


8
PART A

Special Senses

PowerPoint® Lecture Slide Presentation by Jerry L. Cook, Sam Houston University



**ESSENTIALS
OF HUMAN
ANATOMY
& PHYSIOLOGY**
EIGHTH EDITION
ELAINE N. MARIEB

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The Senses

- General senses of touch
 - Temperature
 - Pressure
 - Pain
- Special senses
 - Smell
 - Taste
 - Sight
 - Hearing
 - Equilibrium

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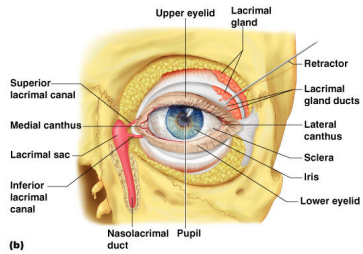
The Eye and Vision

- 70 percent of all sensory receptors are in the eyes
- Each eye has over a million nerve fibers
- Protection for the eye
 - A cushion of fat

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Accessory Structures of the Eye

- Eyelids
- Eyelashes



(b)

Figure 8.1b

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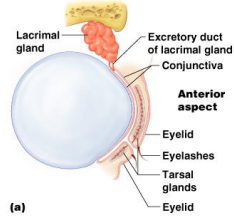
Accessory Structures of the Eye

- Conjunctiva
 - Membrane that lines the eyelids
 - Connects to the surface of the eye
 - Secretes mucus to lubricate the eye

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Accessory Structures of the Eye

- Lacrimal apparatus
 - Lacrimal gland
 - Lacrimal canals



(a)

Figure 8.1a

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Function of the Lacrimal Apparatus

- Properties of lacrimal fluid
 - Dilute salt solution (tears)
 - Contains antibodies and lysozyme
- Protects, moistens, and lubricates the eye
- Empties into the nasal cavity

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The Fibrous Tunic

- Sclera
 - White connective tissue layer
 - the “white of the eye”
- Cornea
 - Allows light to pass through
 - The only human tissue that can be transplanted without fear of rejection

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Choroid Layer

- Blood-rich nutritive layer
- Pigment prevents light from scattering
- Modified interiorly into two structures
 - Ciliary body – smooth muscle
 - Iris
 - Pigmented layer that gives eye color
 - Pupil – rounded opening in the iris

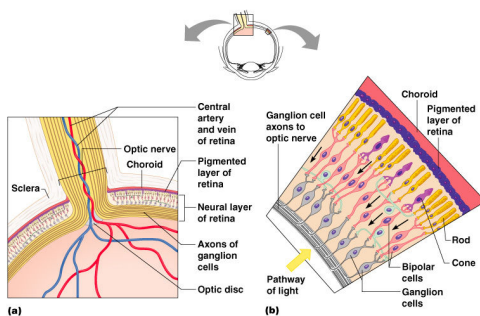
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Sensory Tunic (Retina)

- Contains receptor cells (photoreceptors)
 - Rods
 - Cones
- Signals leave the retina toward the brain through the optic nerve- Cranial nerve ?

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Neurons of the Retina



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Neurons of the Retina and Vision

- Rods
 - found towards the edges of the retina
 - Allow dim light vision and peripheral vision
 - Perception is all in gray tones

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Neurons of the Retina and Vision

- **Cones**
 - Detailed color vision
 - Fovea centralis – area of the retina with only cones
- No photoreceptor cells are at the optic disk, or blind spot

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Cone Sensitivity

- There are **three types of cones** (red, blue, green cones)
- Different cones are sensitive to different wavelengths
- **Color blindness is the result of lack of one cone type**

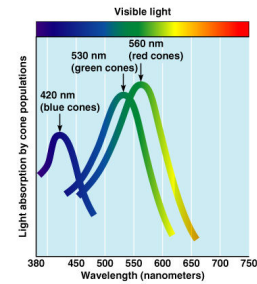


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Lens

- **Biconvex crystal-like structure**
- Held in place by a suspensory ligament attached to the ciliary body

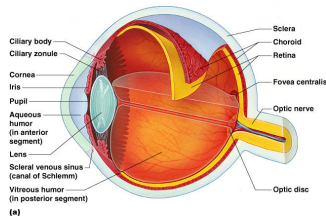


Figure 8.3a

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Internal Eye Chamber Fluids

- **Aqueous humor**
 - Watery fluid found in chamber between the lens and cornea
 - Similar to blood plasma
 - Provides nutrients for the lens and cornea

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Internal Eye Chamber Fluids

- **Vitreous humor**
 - Gel-like substance behind the lens
 - Keeps the eye from collapsing
 - Lasts a lifetime and is not replaced

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Lens Accommodation

- Light must be focused to a point on the retina for optimal vision
- The eye is set for distance vision (over 20 ft away)
- The lens must change shape to focus for closer objects

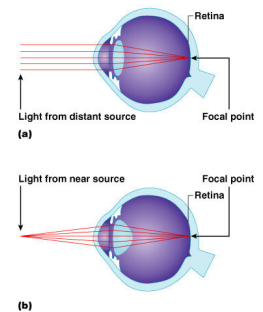


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Images Formed on the Retina

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Figure 8.10

Visual Pathway

- Photoreceptors of the retina
- Optic nerve
- Optic nerve crosses at the optic chiasma

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Figure 8.11

Eye Reflexes

- Autonomic nervous system
 - Bright light causes pupils to constrict through action of radial and ciliary muscles
 - Viewing close objects causes accommodation

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The Ear

- Houses two senses
 - Hearing
 - Equilibrium (balance)
- Receptors are mechanoreceptors
- Different organs house receptors for each sense

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Anatomy of the Ear

- The ear is divided into three areas
 - Outer (external) ear
 - Middle ear
 - Inner ear

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Figure 8.12

The External Ear

- Involved in hearing only
- Structures of the external ear
 - Pinna (auricle)
 - External auditory canal

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Figure 8.12

The External Auditory Canal

- Lined with skin
- Ceruminous (wax) glands
- Ends at the tympanic membrane (Ear drum)

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The Middle Ear or Tympanic Cavity

- Air-filled cavity within the temporal bone
- Only involved in the sense of hearing

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The Middle Ear or Tympanic Cavity

- Two tubes are associated with the inner ear
 - The opening from the auditory canal is covered by the tympanic membrane
 - The auditory tube connecting the middle ear with the throat
 - Allows for equalizing pressure during yawning or swallowing
 - This tube is otherwise collapsed

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Bones of the Tympanic Cavity

- Three bones span the cavity
 - Malleus (hammer)
 - Incus (anvil)
 - Stapes (stirrip)

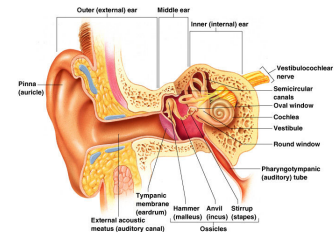


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Bones of the Tympanic Cavity

- Vibrations from eardrum move the malleus
- These bones transfer sound to the inner ear

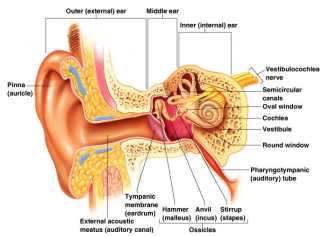


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Inner Ear or Bony Labyrinth

- Includes sense organs for hearing and balance
- Filled with perilymph

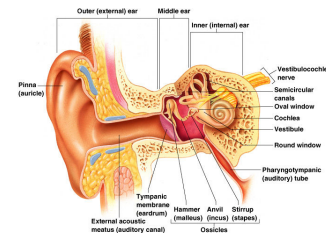


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Inner Ear or Bony Labrynth

- A maze of bony chambers within the temporal bone
 - Cochlea
 - Vestibule
 - Semicircular canals

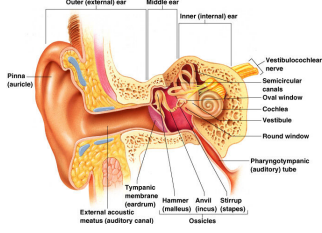


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Organs of Hearing

- Organ of Corti
 - Located in the cochlea
 - Receptors = hair cells on the basilar membrane
 - Gel-like membrane is capable of bending hair cells
 - Cochlear nerve attached to hair cells

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Organs of Hearing

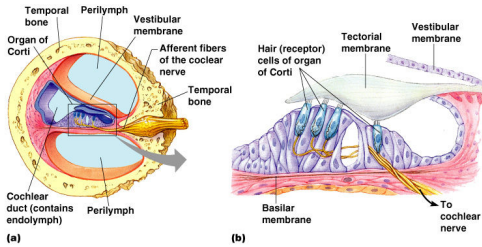


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Mechanisms of Hearing

- Vibrations from sound waves move through the membrane
- Hair cells are bent by the membrane

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Mechanisms of Hearing

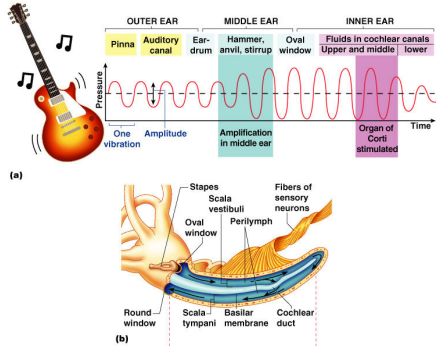
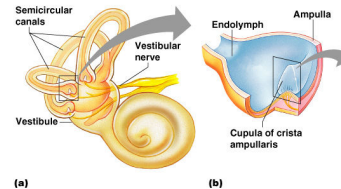


Figure 8.16a-b

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Organs of Equilibrium

- Receptor cells are in two structures
 - Vestibule
 - Semicircular canals



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Figure 8.14a-b

Organs of Equilibrium

- Equilibrium has two functional parts
 - Static equilibrium
 - Dynamic equilibrium

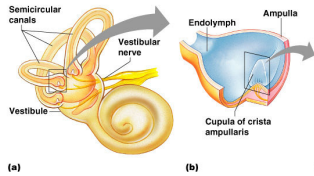


Figure 8.14a-b

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Static Equilibrium

- Maculae – receptors in the vestibule
 - the position of the head
- Anatomy of the maculae
 - Hair cells are embedded in the otolithic membrane
 - Otoliths (tiny stones) float in a gel around the hair cells
 - Movements cause otoliths to bend the hair cells

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Function of Maculae

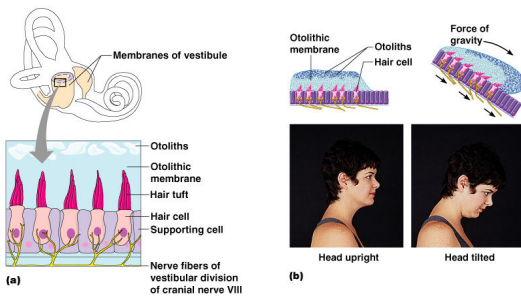


Figure 8.13a-b

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Dynamic Equilibrium

- Crista ampullaris – receptors in the semicircular canals
 - Tuft of hair cells
 - Cupula (gelatinous cap) covers the hair cells

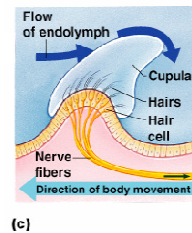


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Dynamic Equilibrium

- Action of angular head movements
 - The cupula stimulates the hair cells
 - Impulse is sent via the vestibular nerve to the cerebellum

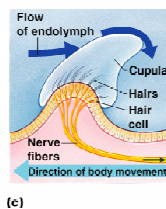


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Chemical Senses – Taste and Smell

- Both senses use chemoreceptors
 - Stimulated by chemicals in solution
 - Taste has four types of receptors
 - Smell can differentiate a large range of chemicals
- Both senses complement each other and respond to many of the same stimuli

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Olfaction – The Sense of Smell

- Olfactory receptors are in the roof of the nasal cavity
 - Chemicals must be dissolved in mucus for detection
- Interpretation of smells is made in the brain

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Olfactory Epithelium

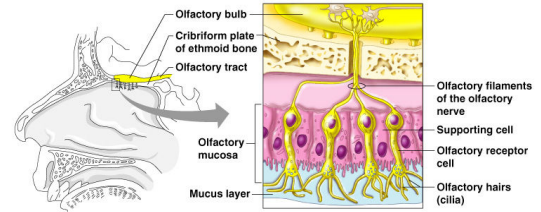


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The Sense of Taste

- Taste buds house the receptor organs
- Locations:
 - Most are on the tongue
 - Soft palate
 - Cheeks

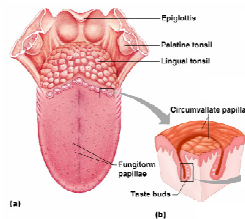


Figure 8.18a–b

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The Tongue and Taste

- The tongue is covered with papillae
 - Filiform papillae – sharp with no taste buds
 - Fungiform papillae – rounded with taste buds
 - Circumvallate papillae – large papillae with taste buds
- Taste buds are found on the sides of papillae

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Structure of Taste Buds

- Gustatory cells are the receptors
 - Have gustatory hairs (long microvilli)
 - Hairs are stimulated by chemicals dissolved in saliva

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Anatomy of Taste Buds

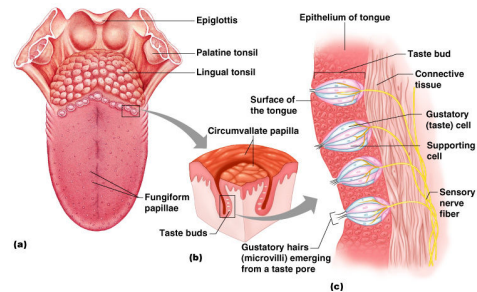


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Taste Sensations

- Sweet receptors
 - Sugars
 - Saccharine
 - Some amino acids
- Sour receptors
 - Acids
- Bitter receptors
 - Alkaloids
- Salty receptors
 - Metal ions

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Developmental Aspects of the Special Senses

- DO NOT COPY THIS DOWN;
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- Formed early in embryonic development
- Eyes are outgrowths of the brain
- All special senses are functional at birth

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