SPECIAL SENSES
PART I: OLFACTION & GUSTATION

5 Special Senses

- Olfaction
- Gustation
- Vision
- Equilibrium
- Hearing

Olfactory Nerves
- Extend through cribriform plate into nasal cavity on both sides of nasal septum
- Odor must be:
  - volatile
  - dissolved in mucous
  - bind to receptors

Olfactory Cells
- Contains:
  - olfactory receptors
  - supporting cells
  - basal (stem) cells
- Olfactory perception
  - detecting chemicals dissolved in mucous
  - can distinguish thousands of chemical stimuli

Olfactory Neural Pathway
- Olfactory nerves (I) → olfactory bulbs → olfactory tracts to:
  - → hypothalamus
  - → olfactory cortex of temporal lobe
  - → limbic system

Olfactory impulses do not go through thalamus first
What are the sensory organs of taste?

**Taste (Gustatory) Receptors**

- Lingual papillae contain taste buds along the sides
- Each taste bud contains:
  - basal (stem) cells
  - gustatory cells:
    - chemical dissolved in saliva
    - extend taste hairs through taste pore
    - survive only 10 days before replacement

**Primary Taste Sensations**

- Sweet
- Salty
- Sour
- Bitter
- Umami (glutamate containing foods)
- Water

**Gustatory Neural Pathway**

- Cranial nerves:
  - Facial (VII), Glossopharyngeal (IX), Vagus (X) to:
    - medulla oblongata
    - thalamus
    - primary somatosensory cortex of parietal lobe
SPECIAL SENSES
PART II: VISION

What are the accessory structures of the eye, and what are their functions?

Accessory Structures of the Eye
• Palpebrae (eyelids)
• Extrinsic Muscles (6 of them)
• Lacrimal Glands (tears)
• Conjunctiva

What are the internal structures of the eye, and what are their functions?

Eyeball Structures: Tunics
• Fibrous Tunic
  - Sclera
  - Cornea
• Vascular Tunic
  - Choroid
  - Ciliary Body
  - Iris
• Neural Tunic
  - Retina

Fibrous Tunic
• Cornea is the transparent part of outer fibrous layer of eye, it is continuous with sclera, the ‘white of the eye’

Vascular Tunic
• Choroid
  - black to reduce glare
• Ciliary Body
  - produces aqueous humor
  - muscles used in accommodation
• Iris
  - muscles to change diameter of pupil

Vascular Tunic Functions
• Provides route for blood vessels and lymphatics that supply tissues of eye
• Regulates amount of light entering eye through the pupil
• Secrectes reabsorbs aqueous humor that circulates within chambers of eye
• Controls shape of lens, which is essential to focusing
Choroid
• Contains blood vessels to deliver oxygen and nutrients to retina
• Colored black in humans to reduce glare
  - Animals that see in low light have a shiny choroid called tapedum lucidum

Ciliary Body
• Contains ciliary muscles which attach to suspensory ligaments of lens
  - Used to focus lens
• Lens
  - Separates anterior and posterior cavities
  - Function:
    • Accommodation (focusing)
    • Far vision: ciliary muscles relax
    • Close-up vision: ciliary muscles contract

Iris
• Continuous with ciliary body
• Colored part of our eyes
• Muscle Arrangement
  - radial for dilation (sympathetic)
  - circular for constriction (parasympathetic)

Internal Chambers of Eye
• Ciliary body and lens divides the chambers:
• anterior chamber:
  • Between cornea and lens
  • filled with aqueous humor
    - drains via Canal of Schlemm
• posterior chamber:
  • behind lens
  • filled with vitreous humor
Neural Tunic

Retina

- **Photoreceptors**
  - Rods - dim light, periphery of retina
  - Cones - bright light, macula lutea, fovea centralis
- **Bipolar Cells and Ganglion Cells**
- **Optic Disk “blind spot”**

Photoreceptors

- **Rods**
  - No color discrimination
  - Highly sensitive to light
- **Cones**
  - Color vision
  - High concentration in macula lutea with greatest density at the fovea centralis (center)

Bipolar Cells

- Neurons of rods and cones synapse with ganglion cells

Optic Disk

- Optic nerve exits here
- Vessels enter/exit here

Visual Pathway

- Axons from ganglion cells converge on optic disc
- Proceed as optic nerve (II)
  - 2 optic nerves (1 for each eye)
- At optic chiasm, nerve fibers cross
- Proceed into brain as optic tracts

Vision Neural Pathway

- Optic nerves (II) → optic chiasma → optic tracts to:
  - → thalamus
  - → primary visual cortex of occipital lobe
  - → thalamus also sends impulses to hypothalamus & superior colliculi of midbrain
SPECIAL SENSES
PART III: HEARING & EQUILIBRIUM

What are the structures of the ear, and how do they function?

The Ear

• External ear
• Middle ear
• Inner ear

External Ear

• Auricle
  - Provides directional sensitivity
• External acoustic canal
  - Ends at tympanic membrane (eardrum)
• Tympanic membrane
  - Is a thin, semitransparent sheet
  - Separates external ear from middle ear

Middle Ear

• Also called tympanic cavity
• Communicates with nasopharynx via auditory eustachian tube
  - Permits equalization of pressures on either side of tympanic membrane
• Contains 3 ossicles

Ossicles

• Malleus (hammer)
• Incus (anvil)
• Stapes (stirrup)

Inner Ear

• Vestibule
  - Static equilibrium
    • Sense of gravity, leaning, and acceleration
• Semicircular canals
  - Dynamic equilibrium
    • Sense of rotation
• Cochlea
  - Hearing
Vestibule and Semicircular Canals: Balance & Equilibrium

- Vestibule:
  - Filled with fluid
  - Saccule and utricle
    - Receptors provide sensations of gravity and linear acceleration

- Semicircular canals:
  - Contain semicircular ducts filled with fluid
  - Ampulla
    - Receptors stimulated by rotation of head

Cochlea: Hearing

- Organ of corti
  - Converts sound waves into action potentials transmitted to brain
  - Hair cells bend when moved by sound waves

Pathway of Sound Waves
1. Enters external auditory canal
2. Vibrates tympanic membrane
3. Moves ossicles
   - Sound waves are magnified (amplified)
4. Vibrates oval window
5. Causes ‘waves’ in fluid inside cochlea
   - Bends hair cells activating neurons to brain
6. Vibrates round window, dampening waves

Volume & Pitch

- Frequency of sound waves (pitch):
  - determined by which part of cochlear duct is stimulated
    - Hertz (Hz)

- Amplitude of sound waves (volume):
  - determined by number of hair cells stimulated
    - Decibels (dB)

Deafness

- Conduction Deafness
  - Middle Ear
    - Otospongiosis: spongy bone deposit between stapes and oval window and limit vibrations transmitted

- Nerve Deafness
  - Unable to convert, transmit, or receive impulses
  - Cochlear nerve degeneration: Tinitis “ringing of the ears”