Sense Organs

16 April 2012

Outline

- Chemical Senses
  - Taste
  - Smell
- Sense of Vision
  - Human Eye
    - Focusing
    - Photoreceptors
- Sense of Hearing
- Sense of Balance

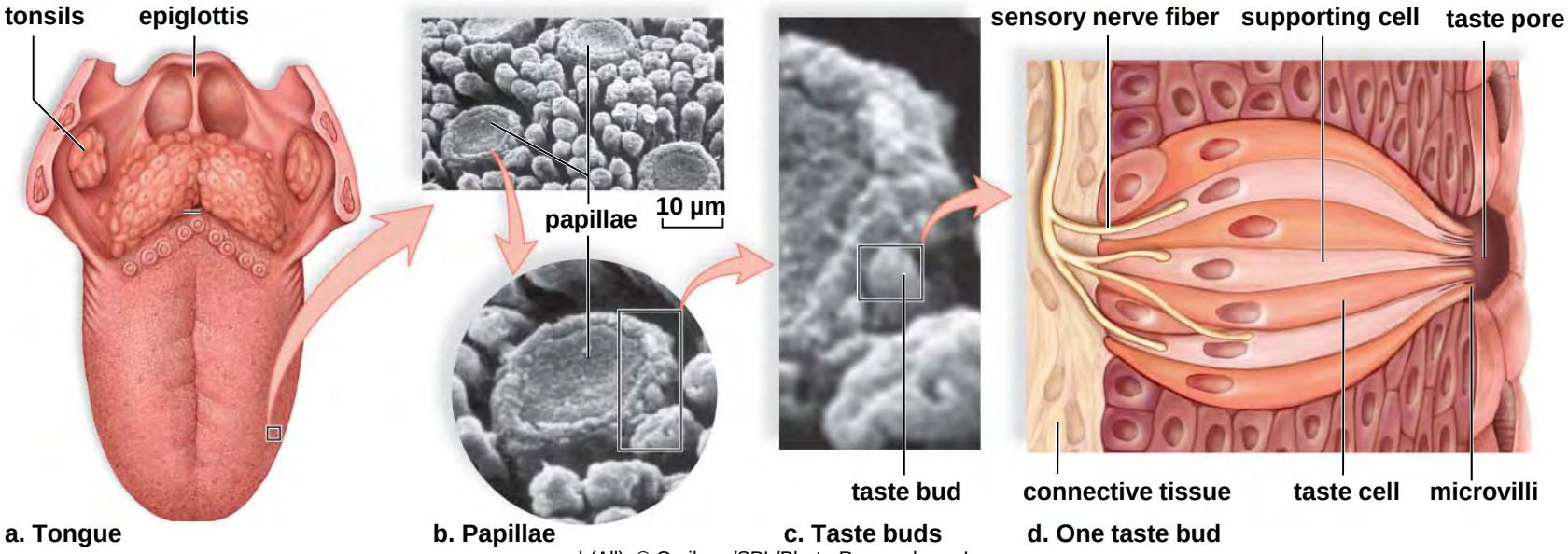
Chemical Senses

- Sensory receptors responsible for taste and smell are termed chemoreceptors
- Chemoreception is found almost universally in animals
- Thought to be most primitive sense

Sense of Taste

- In humans, taste buds are located primarily on the tongue
  - Taste buds open at a taste pore
  - Have supporting cells and elongated taste cells that end in microvilli
  - Four primary tastes
    - Bitter, sour, salty, sweet
    - Taste buds for each are concentrated on the tongue in particular regions

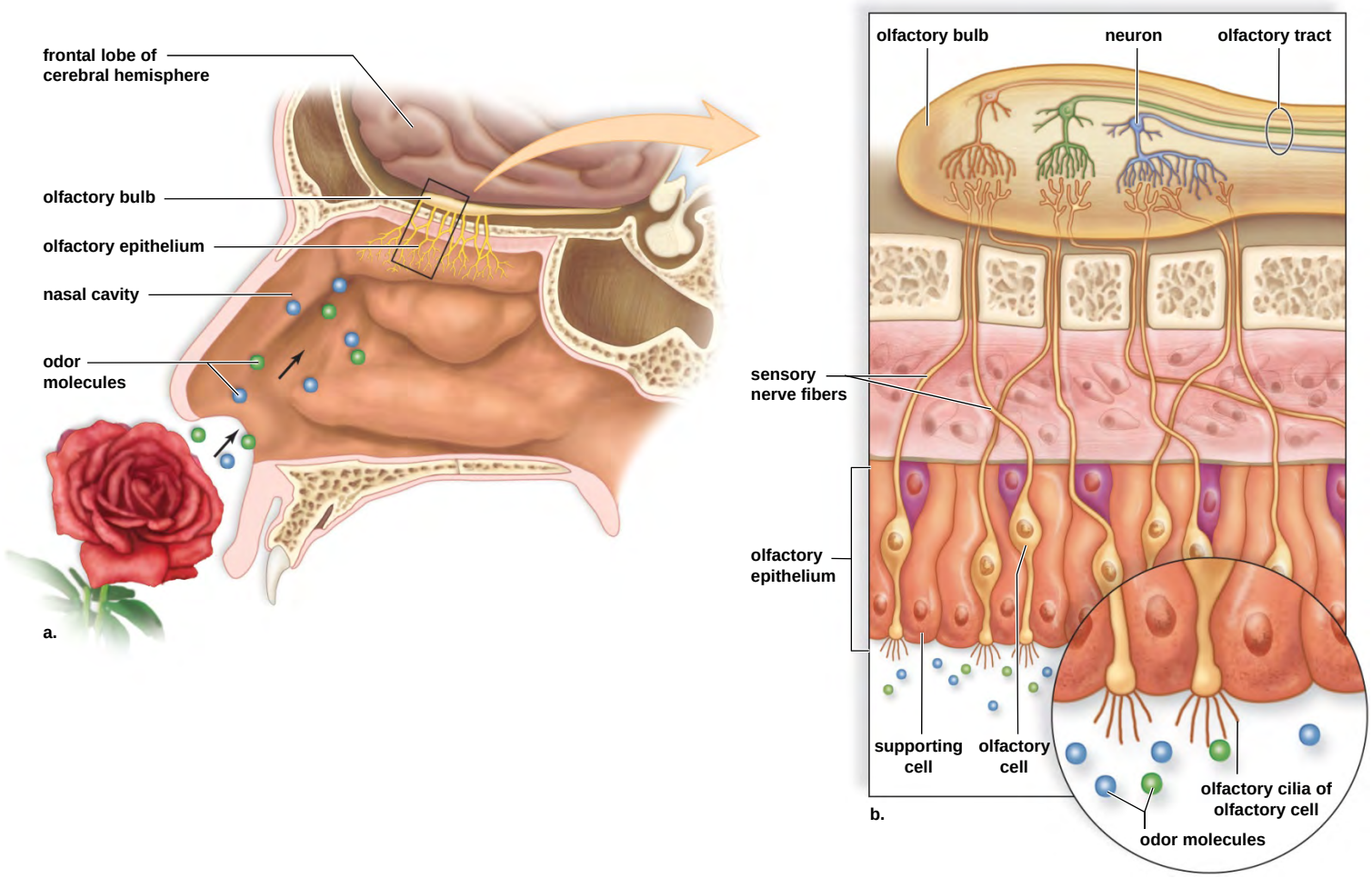
Taste Buds in Humans



Sense of Smell

- Sense of taste and smell
  - Work together to create a combined effect
  - Interpreted by the cerebral cortex
- Dependent on olfactory cells
  - Located within olfactory epithelium
  - In the roof of the nasal cavity
- Nerve fibers from olfactory cells lead to neuron in the olfactory bulb

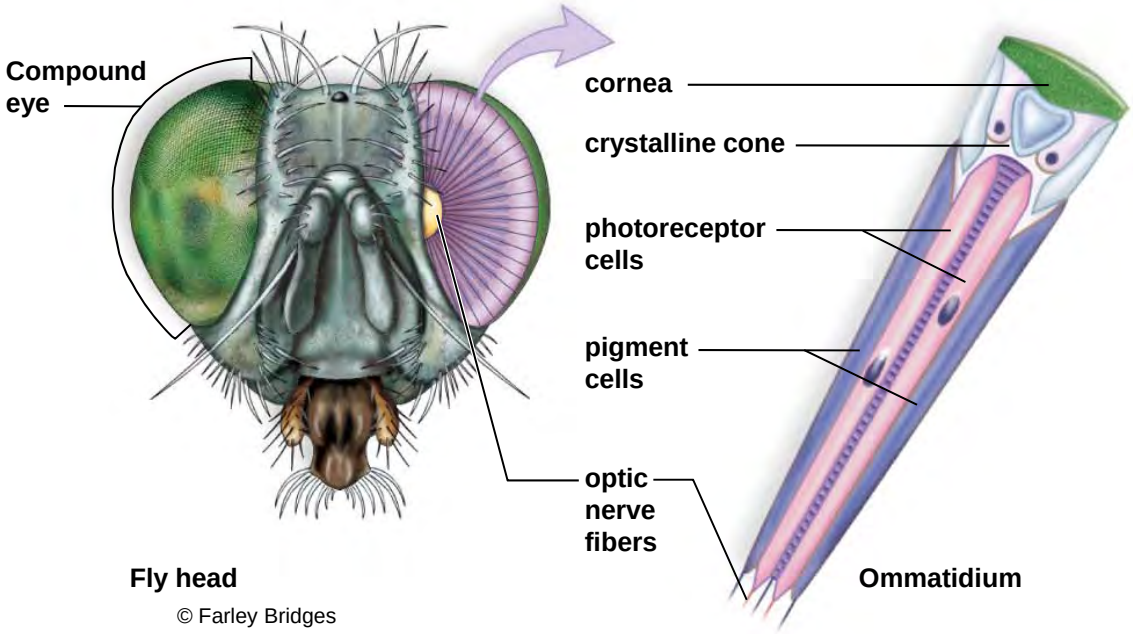
Olfactory Cell Location and Anatomy



Sense of Vision

- Photoreceptors are light sensory receptors
  - Photoreceptors generate nerve impulses which pass to the brain by way of optic nerve fibers
- Arthropods
  - Eyes are compound
  - Insects have limited color vision

Compound Eye



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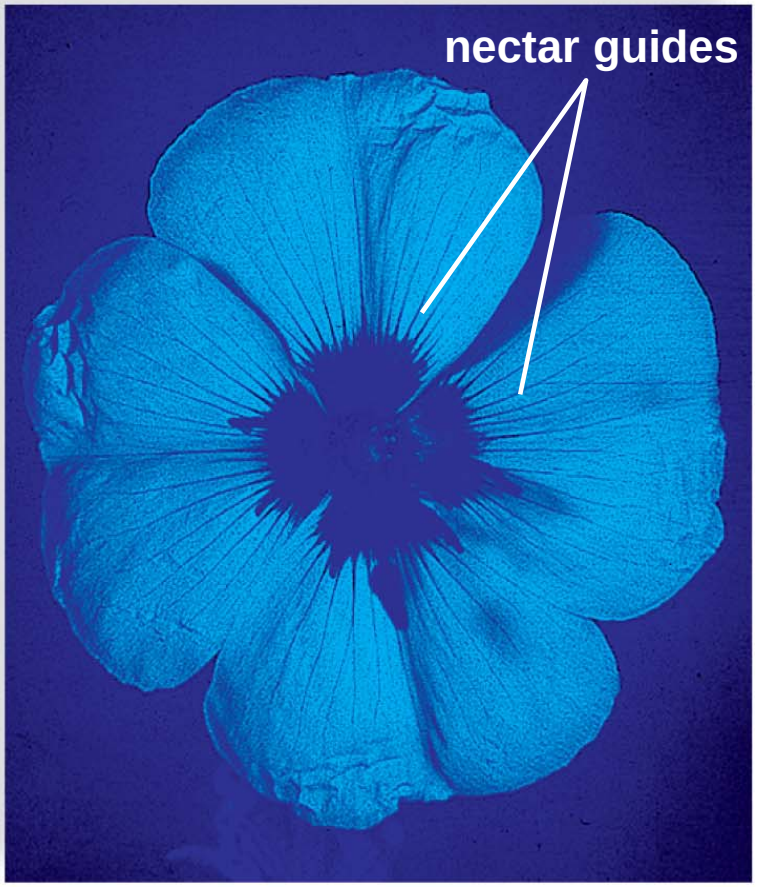
Nectar Guides



(Both): © Heather Angel/Natural Visions

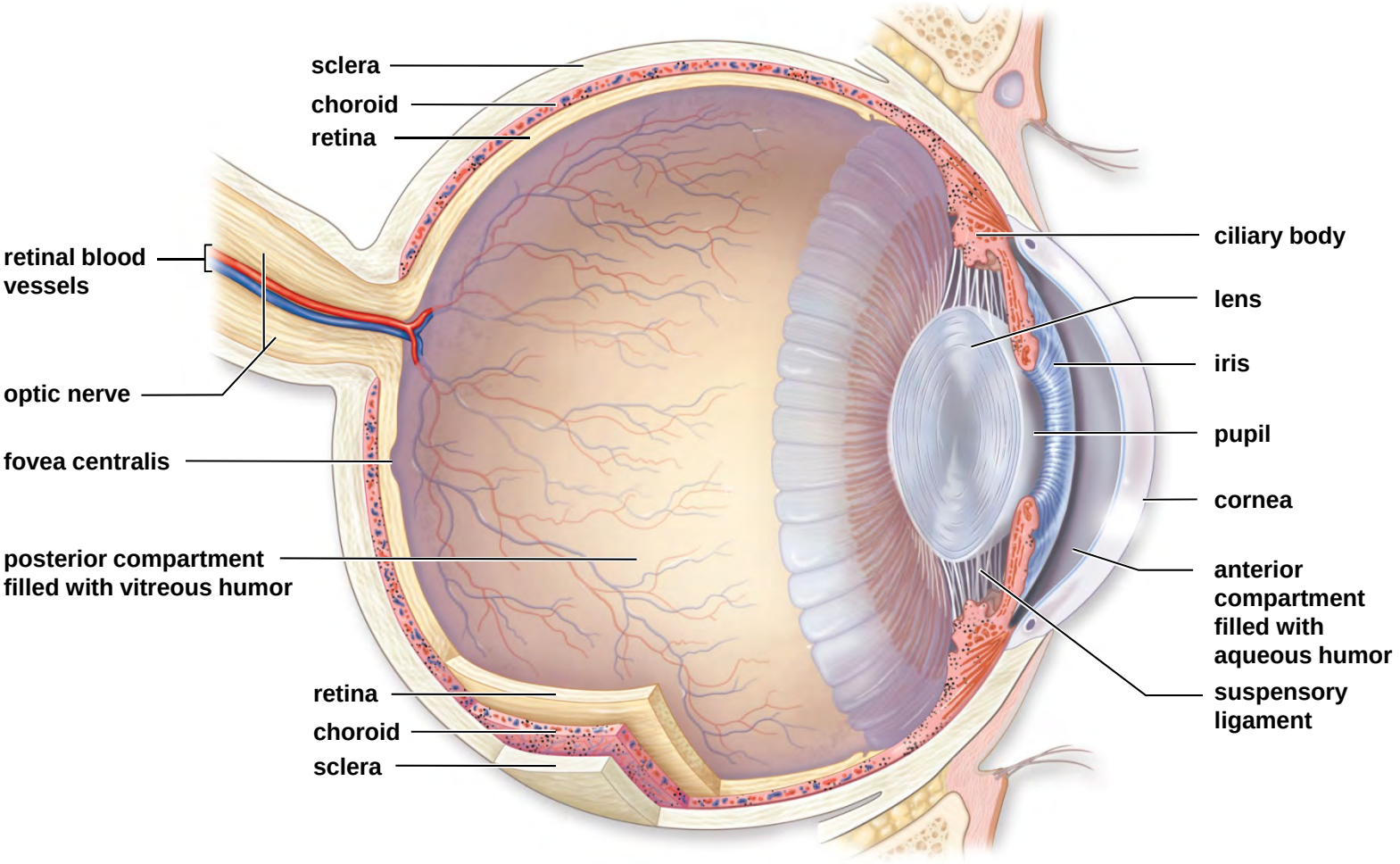
Sense of Vision

- Vertebrates and certain molluscs have a camera-type eye
  - Single lens focuses an image of the visual field on closely-packed photoreceptors

The Human Eye

- Three Layers
  - Sclera - Opaque outer layer
    - Fibrous layer
  - Choroid - Thin middle layer
    - Iris regulates size of pupil
  - Retina - Inner layer
    - Contains rod cells and cone cells

Anatomy of the Human Eye



Focusing the Eye

- Light rays pass through the pupil and are focused on the retina
- Focusing starts at the cornea and continues as rays pass through the lens and humor
  - Shape of lens is controlled by ciliary muscles
    - Distant Object - Muscles Relaxed
    - Near Object - Muscles Contracted

Focusing the Eye

- With normal aging, the lens loses its ability to accommodate for near objects
  - Also may make lens subject to cataracts
- Nearsighted
  - Elongated eyeball - Wear concave lenses
- Farsighted
  - Shortened eyeball - Wear convex lenses

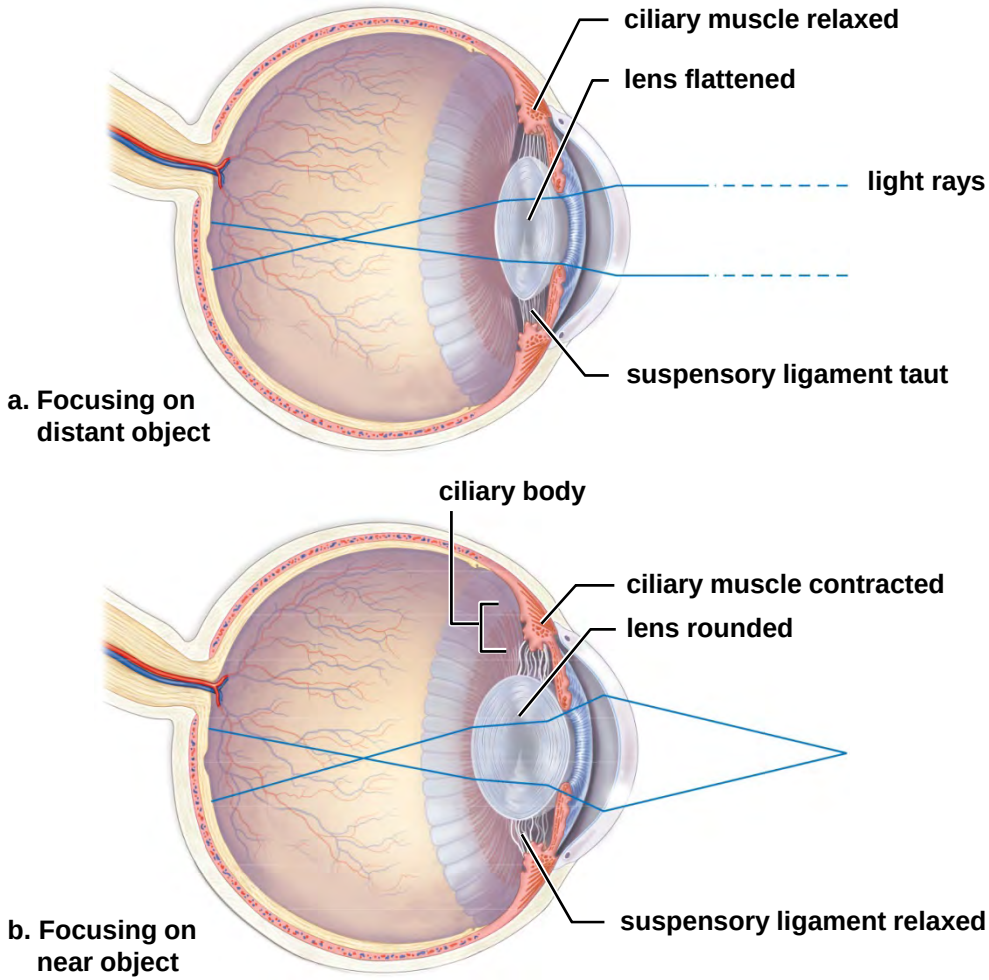
Functions of the Parts of the Eye

TABLE 38.1

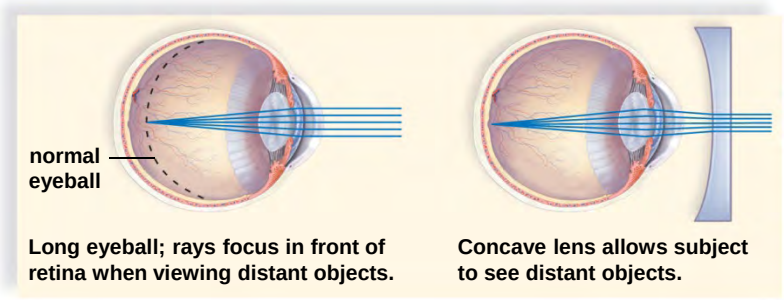
Functions of the Parts of the Eye

Part	*Function*
Sclera	Protects and supports eyeball
Conjunctiva	Moistens eye surface
Cornea	Refracts light rays
Pupil	Admits light
Choroid	Absorbs stray light
Ciliary body	Holds lens in place, accommodation
Iris	Regulates light entrance
Retina	Contains sensory receptors for sight
Rods	Make black-and-white vision possible
Cones	Make color vision possible
Fovea centralis	Makes acute vision possible
Other	
Lens	Refracts and focuses light rays
Humors	Transmit light rays and support eyeball
Optic nerve	Transmits impulse to brain

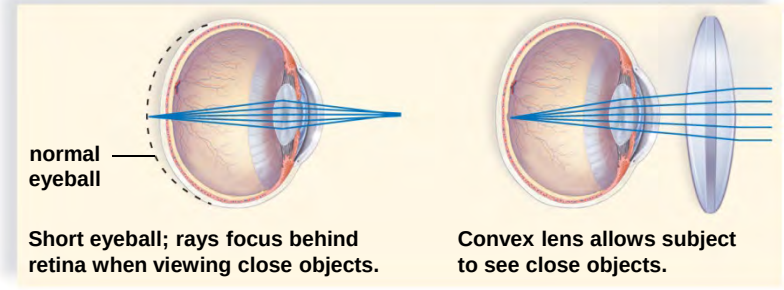
Focusing of the Human Eye



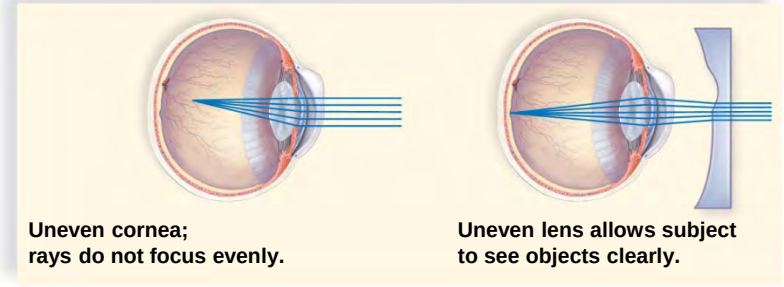
Common Abnormalities of the Eye with Possible Corrective Lenses



a. Nearsightedness



b. Farsightedness

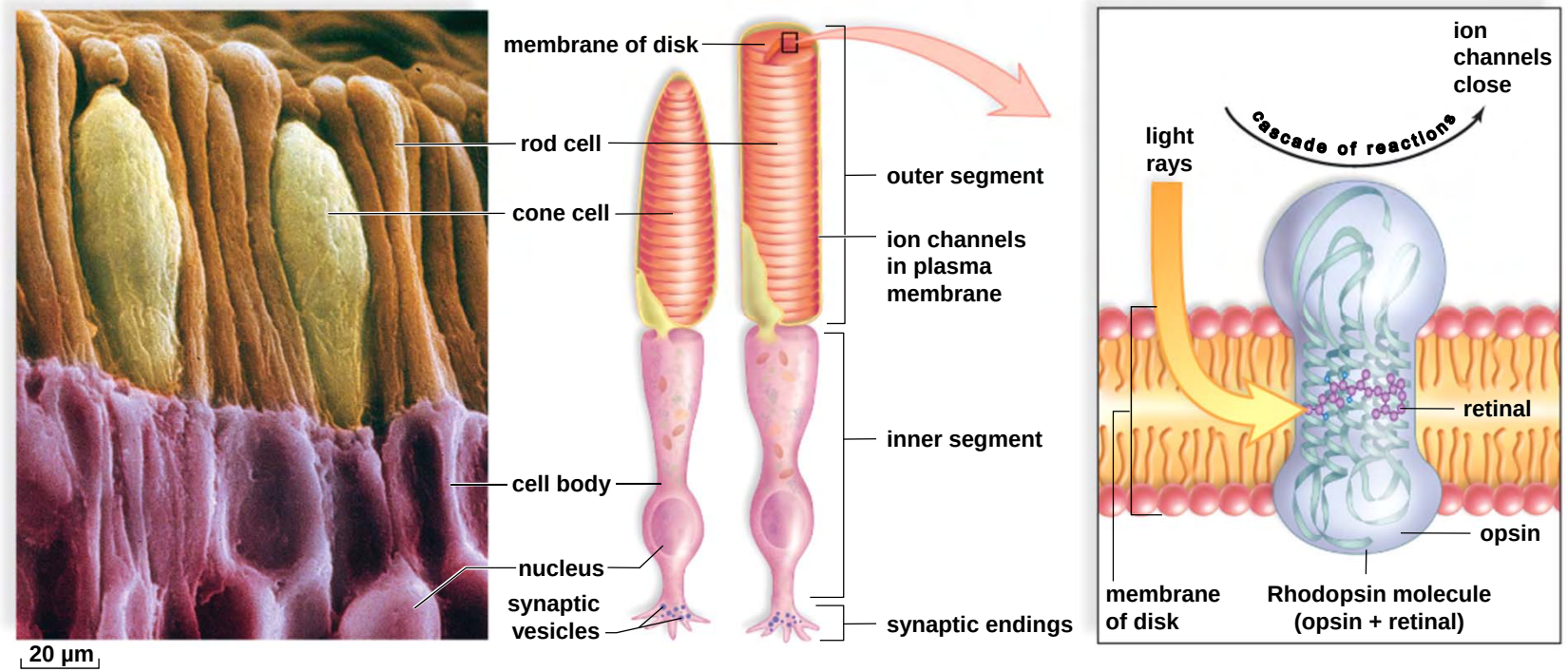


c. Astigmatism

Photoreceptors of the Eye

- Both rods and cones have an outer segment joined to an inner segment
- Pigment molecules are embedded in membrane of disks in the outer segment
  - Rhodopsin
- Rods permit vision in low light
  - Peripheral vision and motion
- Cones permit vision in bright light
  - Fine detail and color

Photoreceptors in the Eye

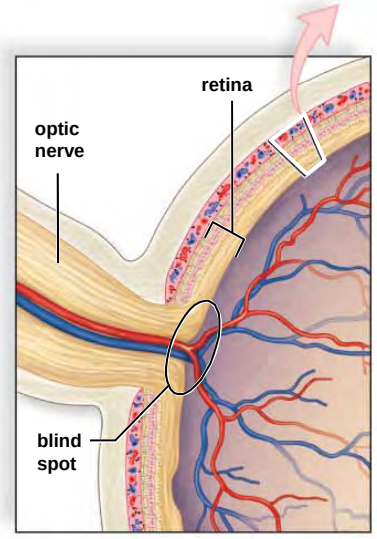


© Lennart Nilsson, from *The Incredible Machine*

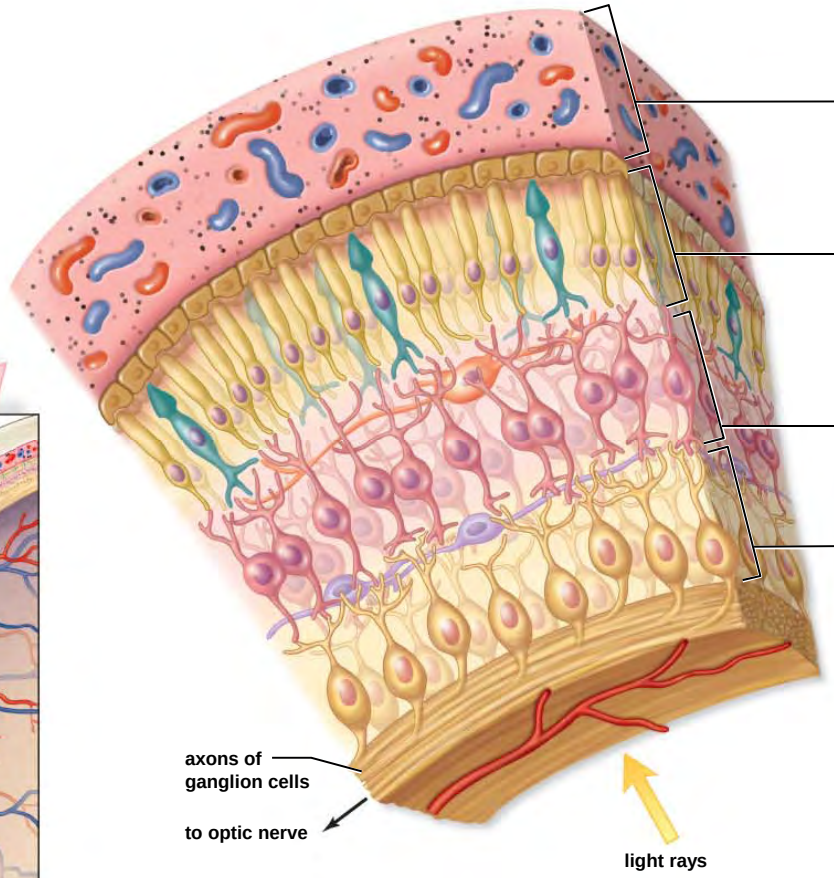
Integration of Visual Signals in the Retina

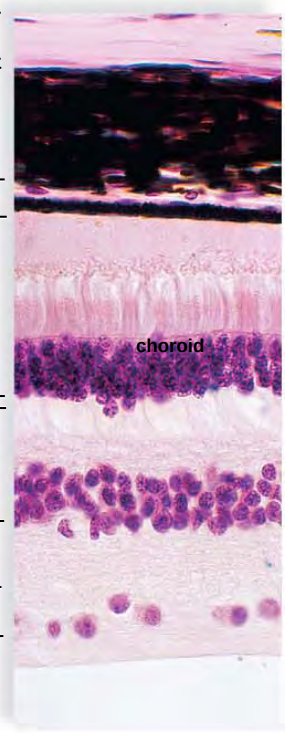
- Retina has three layers of neurons
  - Layer closest to choroid contains rod and cone cells
  - Middle layer contains bipolar cells
  - Innermost layer contains ganglion cells
- Synaptic integration and processing
  - Begin in the retina
  - Then impulses are sent to the brain

Structure and Function of the Retina



a. Location of retina



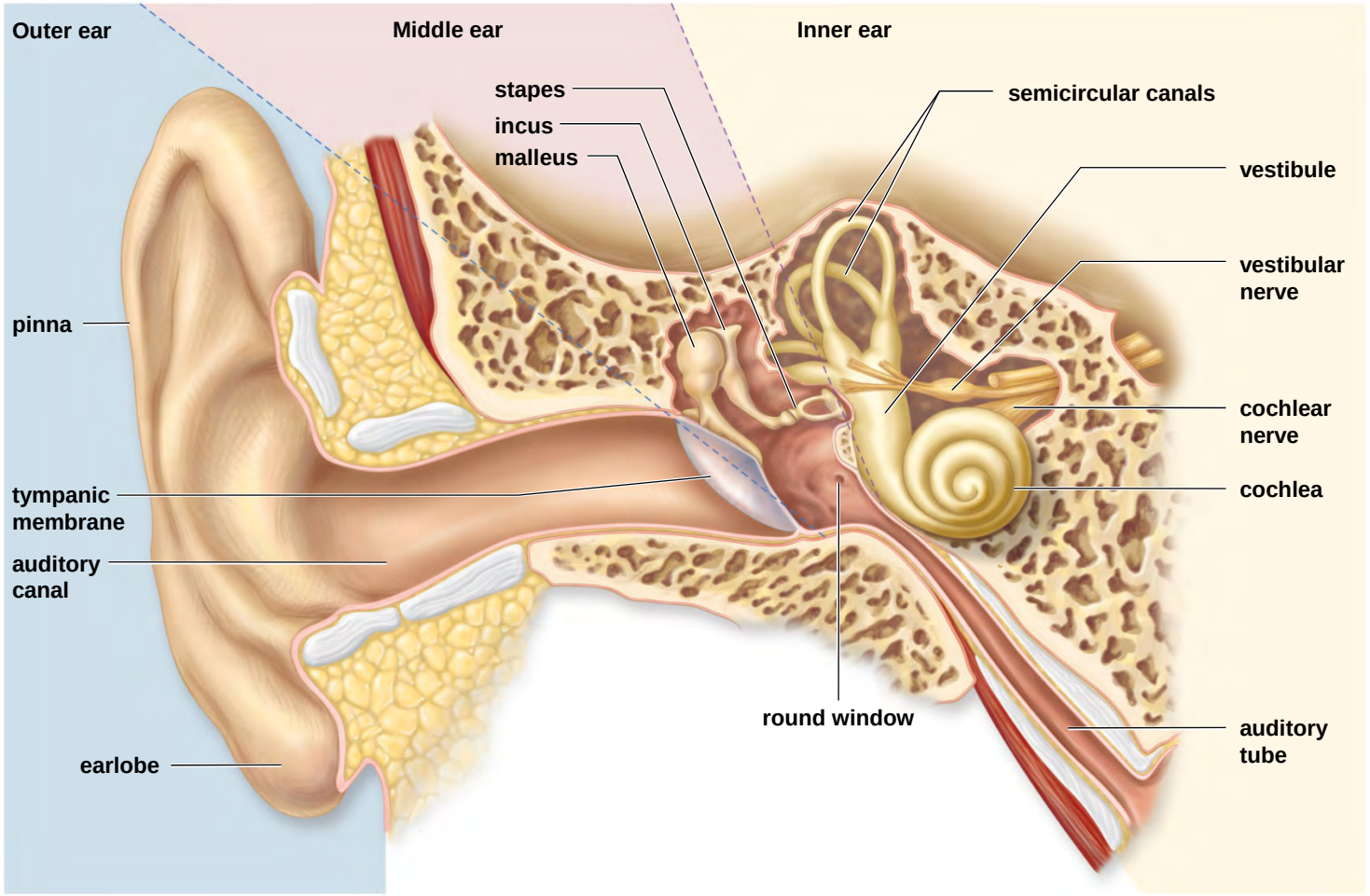


b. Micrograph of retina

Sense of Hearing and Balance

- Anatomy of the Ear
  - Outer ear - Pinna and auditory canal
  - Middle ear begins at tympanic membrane and ends at oval and round windows
    - Ossicles found between tympanic membrane and the windows
    - Auditory tube (eustachian tube) extends from middle ear to nasopharynx
  - Inner ear has three areas
    - Semicircular canals
    - Vestibule
    - Cochlea

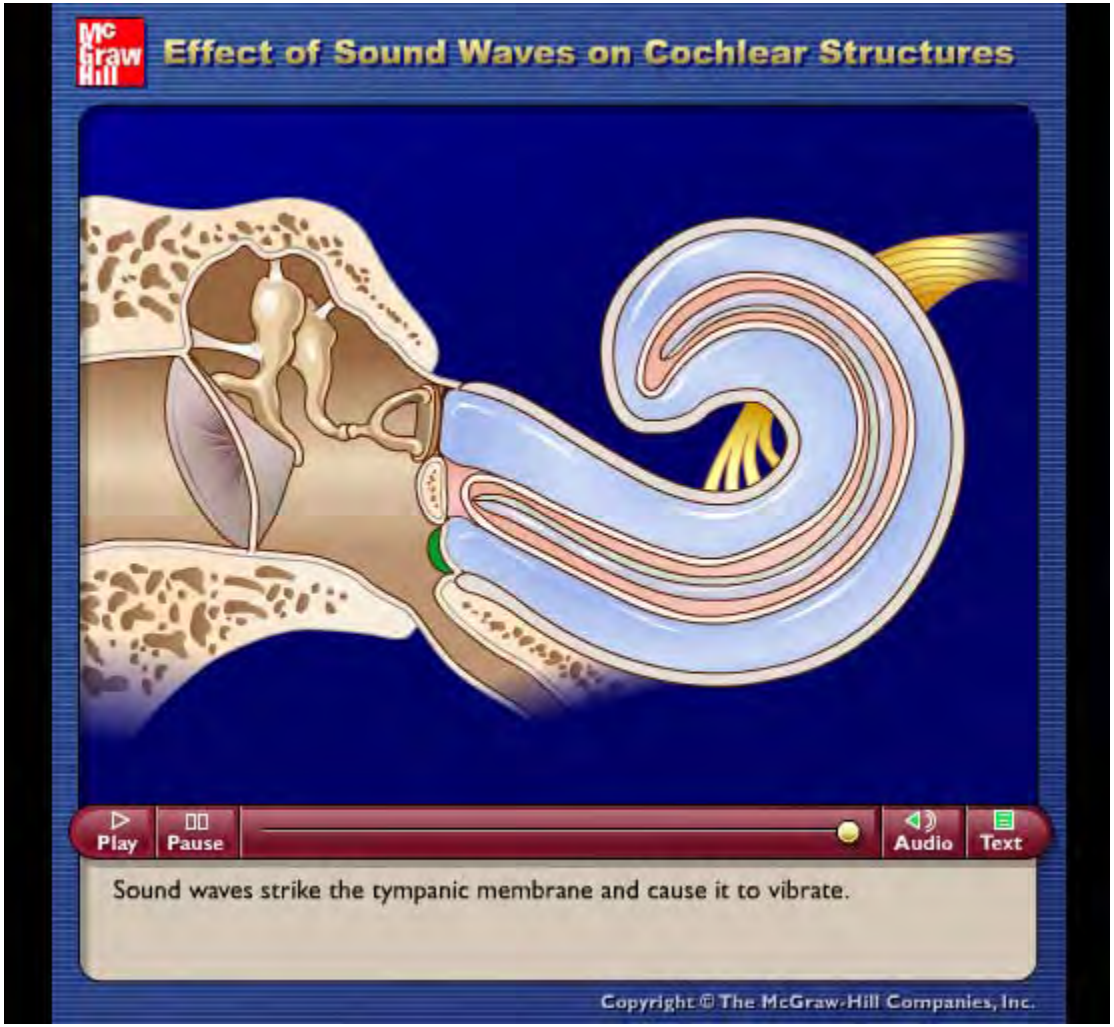
Anatomy of the Human Ear



Process of Hearing

- Sound waves enter the auditory canal
- Strike tympanic membrane, causing it to vibrate
  - Malleus takes pressure from inner surface of tympanic membrane
  - Passes it to the stapes, multiplying the pressure along the way
  - Stapes strikes membrane of oval window, passing pressure to fluid within cochlea

Animation


Effect of Sound Waves on Cochlear Structures
Play
Pause
Audio
Text
Sound waves strike the tympanic membrane and cause it to vibrate.
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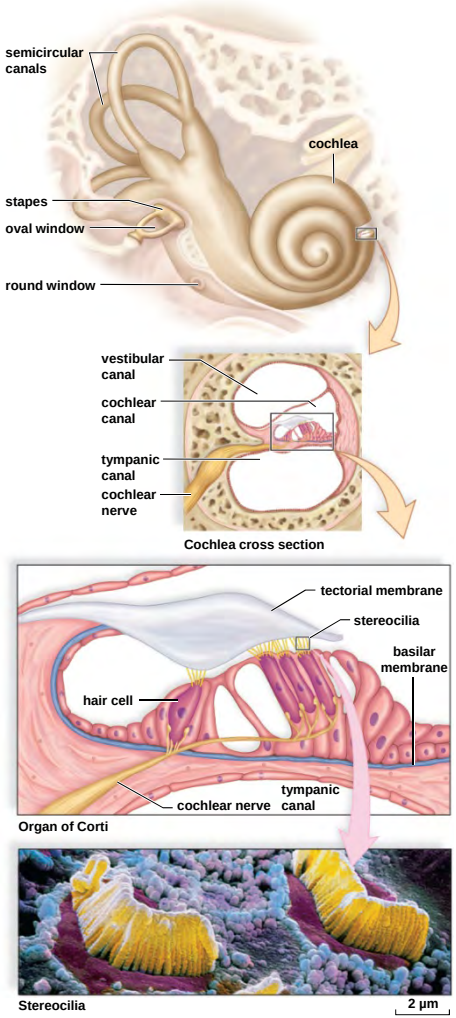
Process of Hearing

- Spiral Organ, hair cells of cochlear canal, synapse with nerve fibers of cochlear nerve
- Mechanoreceptors for sound are the hair cells of cochlear canal
  - Sound causes basilar membrane to vibrate
  - The stereocilia of the hair cells bend
  - Stimulates nerve cells leading to the auditory center

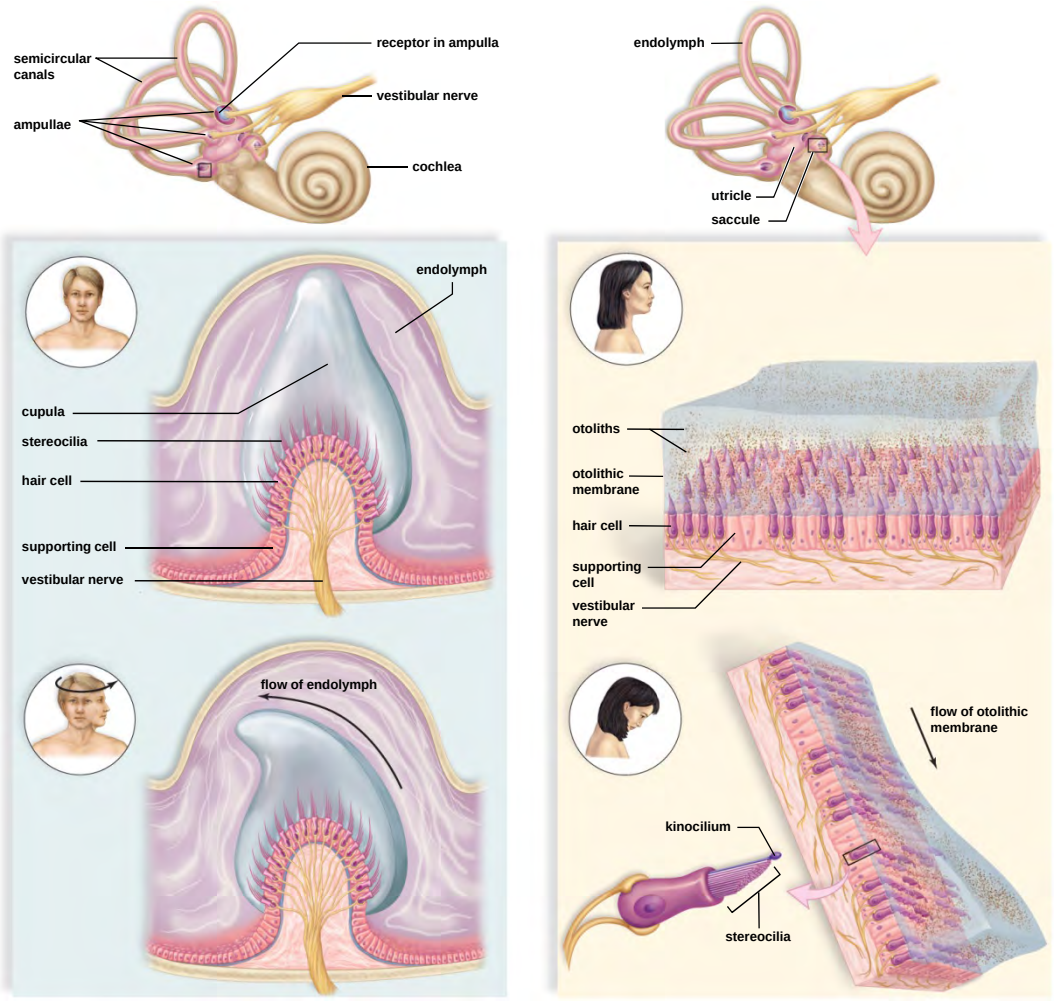
Mechanoreceptors for Hearing



Sense of Balance

- Mechanoreceptors of rotational equilibrium are in semicircular canals
  - Detect rotational and/or angular movements of the head
  - Maintain rotational equilibrium
  - Cupula
- Mechanoreceptors of gravitational equilibrium are in the utricle and saccule
  - Detect straight-line movements of the head in any direction
  - Maintain gravitational equilibrium
  - Otolithic Membrane

Mechanoreceptors for Equilibrium



a. Rotational equilibrium: receptors in ampullae of semicircular canal

b.Gravitational equilibrium: receptors in utricle and saccule of vestibule

Sensory Receptors in Other Animals