Special Senses

- Sight
- Hearing
- Equilibrium (balance)
- Smell
- Taste

Sensory Receptors

5 Types
1. Photoreceptors
   - Seeing
2. Mechanoreceptors
   - Hearing & equilibrium
3. Chemoreceptors
   - Smell and taste
4. Nociceptors
   - Pain
5. Thermoreceptors
   - Temperature
Anatomy of the Eye

External and Accessory Structures
- Eyebrows
- Eye lids
  - Eyelashes
  - Meibomian glands
  - Ciliary glands
- Conjunctiva
- Lacrimal apparatus
  - Lacrimal glands

Internal Structures: The Eyeball
- Tunics (coats)
  - Three (3) covering of the eye walls
- Humors
  - Two (2) fluid filled interior spaces
3 Tunics of the Eyeball

1. Sclera – (fibrous tunic) OUTERMOST
   - Cornea

2. Choroid – (vascular tunic)
   - Ciliary body
   - Suspensory ligament
   - Lens
   - Iris and Pupil

3. Retina – (sensory tunic) INNERMOST
   - Rods and cones

Eye Disorders

- Cataracts
  - Lens becomes hard and opaque

- Glaucoma
  - Drainage of aqueous humor blocked, pressure increases

- Color blindness
  - Lacking one or more cone receptors

Cavities of the Eye

- Anterior cavity
  - Aqueous humor

- Posterior cavity
  - Vitreous humor
Retina Anatomy

- Three retinal layers
  1. Rod and cone layer
  2. Bipolar cell layer
  3. Ganglionic cell layer
- Fovea centralis and macula lutea
- Optic disc - Blind spot
- Optic nerve
Visual Pathways to the Brain

- Binocular vision
- Optic nerves
- Optic chiasma
- Optic tracts
- Thalamus
- Visual cortex in occipital lobes
- Frontal lobe

A DEVICE TO END BLINDNESS

When retina cells are damaged:
Light enters through a tiny camera in the glasses. The visual signal is sent digitally to an antenna behind the ear, then to a receiver/stimulator under the skin. A thin cable takes it to the ocular implant on the retina. Electrodes stimulate healthy retinal cells to pass the visual information to the brain via the optic nerve.
Slide 19

**Focusing—General**

![Diagram of focusing generically](image)

Slide 20

**Focusing—Far and Near**

- **Focusing on distant object**
  - Ciliary muscle relaxed
  - Lens flattened
  - Suspensory ligament taut

- **Focusing on near object**
  - Ciliary muscle contracted
  - Lens rounded
  - Suspensory ligament relaxed

Slide 21

**Nearsightedness**

- Long eyeball: rays focus in front of retina when viewing distant object.
- Concave lens allows subject to see distant objects.
Farsightedness

Short eyeball: rays focus behind retina when viewing close objects.

Convex lens allows subject to see close objects.

Two Types of Astigmatism

Uneven cornea; rays do not focus evenly.

Uneven lens allows subject to see objects clearly.

Uneven lens; rays do not focus evenly.

Uneven lens allows subject to see objects clearly.

Anatomy of Ear

ossicles
stapes
incus
malleus

oval window
cochlear nerve
tympanic membrane
cochlea
round window
Anatomy of the Ear

- **Outer (external) Ear**
  - Pinna (auricle)
  - External auditory canal
  - Tympanic membrane (eardrum)
- **Middle ear**
  - Ossicles - malleus, incus, and stapes
  - Eustachian tube
- **Inner Ear**
  - Cochlea
  - Semicircular canals
  - Vestibule

Pathway to Hearing part 1

- External sound waves
- Eardrum moves (vibrates)
- Malleus (hammer) moves
- Incus (anvil) moves
- Stapes (stirrup) moves
- Stapes (stirrup) moves
- Oval window moves (inner ear)
- Inner ear fluids move
- Hearing receptors excited
- Action potential created

Human Ear Anatomy
Inner Ear Anatomy

- Cochlea
  - Organ of Corti
- Vestibule
  - Utricle
  - Saccule
- Semicircular canals
  - Ampullae
  - Vestibulocochlear nerve

Inner Ear Structure

Location and Structure of Organ of Corti
Ketchner hears the call of the bigs
Left-hander unwilling to let impairment hinder dreams
By Ken Gurnick / MLB.com

"There was no known history of deafness in the family," said Ryan's mother, Kim. "They still don't know how or why it happened. It's a freak thing. He's missing hairs in the ear that transmit noise."
Pathway to Hearing

- Ossicles move
- Fluid in vestibular & tympanic canals (perilymph) moves
- Fluid in cochlear canal (endolymph) moves
- Basilar membrane moves
- Hair cells displaced
- Microvilli bend
- Stimulation of hair cells
- Action potential from hair cell to cochlear N
- Nerve impulse to brain

Mechanisms of Equilibrium

1. Static Equilibrium
   - Position of the head with respect to gravity
   - Vestibule
2. Dynamic Equilibrium
   - Angular or rotational body movements
   - Semicircular canals

Location and Structure of Utricle and Saccule
Pathway for Static Equilibrium

Reports position of head with respect to gravity when the body is still

- Bend over
- Gel moves
- Microvilli bend

- Stimulation of hair cell
- Action potential from hair cell to vestibular nerve
- Nerve impulse to cerebellum

Location and Structure of Ampulla
Hearing and Equilibrium Deficits

Deafness
- Hearing loss of any degree
  1. Conduction deafness
     - Interference with conduction of sound waves to inner ear
  2. Sensorineural deafness
     - Damage to receptor cells in Organ of Corti, cochlear nerve, or neurons of auditory cortex

Equilibrium problems
- Nausea, dizziness, vertigo

Taste and Smell
- Chemoreceptors
- Olfactory receptor cells
  - Olfactory nerve
    - cribriform plate
    - close to temporal lobe
- Taste buds
  - Papillae
    - Gustatory cells
    - Gustatory hairs
**Taste**

**Contributors to the sense of taste**
- Taste buds
  - salty, sweet, sour & bitter
  - locations
- Olfactory cells
  - stuffy nose
- Spicy & Pungent
  - trigeminal N

**Taste Bud Locations on Tongue**
The End