Perception of Stimuli

Eyes & ears

1. Sensory receptors act as energy transducers

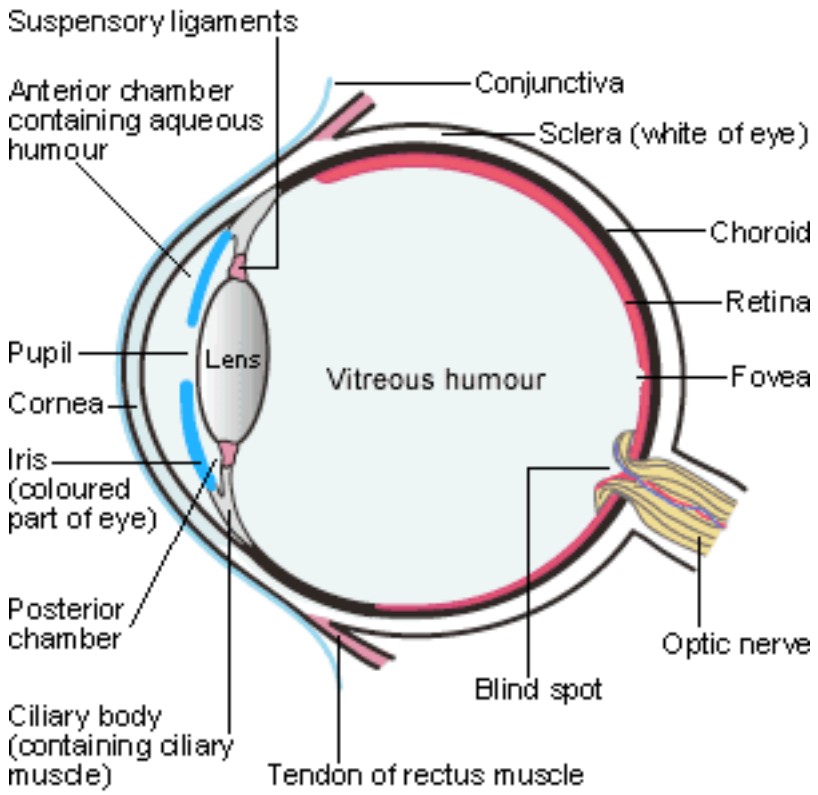
a. A transducer is a device for converting a non-electrical signal into an electrical one.
b. The result is an action potential
c. Example: conversion of light energy into electrical signals in the retina of the eye.

2. Classification of sensory receptors

- **chemoreceptors** - smell and taste, detect blood pH
  - special membrane proteins
  - proteins bind to a particular substance, causing depolarization
  - action potential sent to brain.
- **mechanoreceptors** - sensitive to movement
  - humans, inner ear (semi-circular canals) detect our body's position.
  - at the end of the canals is a system of hair cells which bend when there is a change in direction or speed of the fluid in the canals
  - action potentials sent to the brain
- **photoreceptors** – sight
  - rods and cones - they contain photopigments -broken down when exposed to light
  - sends action potential to brain
- **thermoreceptors** - in skin, for example
  - cold receptors send ap when temp drops
  - warm receptors are deeper, send ap when temp increases
  - the temperature center in the hypothalamus of the brain also contains thermoreceptors to monitor temp of blood

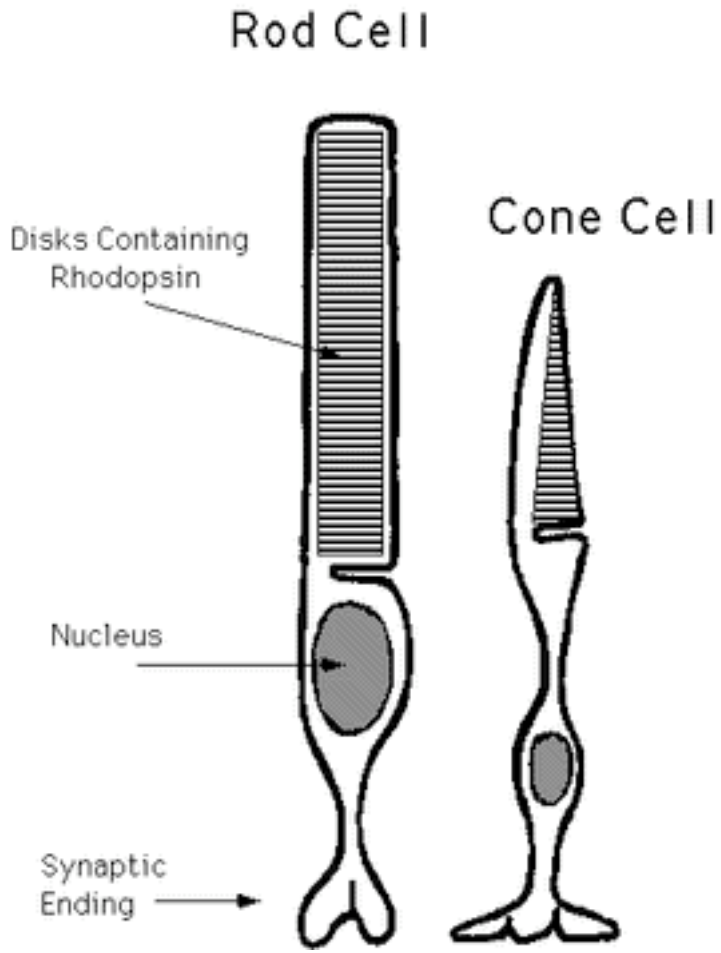
3. Structure & Function of the Human Eye

- •conjunctiva - thin transparent layer within epithelium of eyelids
- •cornea - transparent front of the sclera; curved surface important in refracting light
- •aqueus humour - clear solution of salts
- •pupil - variable openning in the iris to allow light to enter eye
- •lens - transparent, elastic bi-convex structure which focusses the light into the retina
- •iris - colored part of the eye; circular and radial muscles control the size of the pupil
- •vitreous humor - clear gelatinous substance which fills the eyeball
- •sclera - white protective covering of the eye •choroid - black layer which prevents internal reflection of light, blood v. supply retina
- •retina - contains rods and conesand nerve cells for vision
- •fovea - "yello spot" (macula lutea) contins cones only, spot of most accurate vision
- •blind spot - point where optic nerve leaves the eye; not light sensitive
- •optic nerve - carries impulse to brain
- *pupil
- *eyelid



Rods & Cones

Figure 2



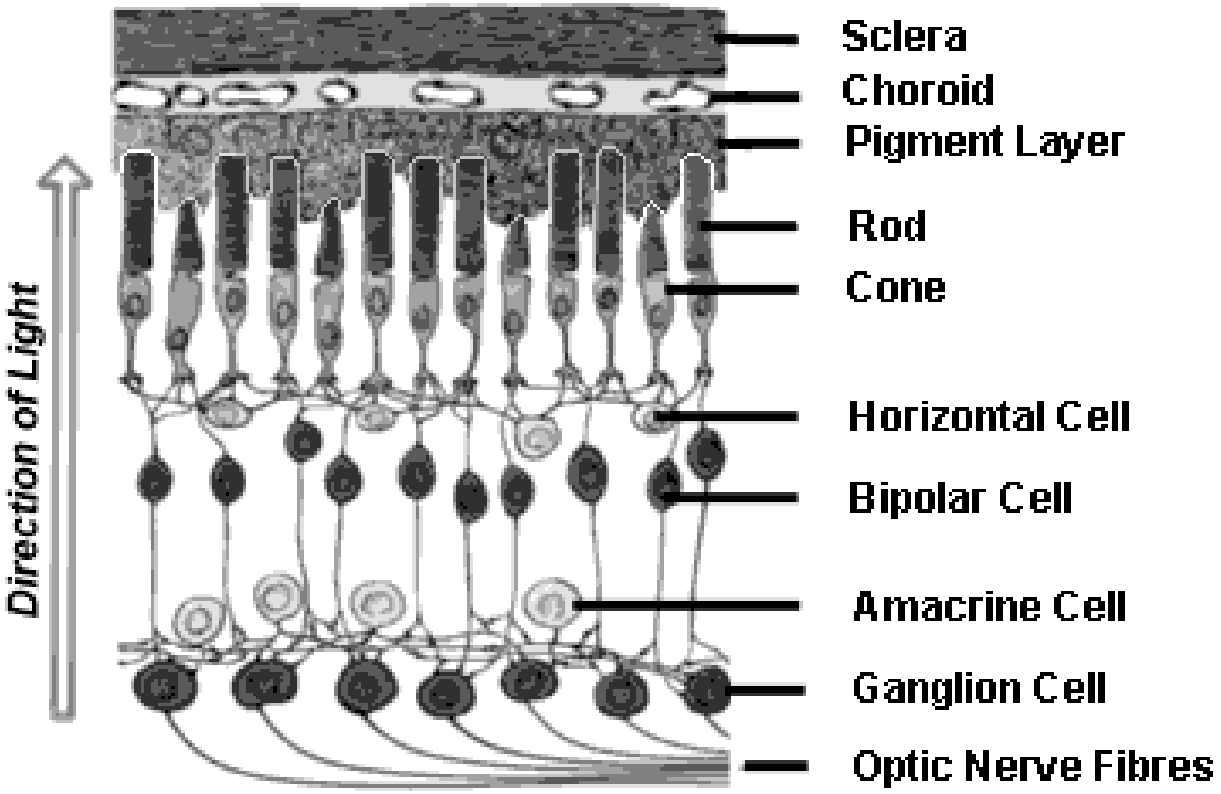
a. RODS

- more sensitive to light
- function better in dim light,
- monochrome, pigment called rhodopsin (visual purple)
- groups of rod cells (up to 200) pass impulses to the same sensory neuron of the optic nerve (impulses "added up", so sensitive, but reduced accuracy)
- rods more widely dispersed throughout retina, giving a greater field of vision

b. CONES

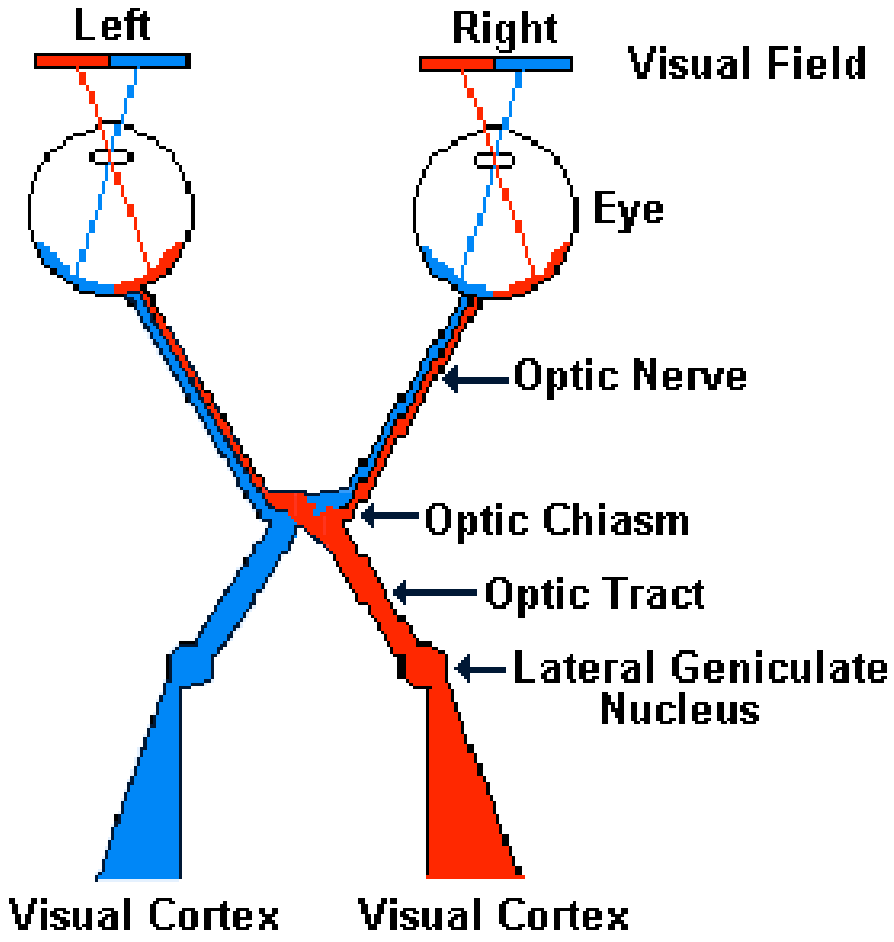
- 3 types, sensitive to red/green/blue
- give color vision, pigments called iodopsins
- overlap will be interpreted by the brain as different colors
- cones have individual neurons
- cones give greater visual accuity than rods
- fovea contains only cones

Human Retina Structure… Seeing



- Breakdown of pigment causes action potential to brain
- Bipolar cells combine impulses from rods & cones
- Passed to sensory neurons of optic nerve (ganglion cells)

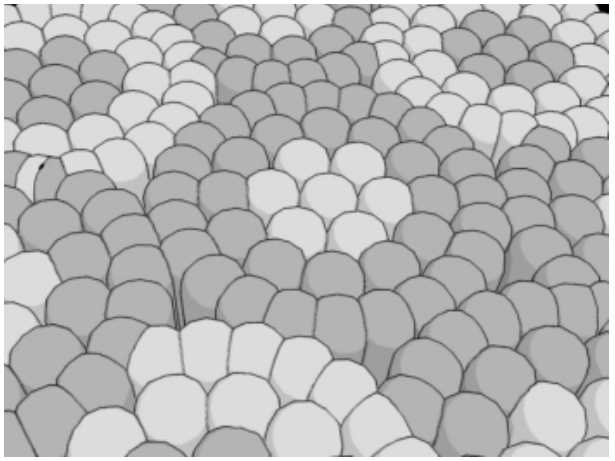
Seeing, continued



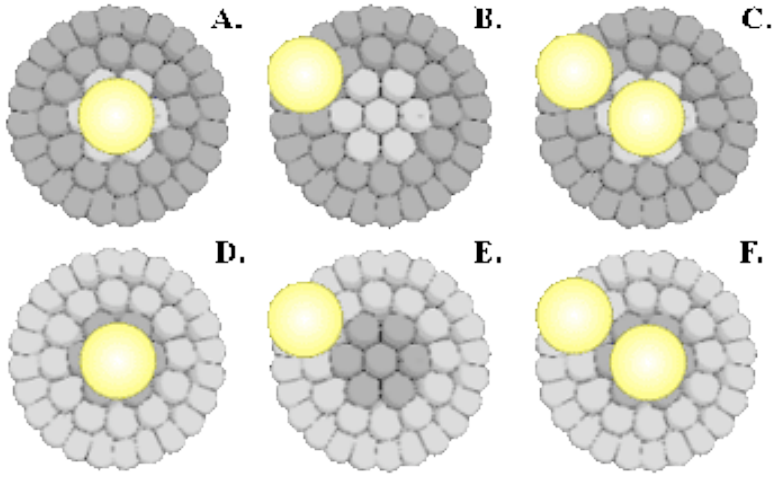
- Optic chiasma is where the right & left optic nerves meet
- Here the neurons closest to the nose cross over to the opposite optic nerve
- So the right optic nerve carries signals from the left field of vision from both eyes (and vice versa)
- Visual cortex in back of brain, is where processing produces images for us. (contralateral processing)

Lateral Inhibition

- **Photoreceptor Type & Arrangement**
  - Light type– stimulated when light detected
  - Dark type– stimulation reduced when light detected
  - Spread out and usually encircle each other for a receptive field of the ganglion cells.

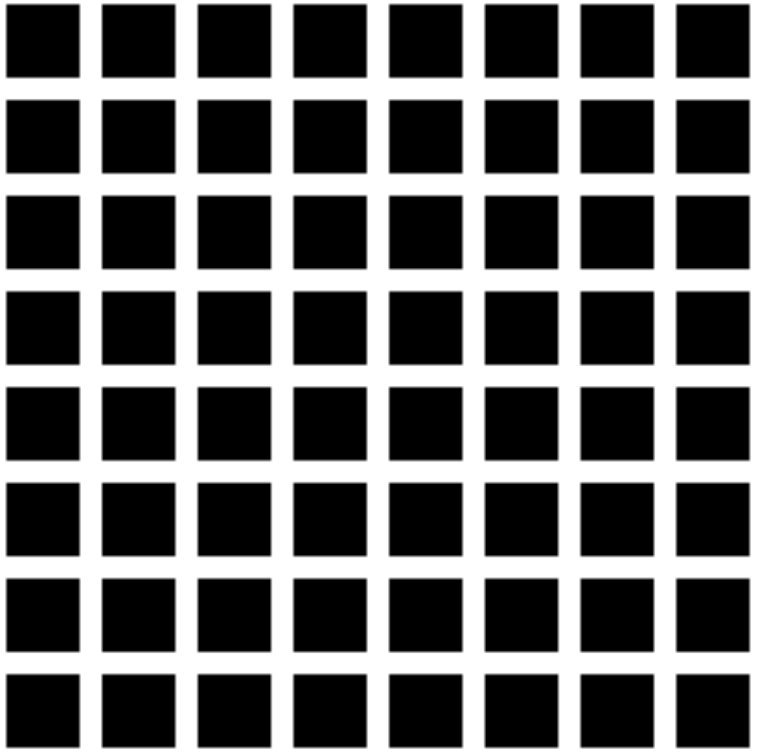


- **On-center or Off-center**
  - A&E. ONLY light photoreceptors are stimulated → entire receptive field is active
  - B&D. ONLY dark photoreceptors are stimulated → entire receptive field is NOT active
  - C&F. BOTH light & dark photoreceptors are stimulated → light photoreceptors become active but dark photoreceptors become inactive :. they compete with each other.



Herman Grid Illusion

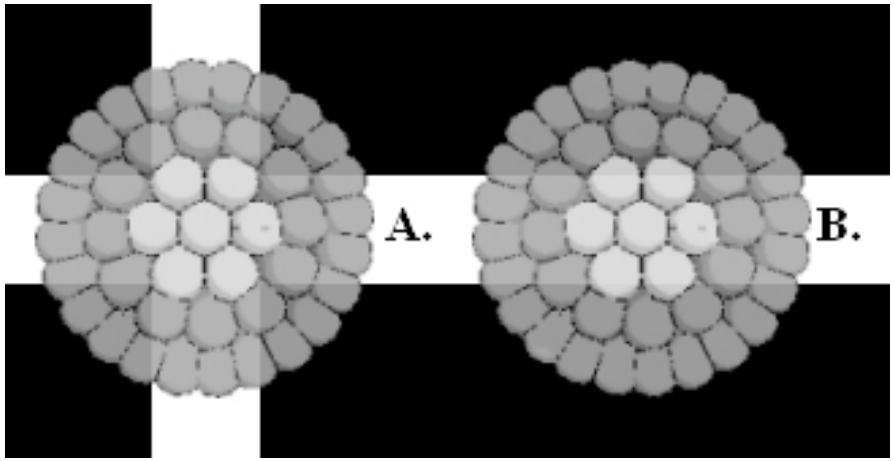
- Illustrates Lateral Inhibition, also called Edge Enhancement.
- Grey spots appear in intersections, disappear when you look at them.

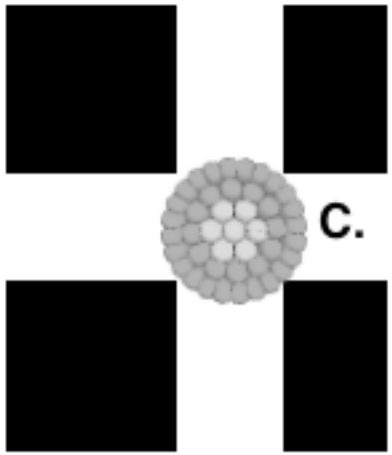


Hermann Grid

Herman Grid Illusion

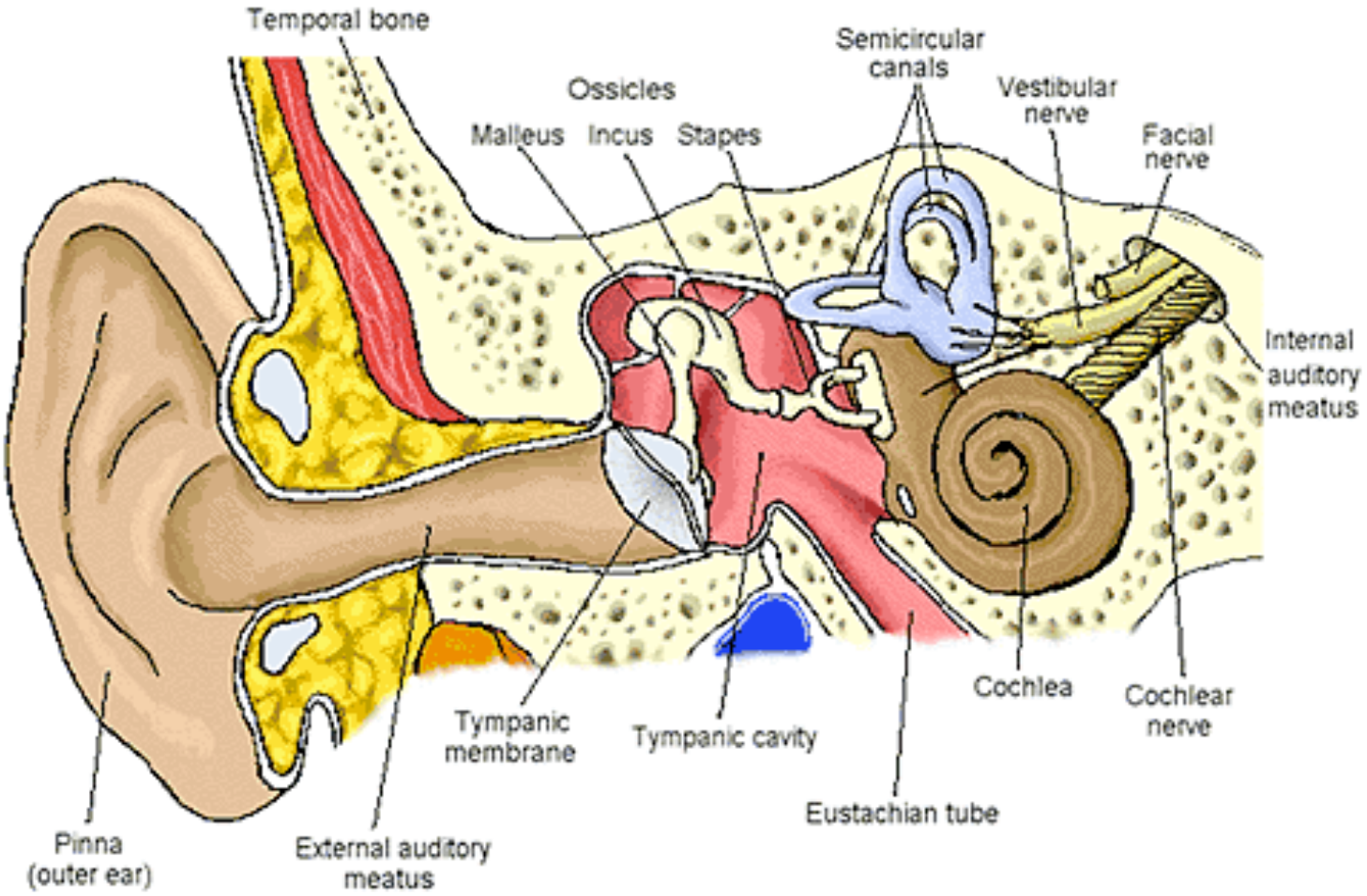
- Intersection in peripheral vision
  - (A.) light photoreceptors are stimulated, and many dark photoreceptors are stimulated, decreasing white → grey spot.
- White lines
  - (B.) the light photoreceptors are stimulated, but not so many dark photoreceptors, so white is perceived correctly.
- Look Directly at Intersection
  - (C.) It focuses on the fovea. The fovea has very small receptive fields, which fit completely in the intersection. Therefore no interference.





*There is evidence that this explanation is not true.

The Ear


Temporal bone
Semicircular canals
Ossicles
Malleus
Incus
Stapes
Vestibular nerve
Facial nerve
Internal auditory meatus
Tympanic membrane
Tympanic cavity
Cochlea
Cochlear nerve
Eustachian tube
Pinna (outer ear)
External auditory meatus

Hearing

- **Vibrations**: sound waves = vibrating air
  - → Eardrum
  - → Malleus (hammer) → Incus (anvil) → Stapes (stirrup)

    [These bones act as tiny levers and amplify sound 20X]

    [Muscles attached to the bones can dampen loud sonds to protect ear.]
  - → Oval window
  - → Cochlear fluid

    [Round window allows volume and pressure to remain constant.]
  - → Cochlear hair bundles →

    [Bundles in different parts of cochlea vibrate at different frequencies.]
- **Action Potential:**
  - Vibrating hair bundles cause action potentials on different neurons on the auditory nerve.