Motion of stapes against oval window initiates movement of the fluid in the cochlea.
  - Stimulation of hair cells in organ of Corti
  - Initiation of nerve impulses
- Impulses conducted to the auditory area in the temporal lobe of cerebral cortex for interpretation of sound

Semicircular Canals



Three semicircular canals at right angles to each other measure equilibrium and balance in 3 dimensions.

At one end of each canal is a swelling, the ampulla, that has sensors that are stimulated by movement of fluid (called endolymph) in the canal.

Nausea from motion sickness is caused due to chaotic signals from the semicircular canals.

Hearing Loss

- Two types
  - Conduction deafness
    - Sound is blocked in the external ear or middle ear.
    - Accumulation of wax, foreign object, scar tissue
    - Otosclerosis of the ossicles
  - Sensorineural impairment
    - **Damage to the organ of Corti or auditory nerve**
    - **Infection**
    - Head trauma
    - Neurological disorders
    - **Ototoxic drugs**
    - Sudden very loud sounds or prolonged exposure to loud noise
    - **Congenital defects**

Infections

- Otitis Externa:
  - Infection of external ear canal
  - Known as “swimmer’s ear”.

- Otitis Media:
  - Infection of middle ear.
  - May require drainage by making a small incision (myringotomy) in the ear drum. Sometimes a tube is inserted.
  - Pathogenesis:
    - Eustachian tube blocked (swelling from allergy or virus).
    - Fluid collects in middle ear.
    - Fluid gets infected (from nasopharyngeal bacteria).