

# Introduction

- **Senses** – our perception of what is “out there”
- 2 groups
  - **General senses**
  - **Special senses**

# Central Processing and Adaptation

- **Adaptation** – the loss of sensitivity after continuous stimulation
  - **Tonic receptors** are always active
  - **Phasic receptors** only relay changes in the conditions they are monitoring
- **Role** – prevents brain from being overloaded with unimportant information

# General Senses

- Includes sensations for:
  - Temperature, pressure, touch, pain, vibration, **proprioception (body position)**
- Pass information along the spinal nerves and pathways to of the the somatosensory cortex of the parietal lobe

Chronic pain affects 97 million American and costs about \$100 billion each year.(Statistic from *Brain Facts*, Society for Neuroscience, 1997)



# Special Senses

- **Olfaction, gustation, equilibrium, hearing, & vision**
- Found within complex sense organs
- Pass information along the cranial nerves to specific areas of the cerebral cortex.

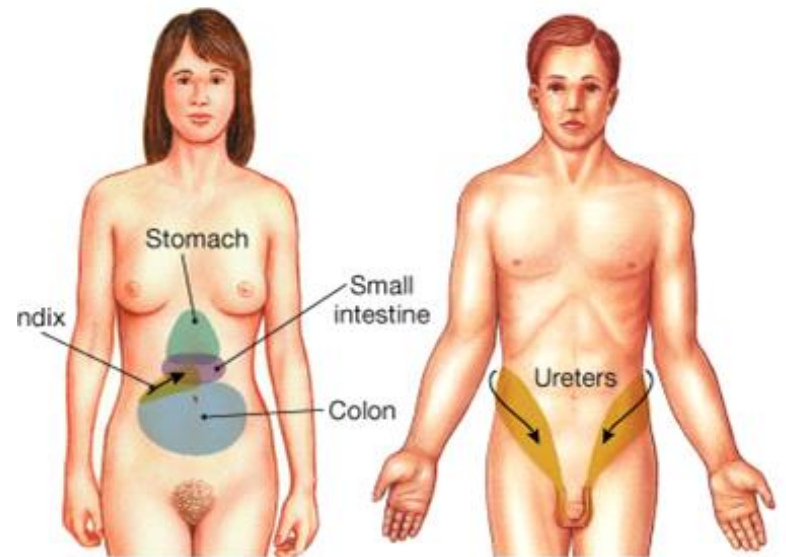
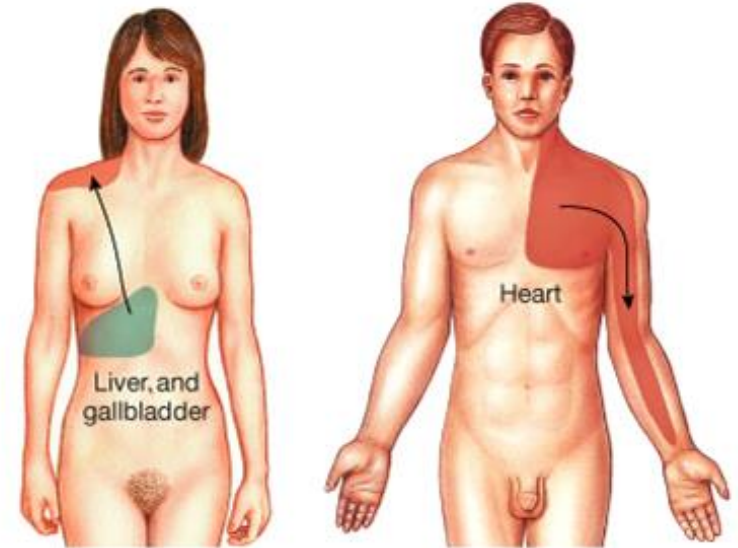
# Receptors of the General Senses

Scattered throughout body

Classified based on the type of stimulus that triggers an action potential

# Nociceptors

- Detect pain
  - Fast pain receptors- myelinated fibers, localized in one area (prick of a needle)
  - Slow pain receptors: unmyelinated, determine only general area involved (aches)
  - **Referred pain**
  - **Phantom pain**

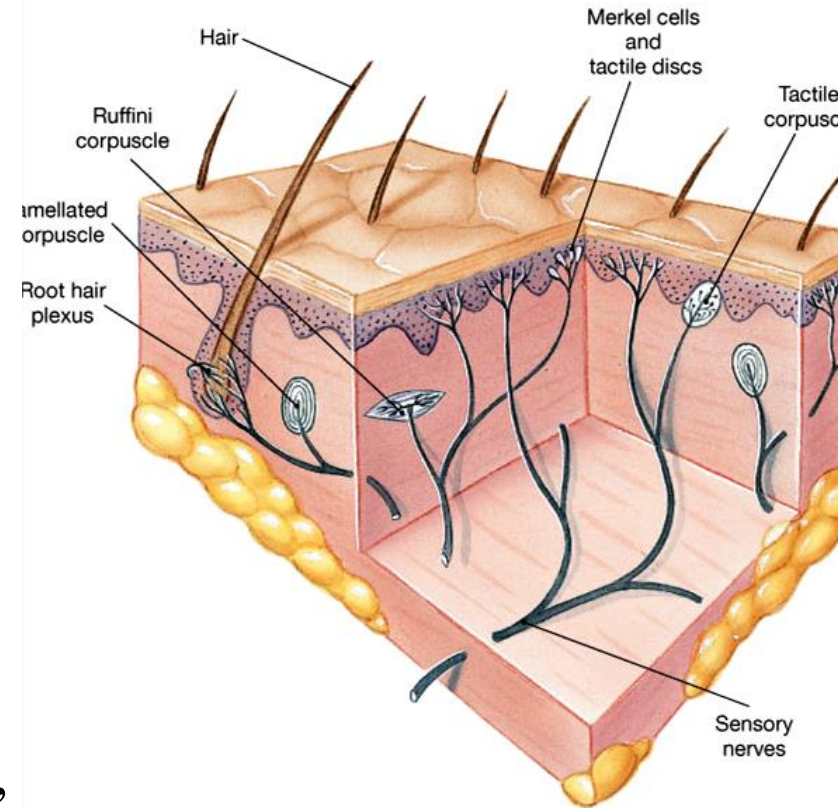


# Thermoreceptors

- **Free nerve endings scattered beneath surface of the skin**
- **Adapt quickly**
- **Can trigger nociceptors if temperature becomes dangerous**

# Mechanoreceptors

- Tactile receptors:
- Dermis
  - Free nerve endings- thermal or mechanical stimuli
  - Root hair plexus-hair displacement
  - Merkel discs- fine touch, pressure
  - Meissner Corpuscle- fine touch, pressure- more common in the eyelid, fingertips, lips
  - Ruffini corpuscle- pressure on skin, located in dermis
  - Pacinian Corpuscles- deep pressure and vibrations

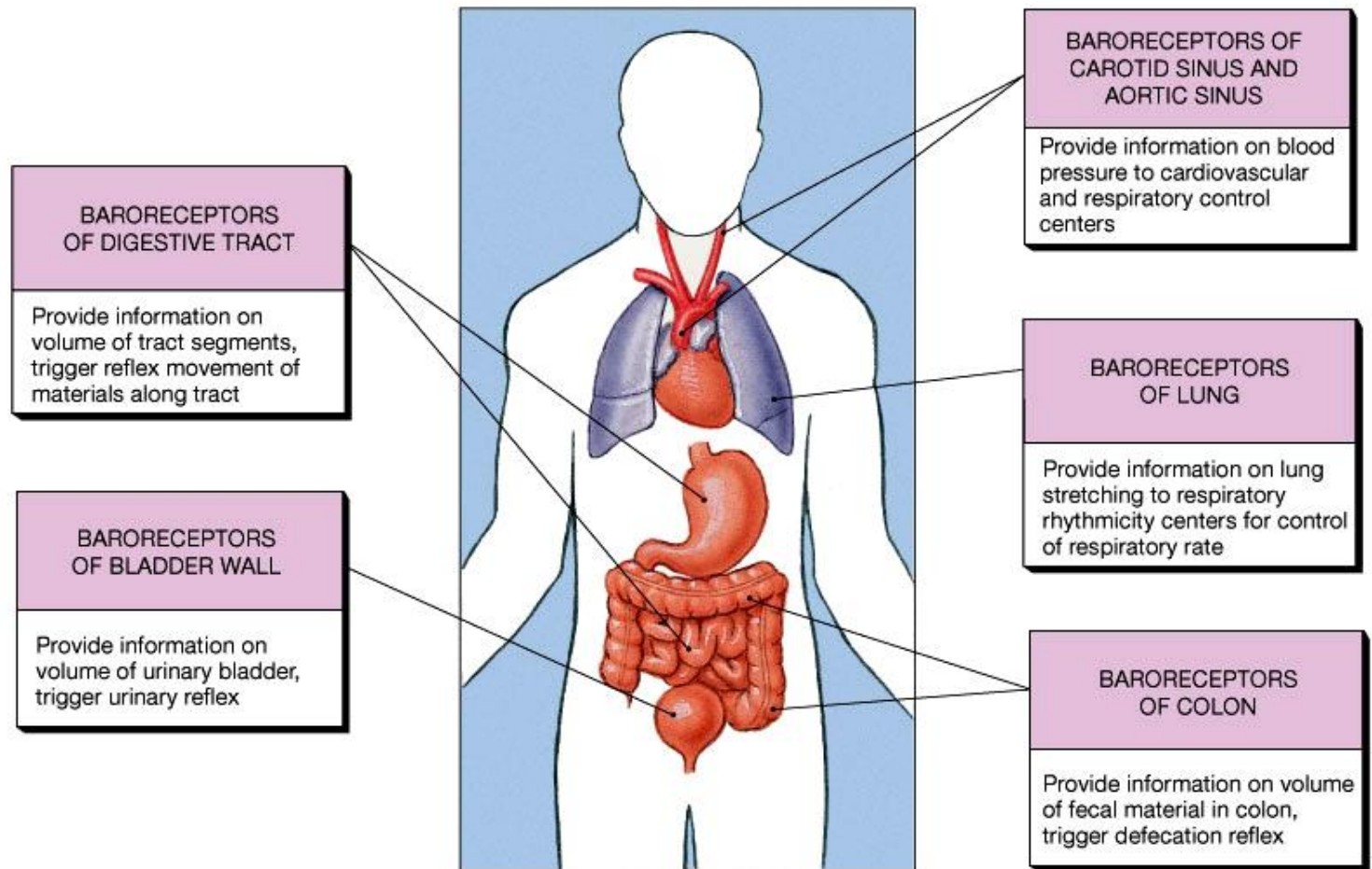


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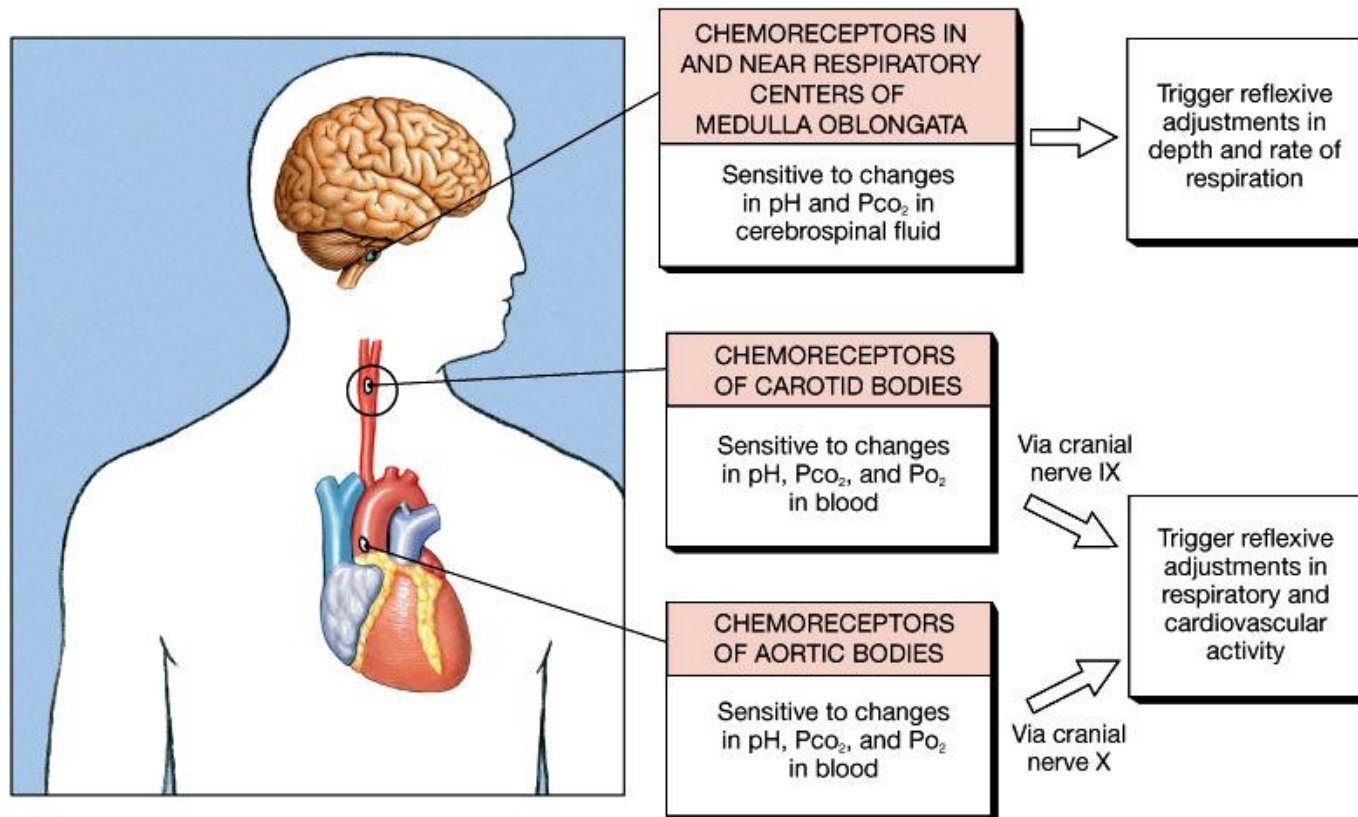
# Baroreceptors

- Monitor changes in pressure of organs and body parts



# Chemoreceptors

- Detect chemicals in solution
  - Blood composition



# Proprioceptors

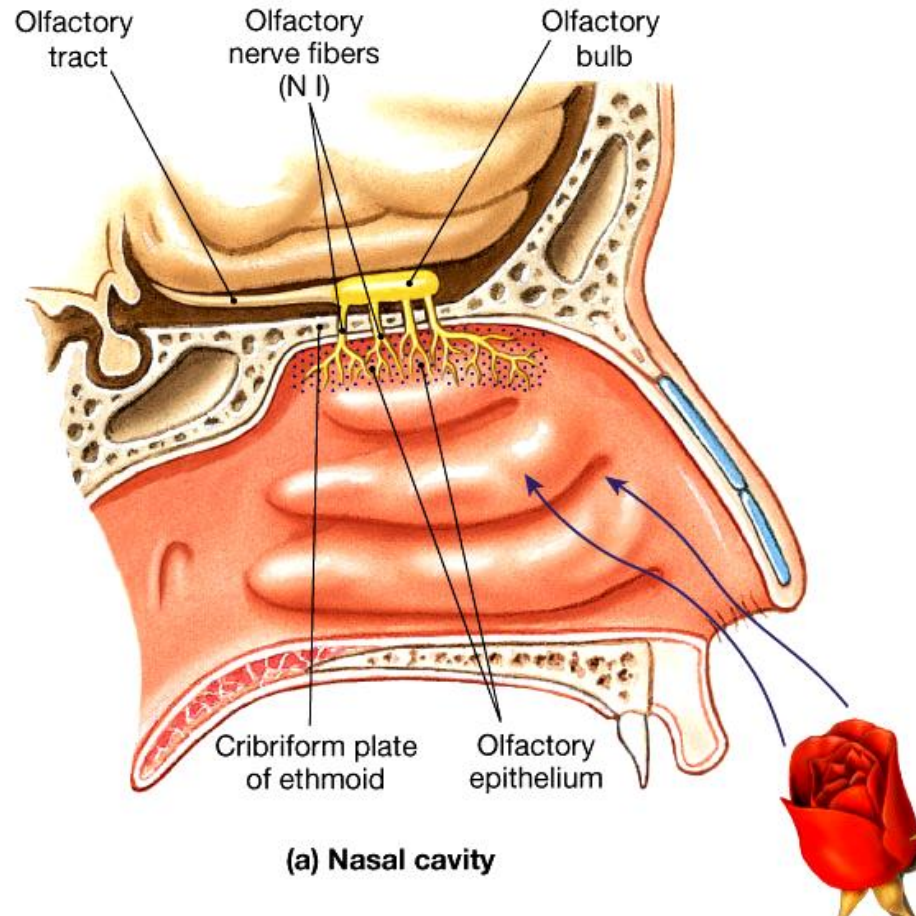
- Monitor changes in position of your joints
- Tension in ligaments and tendons
- Tonic- however most of the processing is done subconsciously

# The Special Senses

# Olfaction (the nose)

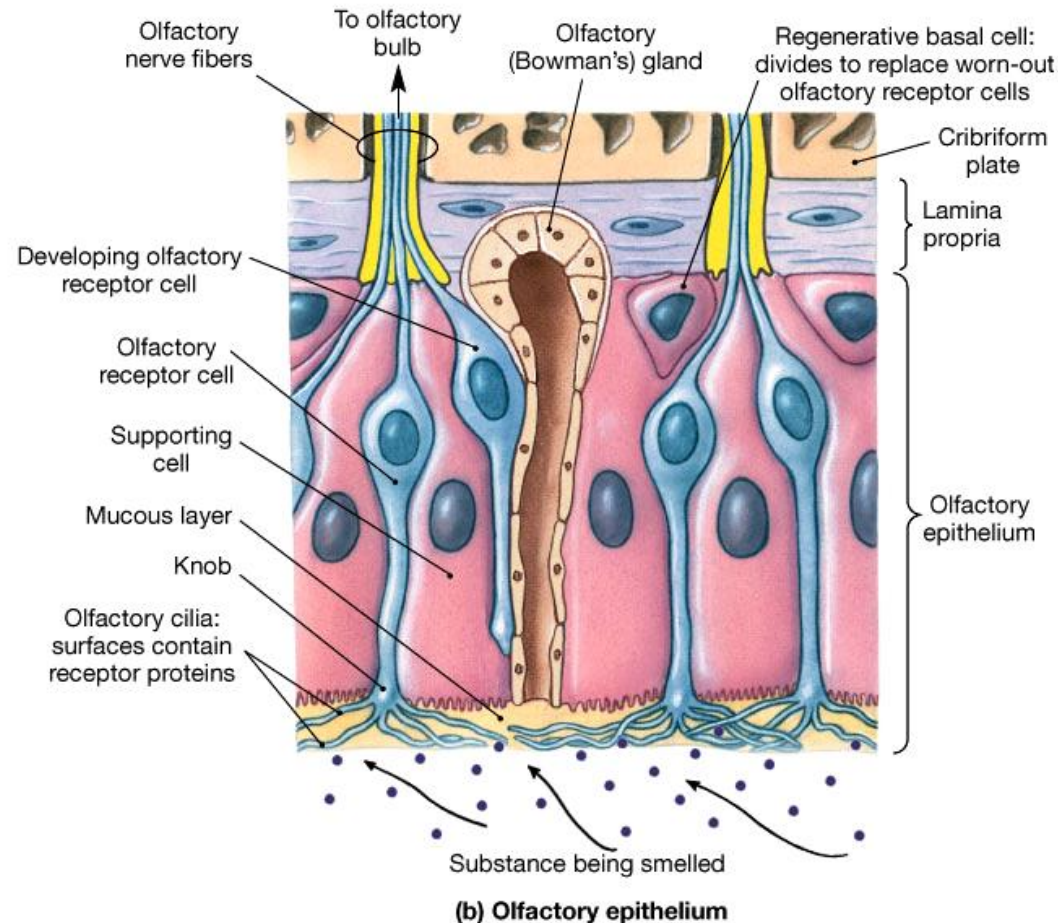
- **Olfactory receptors**

- Can detect between 4000 and 10000 different smells
- Located in the epithelium of roof of nasal cavity



# Olfactory Receptors

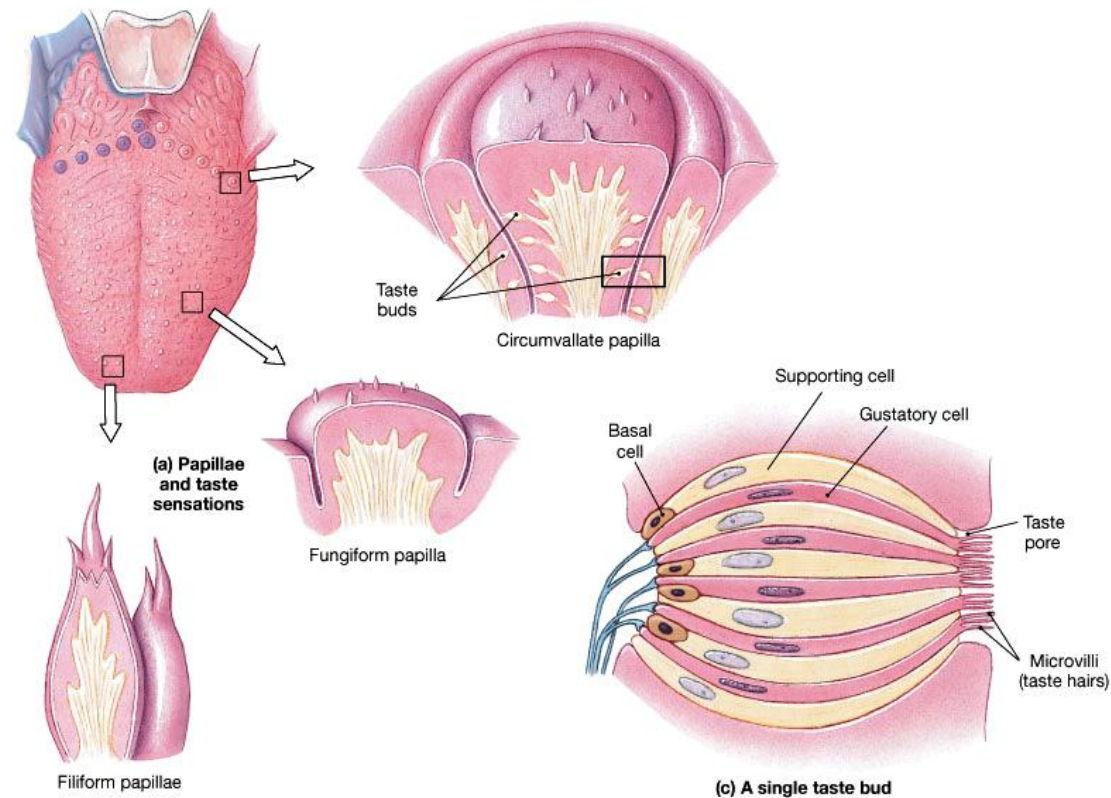
- Molecules dissolve in the mucus or lipids of the epithelium in nasal cavity
- **Olfactory nerve fibers** pass through the **ethmoid bone** and **synapse** in the **olfactory bulb** of the **olfactory nerve**
- **Olfactory signals** go directly to the **cerebral cortex**



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# Gustation (the tongue)

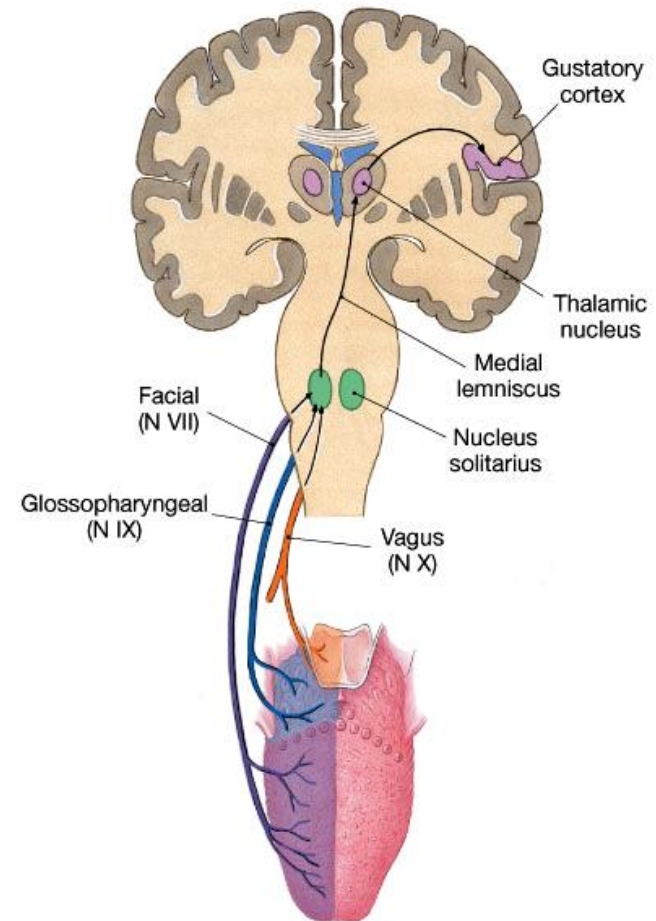
- Molecules dissolve in saliva
- Taste receptors are in the **taste buds**
- Located in **papillae** on the surface of the tongue
- Contain the **gustatory receptors**
- **6 primary tastes**
  - Sweet, sour, salty, bitter, umami, water



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# Pathway of Gustatory Sense

- 3 cranial nerves relay sensory impulses to the cerebral cortex
  - **Facial, glossopharyngeal, vagus**
  - All pass through the medulla & thalamus



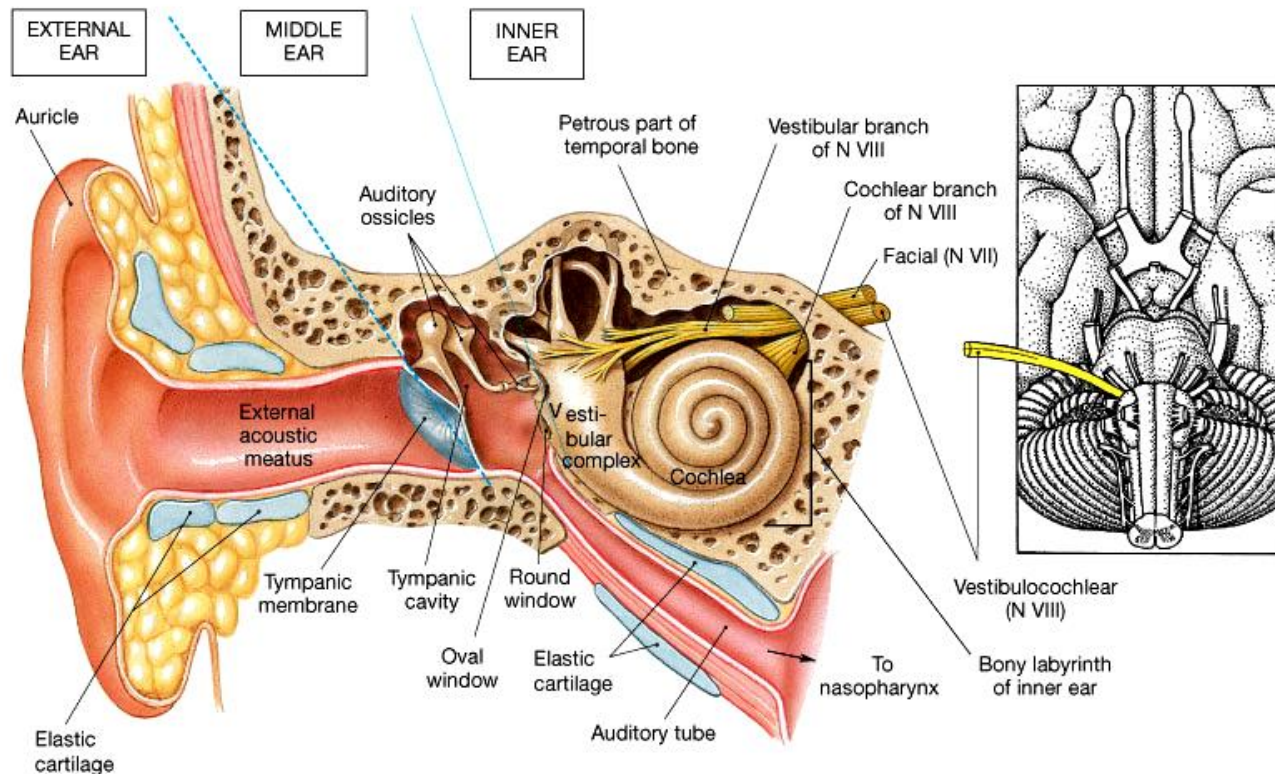


Good Morning!  
Take out packet!  
Hearing and the Ear

# Equilibrium & Hearing (the ear)

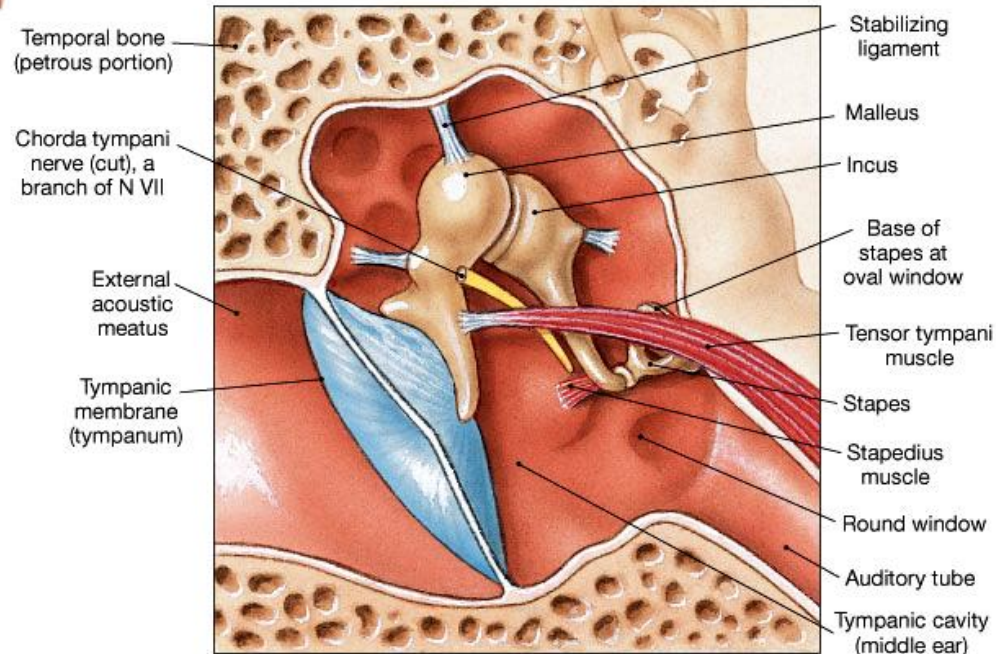
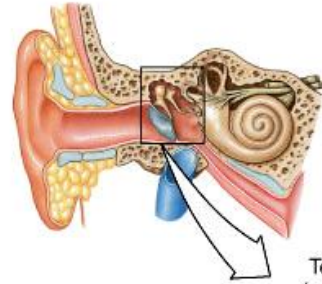
- **External ear**

- The **auricle** directs sound waves into the **external auditory meatus** to the **tympanic membrane**



# The Middle Ear

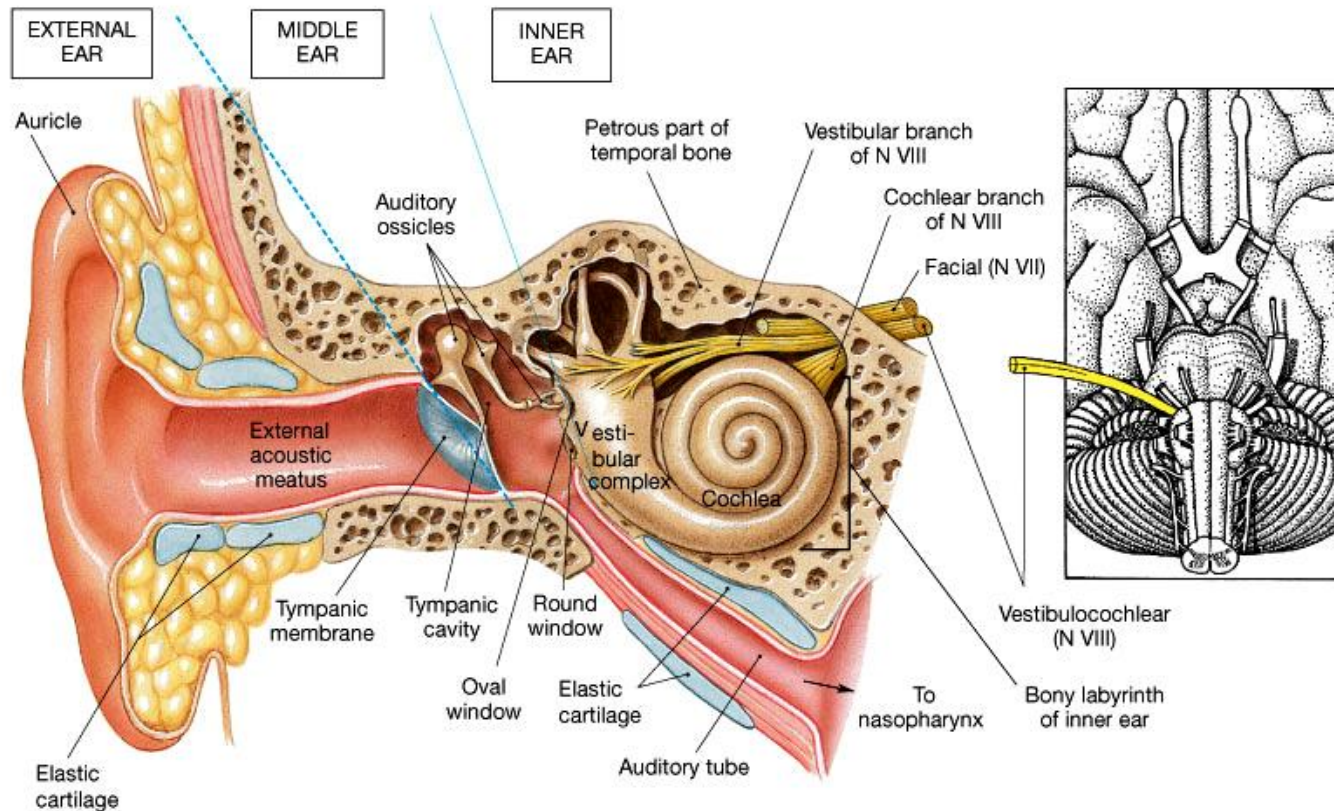
- Located in the **temporal bone**
- Contains the **auditory ossicles**
  - **Malleus**
  - **Incus**
  - **stapes**
- Connected to throat by the **eustachian tube**



(b) The middle ear

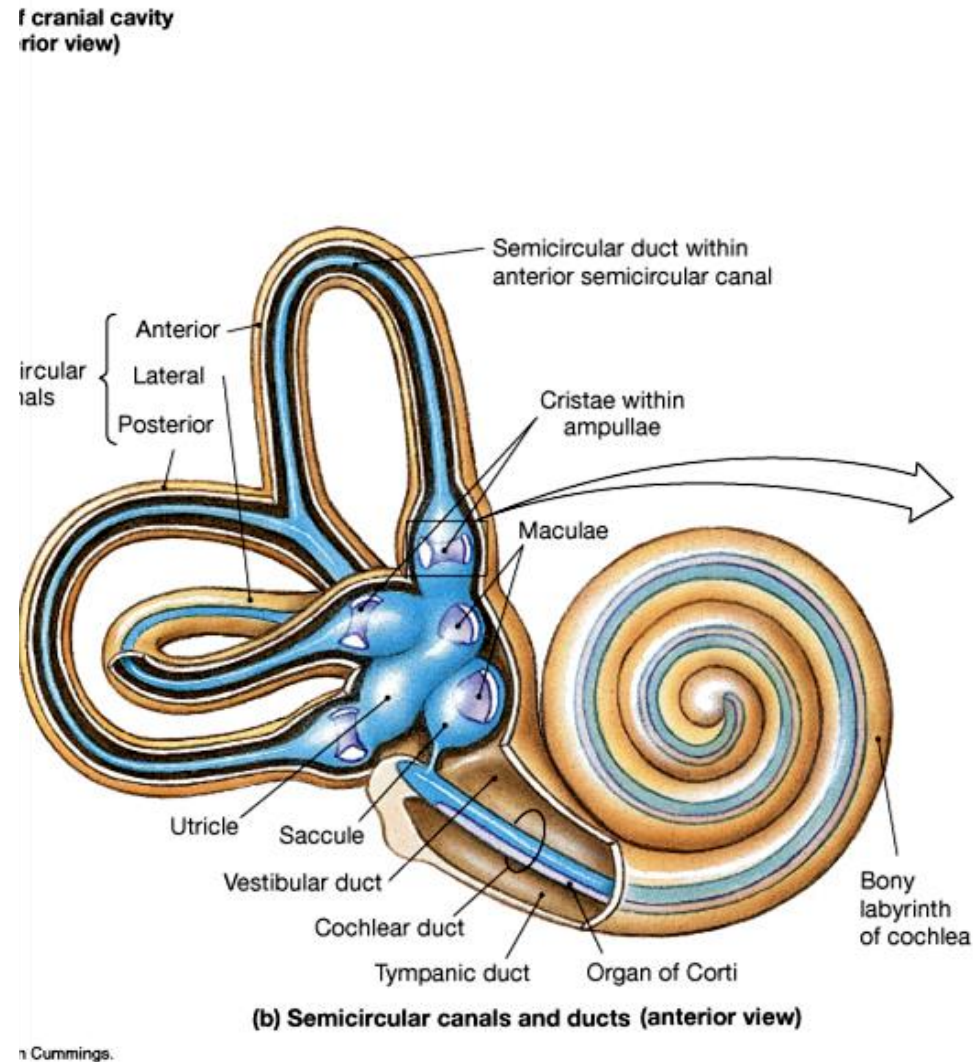
# The Inner Ear

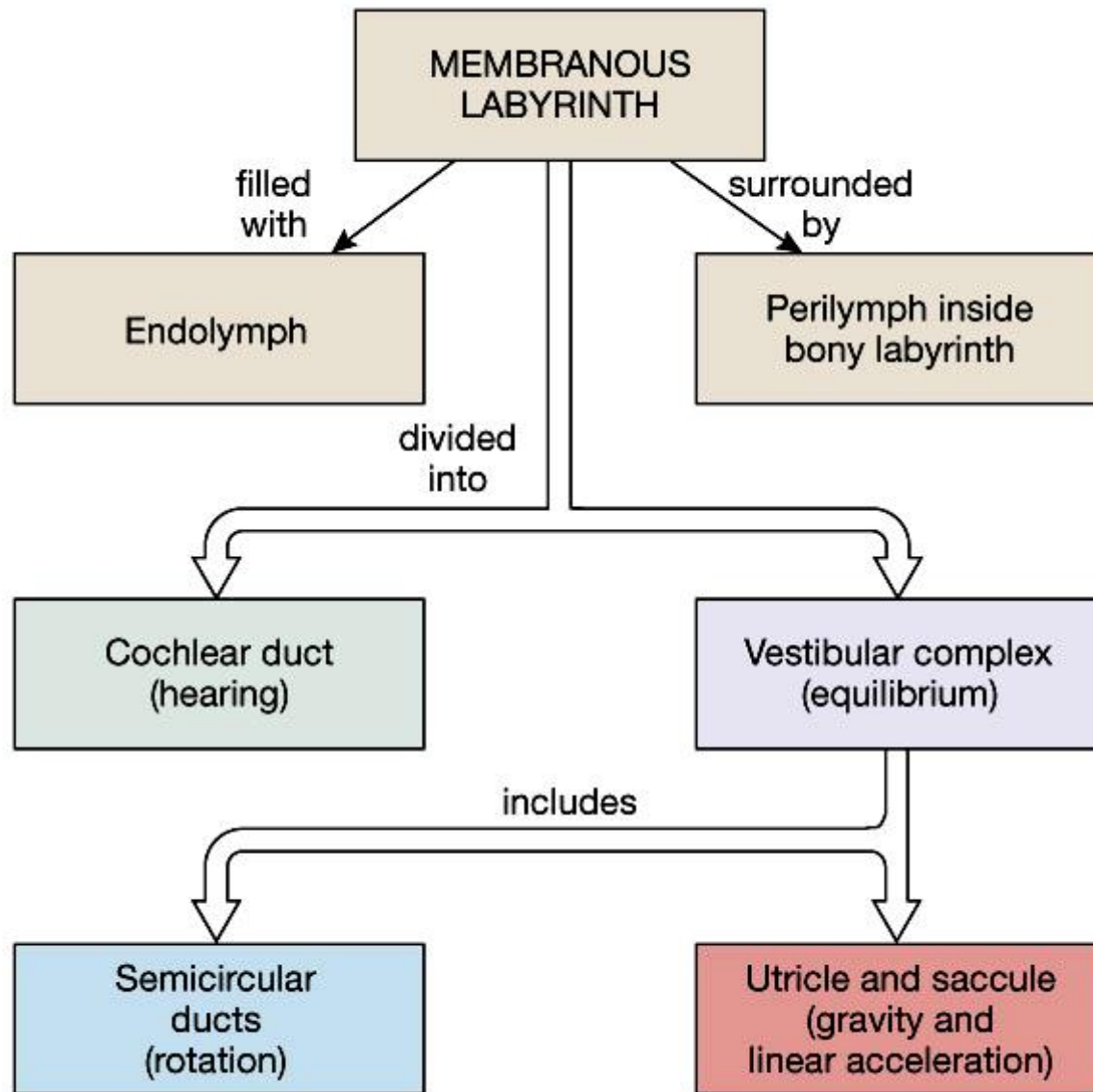
- Located in the temporal bone
- Separated from the middle ear by the **oval window**



# The Inner Ear- Balance and hearing

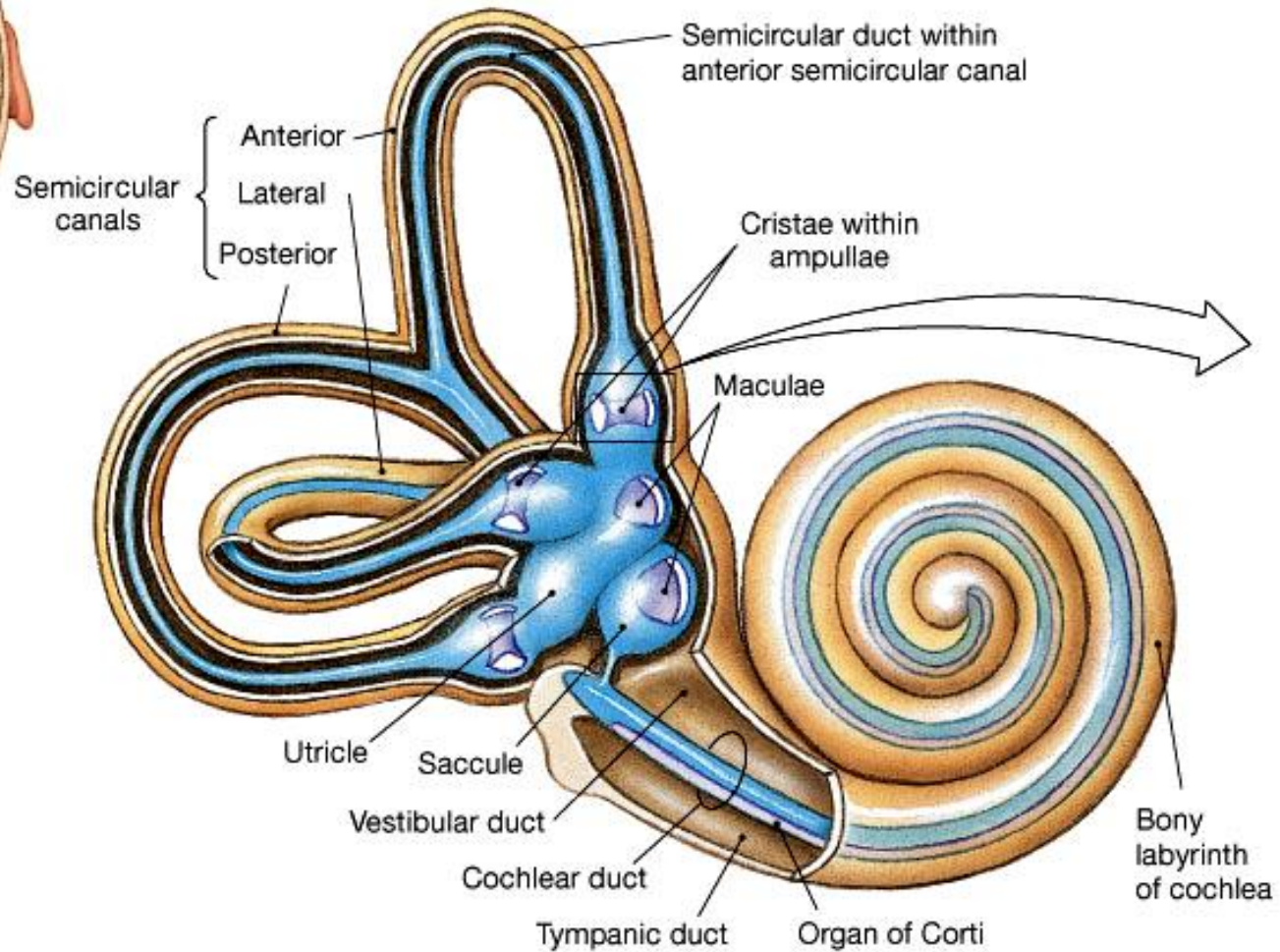
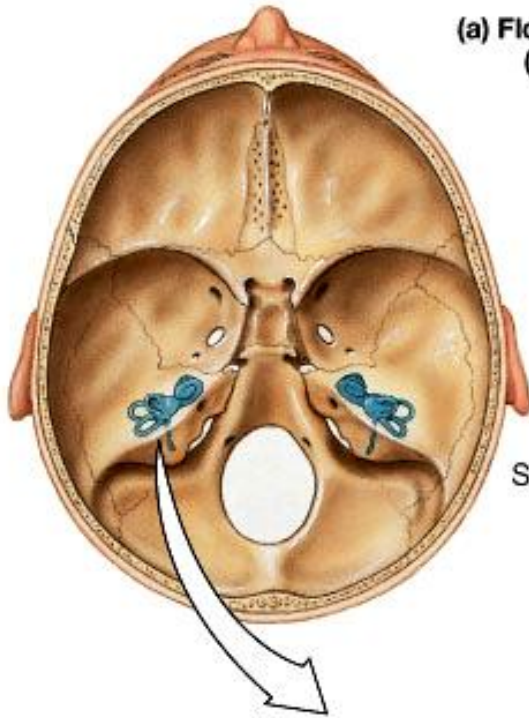
- Consists of a series of canals called the **bony labyrinth**
  - Lined with endolymph and perilymph
  - Vestibule- provide sensations of gravity and linear acceleration
  - Semicircular Canals- sense rotation
  - Cochlea (snail shell)- sense of hearing





# The Inner Ear

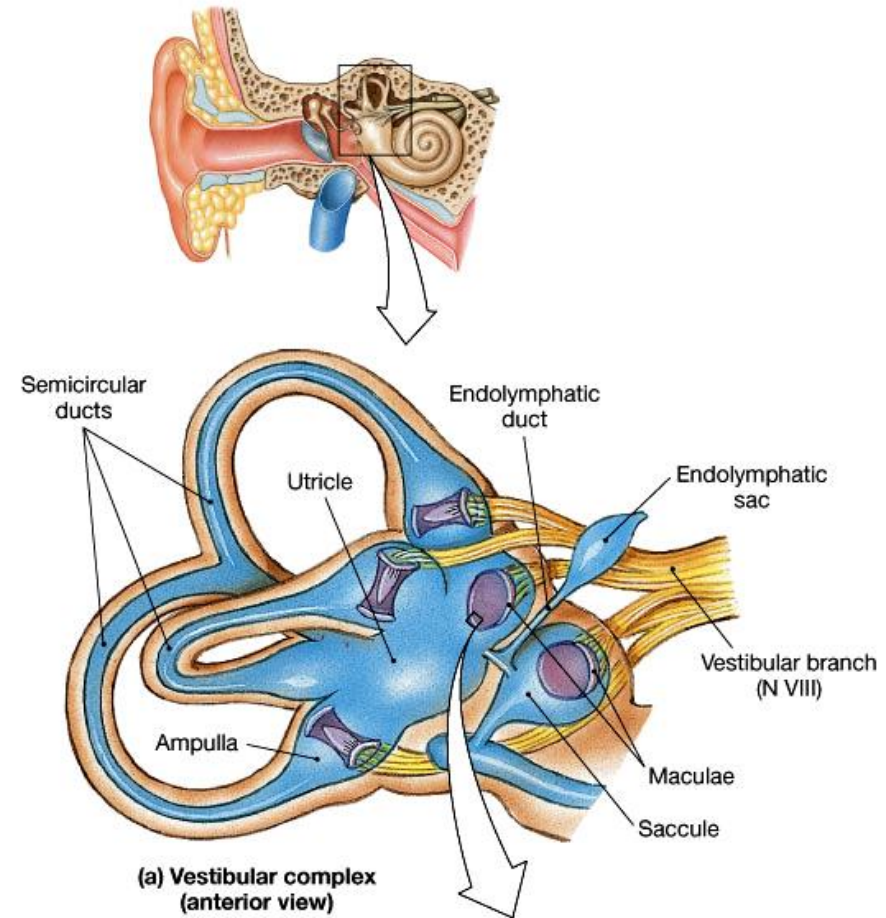
(a) Floor of cranial cavity  
(superior view)



(b) Semicircular canals and ducts (anterior view)

# Inner Ear- Vestibule

- Detects static position
- **Hair cells** are embedded in a **gelatinous material**

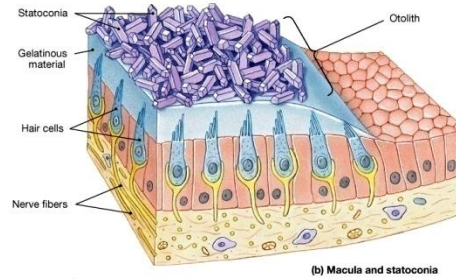




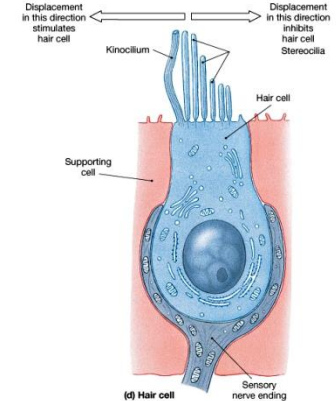
# Vestibule- Otoliths at Work

- **Otoliths** are balanced on top of gelatinous material

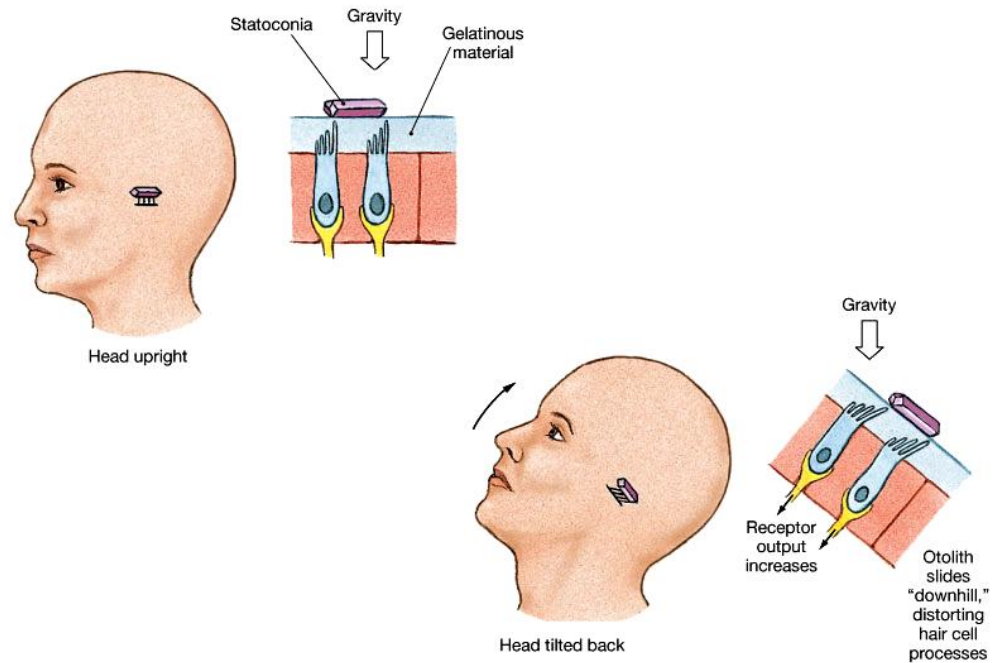
- Slide when head tips
- Bend hairs
- Generates nerve impulse



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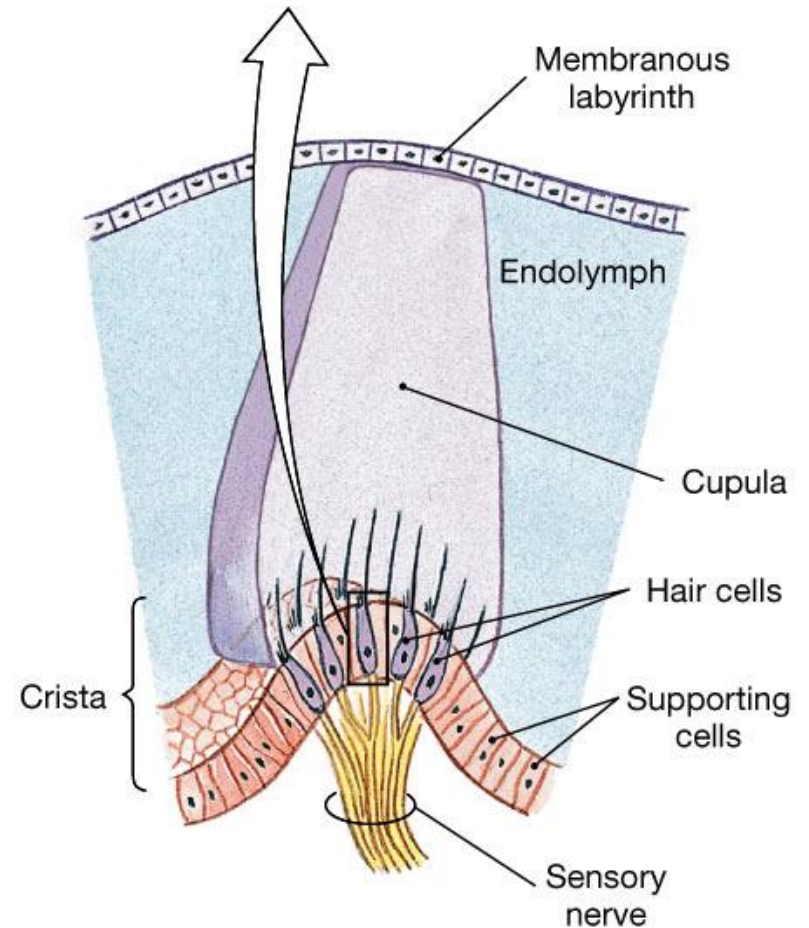
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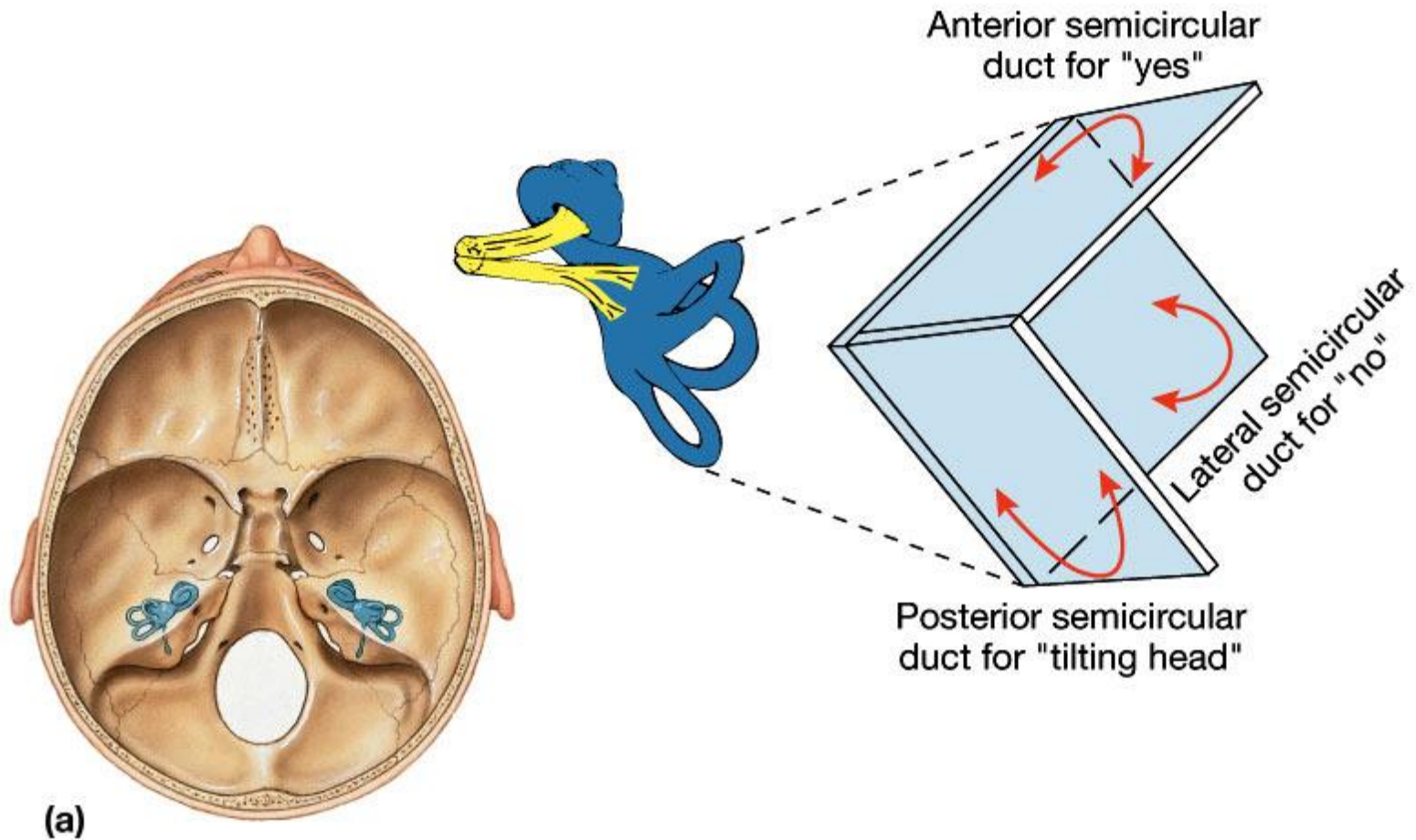
# The Semicircular Canals

- Detect dynamic balance
- Movement of head
  - Bends the hairs
  - Creates nerve impulses



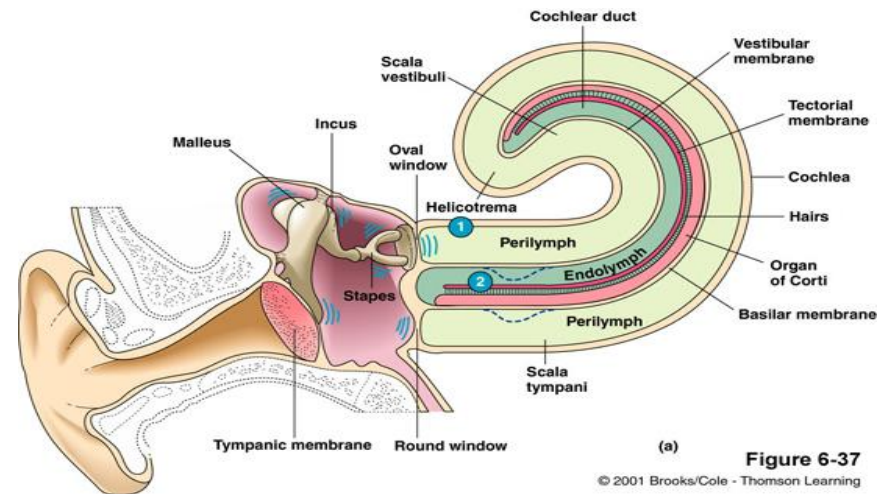
(c) Ampulla, sectional view

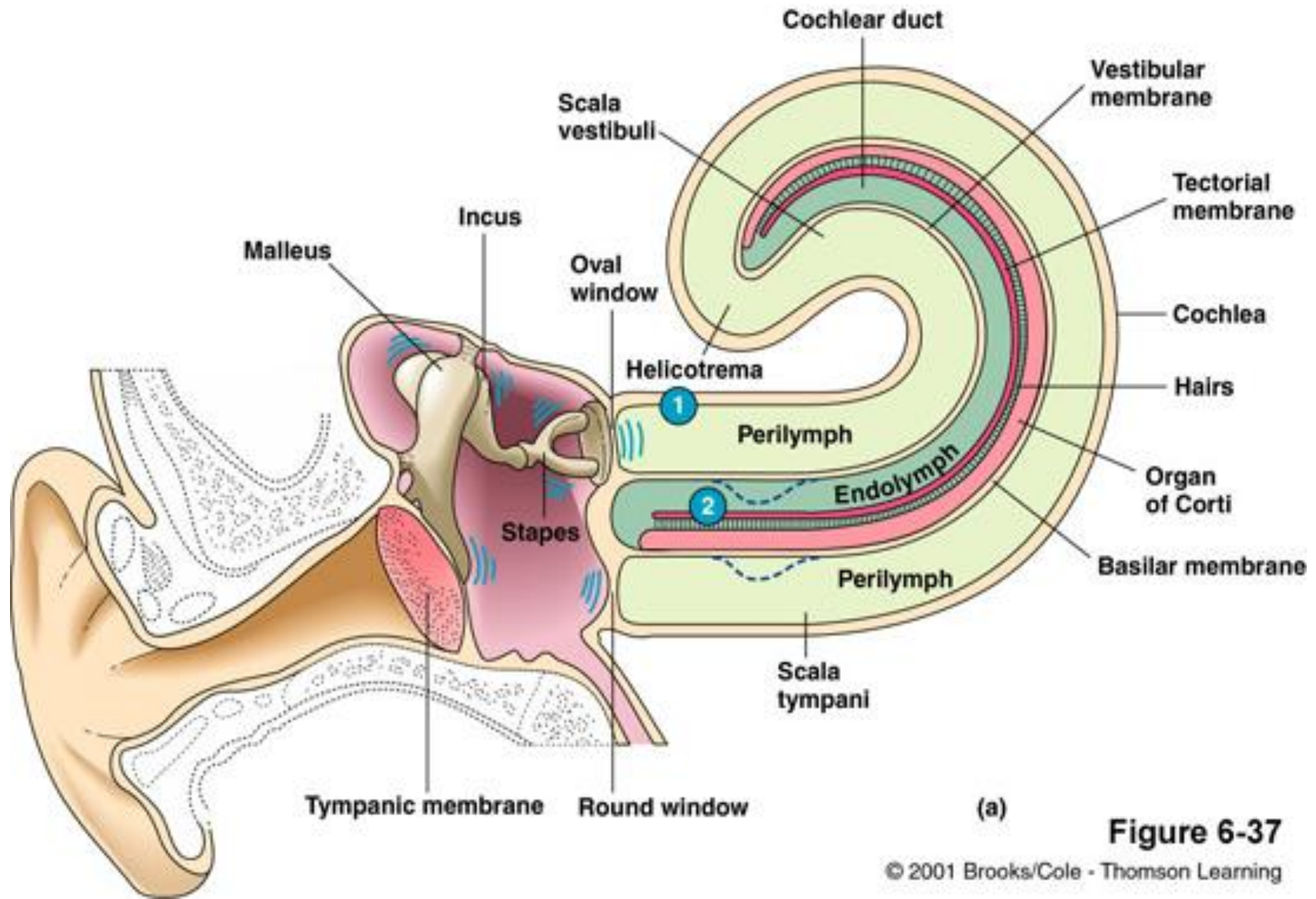
# Semicircular Canals at Work



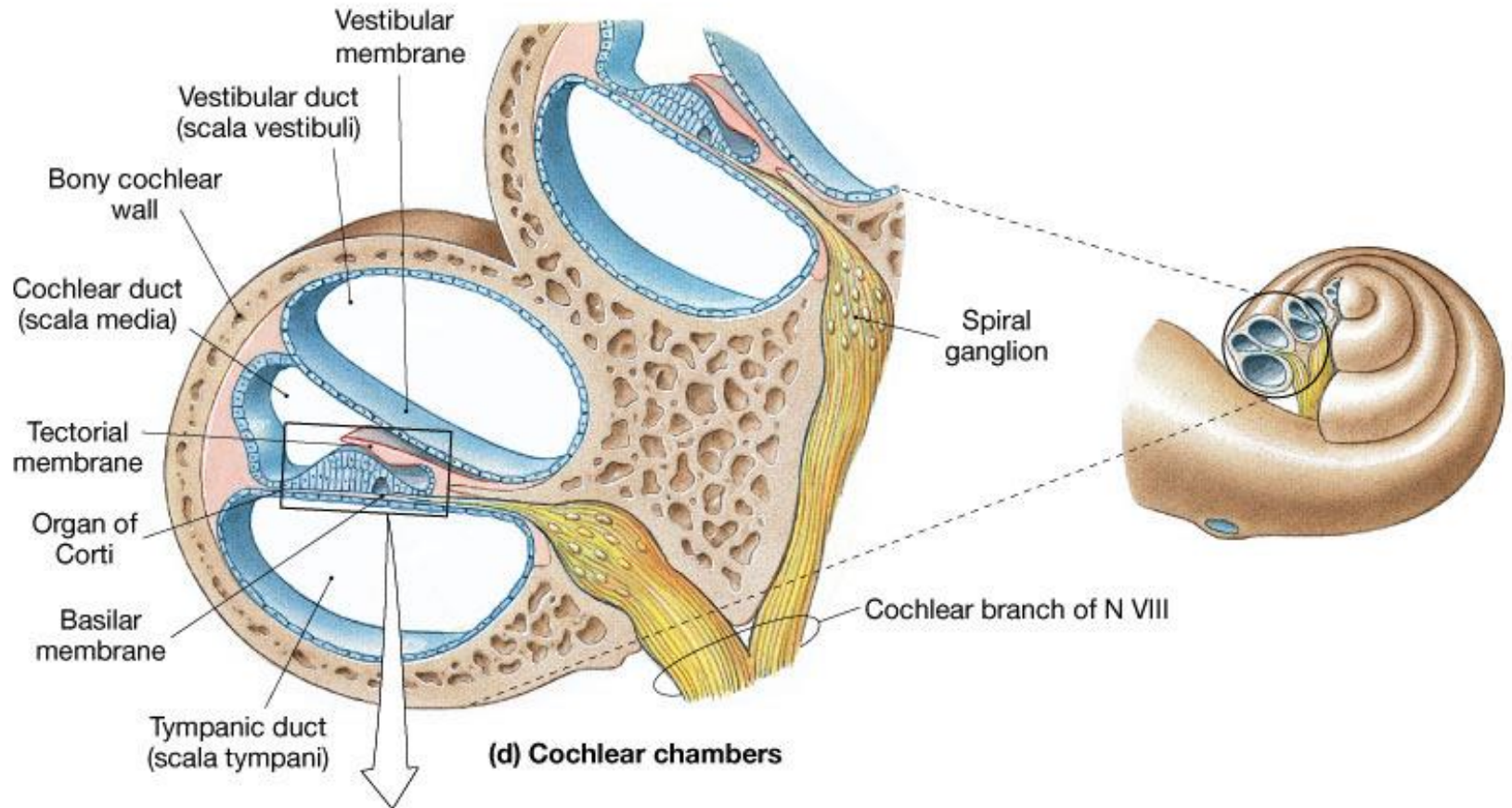
# The Cochlea

- Divided into 3 tunnels by the **vestibular** and **basilar** membranes
  - **Scala vestibuli** ends in the **oval window**- **sound waves vibrate perilymph** → **moves vestibular membrane** →
  - **Cochlear duct** contains the organ of Corti- movement of vestibular membrane causes hair cells to bend
  - **Scala tympani** ends in the **round window**- **endolymph vibrates basilar membrane to dissipate sound waves through round window**



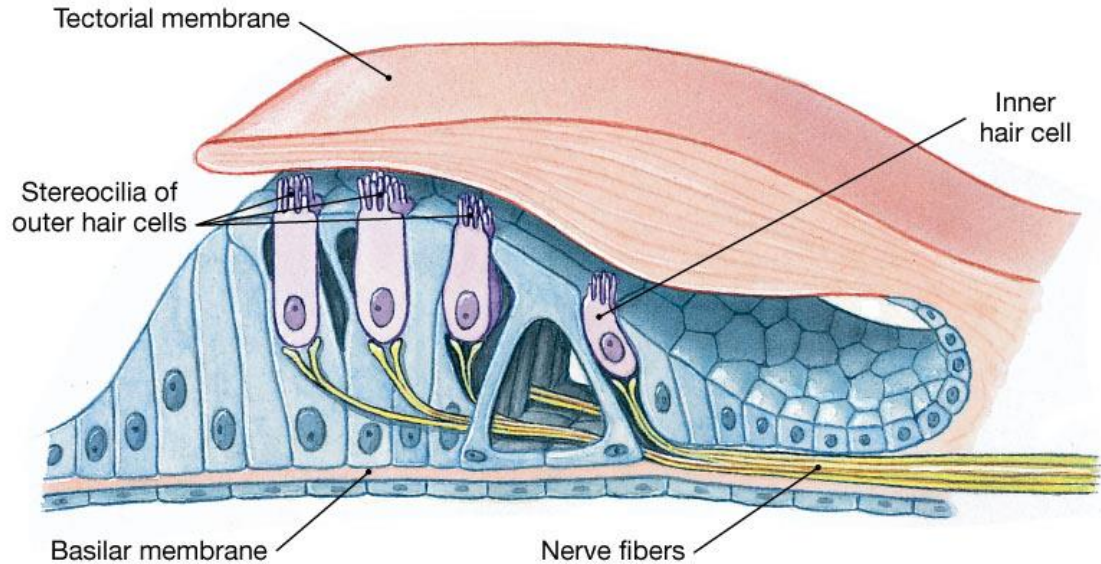


# Cochlear Chambers



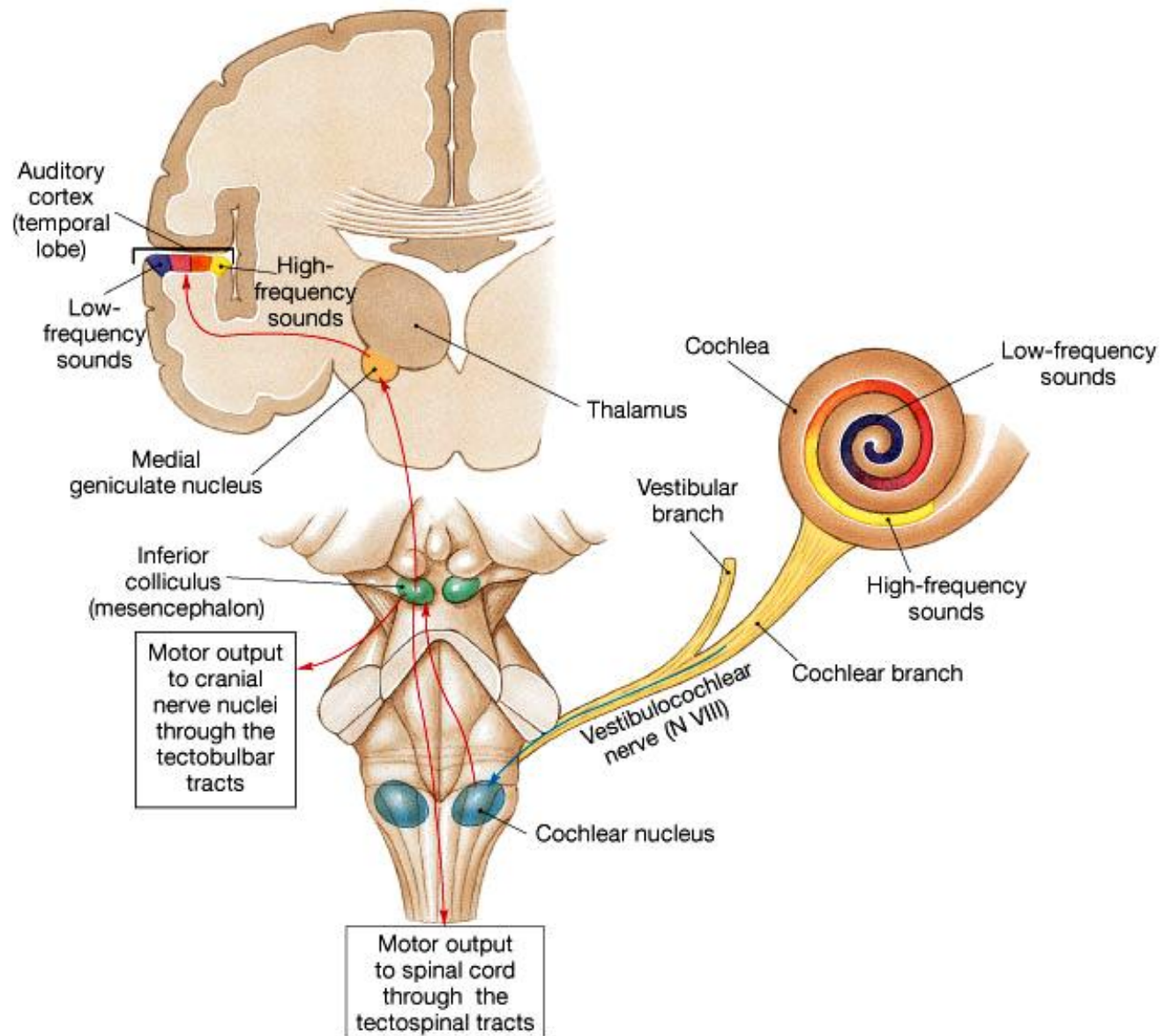
# The Organ of Corti

- Consists of hair cells on the basilar membrane
- Tips of hairs touch the **tectorial membrane**
- Basement membrane vibrates
  - Hair cells bend
  - Sends a nerve impulse



(e) Organ of Corti

# Pathway of Auditory Sense





# Summary of Hearing

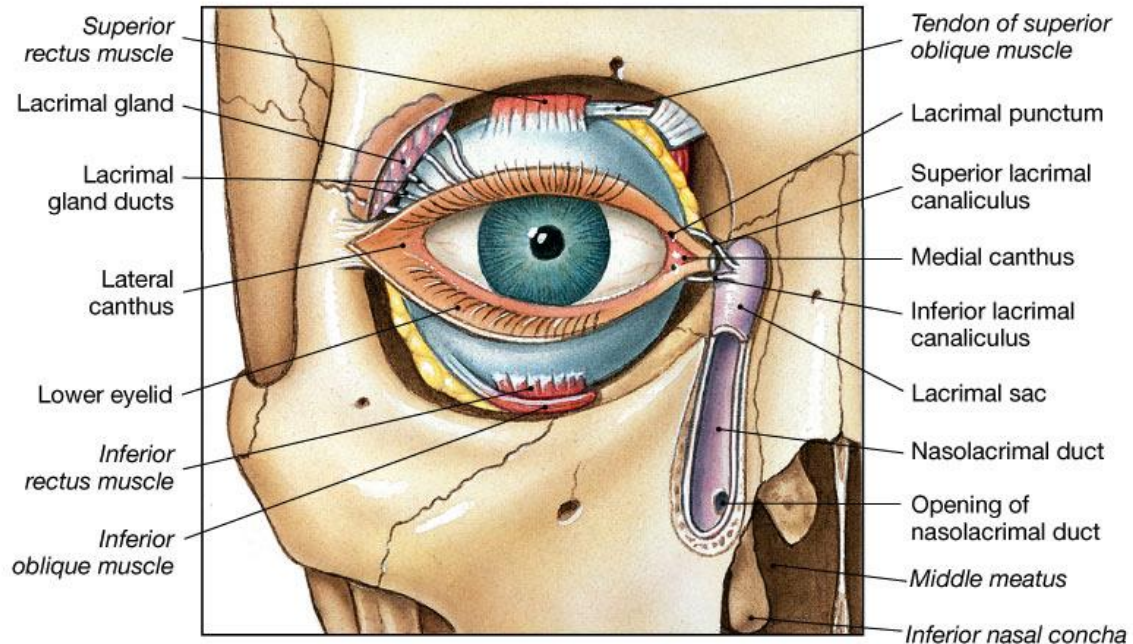
- Sound waves enter the external auditory meatus
- Tympanic membrane vibrates
- Auditory ossicles (bones) vibrate
- Oval window vibrates
- **Perilymph** moves
- Nerve impulse is sent along the vestibulocochlear nerve
- Sent to temporal lobe of the brain

# Good morning!

- Take out your touch/taste/smell dictionary picture dictionary!
- Take out your active reading from last night!
- Take out your notes! The outline is on the board if you would like to copy it down.

# Vision (the eye) – Accessory Structures

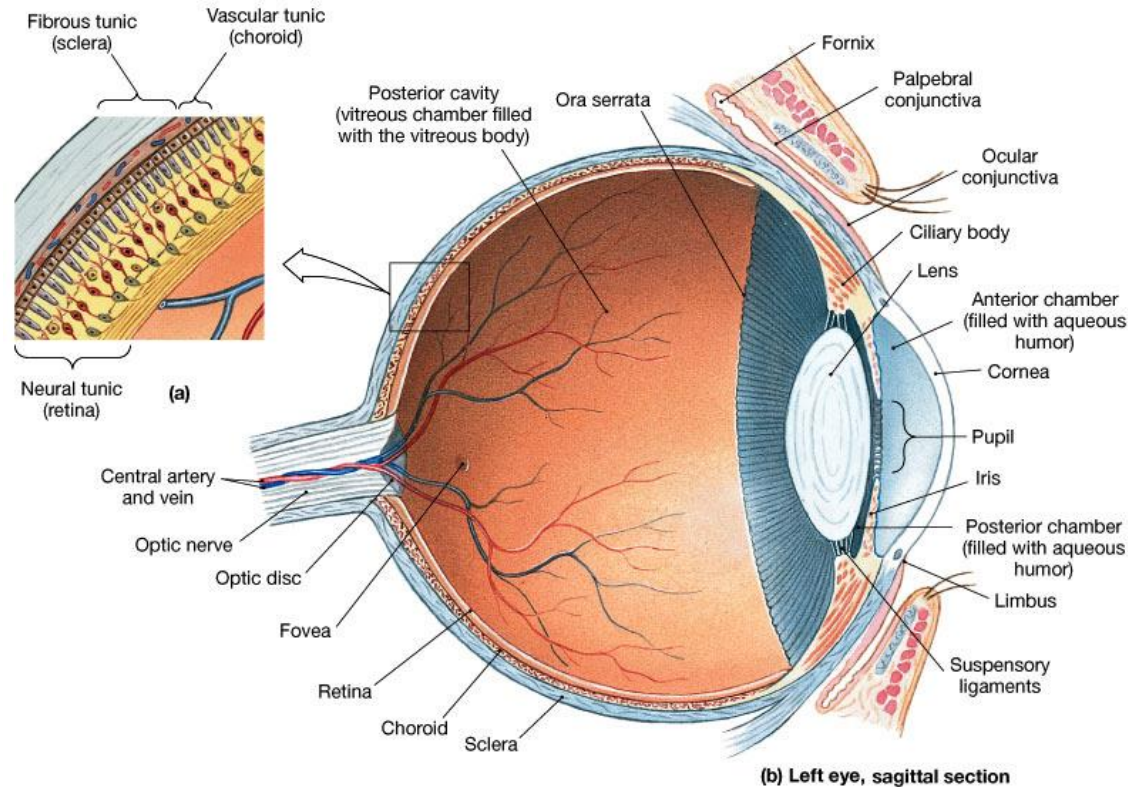
- **Eyelids** protect the eye
  - **Conjunctiva** lines the eyelid
- **Lacrimal apparatus**
  - **Lacrimal gland** produces tears
  - **Lacrimal canals** drain tears into **lacrimal sacs**
- **Extrinsic muscles** move the eyeball



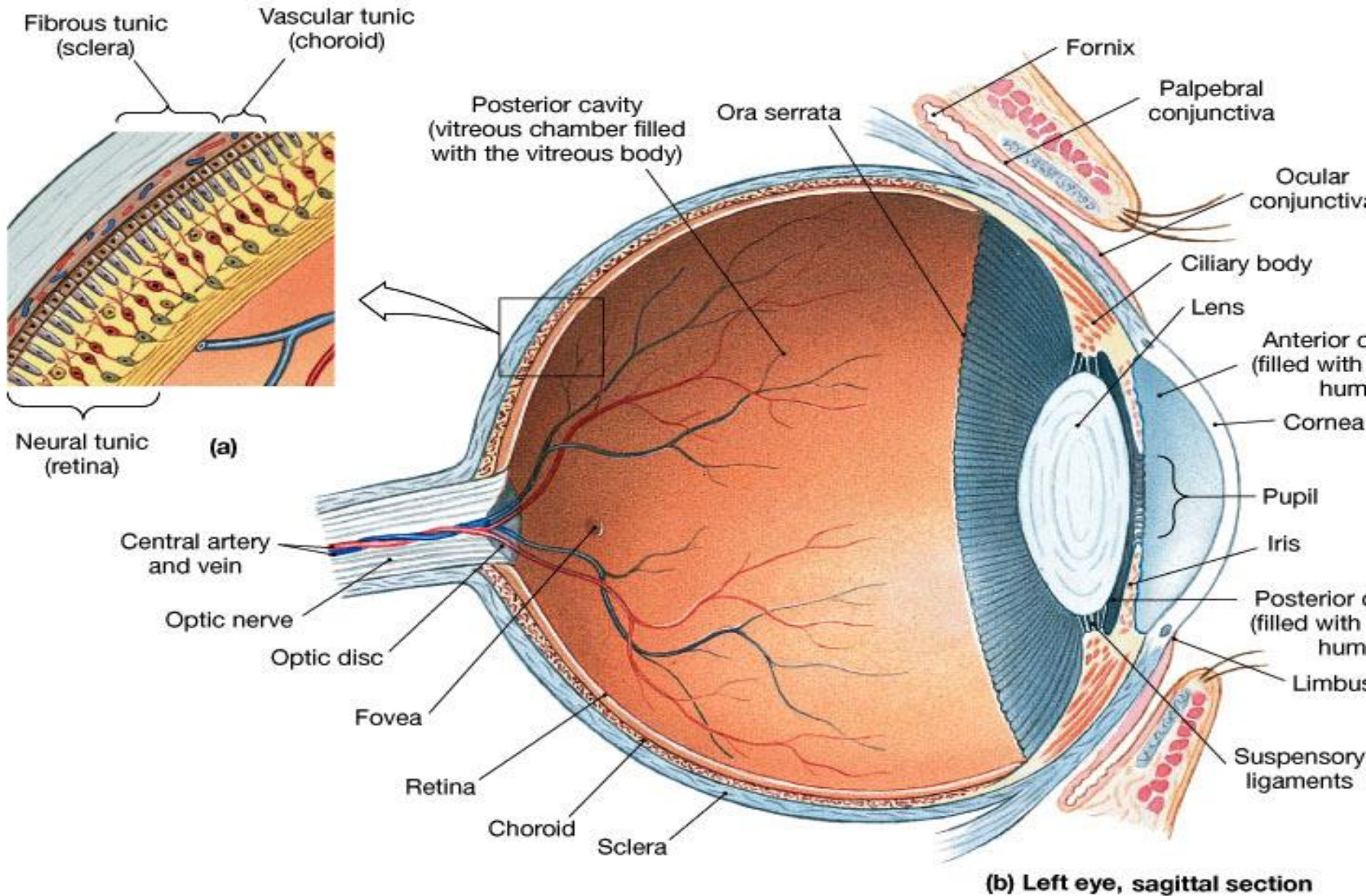
(c) Dissection of right orbit

# Structure of the Eye – 3 Tunics

- **Fibrous tunic**
  - Includes **cornea & sclera**
- **Vascular tunic**
  - Includes, **ciliary body, lens, iris & pupil**
- **Neural tunic (retina)**
  - Contains **photoreceptors**
    - **Rods & cones**
  - Includes **optic disc & fovea centralis**



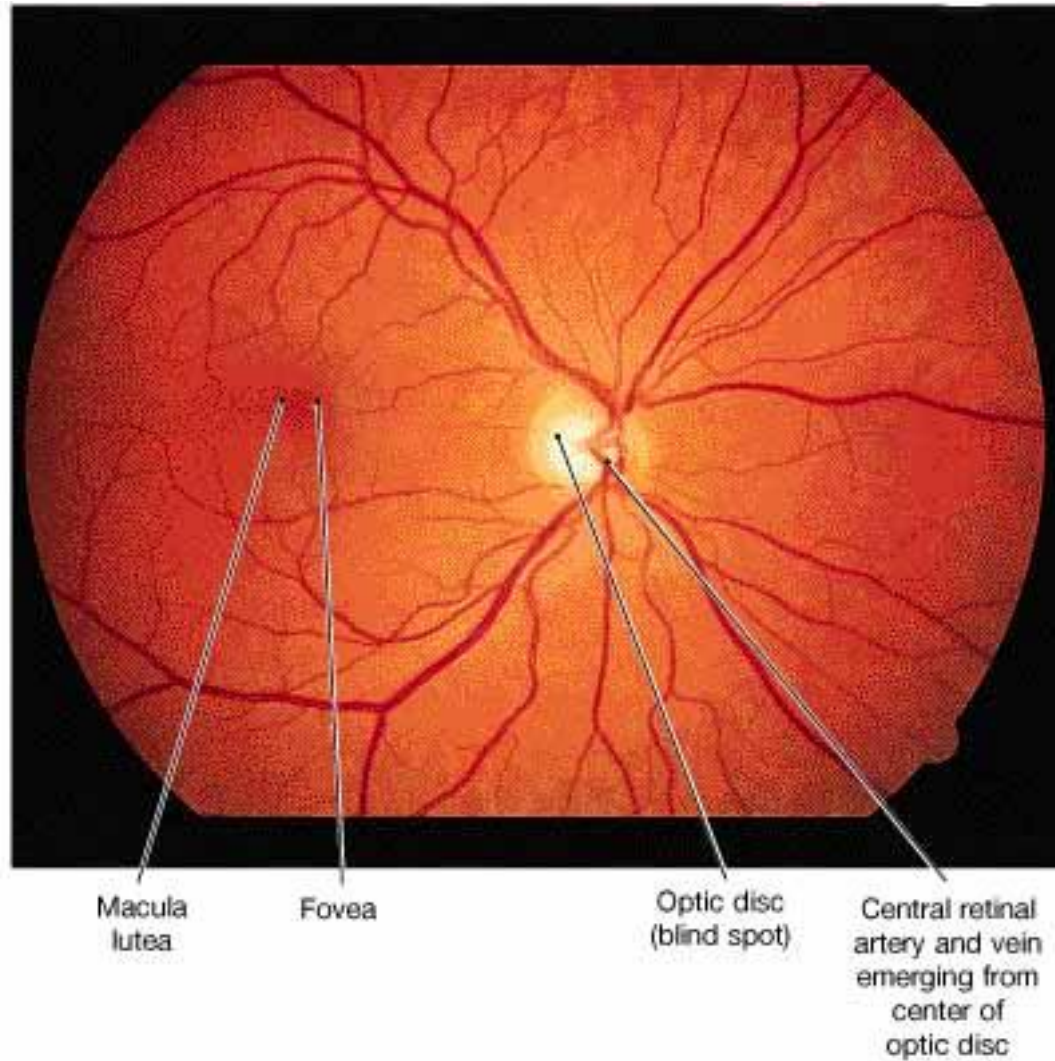
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**(b) Left eye, sagittal section**

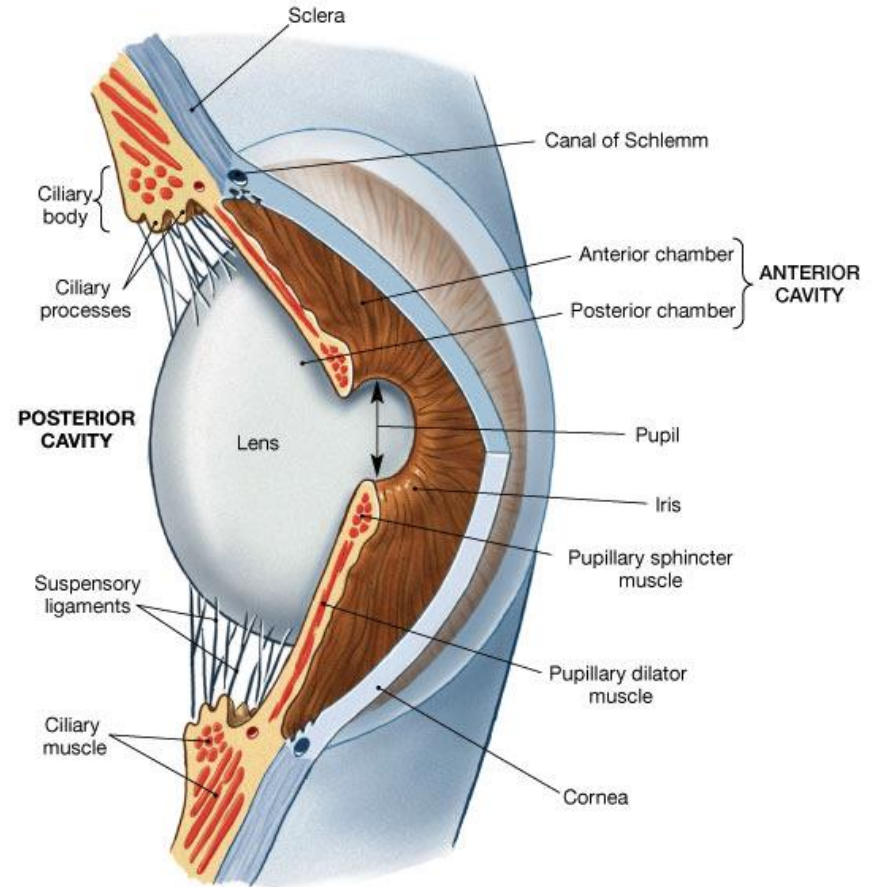
# Photo of Posterior Eye

Figure 18-22c



# The Cavities (chambers) of the Eye

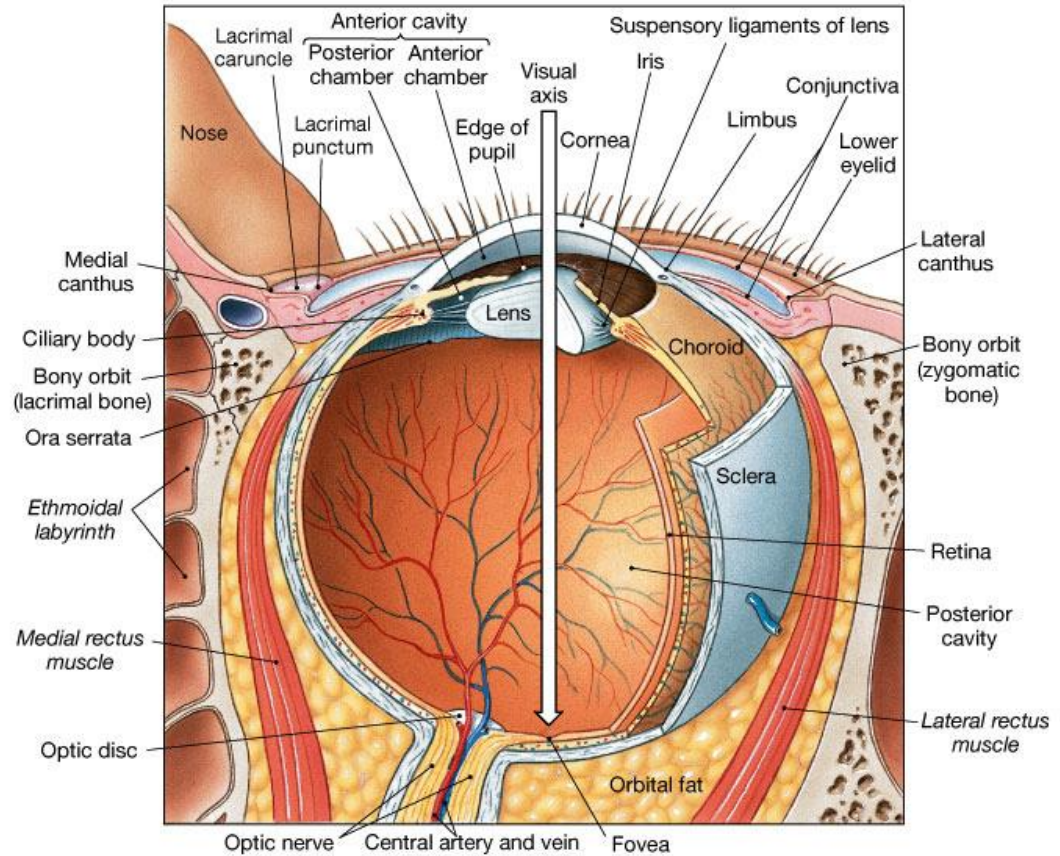
- The **lens** separates the interior of the eye into 2 cavities
  - **Anterior cavity**
    - Contains **aqueous humor- maintains shape of eye**
    - **Glaucoma**
  - **Posterior cavity**
    - Contains **vitreous humor- holds retina in place**



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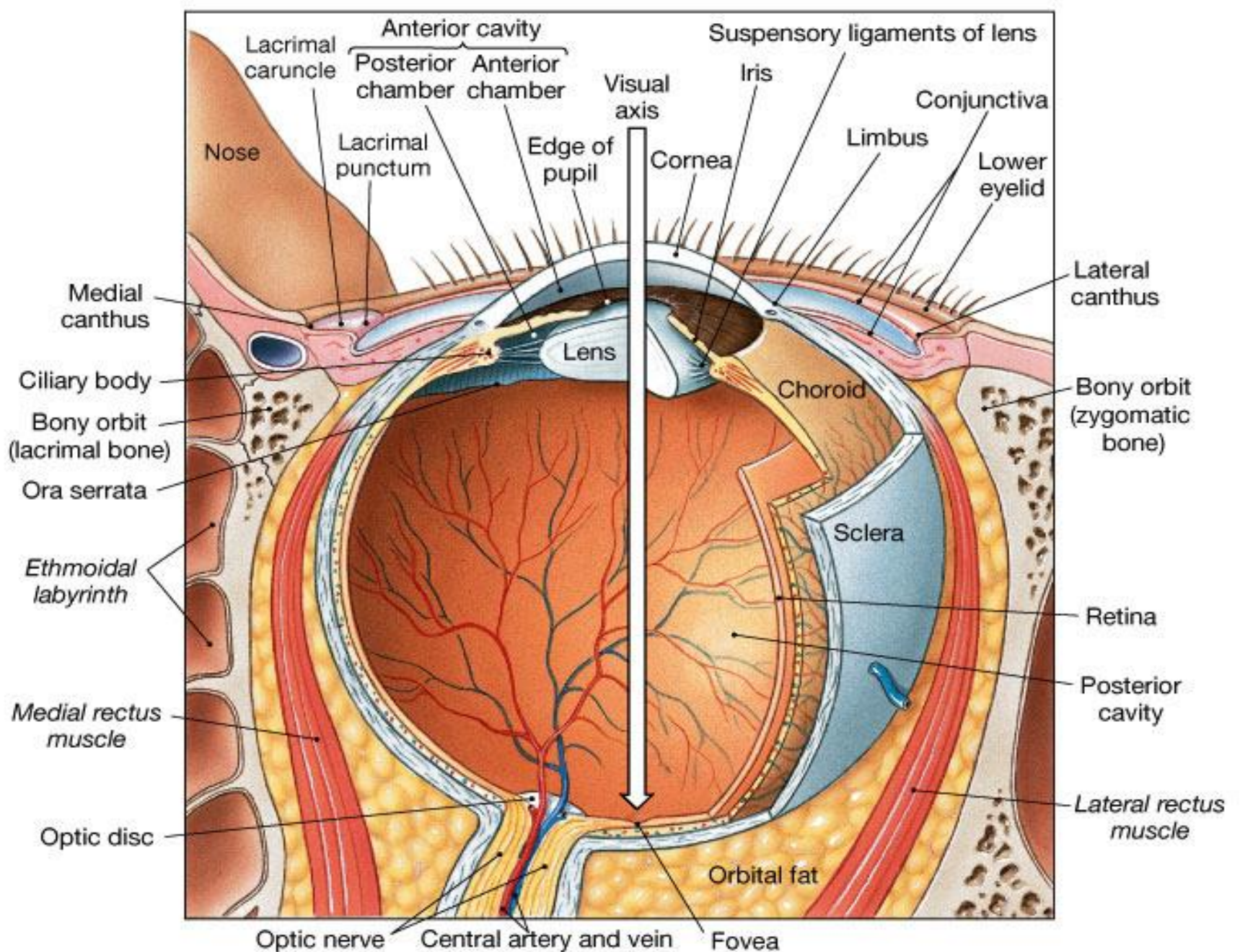
# The Vascular Tunic

- Contains many blood vessels & nerves
- The **iris** controls the size of the **pupil**
- **Suspensory ligaments** attach the lens to the **ciliary body**
  - Controls the shape of the lens



(e) Horizontal section, superior view

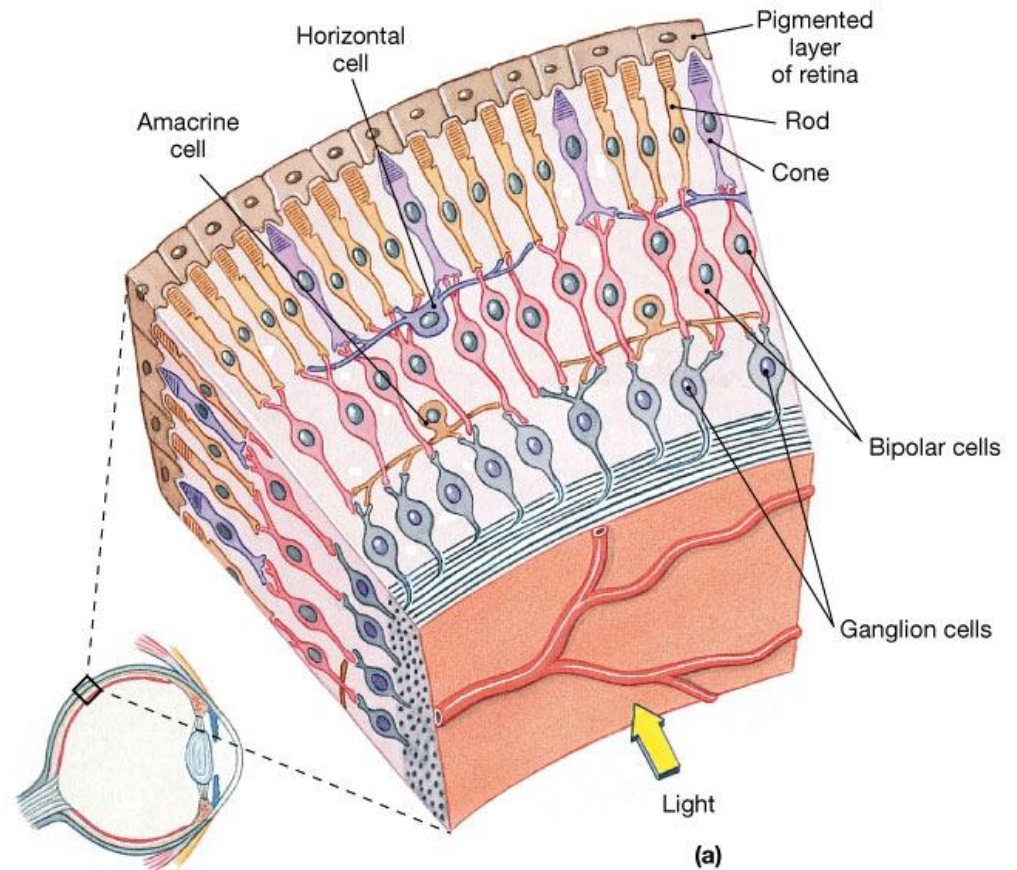




**(e) Horizontal section, superior view**

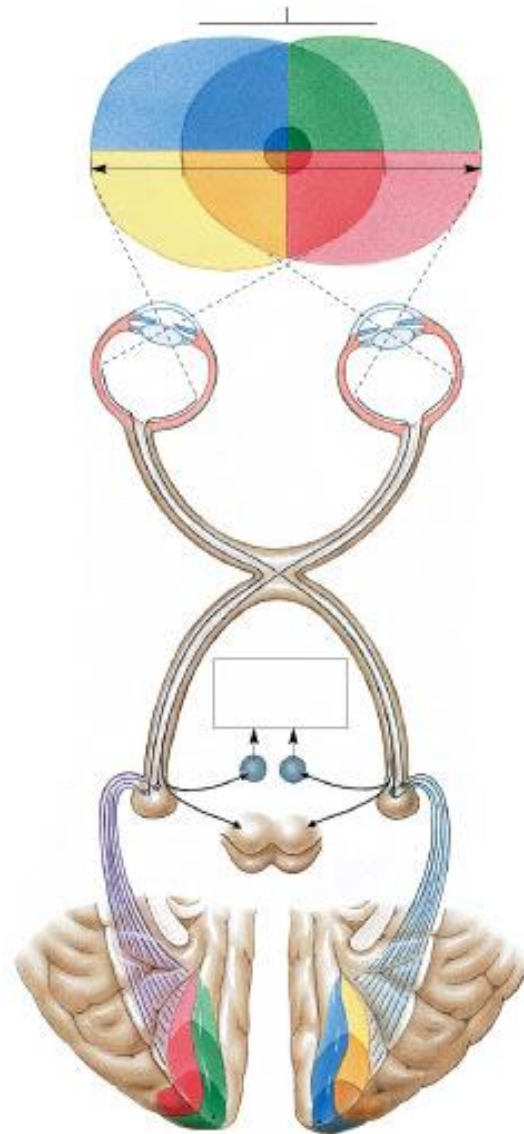
# The Retina

- **Cones** allow for sharp color vision in bright light
  - Contain **pigments**
- **Rods** provide for vision in dim light
  - Contain the pigment **rhodopsin**
  - Most dense at periphery of retina



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# Pathway of Vision Sense



(b)

# Abnormal Vision

- **Myopia-** “near sighted” – close range vision normal, distance blurry
- **Hyperopia-** “far sighted”
- **Presbyopia-** age related “far sighted”
- **Astigmatism-** irregularities in the shape of the lens or cornea
- **Emmetropia-** normal vision



# Summary of Vision

1. Light passes through clear cornea. Iris adjusts pupil size to regulate amount of light.
2. Light rays enters through the pupil
3. Light rays cross in the lens
4. Lens focus the image and sends to the retina
5. Retina receives reversed & upside down image
6. Rods & cones are stimulated
7. Optic nerve carries impulse to the brain-processed on the occipital lobe