

# Contents

- Introduction
- Histology
- Functions of skin
- Embryology
- Cells of skin
- Appendages of skin
- Applied aspects

# Introduction

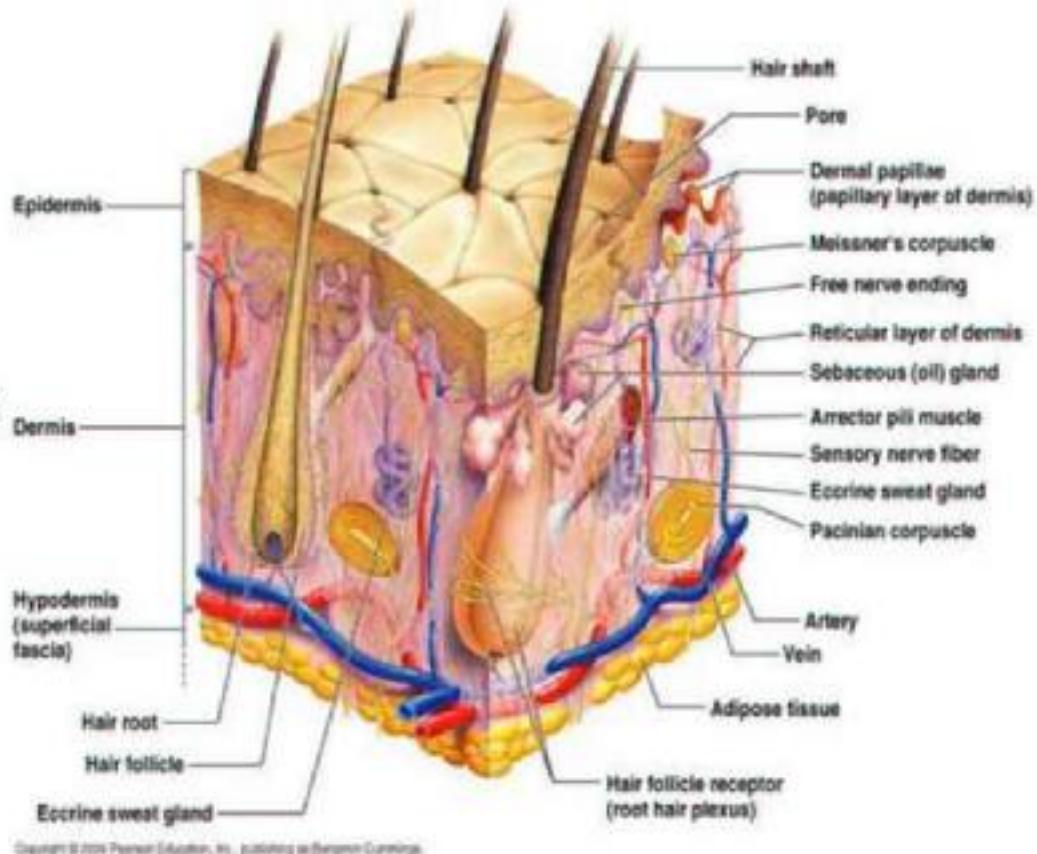
- The human skin (cutis) - outer covering of body & is continuous with mucous membrane in the region of mouth, nose, urogenital organs & anus.
- The mass of skin an adult accounts for approx 5 % while together with subcutaneous fat for about 16 to 18 per cent of the total body mass.

- Largest sensory organ
- Weighs 4 kg
- Surface area 2m<sup>2</sup>
- Thickness – 0.3 – 3 mm
- Rule of nine
- Types ....

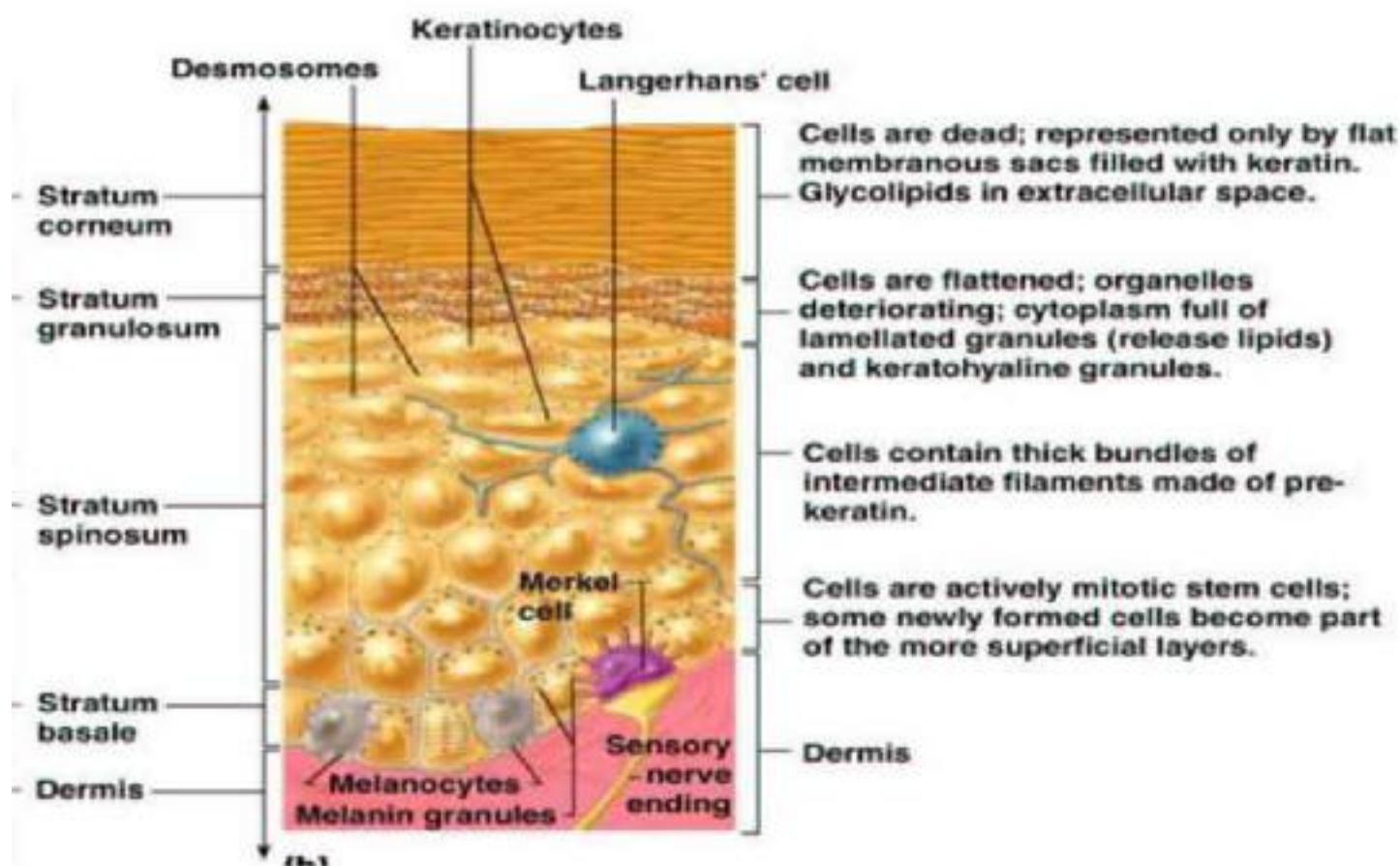
- The skin surface is covered with hairs over a great area.
- The areas devoid of hairs are lips (vermilion border), palms & soles, palmar surface of fingers & plantar surface of toes, glans penis, inner surface of prepuce, & inner surface of anus.

# Histology of Skin

- Epidermis
- Dermis
- Hypodermis



## Epidermis includes the following layers:



## Germinative layer (stratum basale or stratum germinativum)

- It consists of a **single** layer of **columnar** cells arranged like a palisade; between these cells there are slit-like spaces called intercellular bridges.
- Among the cells of germinative layer localize melanocytes, which produce melanin.
- Skin color straightly depends on the amount of melanin.
- This layer presents stem cells concerned to mitosis.

## Prickle cell layer (stratum spinosum)

- Consists of 5 - 10 rows of cells , cuboid in deep parts of layer but become flatter gradually as they approach next layer, the granular layer
- The cells of the prickle-cell layer are marked by presence of specific tonofibrils in their cytoplasm.
- Special Langhan's cells are demonstrated in this layer, which carry immunological function.

## Granular layer (stratum granulosum)

- Contains 1 / 2 / 4 rows of cells elongated parallel to epidermis
- It was considered previously that they were formed of a special substance called keratohyalin
- The presence of the keratohyalin granules is the first visible stage, of the beginning of the process of keratinization of the epidermal cells.
- Serve as water-proof layer.

- The epidermal germinative, prickle-cell, and granular layers are sometimes embraced under the name of **Malpighian layer**.

## Lucid layer (stratum lucidum)

- Composed of elongated cells containing a special protein substance which refracts light strongly
- This substance resembles drops of oil and is called eleidin
- Besides its main component, eleidin, the stratum lucidum contains glycogen and fatty substances (lipoids, oleic acid)

## Horny layer (stratum corneum)

- It is composed of fine, anuclear keratinized elongated cells
- They are firmly attached to one another and are filled with a horny substance (keratin) the chemical structure of which has still not been finally determined
- It is believed that this is an albuminoid substance poor in water and rich in sulphur and contains fats and polysaccharides.
- The outer part of stratum corneum is less compact and occasional lamina separate from the main bulk, i.e. the process of physiological desquamation occurs

## Dermis

- **Papillary layer** - consists of thin bundles of a structural amorphous interstitial substance, collagen fibres & many fine elastic fibres
- **Reticular layer** - consists of collagen bundles are more compact and thick and intertwine into a thick network of loops
- The reticular and particularly the papillary layer of normal skin have a small number of various cell elements: fibroblasts, histiocytes, lymphocytes, mast, plasma cells & peculiar pigment cells
- Hairs, glands (epithelial appendages of the skin), muscles, vessels, nerves and nerve endings are located in the dermis

## Hypoderm

- consists of thick bundles of collagen and elastic fibres stretching from the reticular dermal layer and forming a wide-loop reticulum in which accumulations of large fat cells, lobules of fatty tissue, are lodged
- The thickness of the hypoderm varies from 2mm till 10cm and more, and in some areas there is no hypoderm at all (eyelids, prepuce, small pudendal lips, scrotum)

## Functions of the Skin

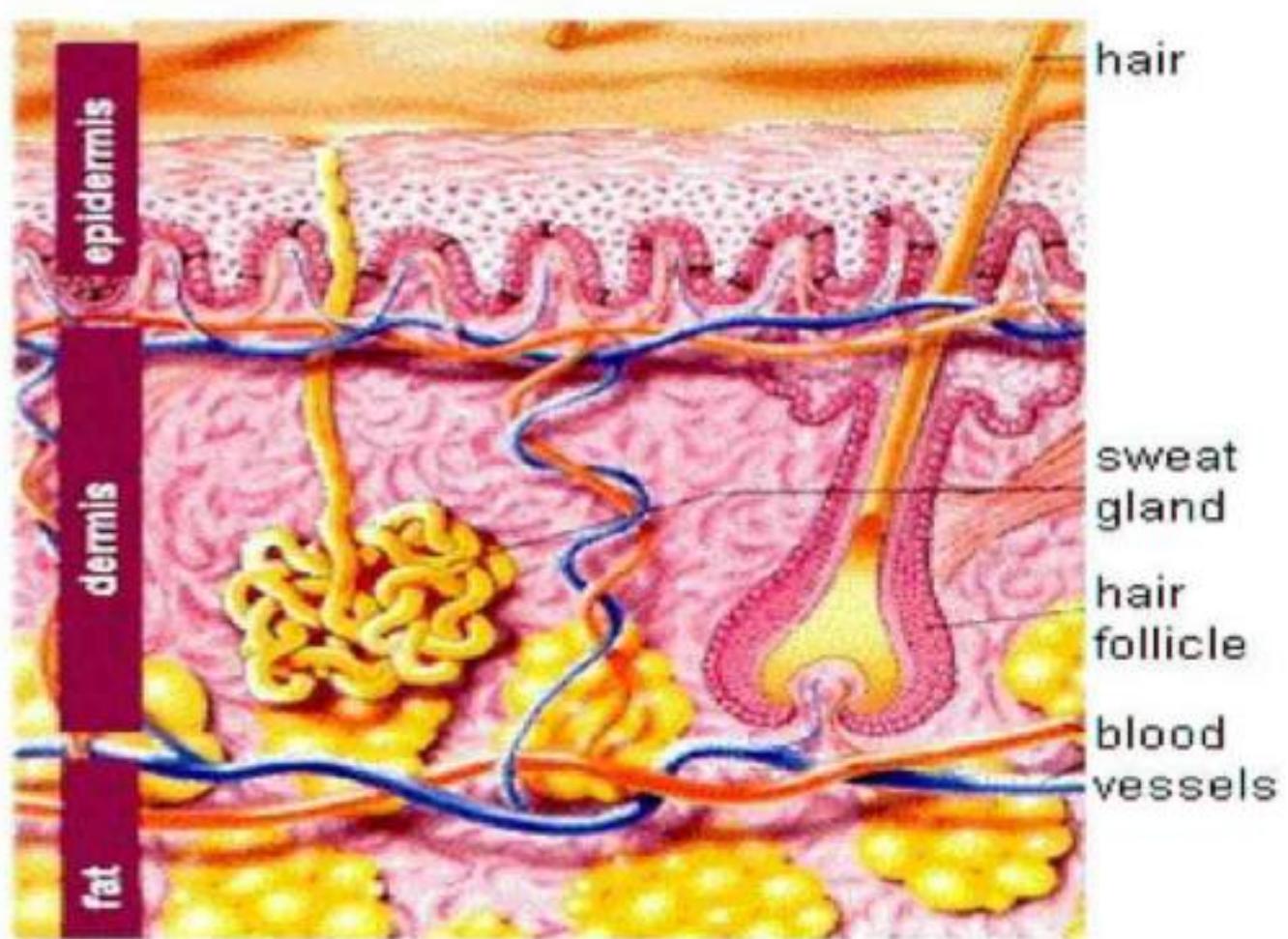
- Immunological function
- Secretory function
- Thermoregulation function
- Receptory function
- Excretory function
- Protective function

## Cells of skin

- Melanocytes
- Keratinocytes
- Langenhan cells
- Merkel's cells

## Appendages of skin

- Hair
- Sebaceous gland
- Sweat glands
- Nail



# Embryology

- The skin develops from two germinative zones:
  - Ectoderm (the outermost embryonal layer) which is represented by the epidermis (the most superficial skin layer) and
  - Mesoderm (the middle embryonal layer) represented by two-layers, namely the true skin, or dermis (the middle layer) & the subcutaneous fat, or hypoderm (the deepest skin layer).

## Applied aspects

- Acne
- Albinism
- Vitiligo
- Skin disorders
- Skin cancer



# TONGUE

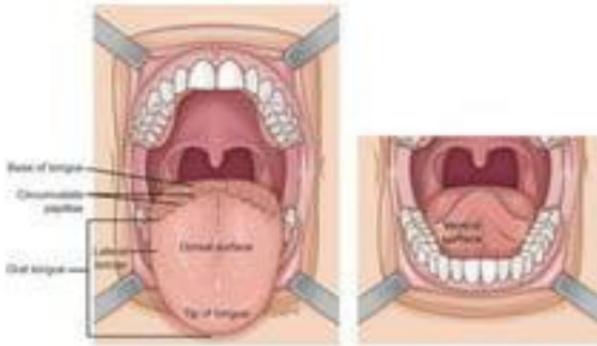
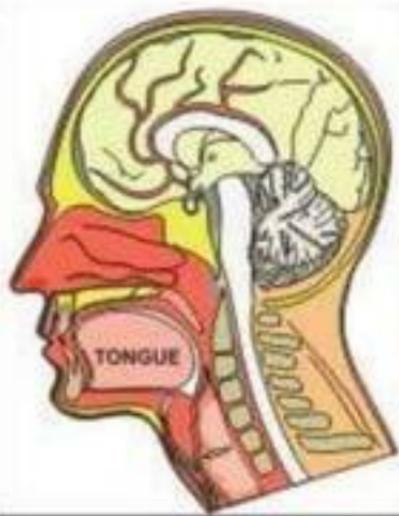
Dr AMITHA G, BDS, MDS  
ORAL AND MAXILLOFACIAL PATHOLOGY

## INTRODUCTION

- Tongue is a muscular organ
- Situated in the floor of the mouth

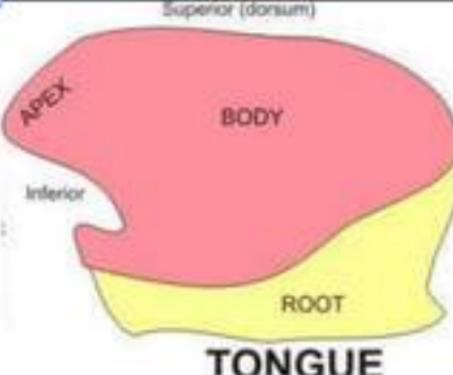
## FUNCTION

- Taste
- Speech
- Mastication
- Deglutition



### EXTERNAL FEATURES

- Tongue has
  - A Root
  - A tip
  - A body



### ROOT

- Is attached to the mandible and soft palate above and hyoid bone below.
- These attachments prevent the swallowing of the tongue.
- In between the 2 bones → it is related to the geniohyoid and mylohyoid muscles.

### TIP

- Of the tongue forms the anterior free end which lies behind the upper incisor teeth.

### BODY

- Has
  - A curved upper surface or dorsum
  - An inferior or ventral surface

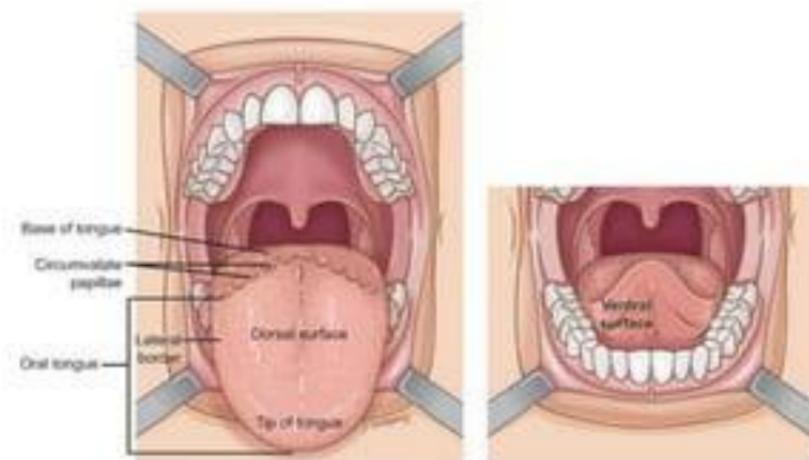
## DORSUM

- Is convex in all directions
- Is divided into
  - **Oral part (ant 2/3<sup>rd</sup>)**
  - **Pharyngeal part (post 1/3<sup>rd</sup>)**
  - **Posterior most part of the tongue**
  - **Sulcus terminalis** → V shaped sulcus → that separates the oral and pharyngeal parts.
  - **Foramen caecum** → the 2 limbs of the V meet at the median pit. They run laterally and forwards up to the palatoglossal arches
  - The foramen caecum → represents the site from which the thyroid diverticulum grows down in the embryo.



## Inferior or ventral surface

- Is confined to the oral part only
- Inferior surface is covered with a smooth mucous membrane, which shows a median fold called **frenulum linguae**.
- On either side of the frenulum there is a prominence produced by the **deep lingual veins**.
- More laterally there is a fold called the **plica fimbriata** that is directed forwards and medially towards the tip of the tongue .



## ORAL AND PHARYNGEAL PARTS OF THE TONGUE DIFFER IN THEIR DEVELOPMENT, TOPOGRAPHY, STRUCTURE AND FUNCTION.

### ORAL PART

- Or **papillary part** of the tongue
- Lies in the mouth (floor of the mouth)
- Lies in front of the **palatoglossal arches** and the **sulcus terminalis**.
- Its margins are free and in contact with the gums and teeth.
- Just in front of the palatoglossal arch each margins shows 4 – 5 vertical folds, named **foliate papillae**.
- Superior surface of the oral part shows a median furrow and is covered with papillae which make it rough.

## PHARYNGEAL PART

- Also called **lymphoid part** of the tongue
- Lies in the pharynx
- Lies behind the **palatoglossal arches** and the **sulcus terminalis**.
- Its posterior surface (called base of the tongue) forms the anterior wall of the oropharynx.
- The mucous membrane has **no papillae**, but has many **lymphoid follicles** that collectively constitute the **lingual tonsil**.
- **Mucous glands** are also present.

## **POSTERIOR MOST PART OF THE TONGUE**

- Is connected to the epiglottis by 3 folds of mucous membrane.
- These are the **median glossoepiglottic fold** and the **right** and **left** lateral glossoepiglottic folds.
- On either side of the median fold there is a depression called **vallecula**.
- The lateral folds separate the vallecula from the piriform fossa.

## MUSCLES OF THE TONGUE

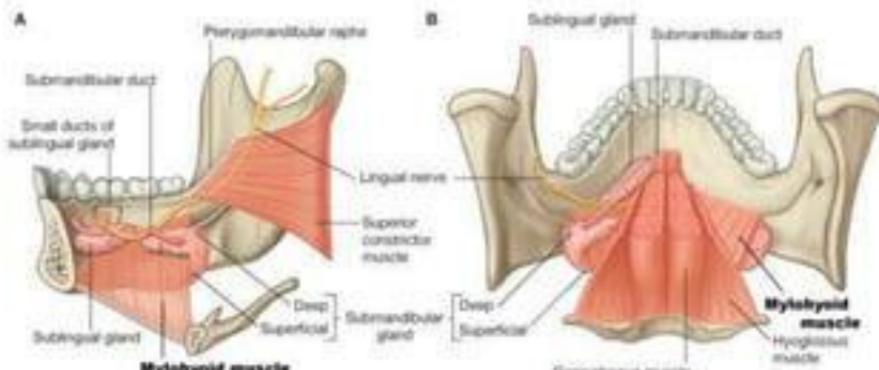
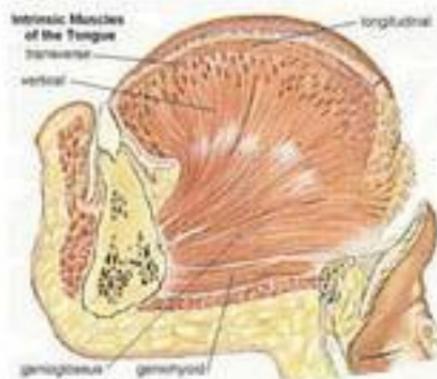
- *Middle fibrous septum* divides the tongue into right and left halves.

### Intrinsic muscles

- Superior longitudinal
- Inferior longitudinal
- Transverse
- Vertical

### Extrinsic muscles

- Genioglossus
- Hyoglossus
- Styloglossus
- Palatoglossus



## INTRINSIC MUSCLES

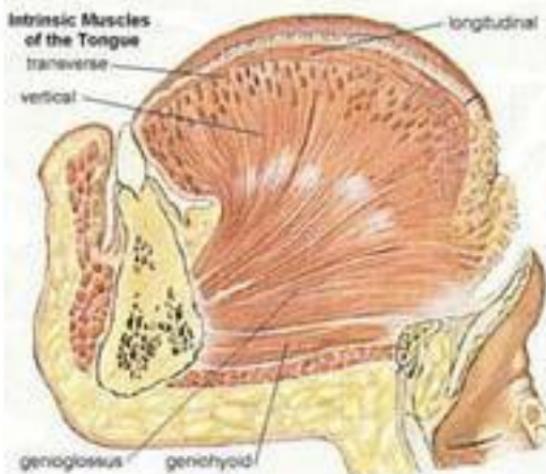
- Occupy the upper part of the tongue
- Are attached to the submucous fibrous layer and to the median fibrous septum.
- They alter the shape of the tongue

### Superior longitudinal muscle

- Lies beneath the mucous membrane.
- It shortens the tongue and makes its dorsum concave

### Inferior longitudinal muscle

- Is a narrow band lying close to the inferior surface of the tongue between the styloglossus and the hyoglossus
- It shortens the tongue and makes the dorsum convex.

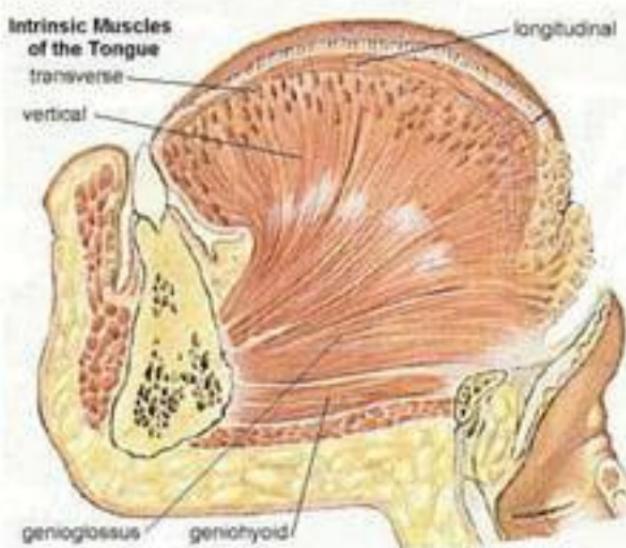


### Transverse muscle

- Extends from the median septum to the margins.
- It makes the tongue **narrow** and **elongated**.

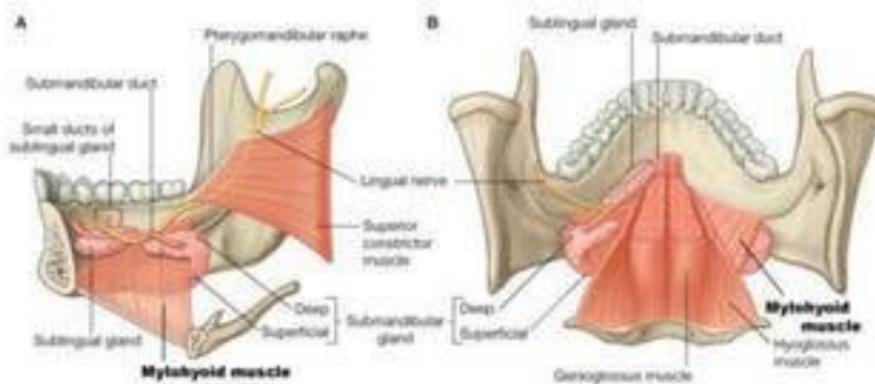
### Vertical muscle

- Is found at the borders of the anterior part of the tongue.
- It makes the tongue **broad** and **flattened**.



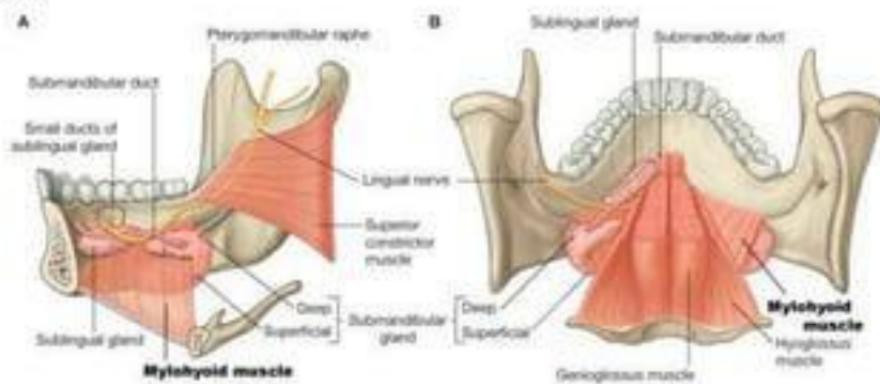
## EXTRINSIC MUSCLES

- Connect the tongue to the
  - Mandible via genioglossus
  - Hyoid bone through hyoglossus
  - Styloid process via styloglossus
  - Palate via palatoglossus



## GENOGLOSSUS

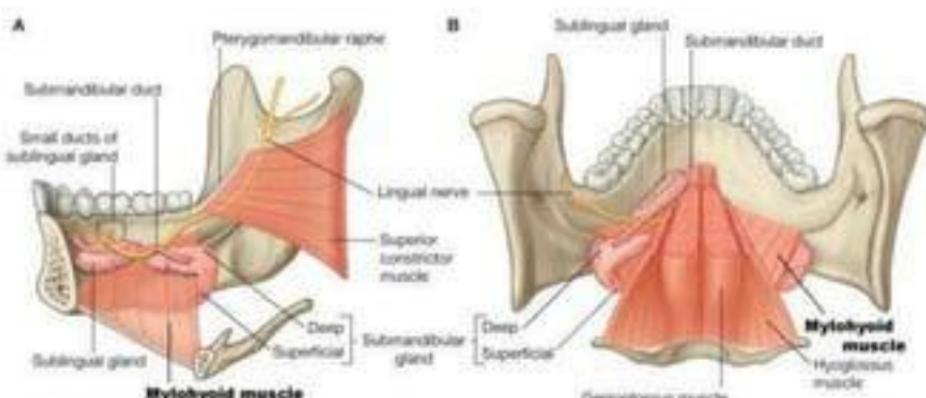
- Fan shaped muscle.
- Which forms the main bulk of the tongue
- It arises from the upper genial tubercle of the mandible
- From here the fibers fan out and run backwards
- Upper fibers are inserted into the tip
- Middle fibers are inserted into dorsum
- Lower fibers into hyoid bone.
- **Upper fibers →** retract the tip
- **Middle fibers →** depress the tongue
- **Lower fibers →** pull the posterior part of the tongue forwards and thus protrude the tongue from the mouth.



© Elsevier Ltd; Drake et al: Gray's Anatomy for Students [www.studentconsult.com](http://www.studentconsult.com)

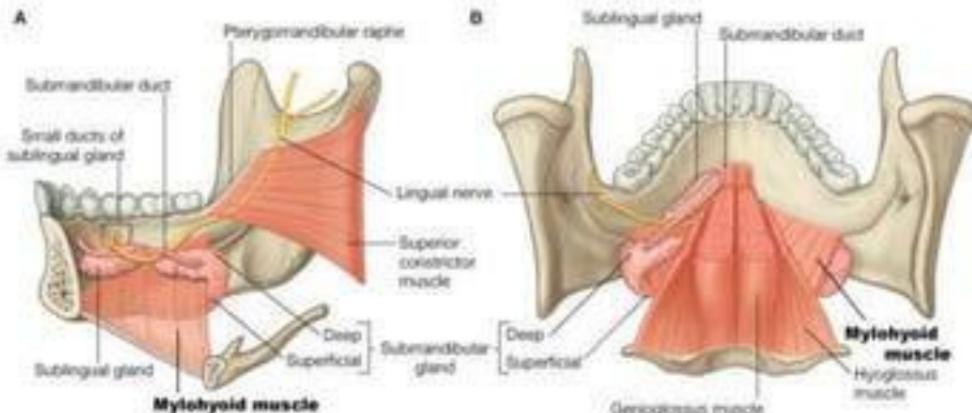
## HYGLOSSUS

- Is an important landmark in the submandibular region
- **Origin** → whole length of greater cornua and lateral part of body of hyoid bone.
- **Fibers** → run upwards and forwards
- **Insertion** → side of tongue between styloglossus and inferior longitudinal muscle of tongue
- **Nerve supply** → hypoglossal nerve
- **Action** → depresses tongue, makes dorsum convex and retracts the protruded tongue.



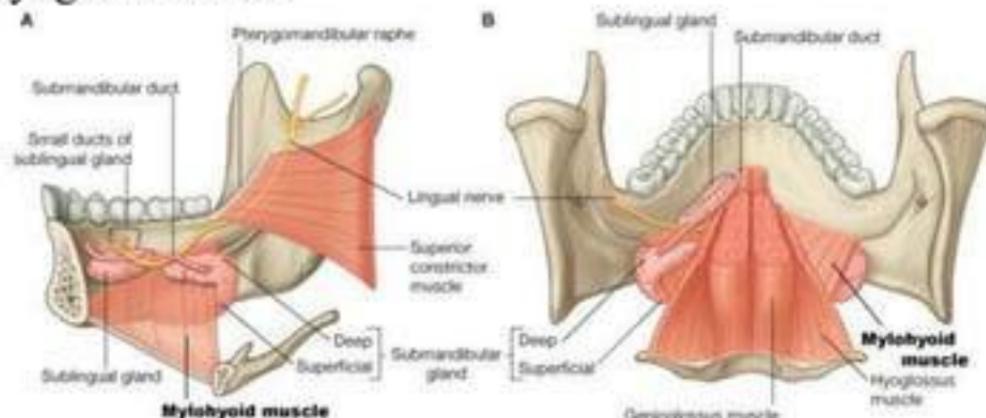
## STYLOGLOSSUS

- **Origin** → tip and adjacent part of the anterior surface of the styloid process as well as from the upper end of the stylohyoid ligament.
- **Fibers** → pass downwards and forwards
- **Insertion** → into the side of the tongue, intermingling with the fibers of the hyoglossus
- **Nerve supply** → hypoglossal nerve
- **Action** → during swallowing it pulls the tongue upwards and backwards.



## PALATOGLOSSUS

- Origin → oral surface of palatine aponeurosis
- Fibers → descends in the palatoglossal arch
- Insertion → Side of the tongue (at the junction of oral and pharyngeal parts)
- Nerve supply → cervical part of accessory nerve
- Action → pulls up the root of the tongue, approximates the palatoglossal arches and thus closes the oropharyngeal isthmus.



## ARTERIAL SUPPLY

- Chiefly derived from lingual artery
- A branch of external carotid artery
- Root of the tongue is also supplied by the tonsillar and ascending pharyngeal arteries.

## VENOUS DRAINAGE

- Veins of the tongue are called vena comitantes.
- The arrangement of vena comitantes is variable.
- 2 vena comitantes accompany the lingual artery and 1 vena comitantes accompanies the hypoglossal nerve.
- The deep lingual vein is the largest and the principal vein of the tongue.
- It is visible on the inferior surface of the tongue.
- It runs backwards and crosses the genioglossus and the hyoglossus below the hypoglossal nerve.
- These veins unite at the posterior borders of the yoglossus to form lingual vein which ends either in the common facial vein or in the internal jugular vein.

## Lymphatic Drainage

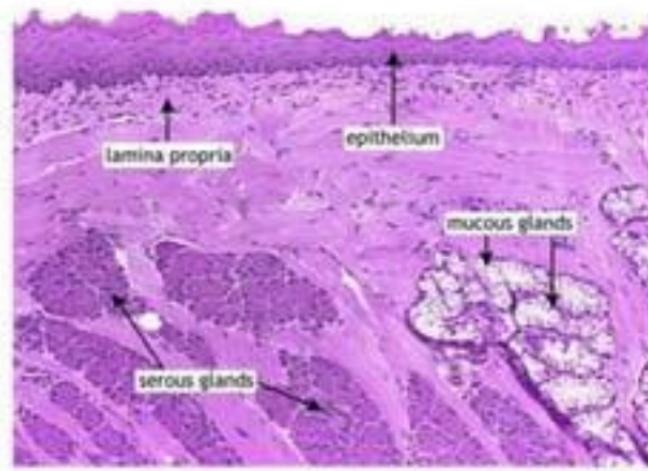
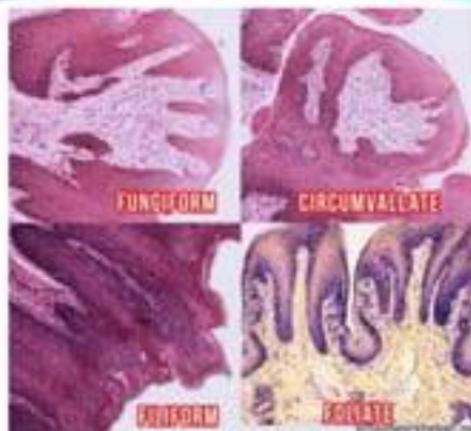
- Tip of the tongue drains bilaterally to the **submental nodes**
- Right and left halves of the remaining part of the anterior 2/3<sup>rd</sup> of the tongue drains unilaterally to the **submandibular nodes**.
- Few central lymphatics drain bilaterally to the same nodes.
- Posterior 1/3<sup>rd</sup> of the tongue drains bilaterally to the **jugulo-omohyoid nodes**, these are known as the lymph nodes of the tongue.

## NERVE SUPPLY OF THE TONGUE

Nerve supply	Anterior 2/3 <sup>rd</sup>	Posterior 1/3 <sup>rd</sup>	Posterior most part or vallecula
Sensory	Lingual	Glossopharyngeal	Internal laryngeal branch of vagus
Taste	Chorda tympani except vallate papillae	Glossopharyngeal including the vallate papillae	Internal laryngeal branch of vagus
Development of the epithelium	Lingual swellings of 1 <sup>st</sup> arch Tuberculum impar which soon disappears	Third arch which forms large ventral part of hypobranchial eminence	Fourth arch which forms small doral part of hypobranchial eminence

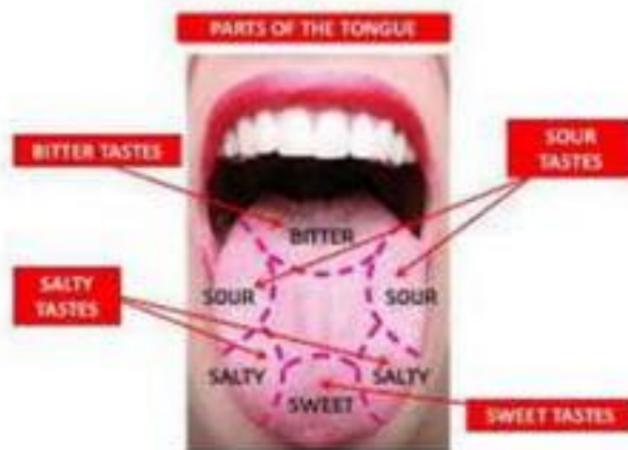
## HISTOLOGY

- Bulk of the muscle is made up of striated muscles
  - Mucous membrane consists of a layer of CT (corium), lined by stratified squamous epithelium.
- **Oral part of dorsum** → is thin, forms papillae and is adherent to the muscles.
- **Pharyngeal part of the dorsum** → is very rich in lymphoid follicles.
- **Inferior surface** → is thin and smooth. Numerous glands, both mucous and serous lie deep to the mucous membrane.



## TASTE BUDS

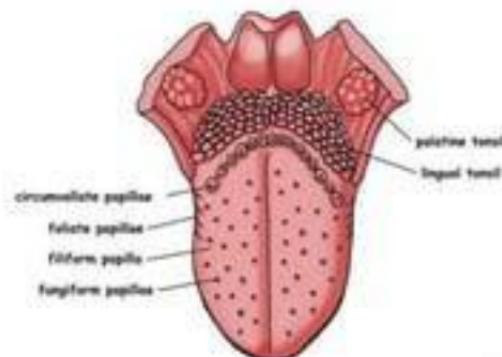
- Are most numerous on the sides of the vallate papillae and on the walls of the surrounding sulci.
- They are numerous over foliate papillae and posterior one third of the tongue
- Sparsely distributed on the fungiform papillae, soft palate, epiglottis and pharynx.
- No taste buds on the mid dorsal region of the oral part of the tongue.



## PAPILLAE OF TONGUE

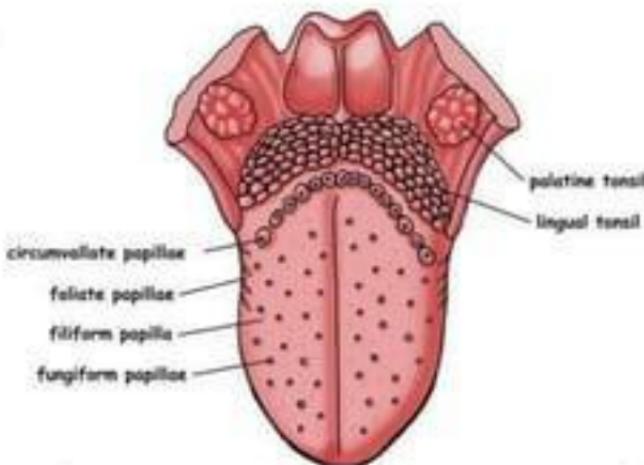
- Papillae are projections of the mucous membrane of corium → which give the anterior 2/3<sup>rd</sup> s of the tongue its characteristic roughness.
- They are of the following types
  - I. **Vallate or circumvallate papillae**

- These are large in size 1-2mm in diameter and are 8-12 in number.
- They are situated immediately in front of the sulcus terminalis.
- Each papillae are cylindrical projection surrounded by a circular sulcus.
- The walls of the papilla are raised above the surface.



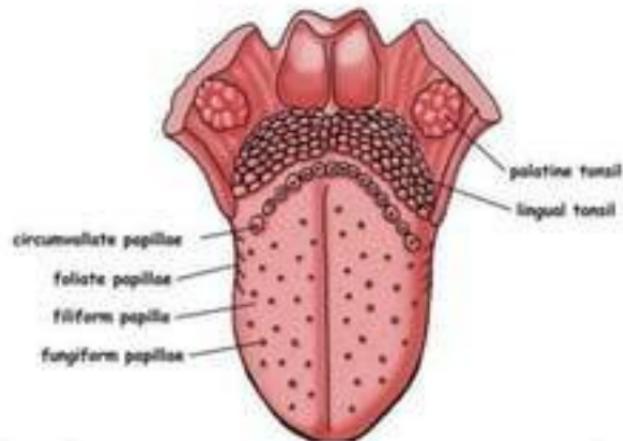
## 2. Fungiform papillae

- Are numerous
- Near the tip and margins of the tongue, but some of them are scattered over the dorsum.
- These are smaller than the vallate papillae but larger than the filiform papillae.
- Each papilla consists of a narrow pedicle and a large rounded head.
- They are distinguished by their bright red colour.



### 3. Filiform papillae

- Conical papilla
- Cover the presulcal area of the dorsum of the tongue and gives it a characteristic velvety appearance.
- They are the smallest and most numerous of the lingual papillae.
- Each are pointed and covered with keratin
- The apex is often split into filamentous processes.



## DEVELOPMENT OF TONGUE

### I. EPITHELIUM

#### *Anterior 2/3rd*

- From 2 lingual swellings and one tuberculum impar → which arise from the first branchial arch
- Tuberculum impar → soon disappears
- Therefore supplied by lingual nerve (post. trematic) and chorda tympani (pre-trematic)

#### *Posterior 1/3rd*

- From cranial large part of the hypobranchial eminence, i.e. from the third arch.
- Therefore supplied by the glossopharyngeal nerve.

#### *Posterior most part*

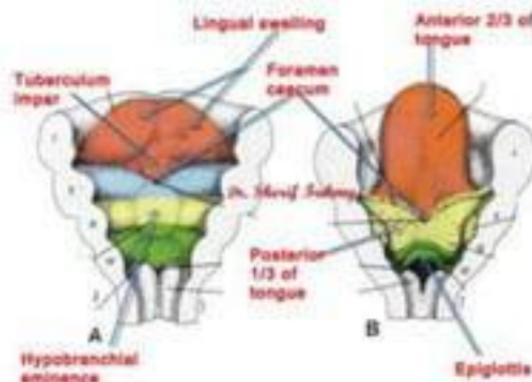
- From 4<sup>th</sup> arch
- Therefore, supplied by vagus nerve

### I. MUSCLES

Muscles develop from the occipital myotomes which are supplied by the hypoglossal nerve

### I. CONNECTIVE TISSUE

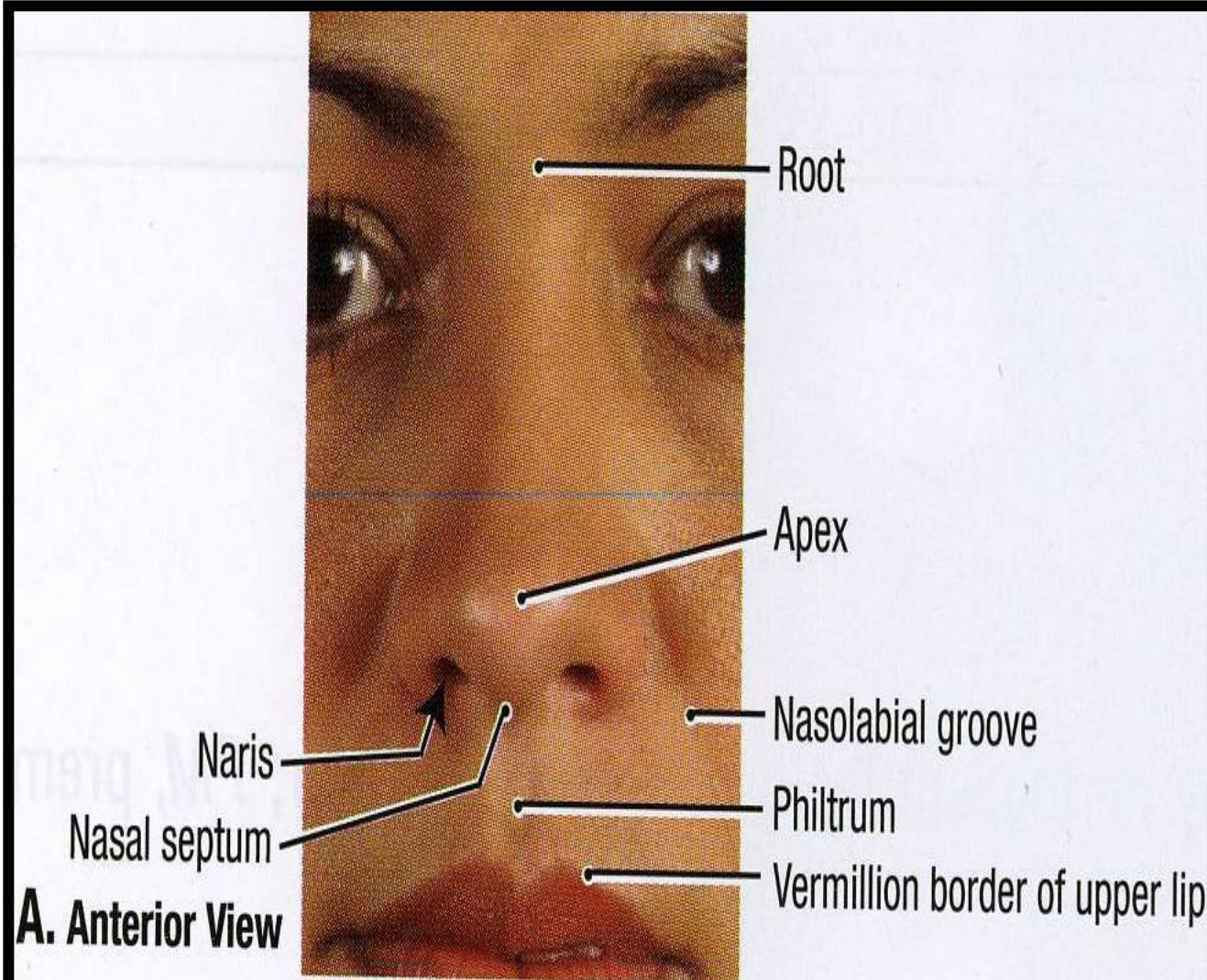
CT develops from the local mesenchyme.





THANK YOU

# ANATOMY OF THE NOSE AND OLFAC TORY NERVE

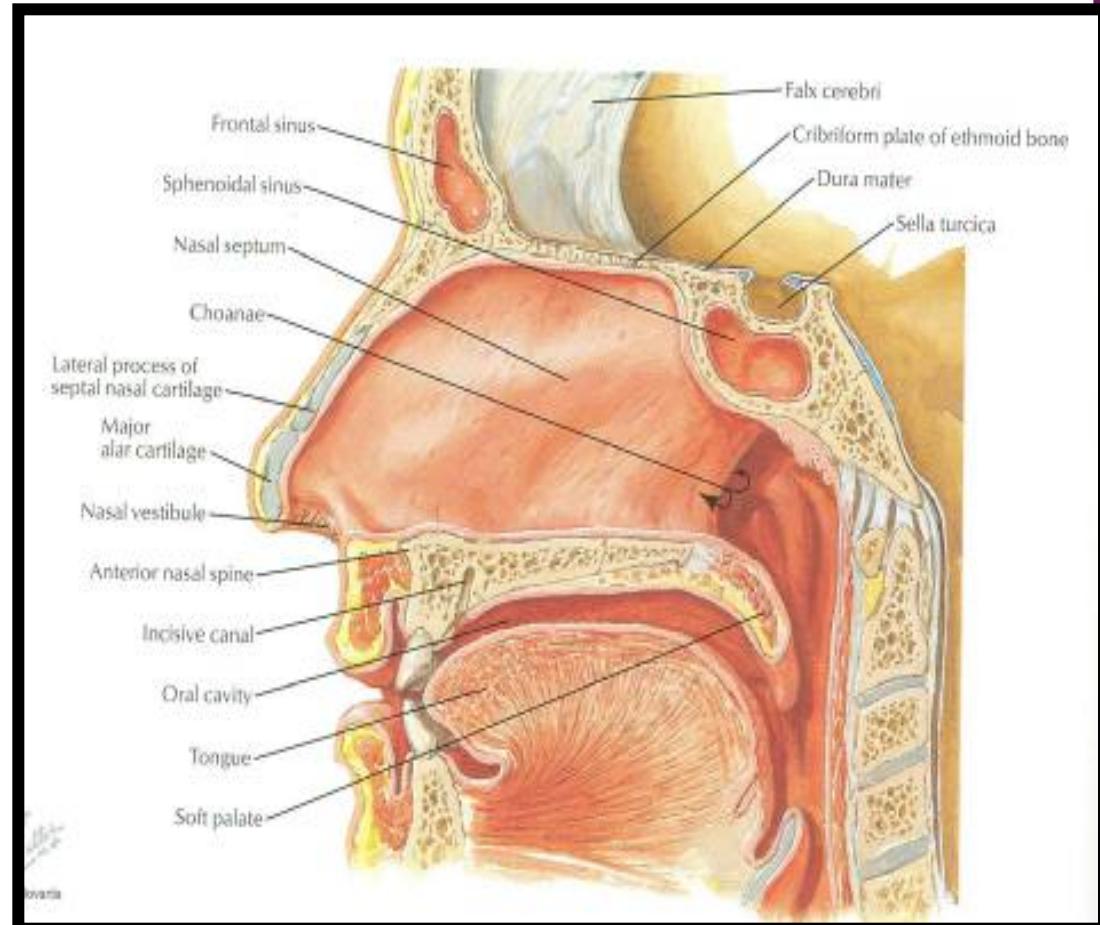


# OBJECTIVES

- By the end of this lecture the students should be able to:
- Describe the structures forming the walls of the nasal cavity.
- List the main structures draining into the lateral wall of the nasal cavity.
- Differentiate between the respiratory and olfactory regions of the nasal cavity.
- List the main sensory and blood supply of the nose.
- Describe the olfactory pathway.

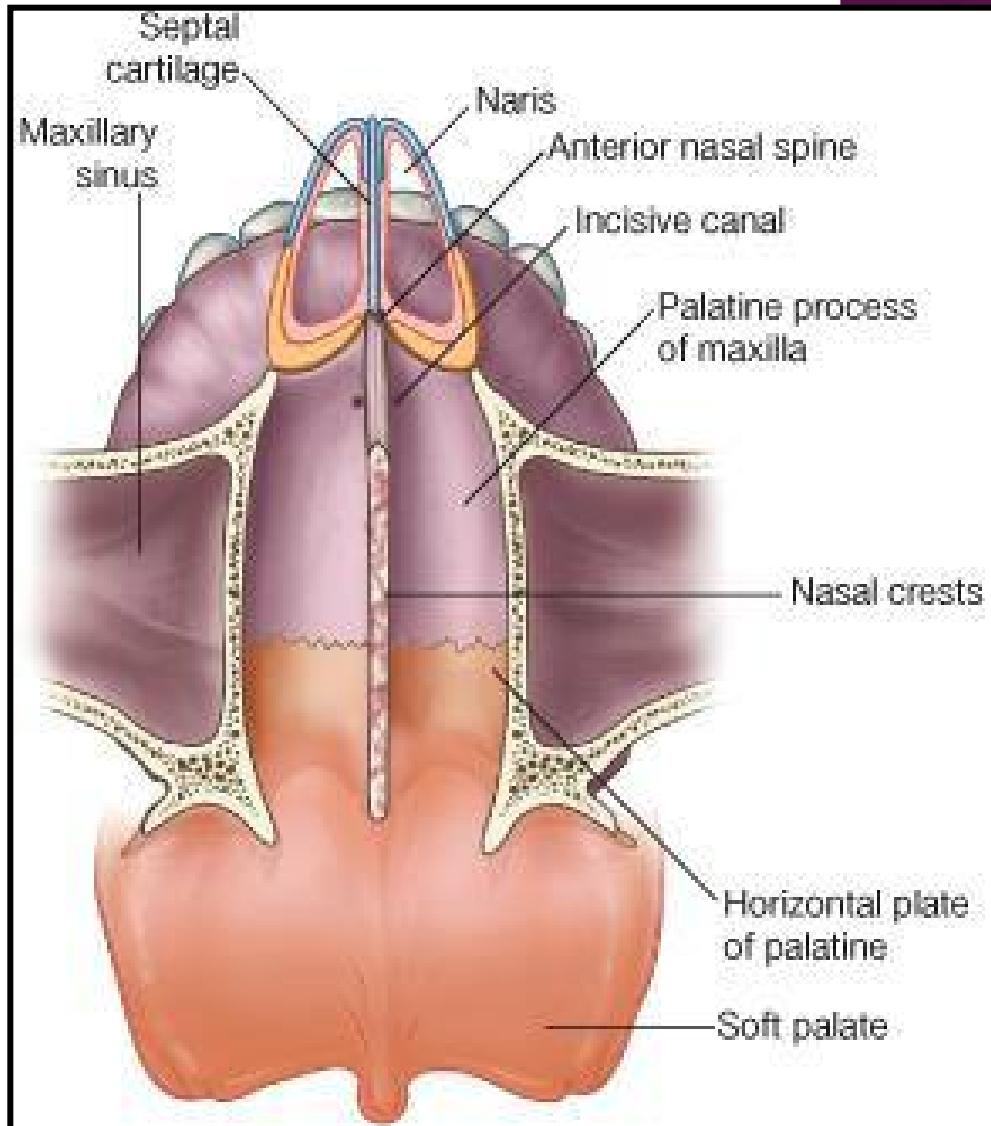
# NASAL CAVITY

- It extends from nostrils anteriorly to the choanae posteriorly.
- Divided into right and left parts by the nasal septum.
- Each part has:
  - Roof**
  - Floor**
  - Lateral and**
  - Medial walls.**



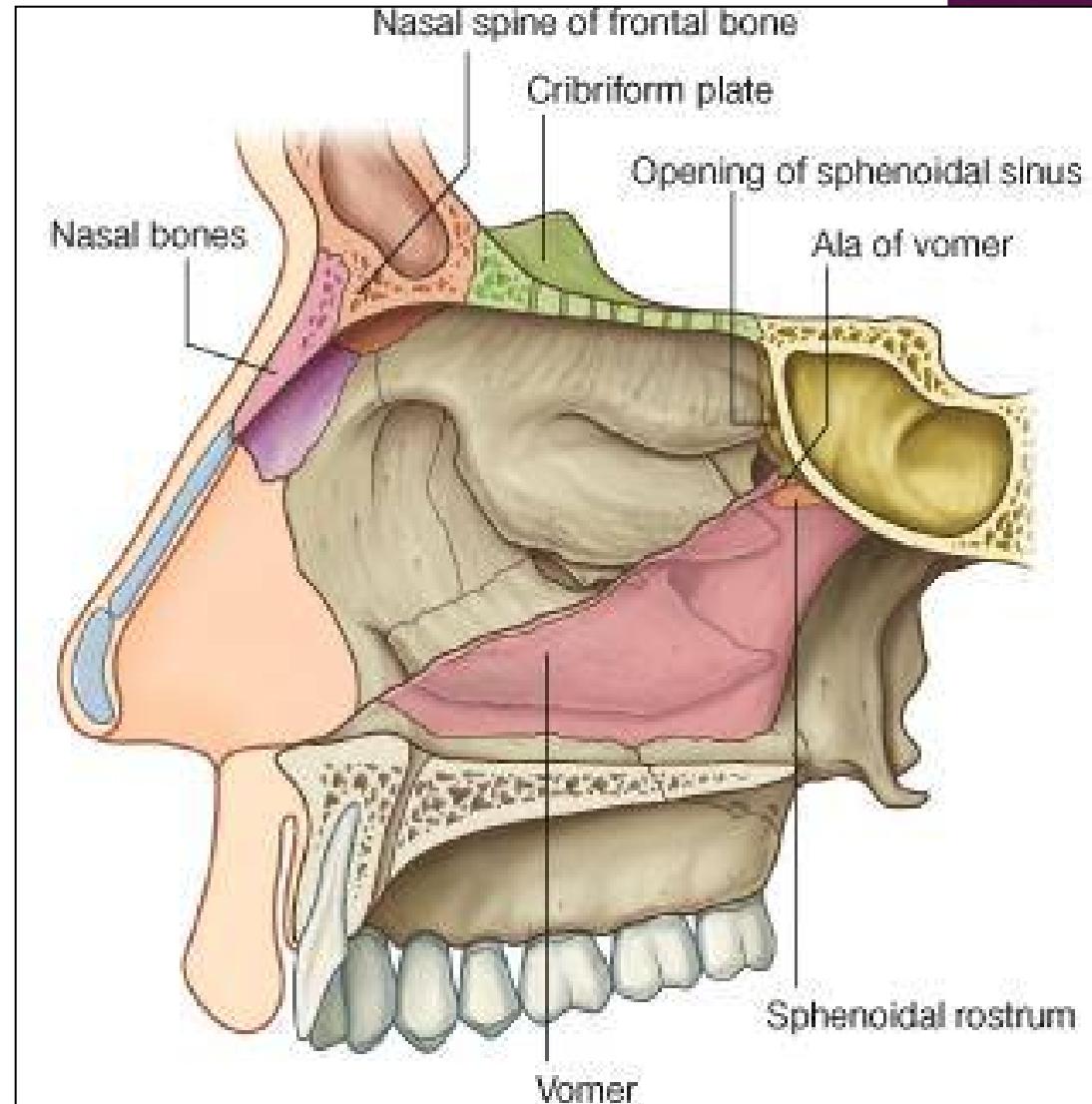
# FLOOR

- Formed by:
- Nasal (upper)surface of the hard (bony) palate:
- Palatine process of maxilla, **anteriorly.**
- Horizontal plate of the palatine bone, **posteriorly.**



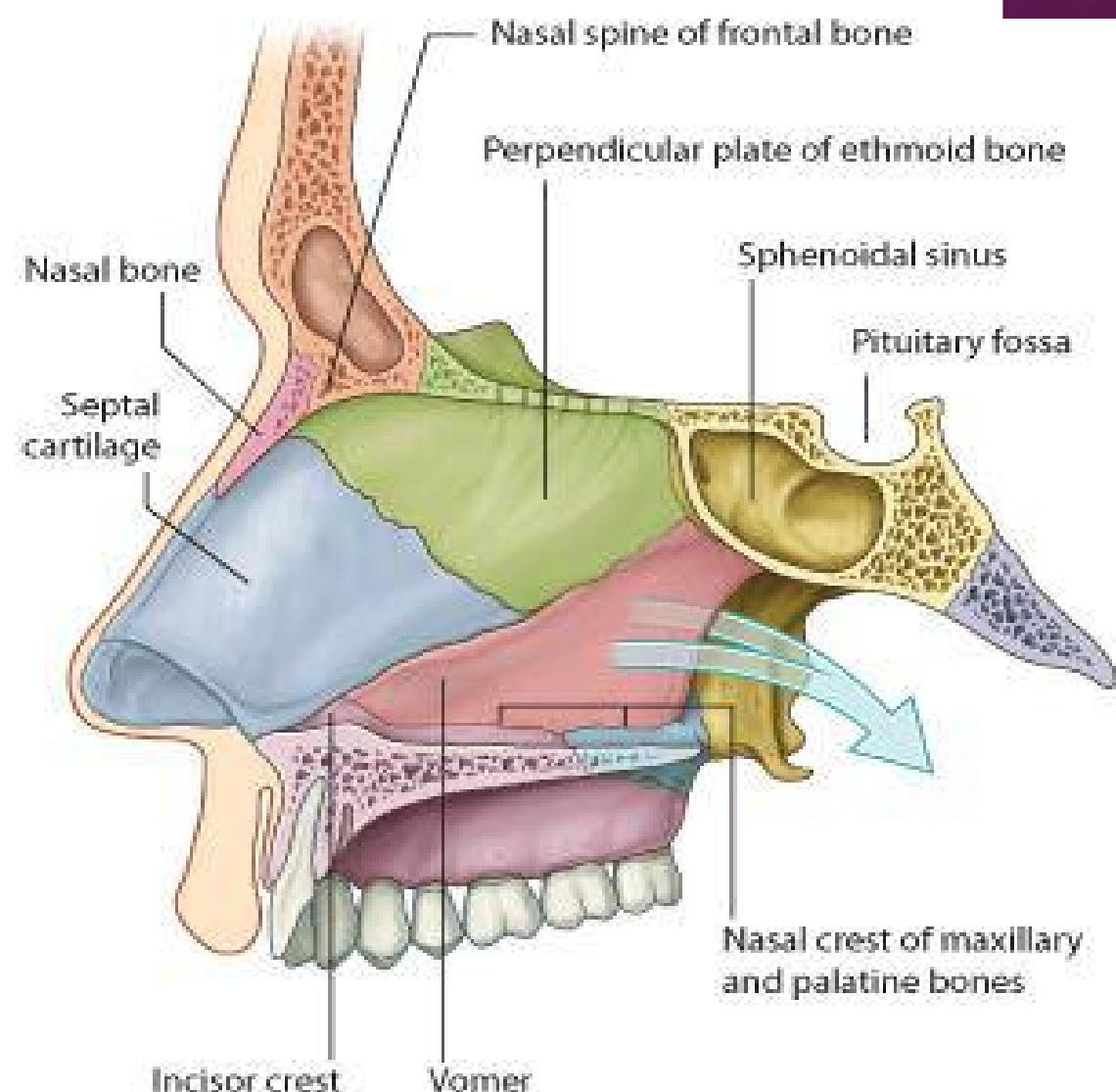
# ROOF

- Formed by:
- Body of sphenoid, **posteriorly.**
- Cibriform plate of ethmoid, in the **middle.**
- Frontal, and nasal bones, **Anteriorly.**



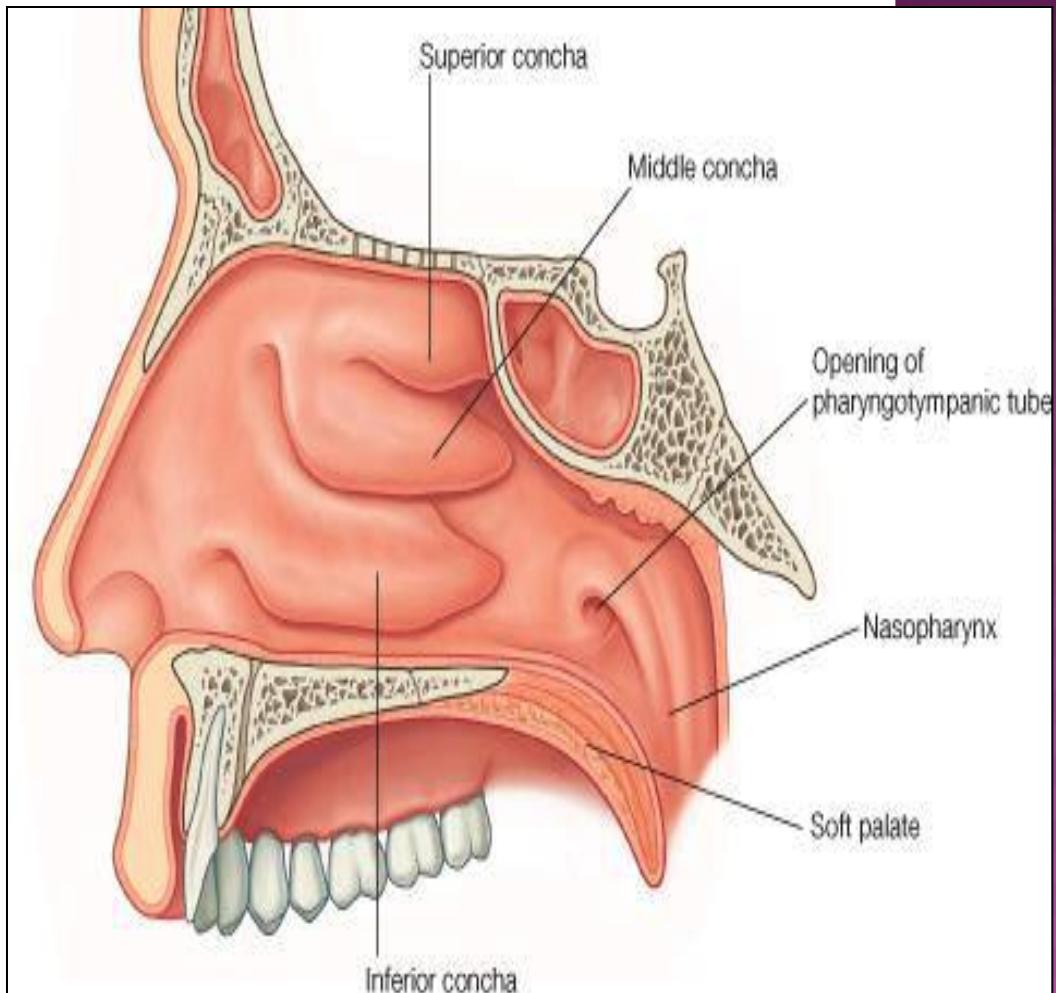
# MEDIAL WALL

- The nasal septum :
- Vertical plate of ethmoid.
- Septal cartilage.
- Vomer.

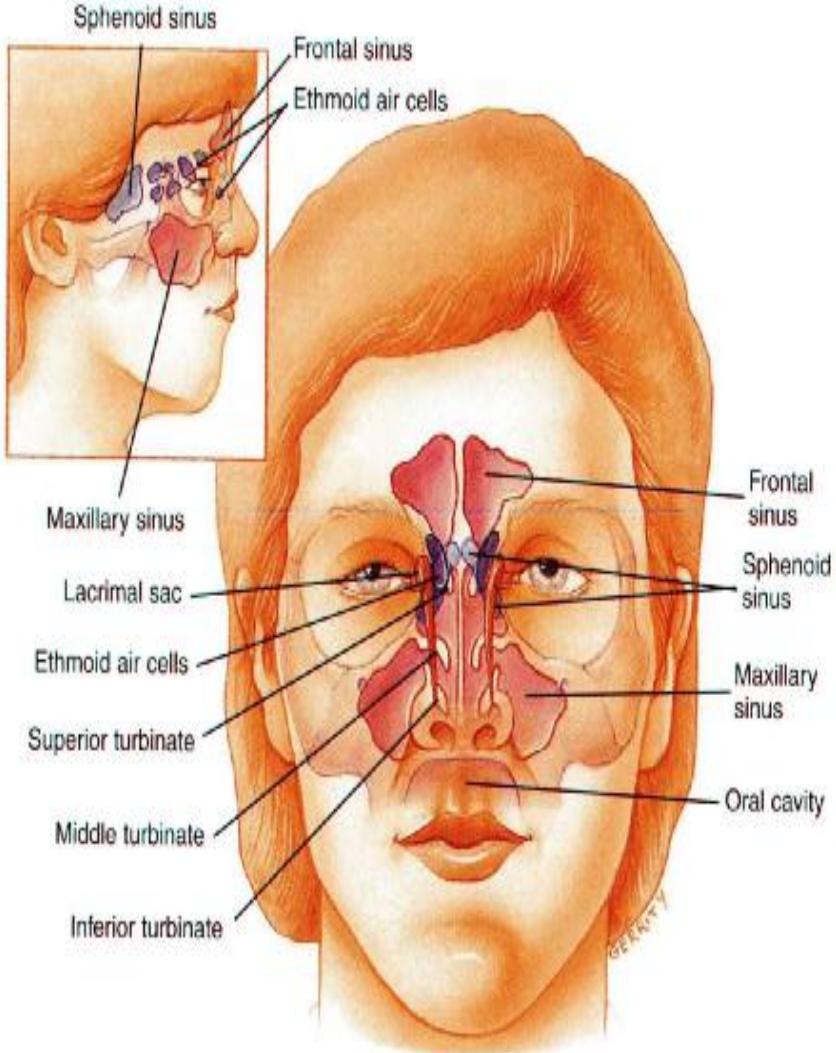


- Marked by:
- Three projections (Nasal Conchae):
- **Superior, middle, and inferior**
- The space below each concha is called **Meatus.**
- **Superior, middle, and inferior meatus.**
- The space (fossa) above the superior concha is the **Sphenoethmoidal recess.**

## LATERAL WALL



# PARANASAL SINUSES



❖ They are **cavities** inside the:

- ❖ Maxilla
- ❖ Frontal bone
- ❖ Sphenoid bone
- ❖ Ethmoid bone

❖ They are:

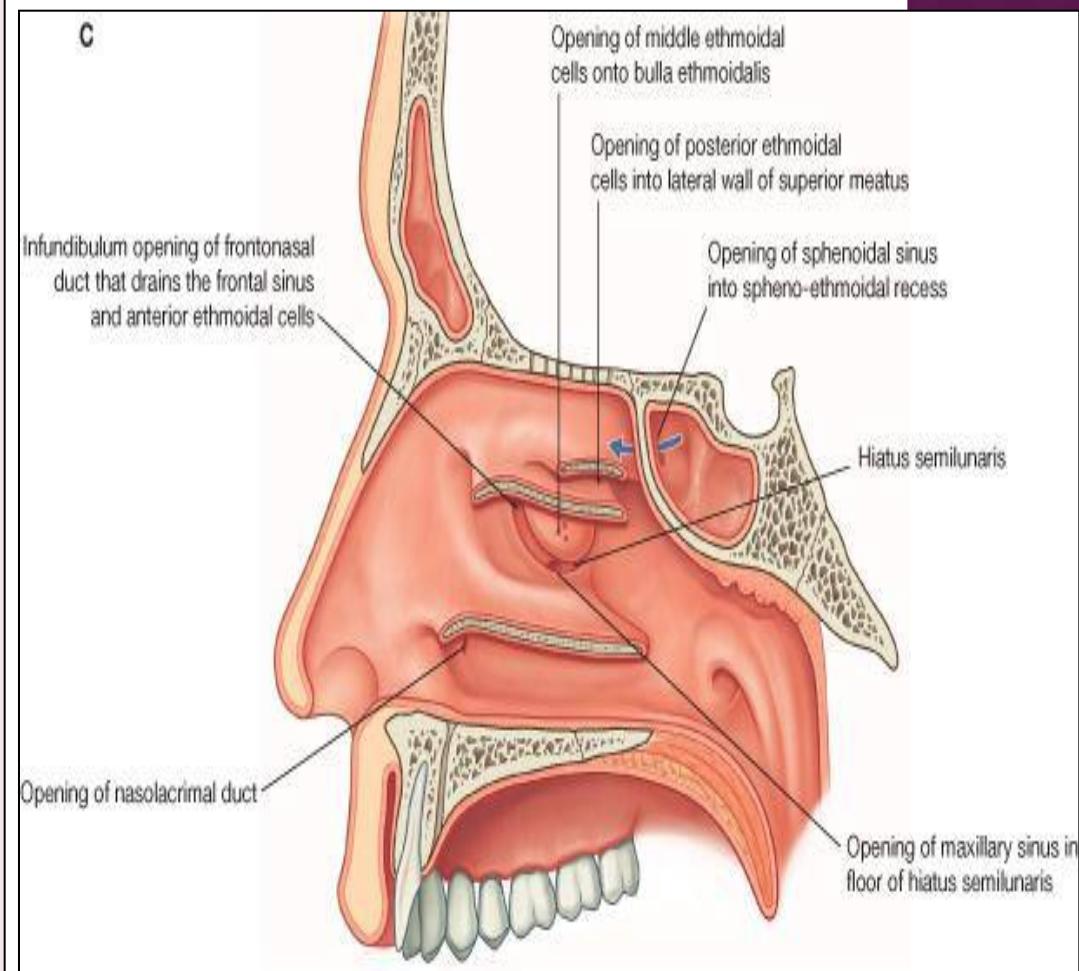
- ❖ Lined with mucoperiosteum;
- ❖ Filled with air; &
- ❖ Communicate with the nasal cavity.
- ❖ Open in the lateral wall of the nasal cavity

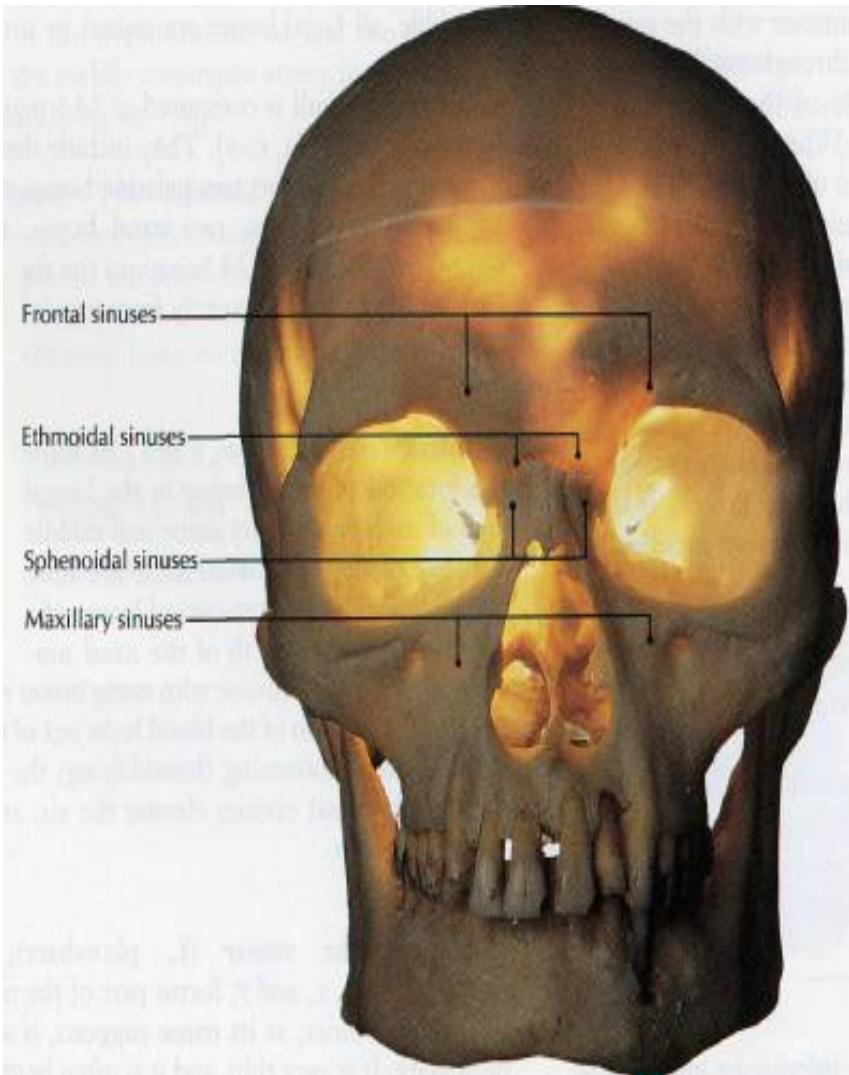
❖ **Function:**

- Lighten the skull weight
- Amplify the sound as we speak.

# SINUSES OPENING IN LATERAL WALL

- **Sphenoethmoidal recess** receives the opening of **sphenoidal air sinus**
- **Superior meatus;** receives the opening of **posterior ethmoidal sinus.**
- **Middle meatus;** contains **bulla ethmoidalis** and **hiatus semilunaris**,
- Receives the openings of **maxillary, frontal, & anterior , middle ethmoidal sinuses.**
- **Inferior meatus;** receives the opening of **nasolacrimal duct.**



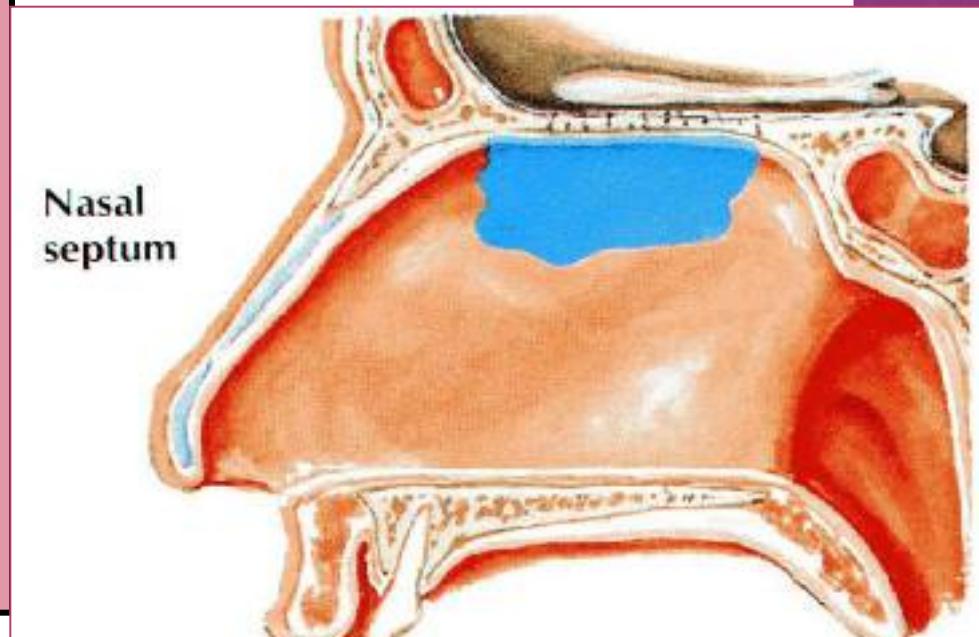
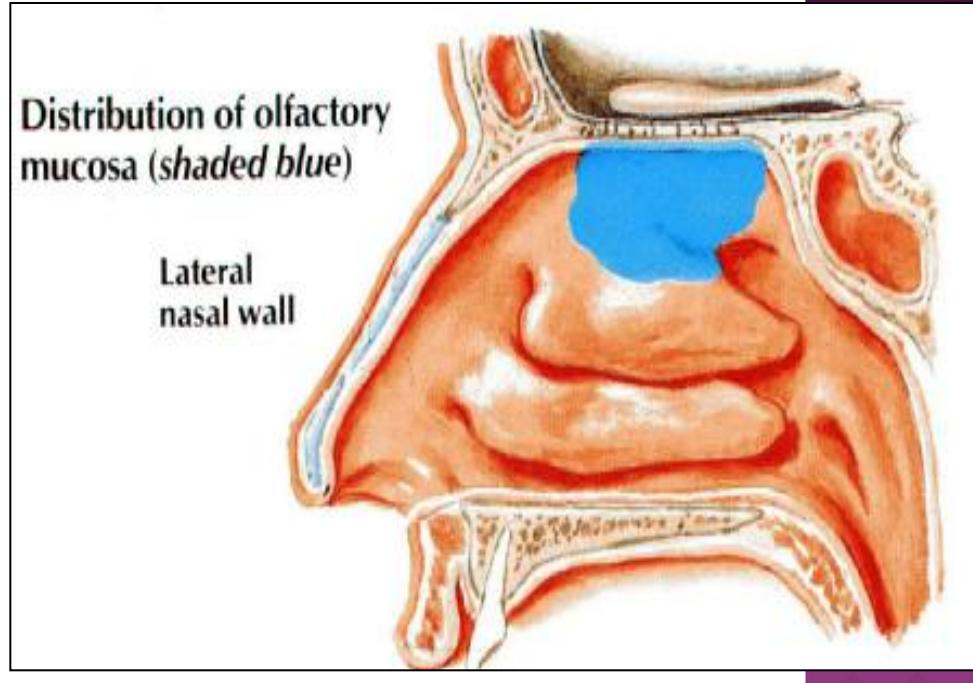


The mucosal lining of these sinuses is continuous with that in the nose and the throat. So infection in this area tends to migrate into the sinuses causing sinusitis.

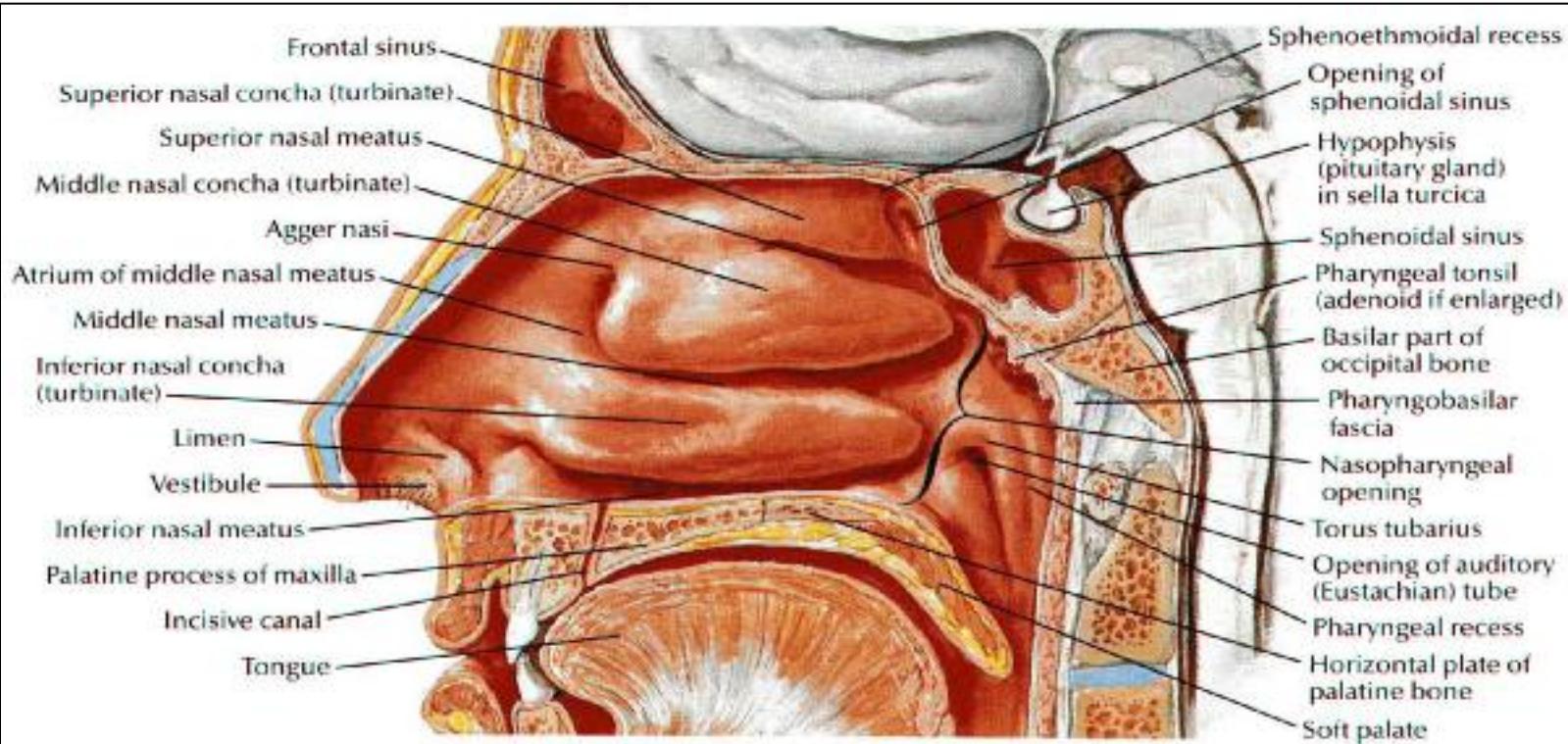
- **Note** : all sinuses open into the middle meatus **EXCEPT:**
- **Sphenoidal sinus** : in sphenoethmoidal recess.
- **Posterior ethmoidal sinus** : in superior meatus.

# NASAL MUCOSA

- Olfactory :
- It is delicate and contains olfactory nerve cells.
- It is present in the upper part of nasal cavity:
- Roof
- On the lateral wall, it lines the upper surface of the superior concha and the sphenoethmoidal recess.
- On the medial wall, it lines the superior part of the nasal septum.



# RESPIRATORY MUCOSA

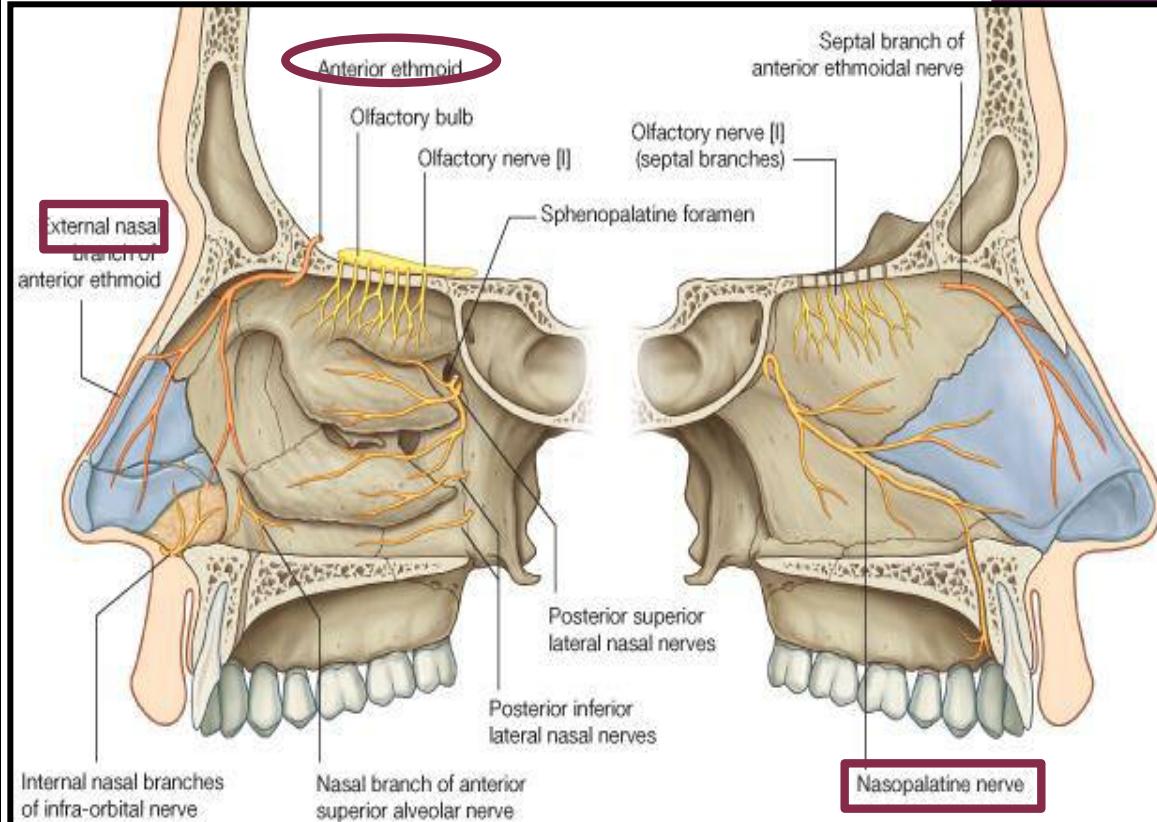


- It is thick, ciliated, highly vascular and contains mucous glands & goblet cells
- It lines the **lower part** of the nasal cavity (from skin of vestibule to the superior concha).
- It functions to moisten, clean and warm the inspired air.
- The air **is moistened** by the secretion of numerous serous glands.
- It is **cleaned** by the removal of the dust particles by the ciliary action of the columnar ciliated epithelium that covers the mucosa.
- The air **is warmed** by a *submucous venous plexus*.

- The nerves of General Sensation are derived from the **Ophthalmic & Maxillary** divisions of *trigeminal nerve*.

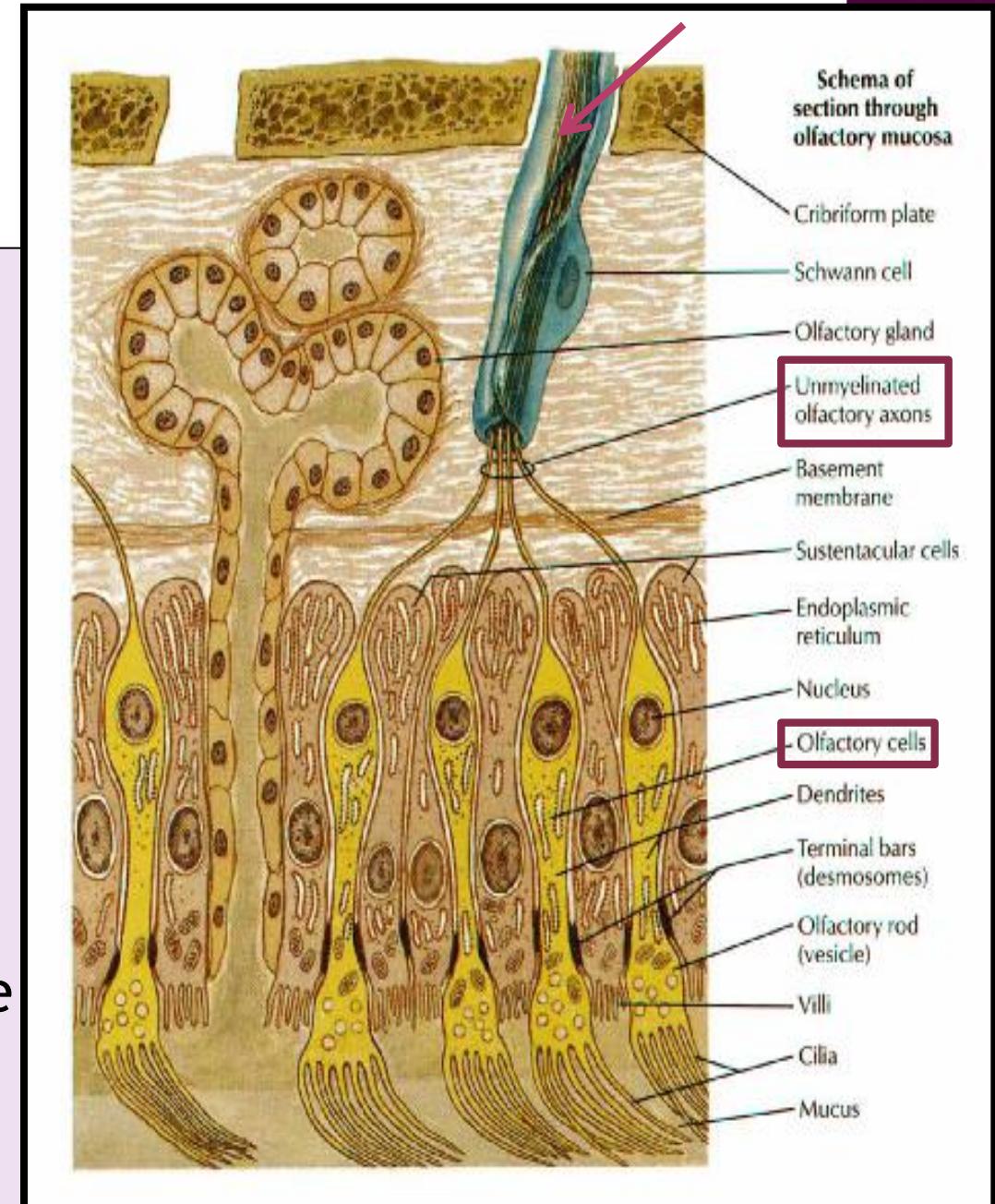
- The *anterior part is supplied by:* Anterior Ethmoidal nerve.
- The *posterior part is supplied by branches of the pterygopalatine ganglion:*
- 1-*Nasopalatine*,
- 2- *Nasal*, and
- 3- *Palatine*

## NERVE SUPPLY

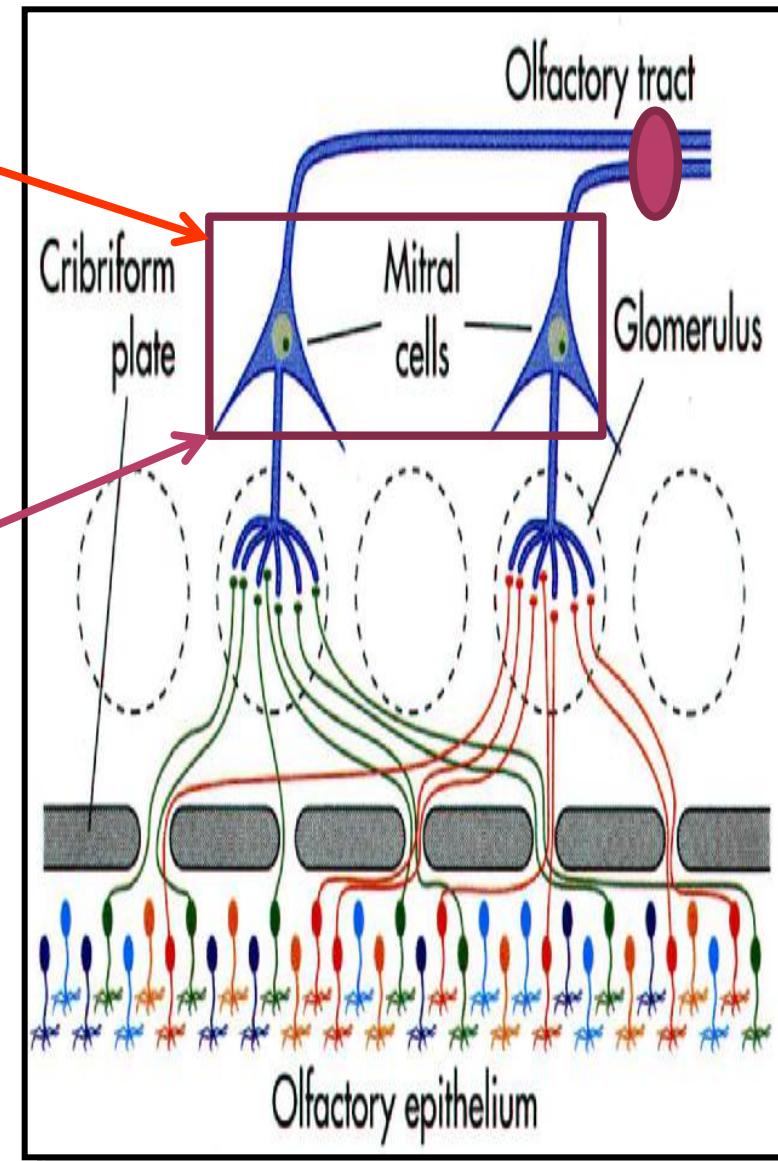
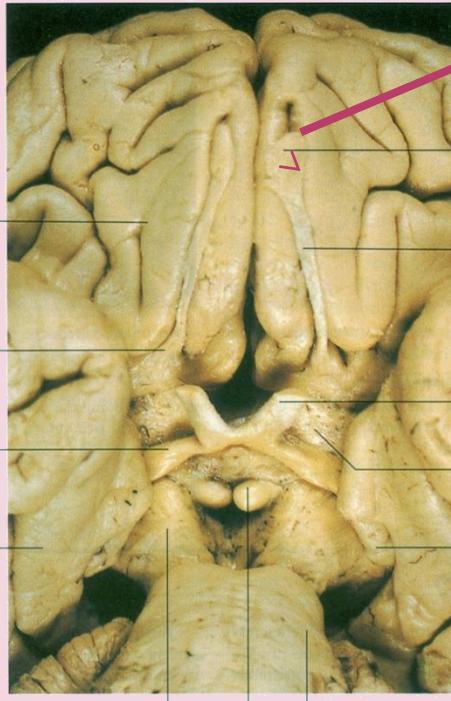


# SPECIAL SENSATION OLFACTORY NERVE

- Olfactory pathway:
- 1<sup>st</sup> neurone:
- Olfactory receptors are specialized, **ciliated nerve cells** that lie in the olfactory epithelium.
- The axons of these bipolar cells 12-20 fibers form the true olfactory nerve fibers.
- Which passes through the cribriform plate of ethmoid.
- They join the olfactory bulb

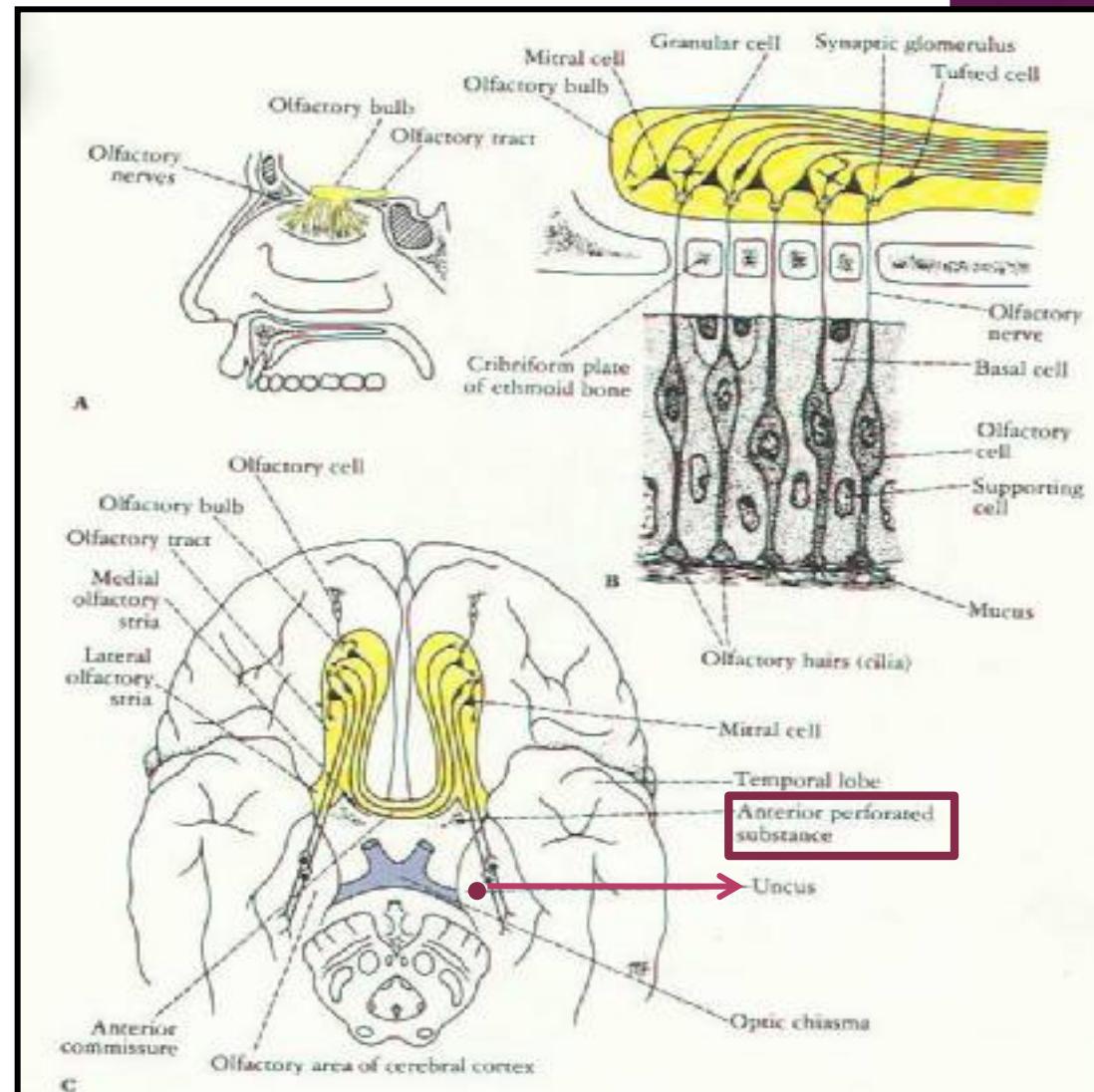


Preliminary processing of olfactory information is within the **olfactory bulb**, which contains interneurones and large Mitral cells; axons from the latter leave the bulb to form the **olfactory tract**.

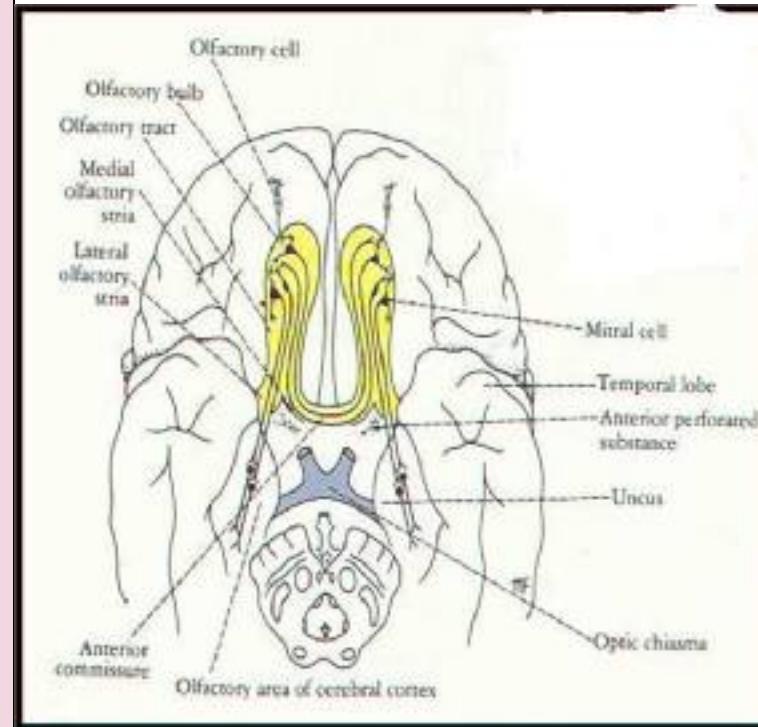


- **2<sup>nd</sup> neurone:**
- It is formed by the **Mitral cells of olfactory bulb.**
- The axons of these cells form the olfactory tract.
- **Each tract divides** into 2 roots at the anterior perforated substance:
  - **Lateral root:**
  - Carries olfactory fibers to end in cortex of the **Uncus** & adjacent part of **Hippocampal gyrus** (**center of smell**).

## OLFACtORY PATHWAY

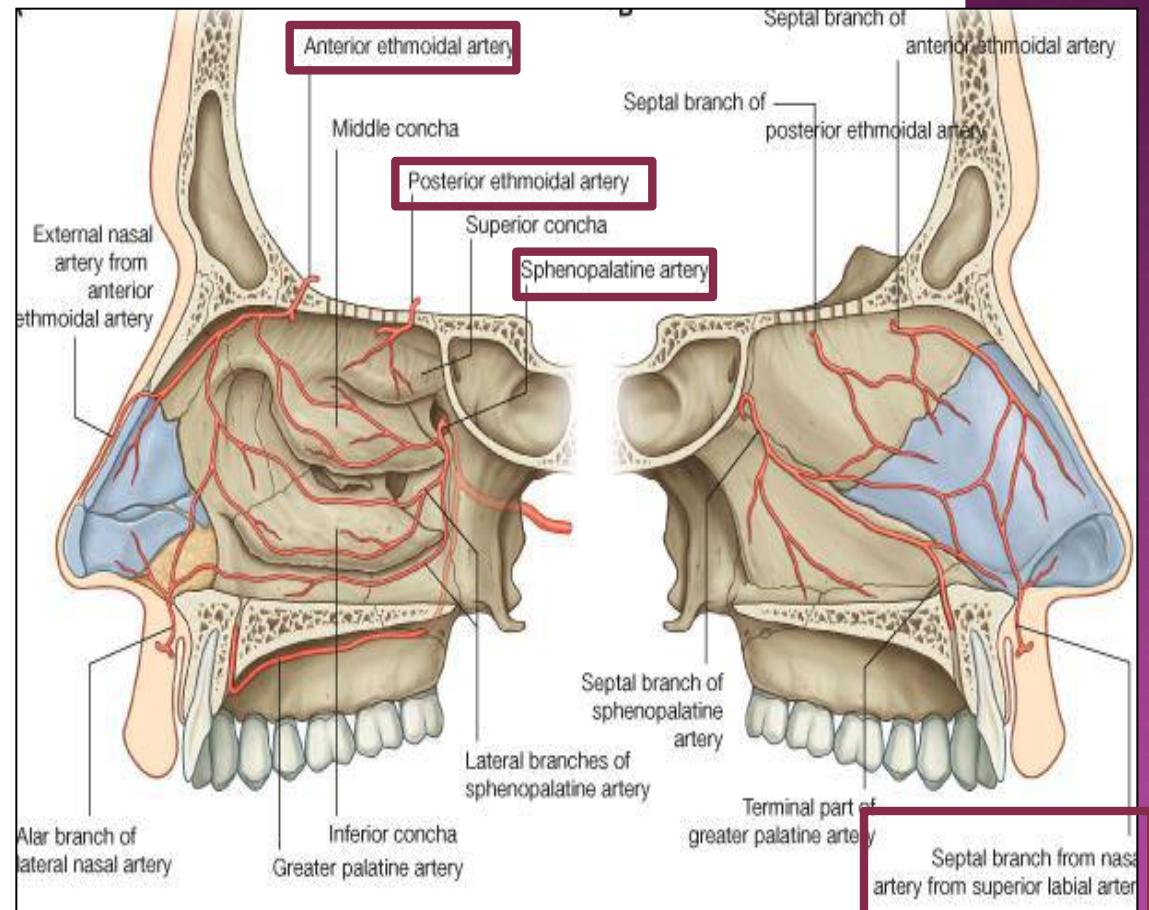


- **Medial root :**
- crosses midline through **anterior commissure** and joins the uncrossed lateral root of opposite side.
- It connects olfactory centers of 2 cerebral hemispheres.
- So each olfactory centre receives smell sensation from both halves of nasal cavity.
- **NB. Olfactory pathway is the only sensory pathway which reaches the cerebral cortex without passing through the Thalamus.**

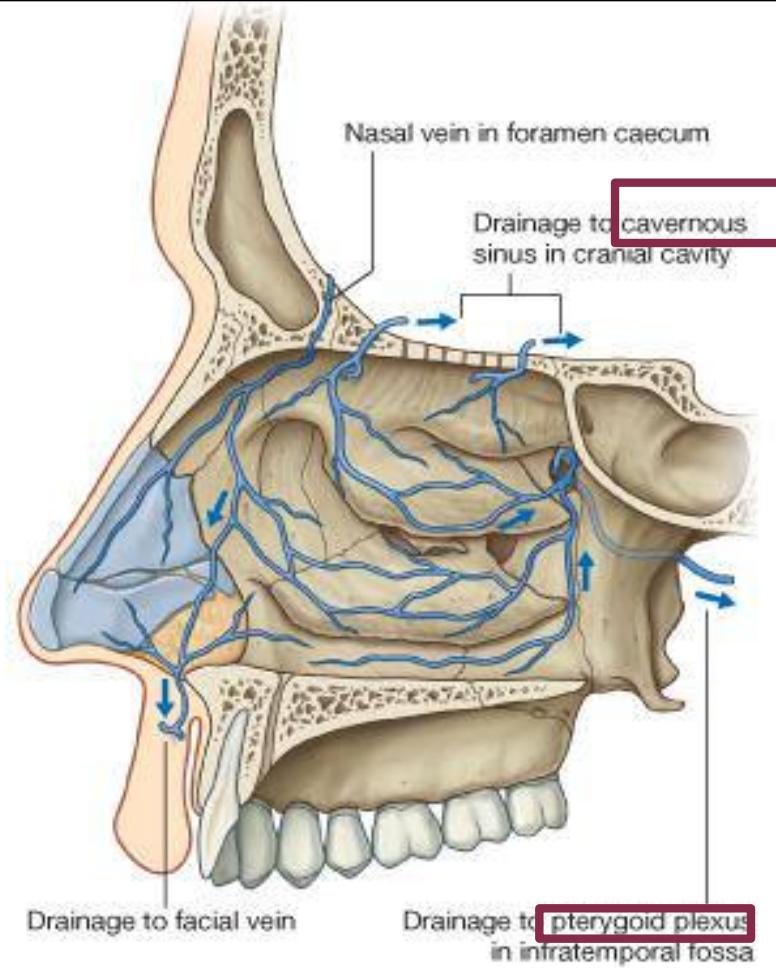


- Sphenopalatine artery (maxillary) .
- Anterior and Posterior Ethmoidal (ophthalmic).
- Superior labial (facial).
- Applied anatomy :
- The most common site for epistaxis is at the anterior & inferior part of nasal septum (Little's area) because of the rich arterial anastomosis .

## ARTERIAL SUPPLY



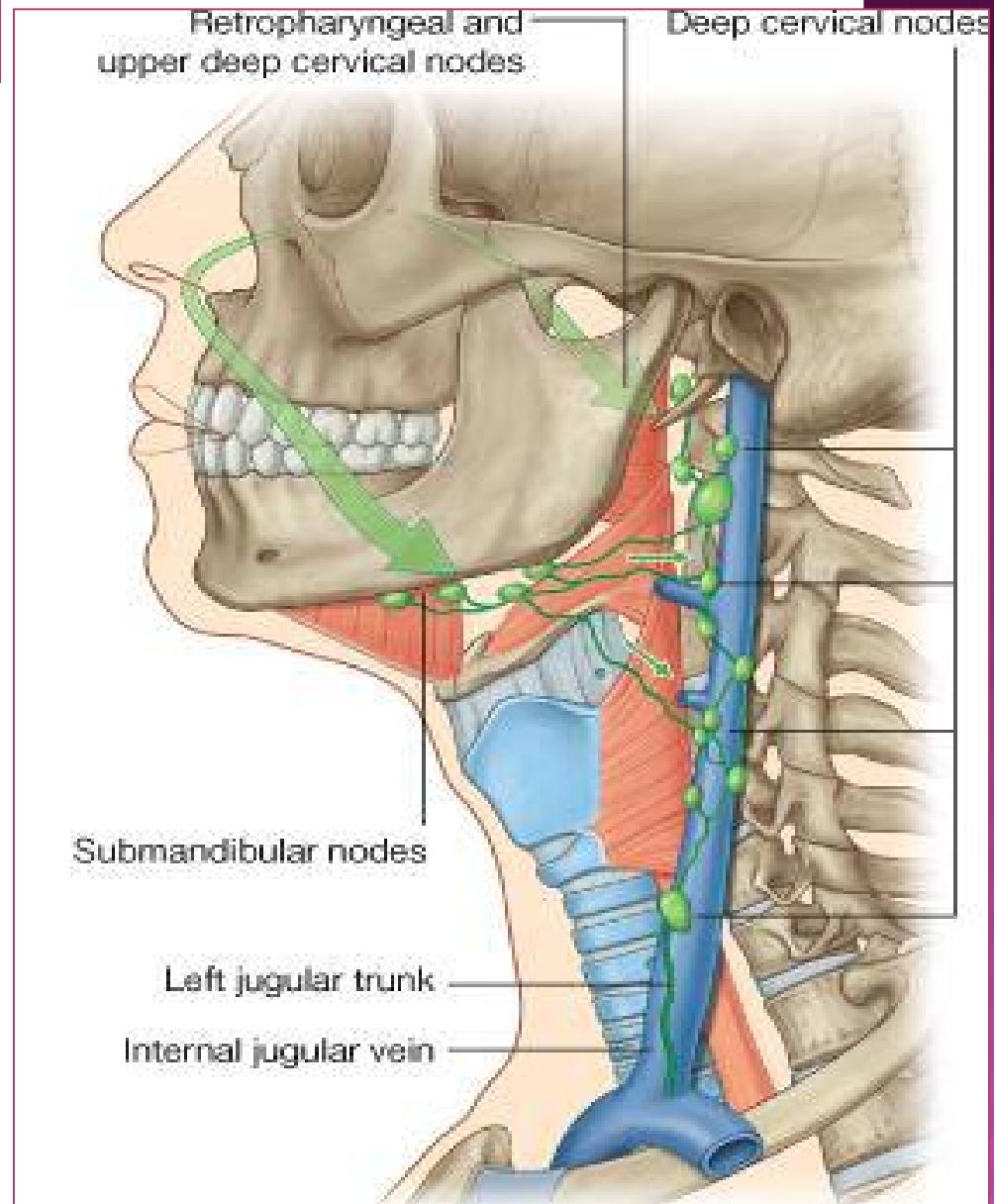
# VENOUS DRAINAGE



- Venous plexus in the sub mucosa formed by veins accompanying the arteries
- They drain into cavernous sinus & pterygoid venous plexus.

# LYMPH DRAINAGE

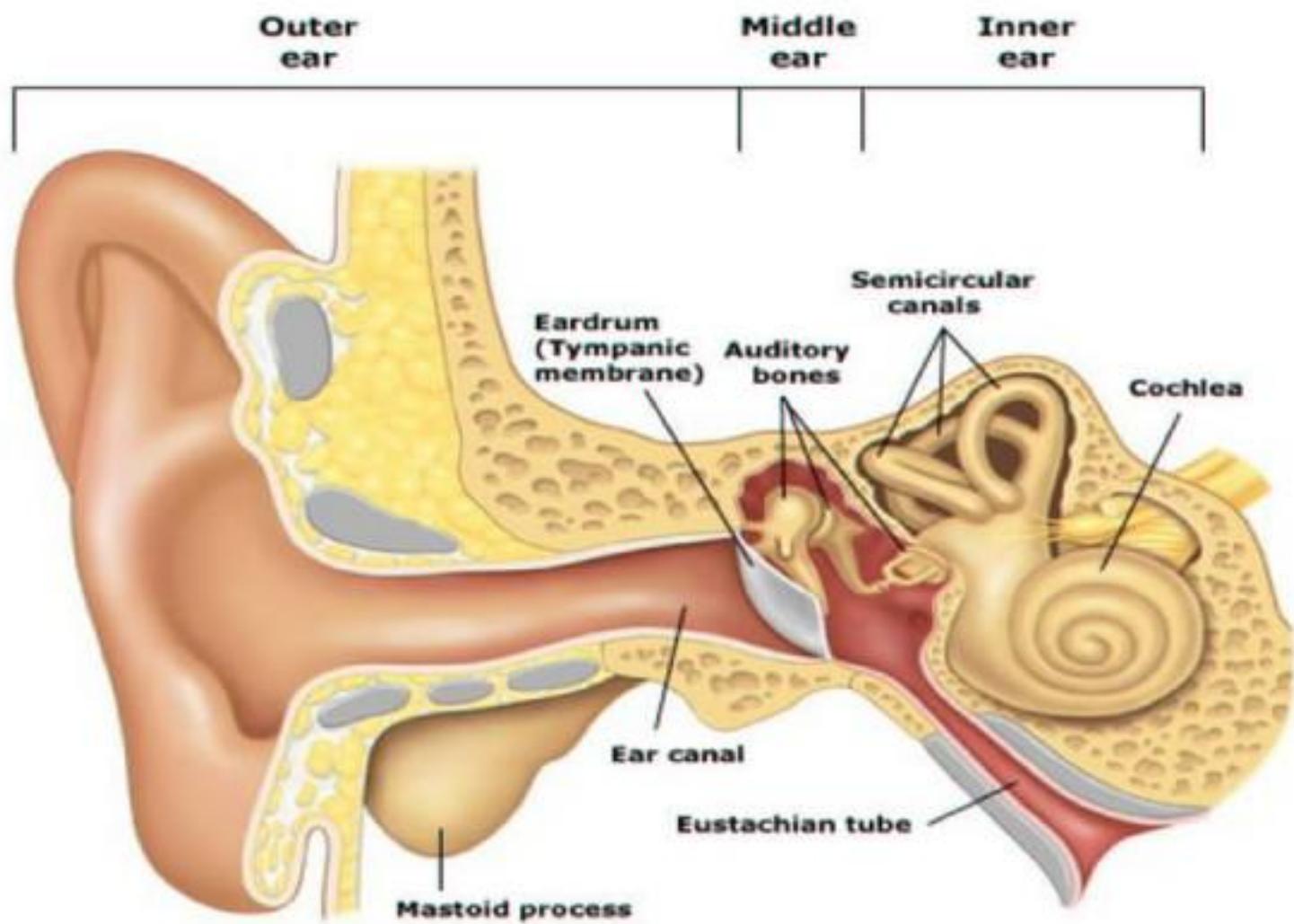
- To Submandibular &
- Upper deep cervical nodes.



**THANK YOU**

## Anatomy of Ear

- Ear is divided into three main regions
  - External ear
  - Middle ear
  - Inner ear



## **Anatomy of Ear**

### **External ear**

- 1.Auricle  
(pinna)
- 2.External  
auditory canal
- 3.Tympanic  
membrane  
(Ear drum)

### **Middle ear**

- 1.Auditory  
Ossicles
- 2.Oval window
- 3.Eustachian  
tube

### **Inner ear**

- 1.Semicircular  
canals
- 2.Vestibule
- 3.Cochlea

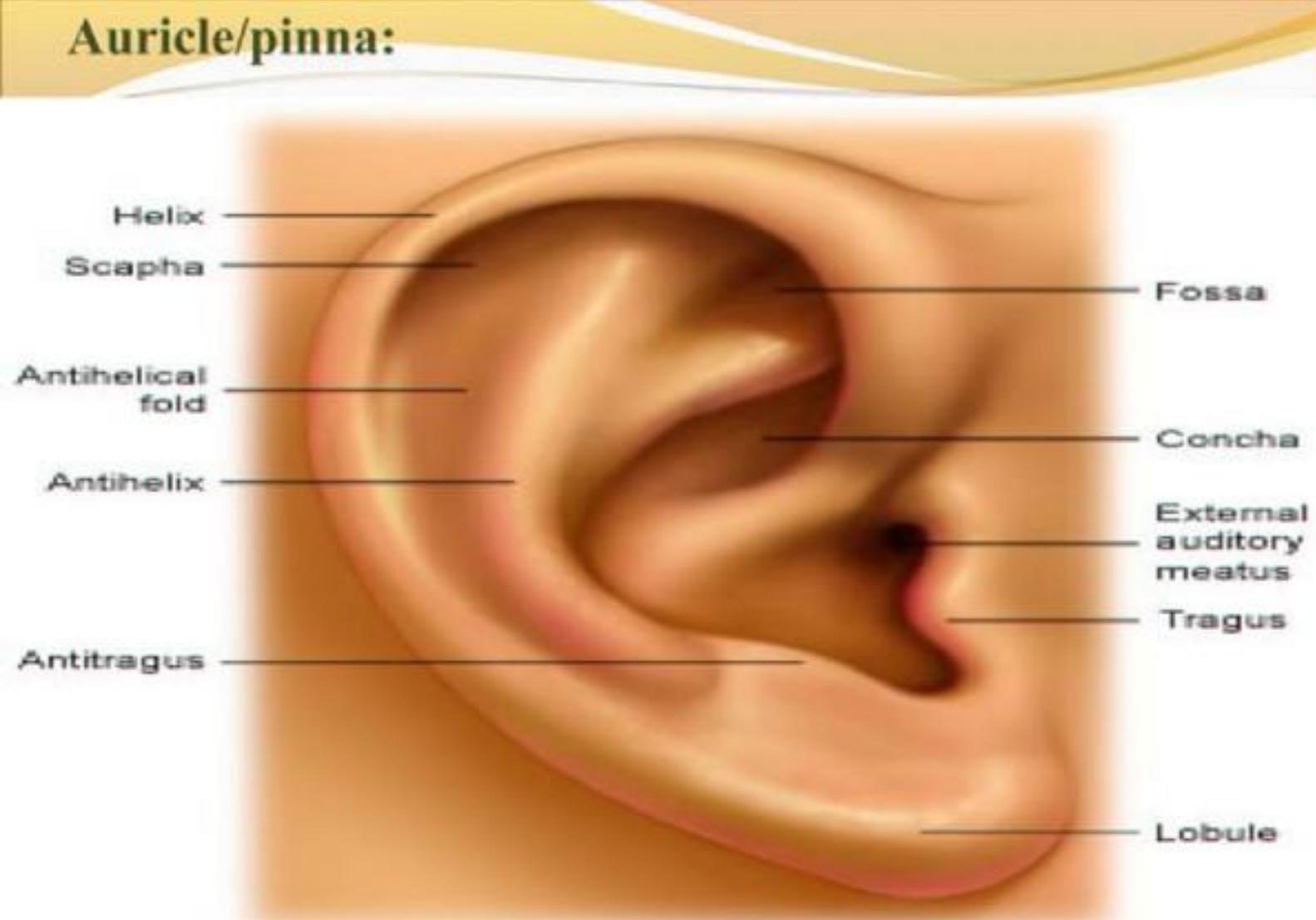
## External ear (outer ear)

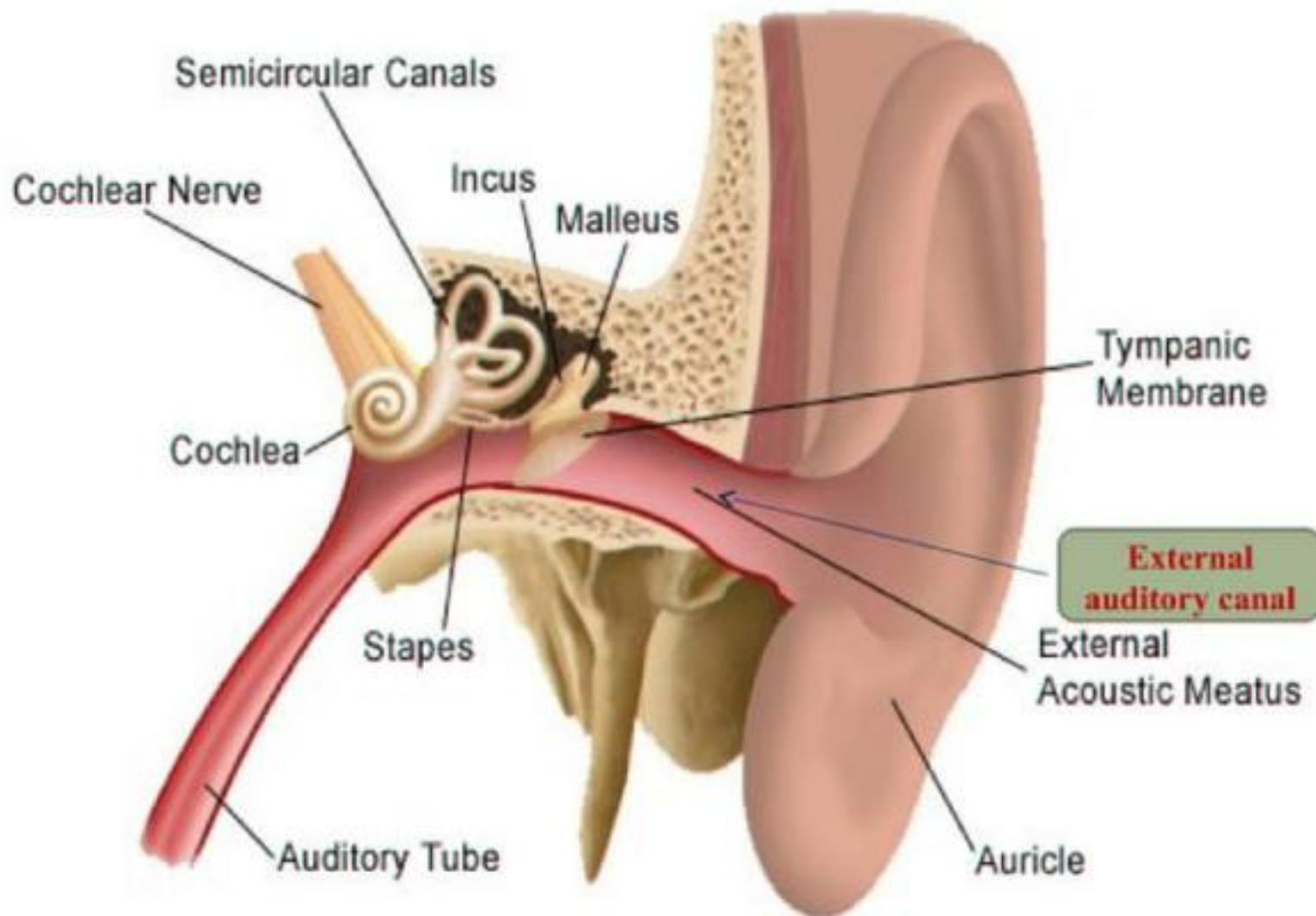
- (A) External ear is consist of:
  - Auricle (pinna)
  - External auditory canal
  - Tympanic membrane (Ear drum)

### 1) Auricle/ Pinna

- It is flap of elastic cartilage
- It is covered by skin
- Rim of auricle is called **helix**
- Inferior portion is called **lobule**.
- Plays important role in localization of sound.
- It opens into **External auditory canal**

## Auricle/pinna:





## 2) External auditory canal/ External auditory meatus

- Curved tube, extends from pinna to ear drum.
- 2.5cm long
- Near the external opening the external auditory canal contains a few hairs and ceruminous glands.
- **Ceruminous glands** secrete the cerumen (ear wax)
- Combination of hairs and cerumen helps prevent dust and foreign objects from entering the ear

### 3) Tympanic membrane /Ear drum

- External auditory canal ends at the **Tympanic membrane** also called as **ear drum**.
- It is a thin, semitransparent partition between external auditory canal and middle ear.
- It is covered by epidermis
- Lined by simple cuboidal epithelium

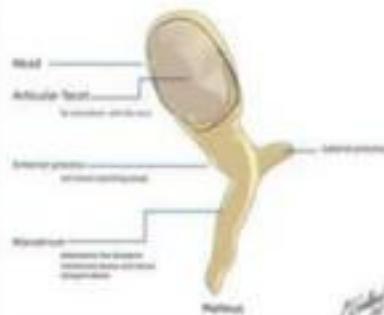
## **(B) Middle ear**

- Middle ear is small, air filled cavity in temporal bone
- It is lined by epithelium
- It is separated from external ear by ear drum
- It is separated from inner ear by oval window
- The structures of middle ear are:
  - **Auditory Ossicles**
  - **Oval window**
  - **Eustachian tube**

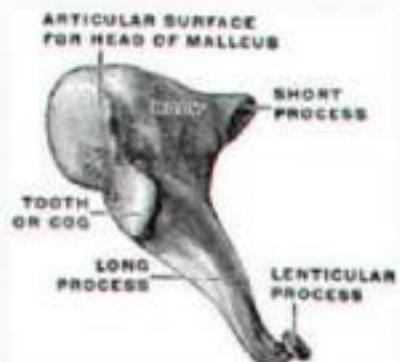
## 1) Auditory Ossicles:

- These are the smallest three bones of the body
- Connected by synovial joints

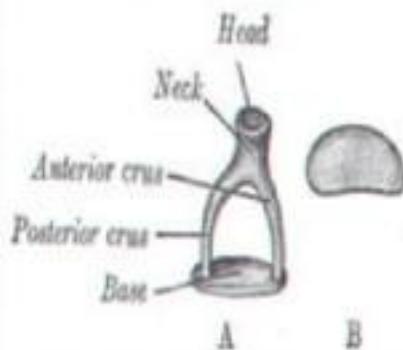
3. The  
Malleus OR  
The Hammer



2. The Incus OR  
The Anvil

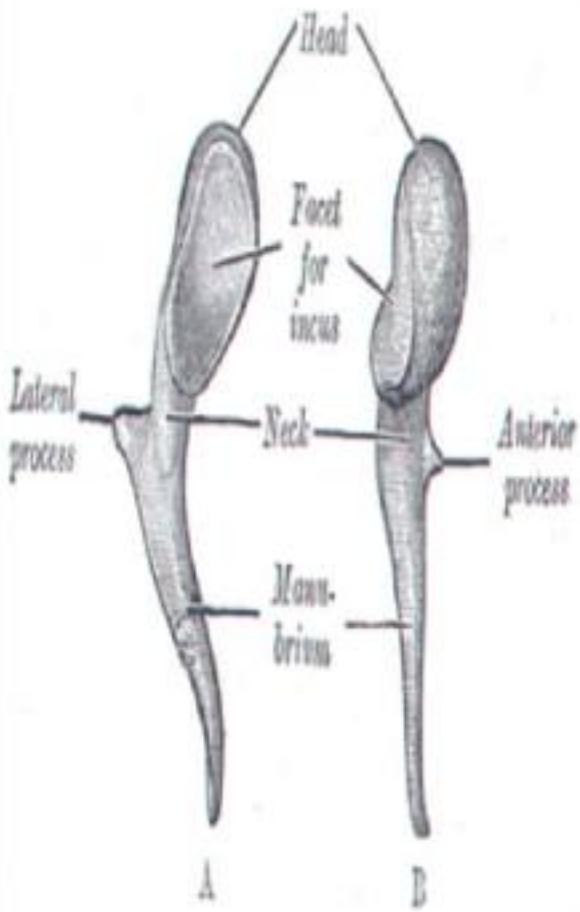


3. The Stapes OR  
The Stirrup



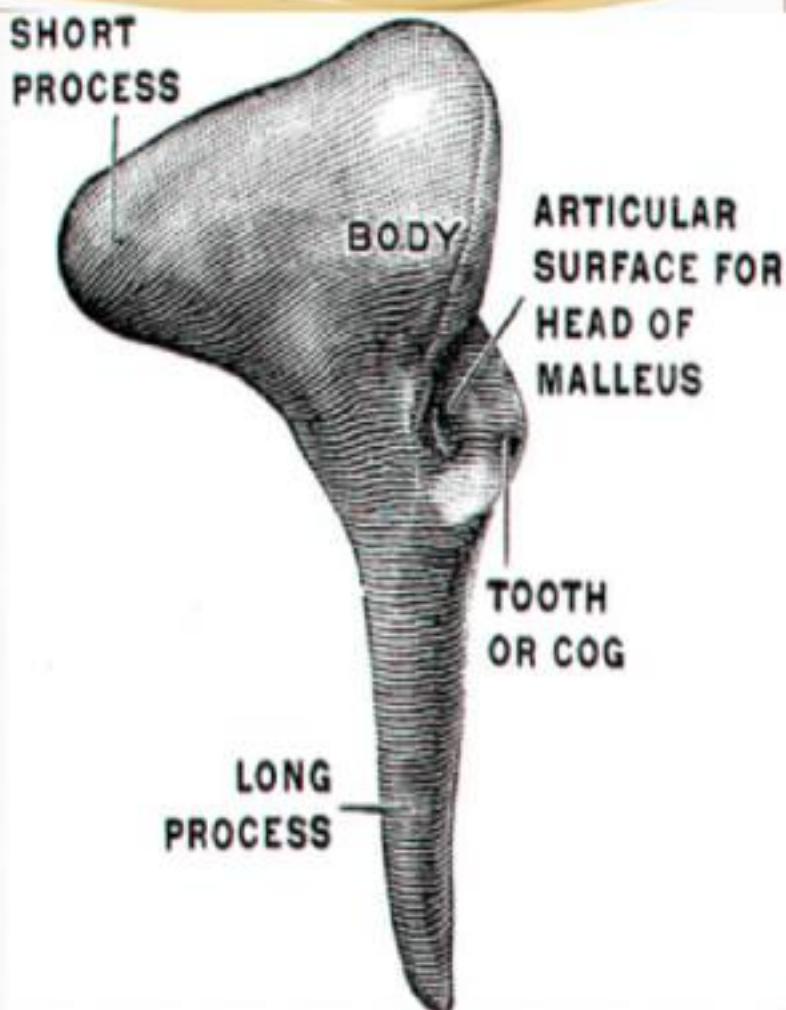
### a) Malleus:

- Word malleus is Latin for hammer
  - It is the first bone of the middle ear
  - The handle of malleus is attached with internal surface of eardrum
  - Head of malleus is attached with body of incus.
- 
- The primary function of the malleus is the transmission of sound waves or vibrations from the eardrum to the incus

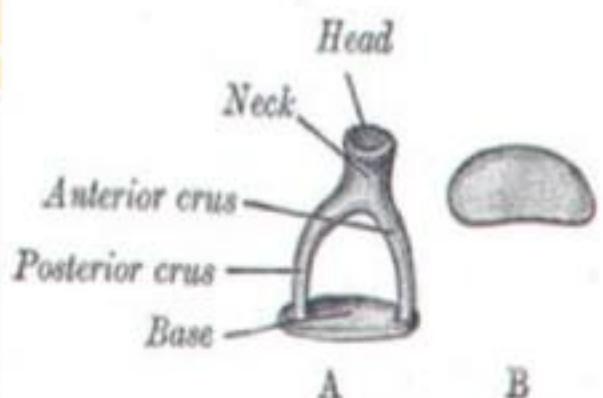


### b) Incus (Anvil)

- It is second bone
- located in between the malleus and the stapes
- The incus transmits vibrations from the malleus to the stapes

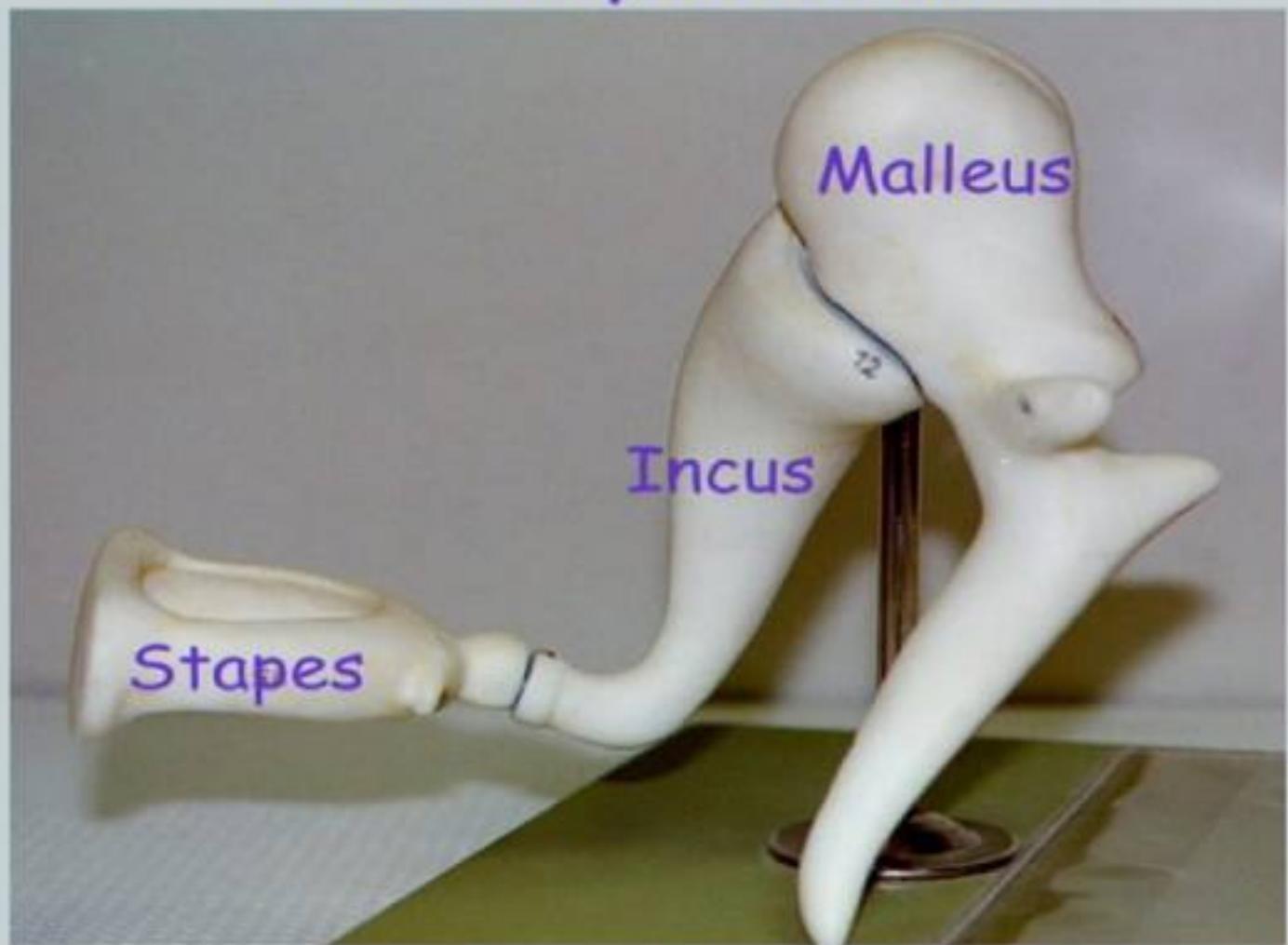


### c) Stapes



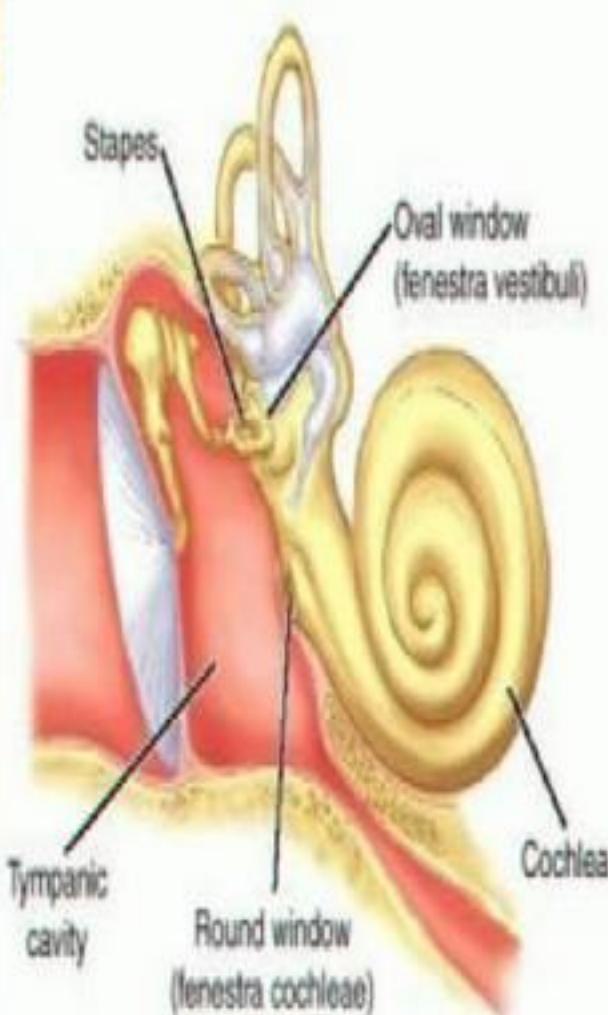
- Stapes is the third and final bone of the middle ear
- It is the smallest and lightest bone of the human body
- The stapes connects to the incus on the outward side and to the oval window
- The primary function of the stapes is transmitting sound waves from the incus to the membrane of the inner ear.
- The base or footplate of stapes is fits into oval window

## Auditory Ossicles



## 2) Oval window:

- It is a membrane-covered opening that leads from the **middle ear** to the **vestibule** of the **inner ear**.
- The oval window is the intersection of the middle ear with the inner ear and is directly contacted by the **stapes**;
- by the time vibrations reach the oval window, they have been amplified over 10 times from what they were when they contacted the tympanic membrane.



### **3)Eustachian Tube**

- The middle ear is an air-filled space
- It consists of both bone and hyaline cartilage
- This runs from the middle ear to the naso-pharynx behind the nose.
- It is normally closed at pharyngeal end
- During swallowing, chewing and yawning it opens
  
- It helps maintaining equal air pressure on the two sides of ear drum.
- If pressure disturbed hinders clear and normal hearing.

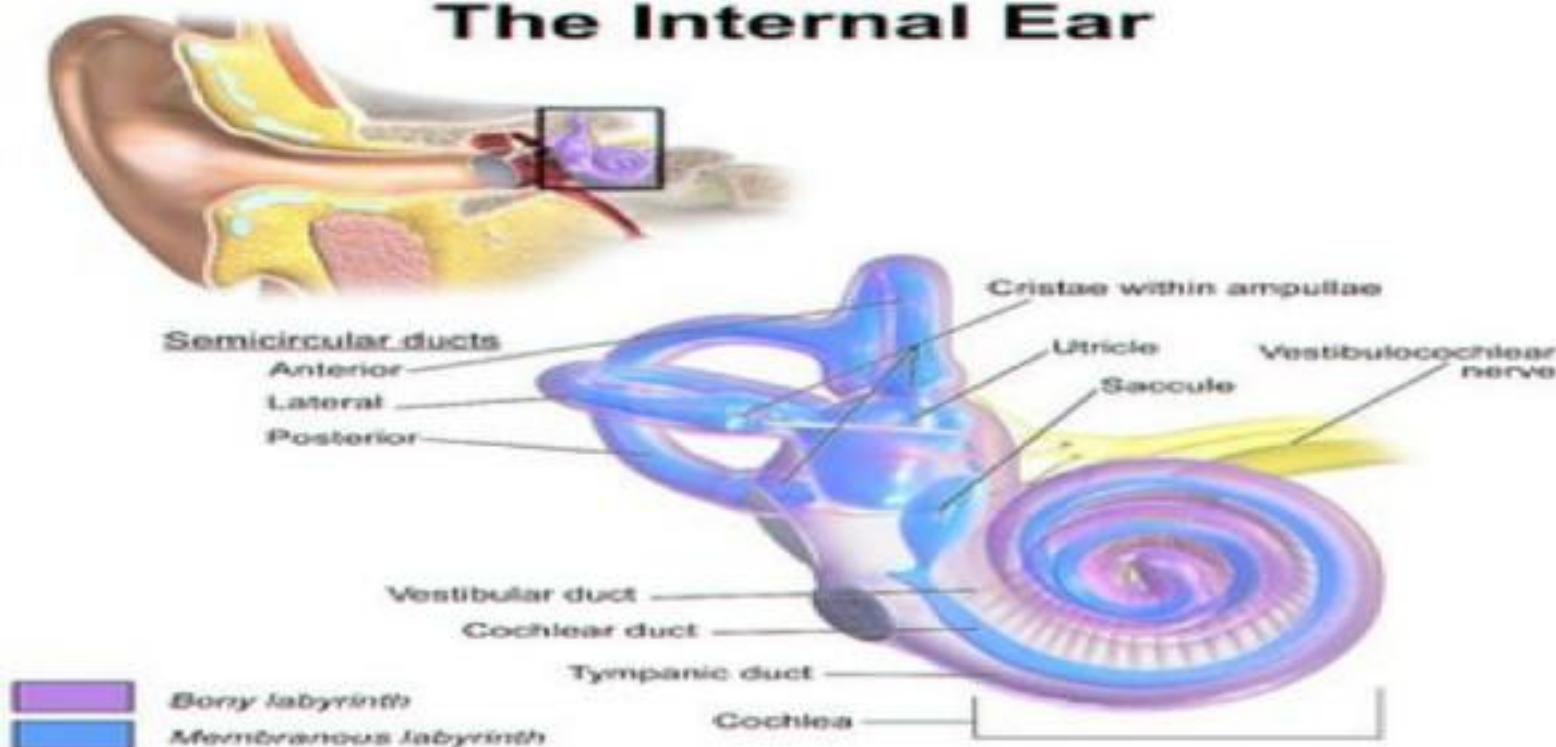
## Eustachian Tube



### (3) Inner Ear:

- It is also called as labyrinth
- Two main divisions of labyrinth
  - Outer Bony labyrinth
  - Inner membranous labyrinth

#### The Internal Ear



# Inner ear:

## Outer Bony labyrinth

Bony labyrinth is a series of cavities in the temporal bone

It is divided into three regions

- ❖ Semicircular canals
- ❖ Vestibule
- ❖ Cochlea

Bony labyrinth is lined with periosteum and contains fluid **perilymph** which is similar to CSF.

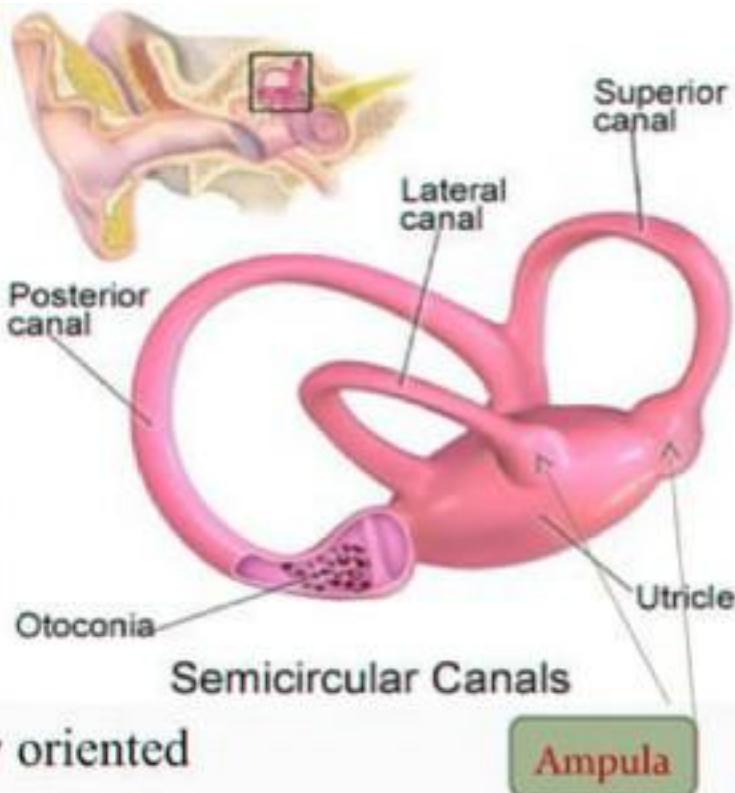
## Inner membranous labyrinth

- ❖ It is series of sacs and tubes inside of bony labyrinth
- ❖ membranous labyrinth is lined with epithelium
- ❖ It contains **endolymph**
- ❖ The level of potassium ions are high in endolymph
- ❖ Potassium ions generates the of auditory signals
- ❖ Membranous labyrinth consists of two sacs.
  - ❖ Utricle
  - ❖ Saccule

## Outer Bony labyrinth

### 1) Semicircular canals

- They are named:
  - Anterior Semicircular canals
  - Posterior Semicircular canals
  - Lateral Semicircular canals
- Anterior and posterior are vertically oriented
- lateral is horizontally oriented
- Contains crista, site of hair cells, maintain static equilibrium



### Ampula

- One end of each canal is swollen enlargement is called ampula

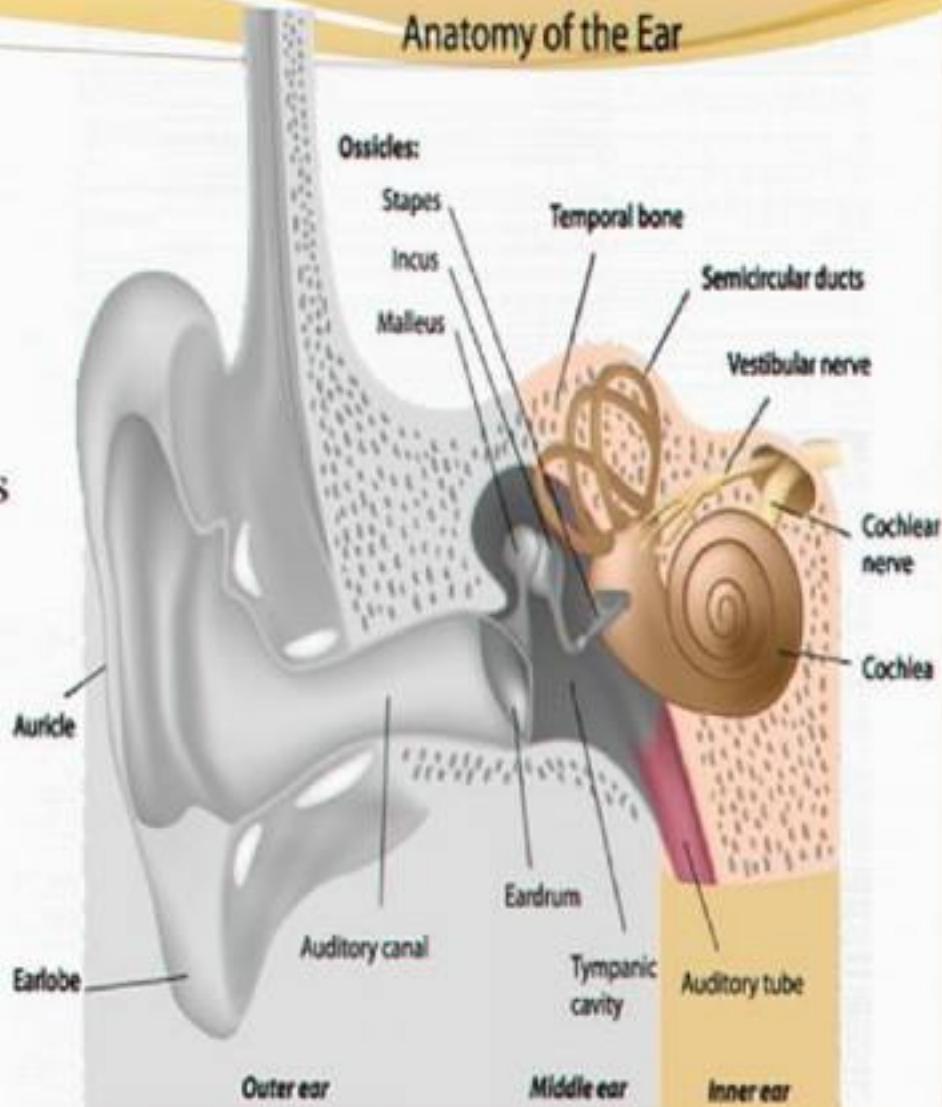
## (2) vestibule:

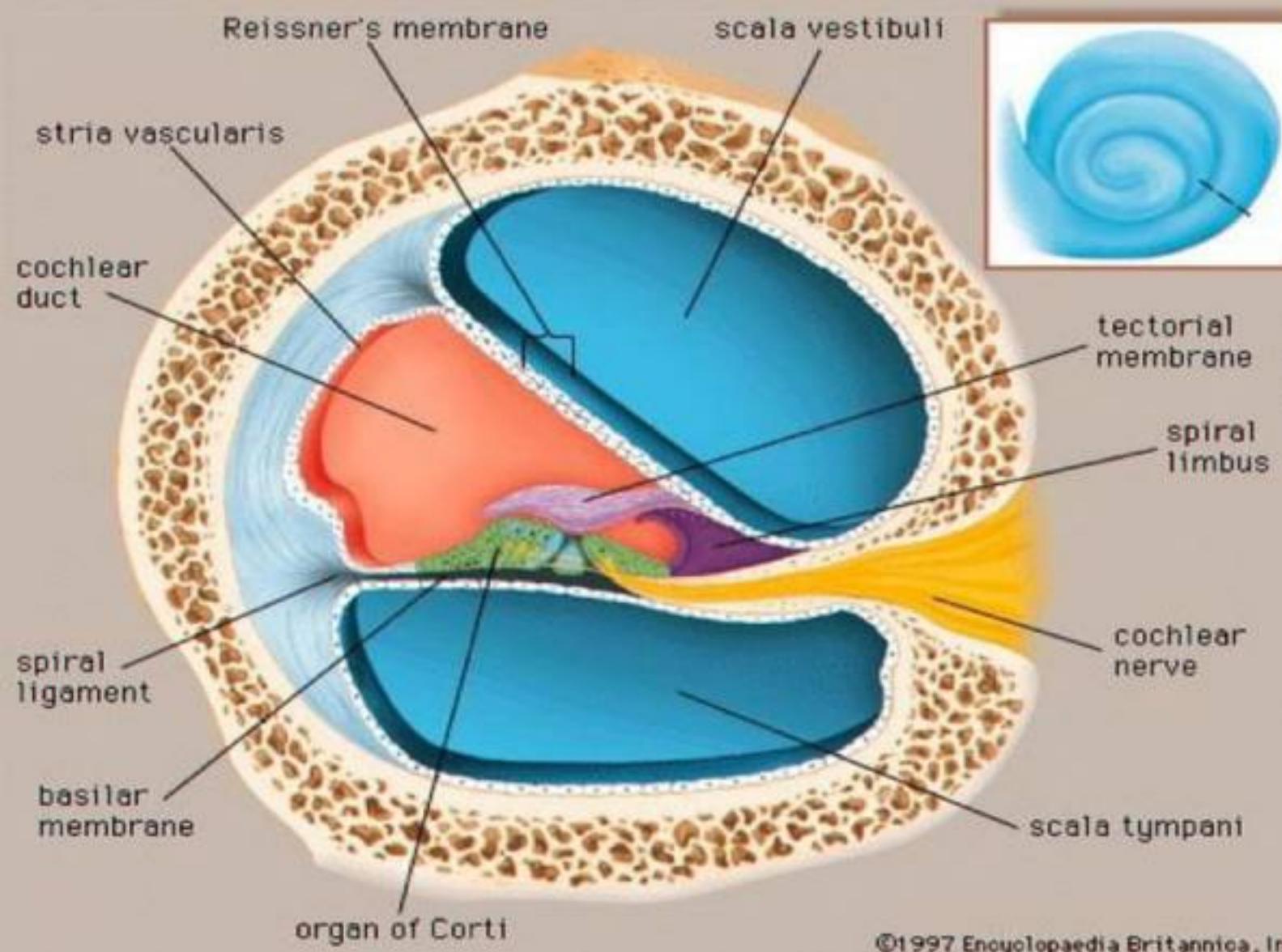
- It is the central part. Lies between cochlea in front and semicircular canal behind.
- It contains utricles and saccule which are part of **membranous labyrinth**
- The walls of both Saccule and Utricle contain small thickened region is called macula.
- Contains receptor for static equilibrium
- Maintains posture and balance
- Maculae contains two types of cells
  - Hair cells
  - Supporting cells

## Anatomy of the Ear

### 3) Cochlea

- Snail shaped
- Bony spiral canal
- Divided into three channels
  - Cochlear duct
  - Scala vestibuli
  - Scala tampani





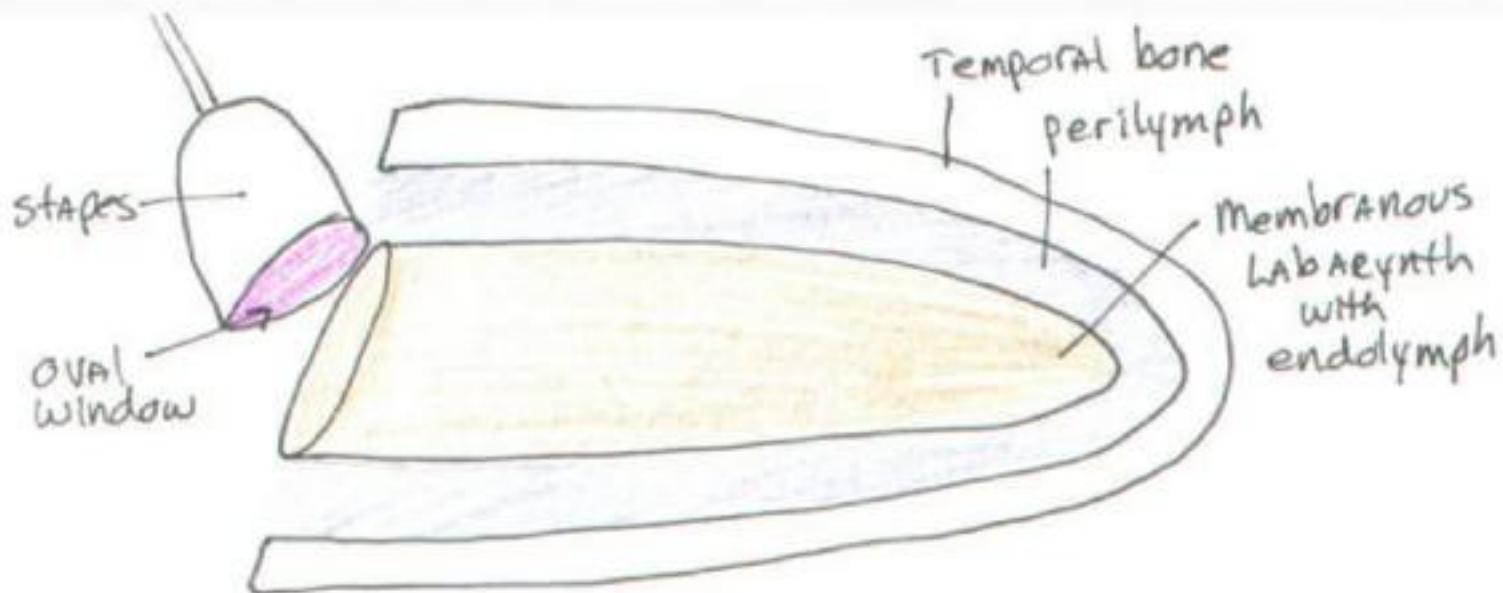
©1997 Encyclopaedia Britannica, Inc.

## Organ of Corti

- It is also known as spiral organ
- Coiled sheet of epithelial cells
  - Supporting cells
  - Hair cells
- Two groups of hair cells
  - Inner hair cells
  - Outer cells

## Inner ear

Instead of drawing the cochlea curled up,  
I've drawn it laying out straight.



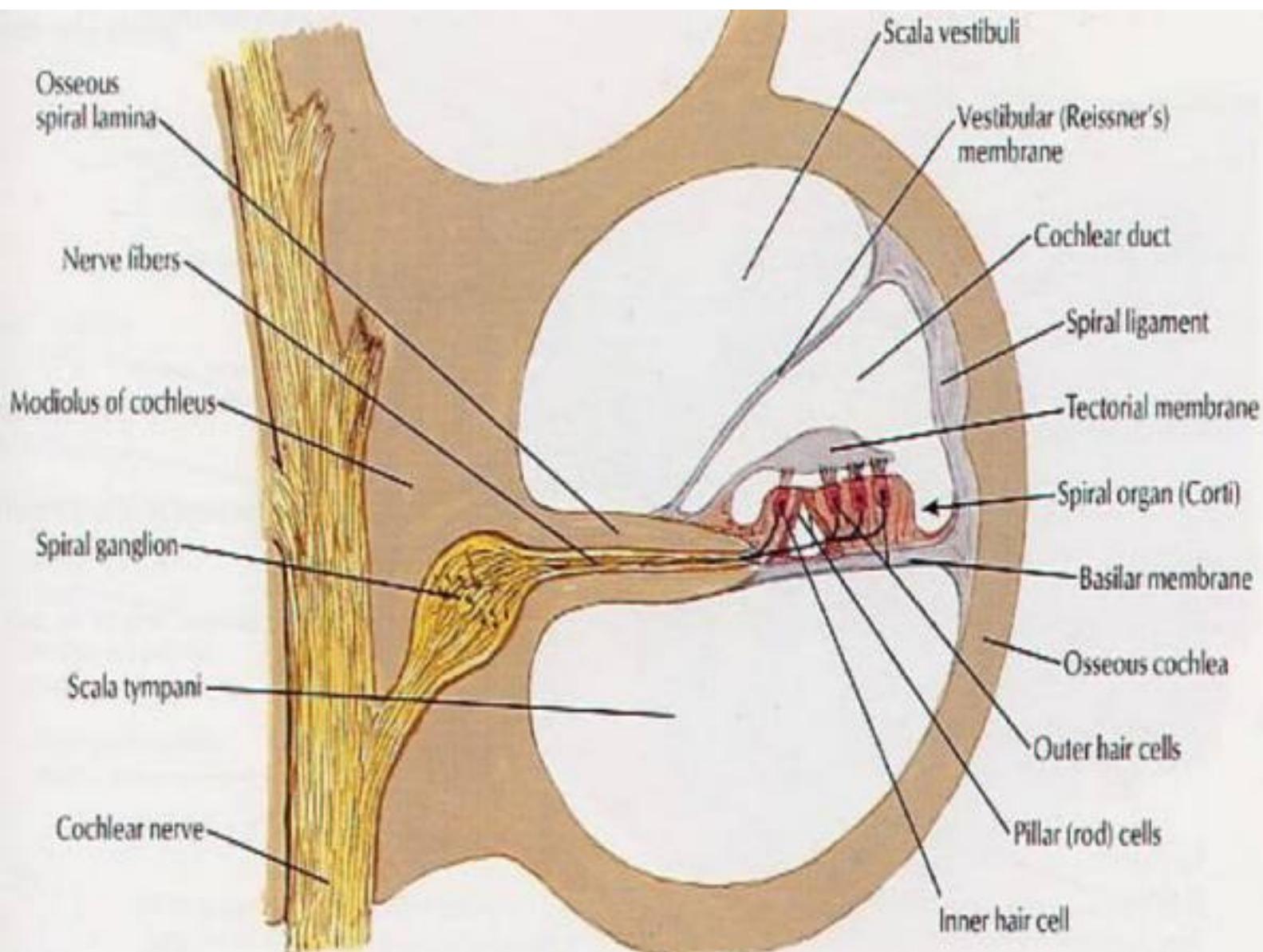
- It consists of neurons called **HAIR CELLS**; their axons form CN VIII.
- The stapes is attached to the **OVAL WINDOW**, and vibrations cause the perilymph to vibrate; the hair cells here transmit this vibration.
- Therefore the **HAIR CELLS** in this region are receptors for **HEARING**.
- 
- the **VESTIBULAR COCHLEAR NERVE**, which takes the signals to the brain.
- Therefore, the cochlea is where the hearing receptors are located, so the cochlea is responsible for all of the hearing of sounds.
- 
- However, the ear does more than just hear; it is also responsible for balance and equilibrium.

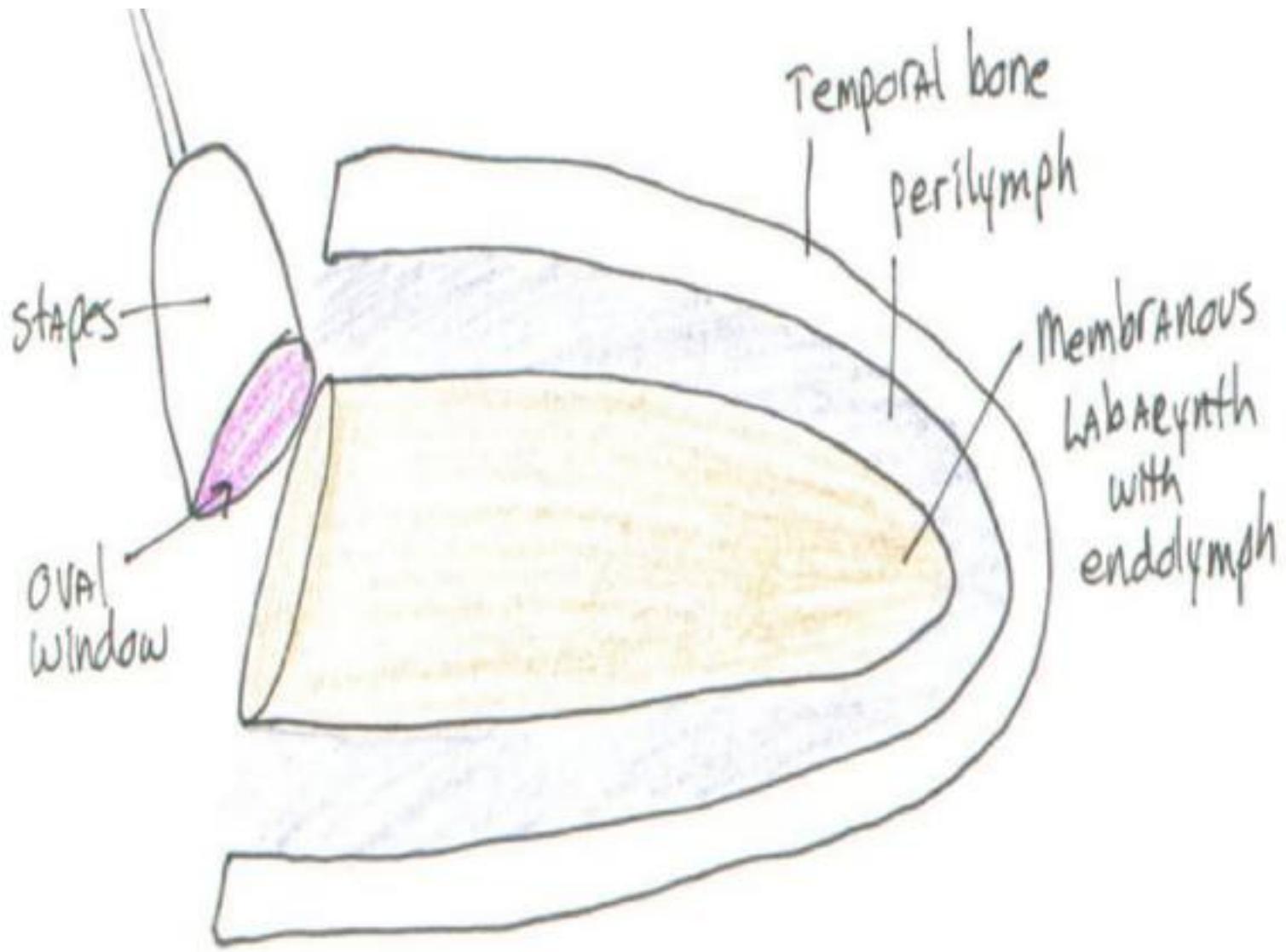
## Physiology of Hearing

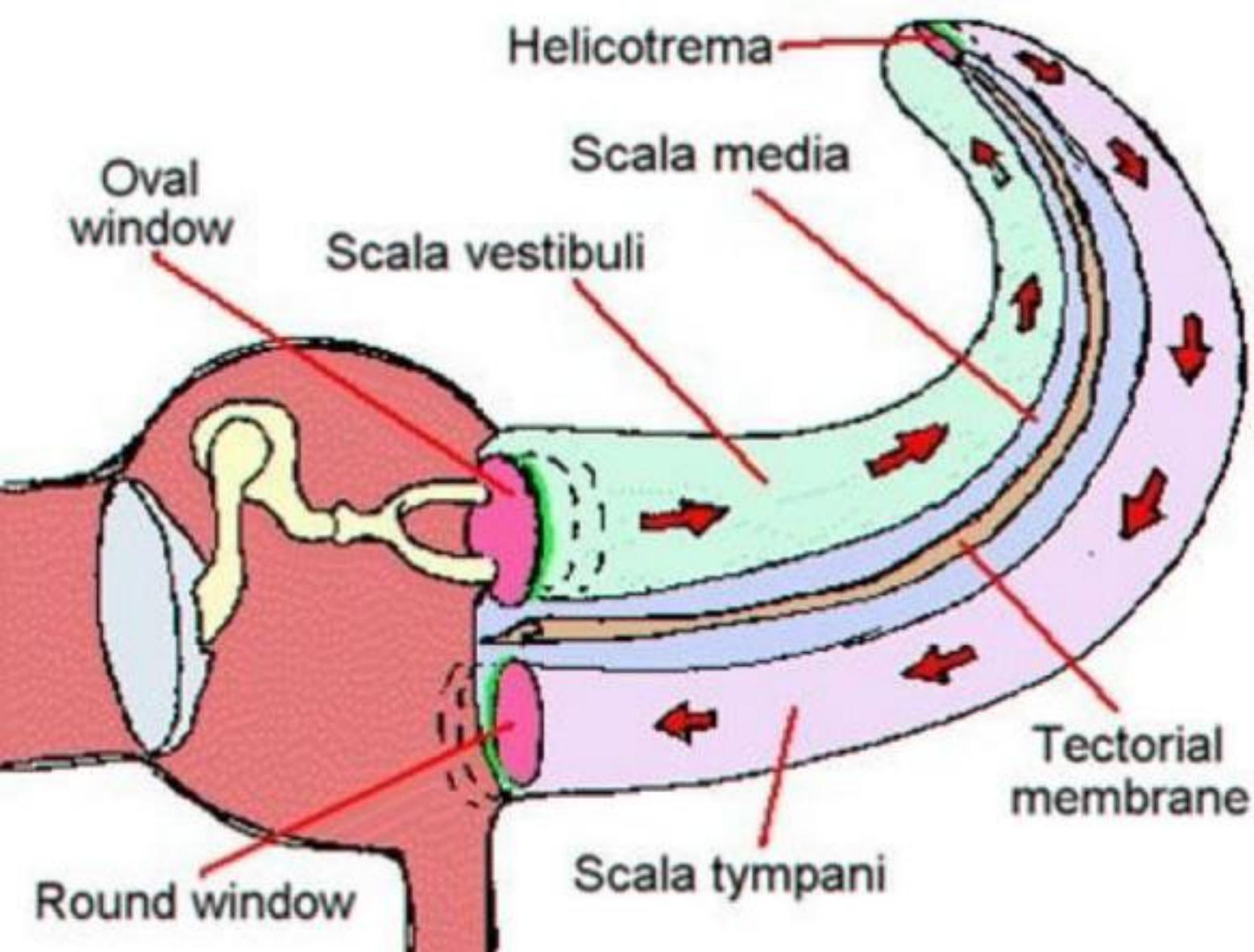
1. Auricle/ pinna directs sound waves into external auditory canal
2. When sound waves strike eardrum that cause eardrum to vibrate
3. The central area of Ear drum is connected to malleus which starts to vibrate. The vibration is transmitted from malleus to incus then to stapes
4. As a stapes moves back and forth it pushes the membrane of oval window in and out

Conti....

5. The movements of the oval window sets up fluid pressure waves in the perilymph.
6. So the vibrations are transmitted to “organ of corti” through perilymph and endolymph.
7. From the organ of corti, the impulses (produced by vibrations) are carried to brain through 8<sup>th</sup> cranial nerve to auditory centers of brain which is present in temporal lobe.



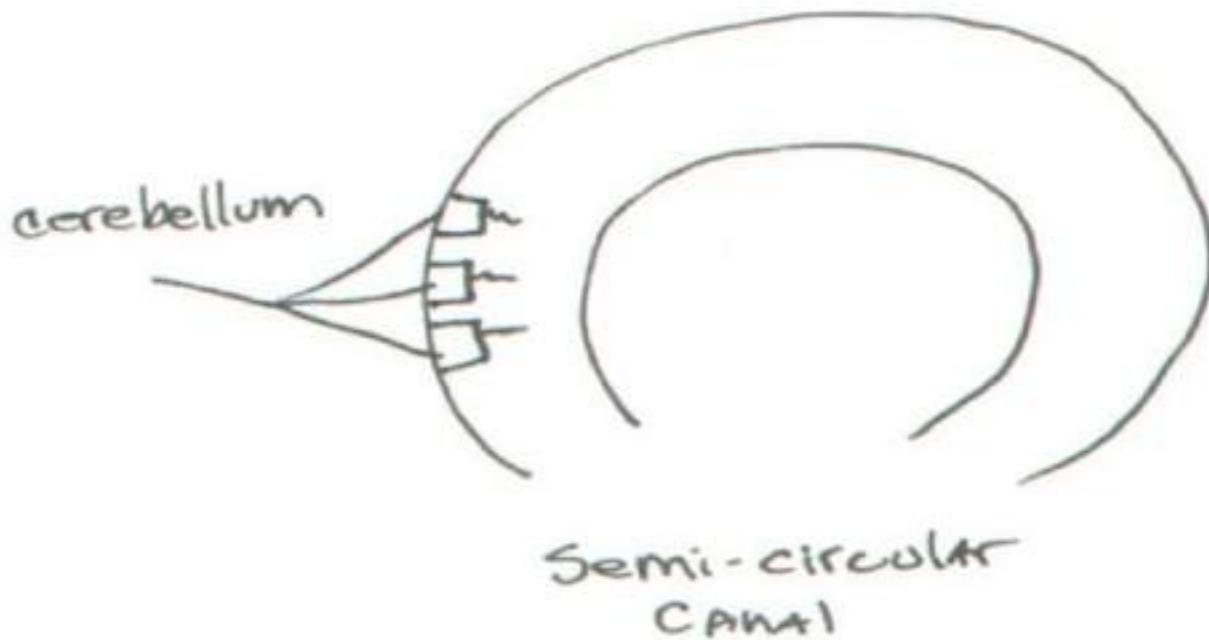




## VESTIBULAR SYSTEM

- This system regulates balance.
- It is also within the inner ear.
- **SEMI-CIRCULAR CANALS** (Three of them, all in different planes) determine movement in three planes.
- Within each semi-circular canal is endolymph and hair cells, which connect to nerves that go to the cerebellum.

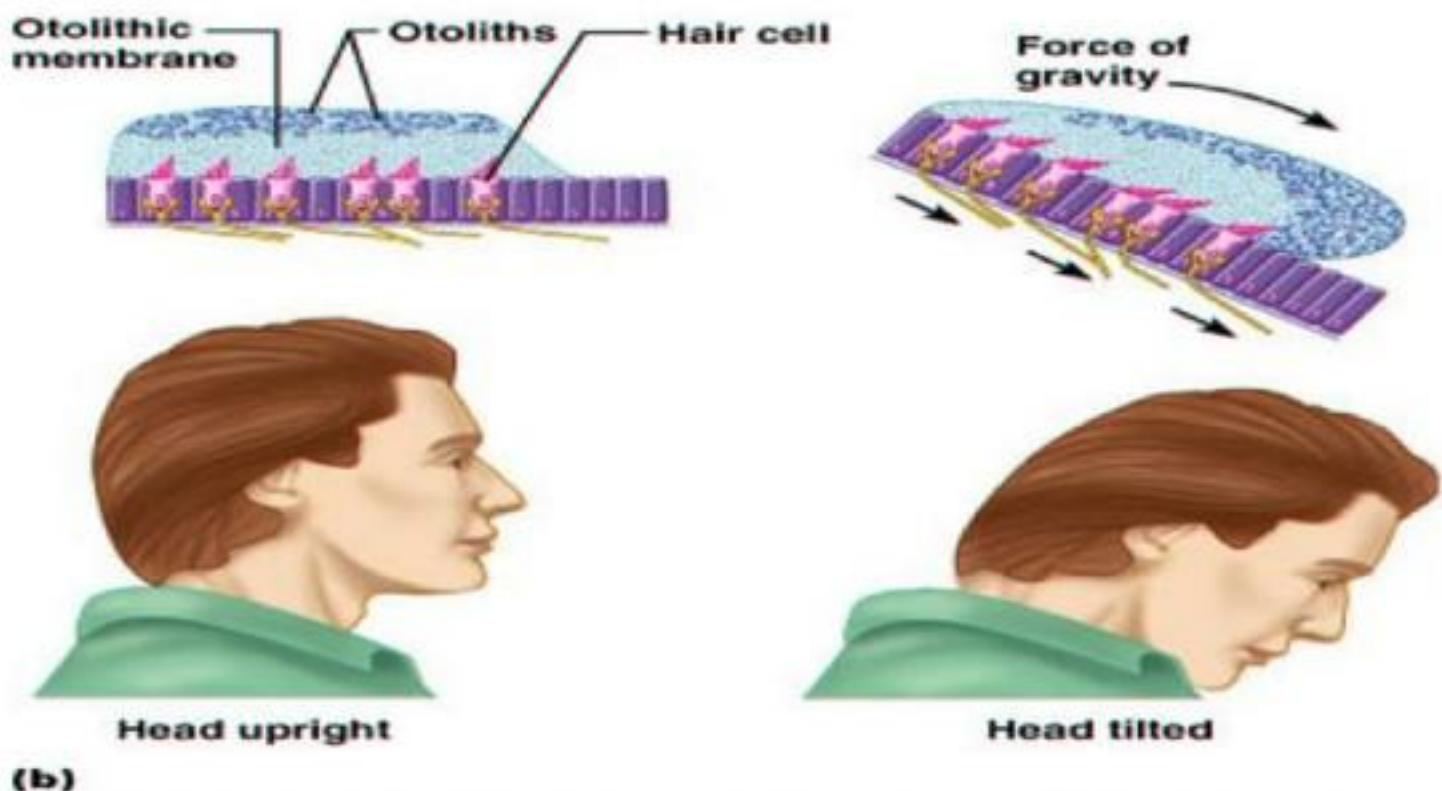
- When you move in one direction, like sliding across the room, the fluid sloshes like a cup of coffee, and it makes the hair cells move.



## Utricle and Saccule

- Attached to the semi-circular canals are two joined structures called the **UTRICLE** and the **SACCULE**.
- These also contain **HAIR CELLS** and **ENDOLYMPH**.
- Within the endolymph here are **OTOLITHS** (“ear rocks”) which are calcium deposits.
- When you stand perfectly upright, these otoliths fall directly down and bend the **HAIR CELLS** (a special type of neuron) on the lower cells. When you tip your head to the side, they will stimulate the hairs on that side.
- The otoliths stimulate the hair cells to tell you what position your head is in and give you a sense of equilibrium.
- Therefore, the **HAIR CELLS** in this region are receptors for equilibrium and the **OTOLITHS** are an essential component of this process.

# Anatomy and Function of the Otoliths





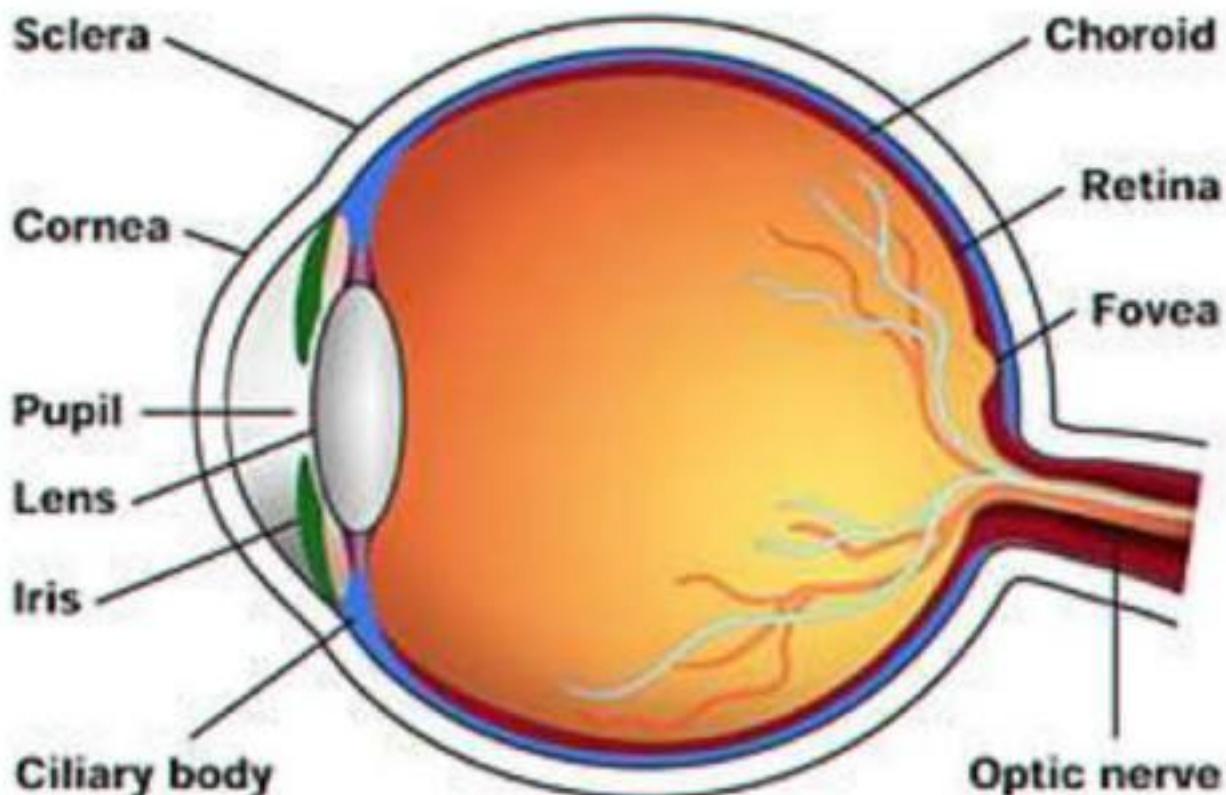
**Thank you**

## **Introduction**

- The eye is the organ of sight. It is situated in the orbital cavity and supplied by the optic nerve (2<sup>nd</sup> cranial nerve).
- It is almost spherical in shape and about 2.5 cm in diameter. The space between the eye and the orbital cavity is occupied by adipose tissue. The bony walls of the orbit and the fat help to protect the eye from injury.

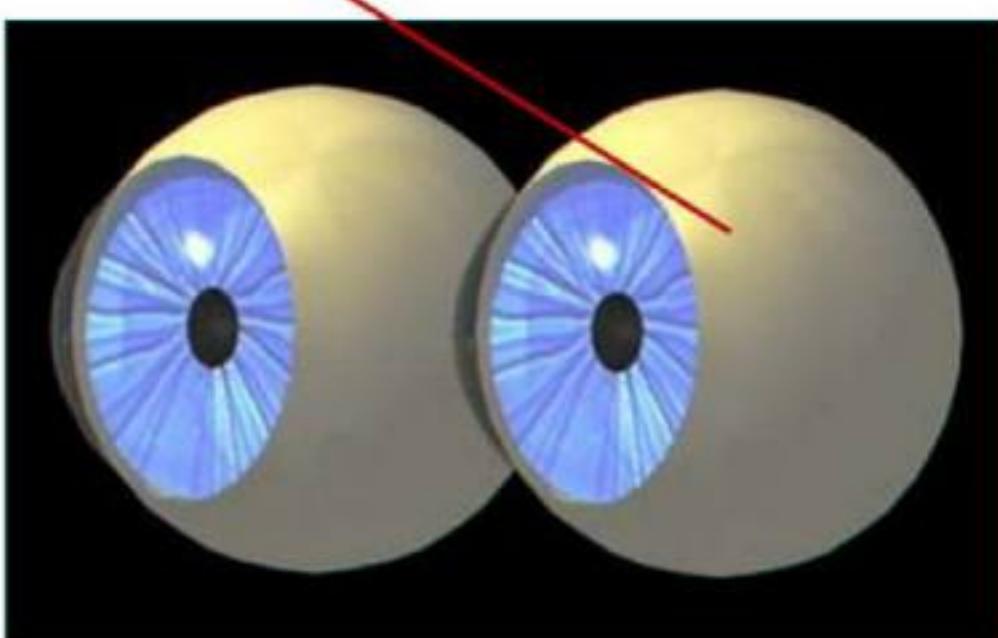
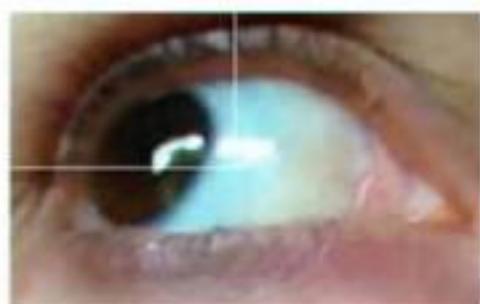
## **Structure of the eye**

1. Outer fibrous layer: sclera and cornea.
2. Middle vascular layer or uveal tract:  
consisting of the choroid, ciliary body and  
iris.
3. Inner nervous tissue layer: retina.



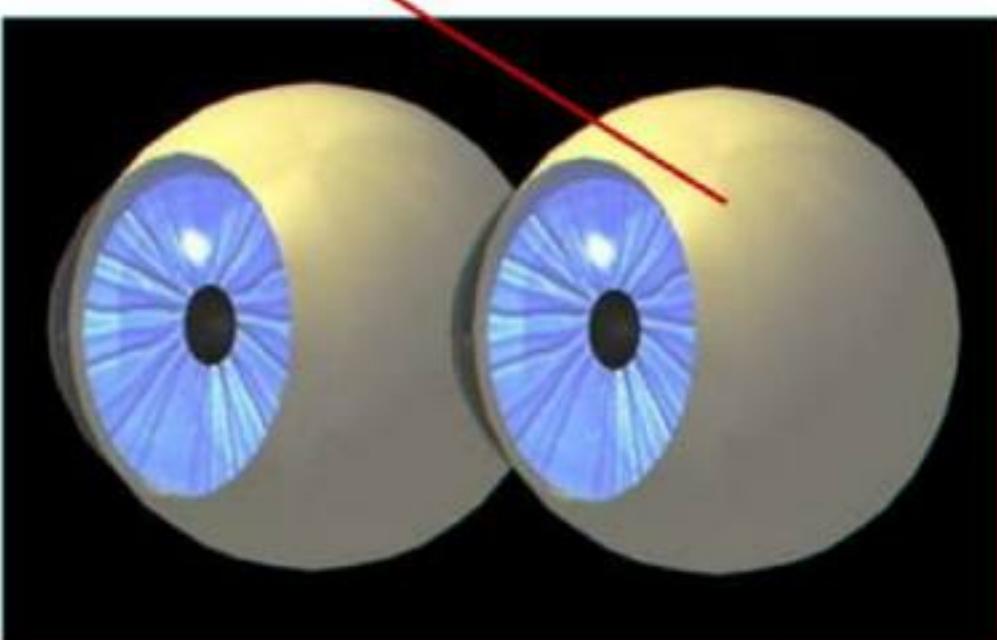
## **SCLERA (*white part*)**

**SCLERA** – a tough white skin (made of tissue) that covers all of the eyeball except the cornea.



- whites of the eye
- supports eyeball
- provides attachment for muscles

## Function of sclera



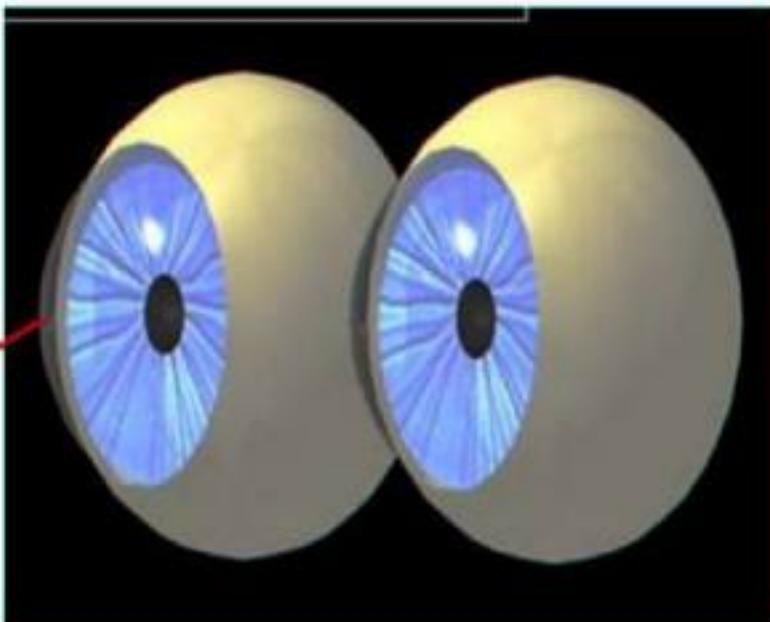
**supports  
eyeball and  
provides  
attachment  
for muscles**

## CORNEA

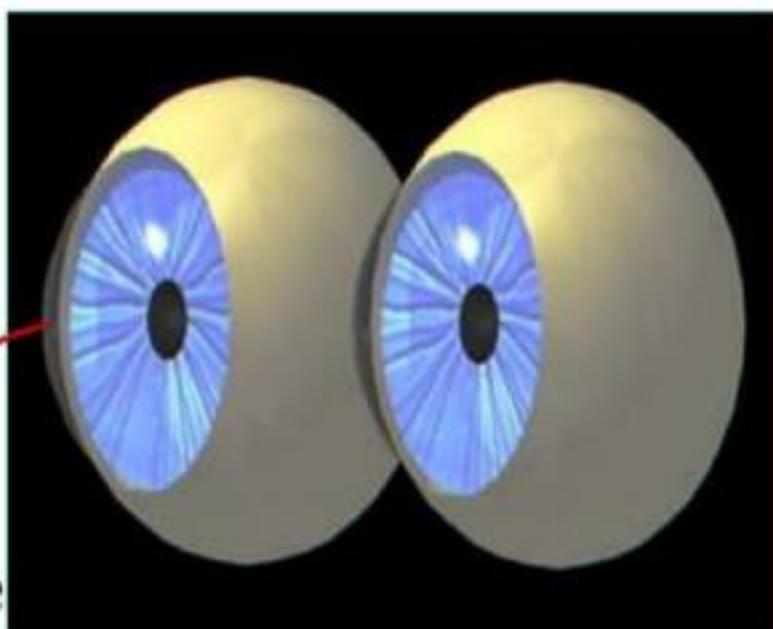
*(clear lens in front of eye)*



- Transparent covering of the front of the eye
- Allows for the passage of light into the eye and functions as a fixed lens.



## Function of Cornea

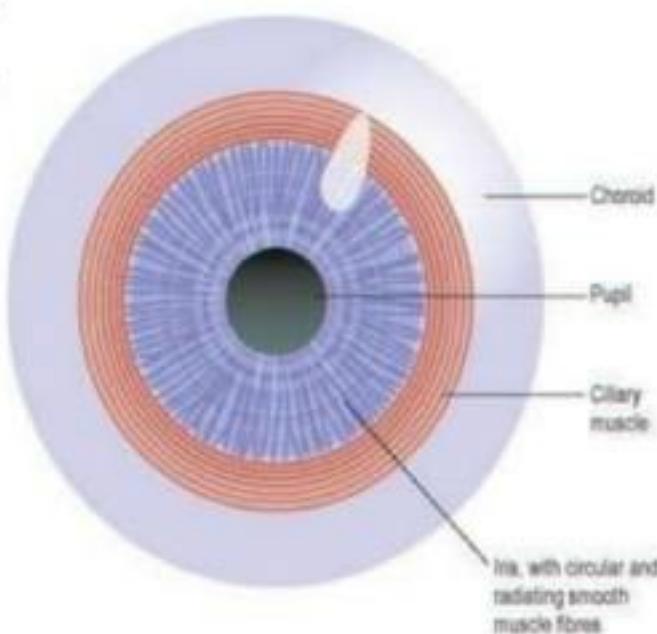


**Allows for the passage  
of light into the eye  
and it also focuses the  
light**



## Choroid *(chocolate brown in color)*

- choroid lines the posterior five-sixths of the inner surface of the sclera.
- It is very rich in blood vessels and is deep chocolate brown in colour.

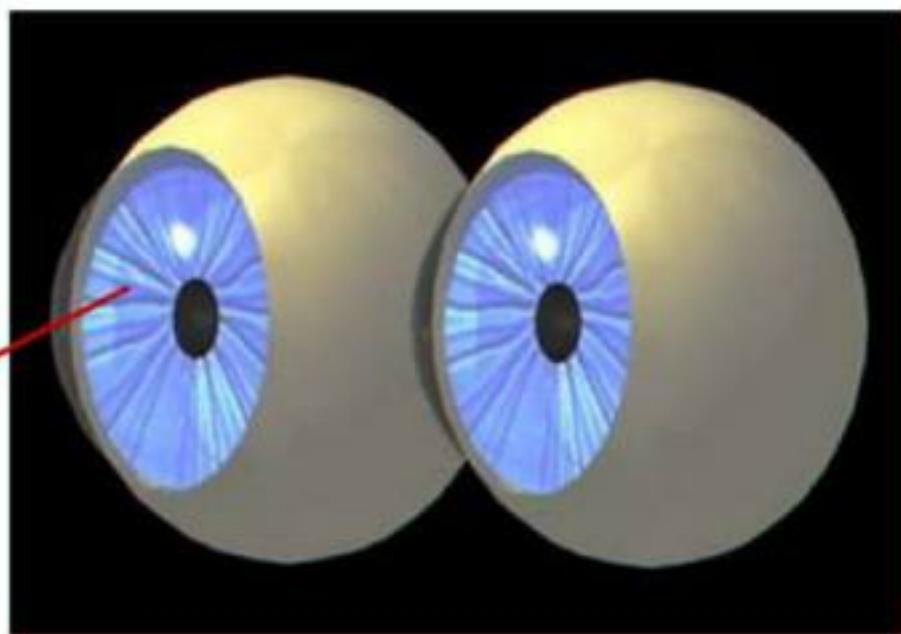
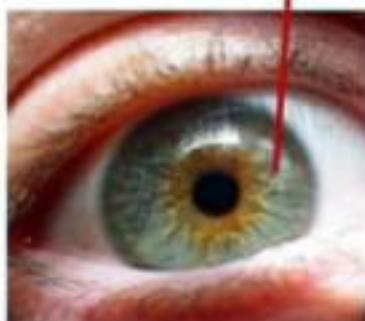


## **Function of Coroid**

Light enters the eye through the pupil, stimulates the sensory receptors in the retina and is then absorbed by the choroid.

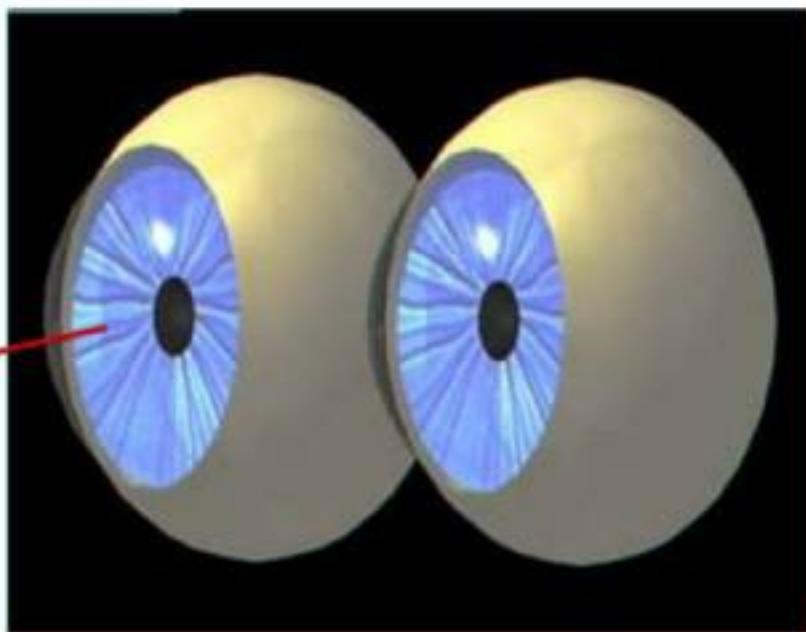
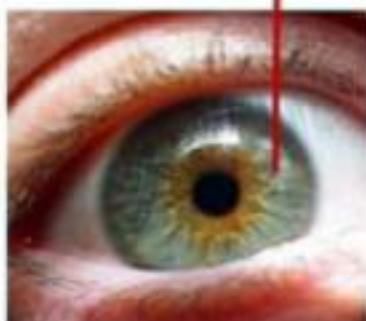
## IRIS *(colored part)*

- colored part of eye
- controls light entering



## Function of iris

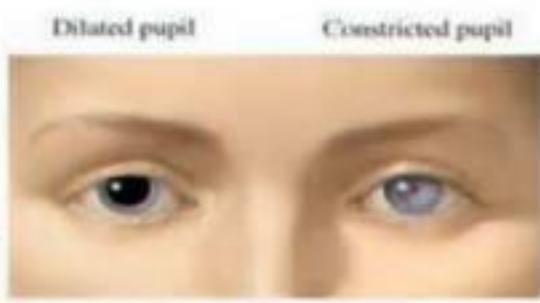
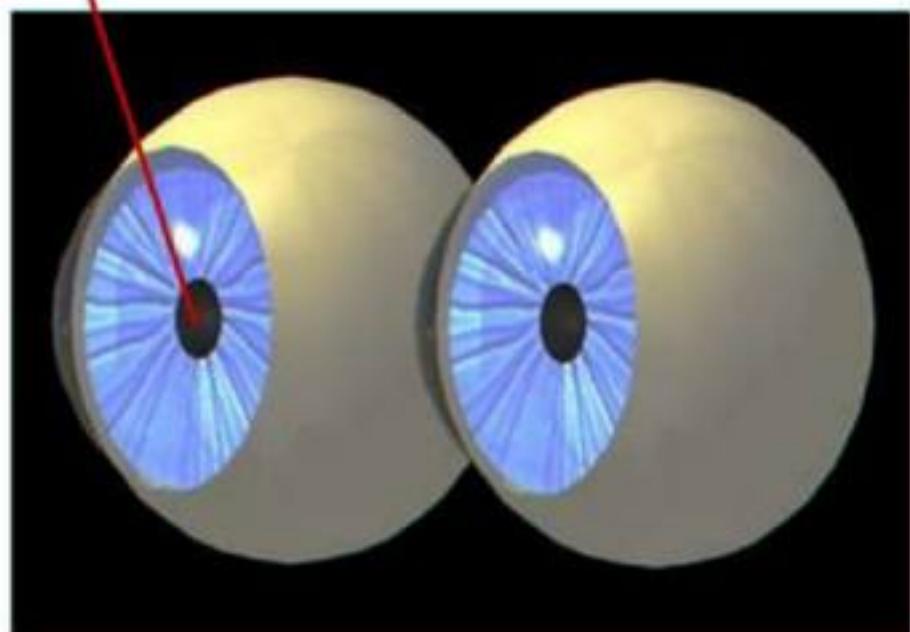
Parasympathetic stimulation constricts the pupil and sympathetic stimulation dilates it



controls the amount of light entering the eye

## PUPIL (*black hole*)

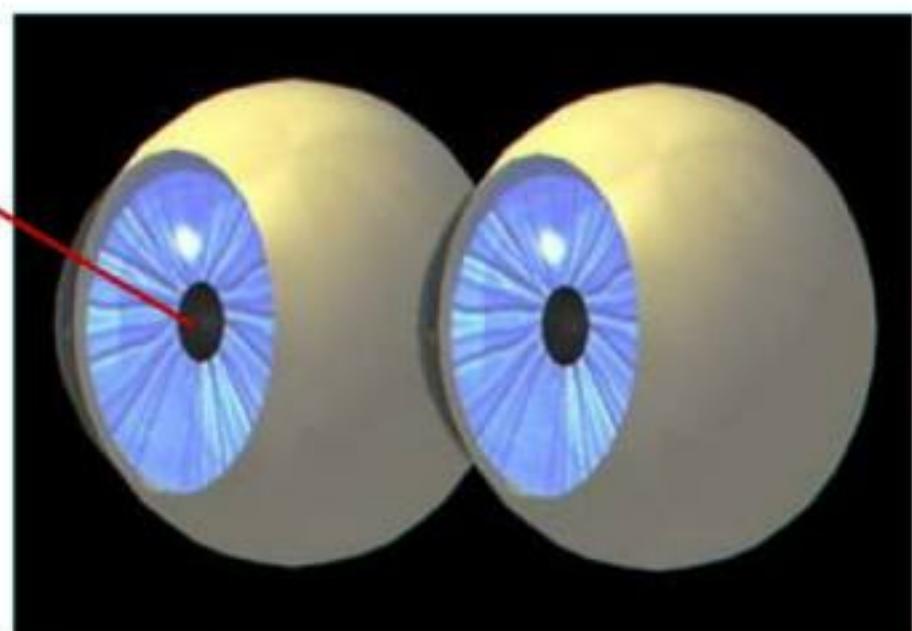
- Black hole in iris
- Where light enters



Pupil size is controlled by iris muscles

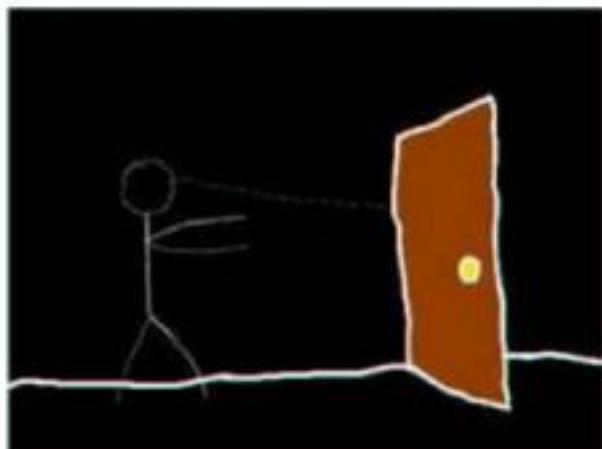
## Function of pupil

The hole where light enters into the eye



## PUPIL

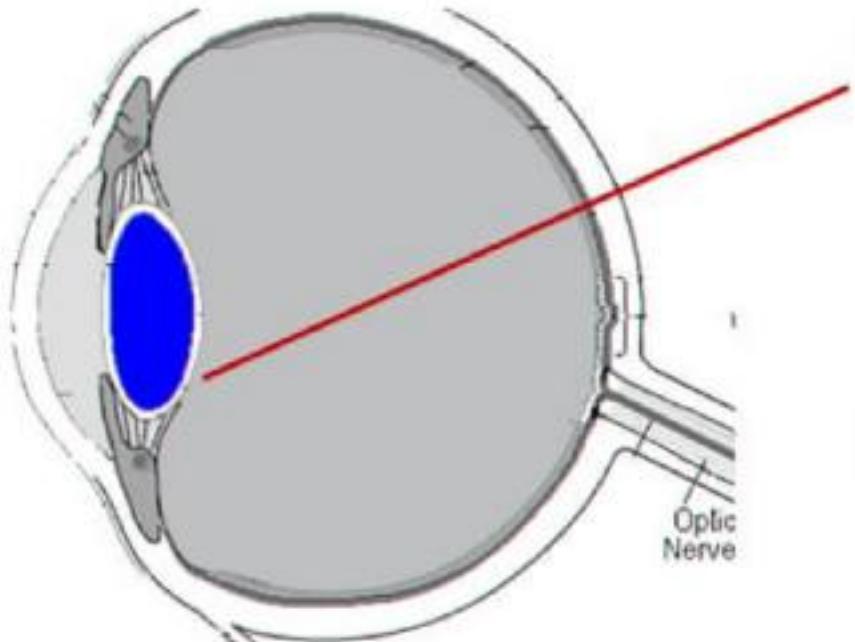
When the eye needs **more light** to enter (when it is dark), the **pupils get larger**; allowing more light to enter the eye



When the eye needs **less light** to enter (when it is very bright), **the pupils get smaller**; allowing less light to enter the eye

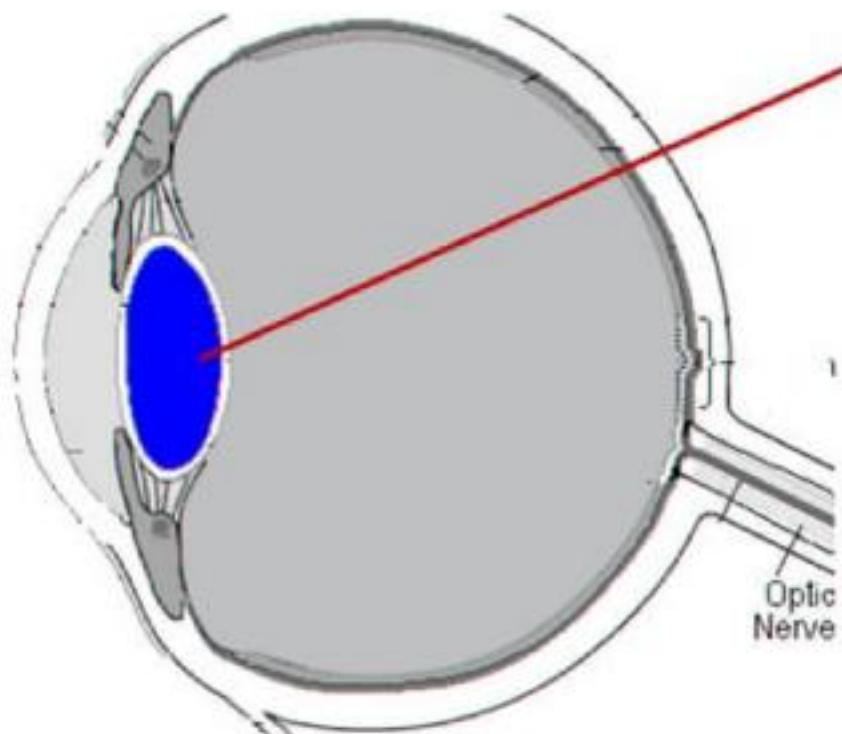


## **LENS** *(lens behind pupil)*



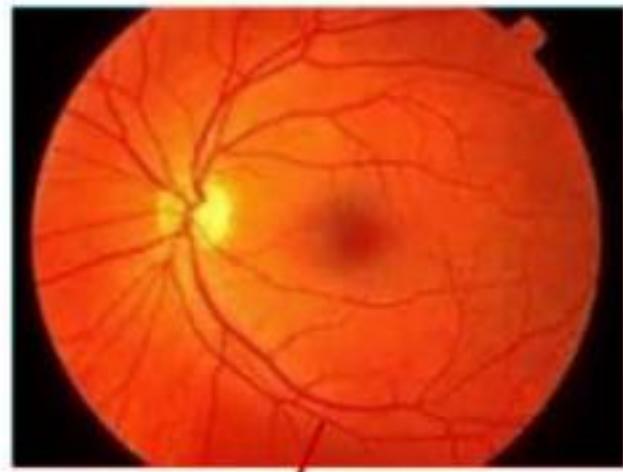
- lens is a highly elastic circular biconvex body, lying immediately behind the pupil
- allows us to see objects near and far

## Function of lens

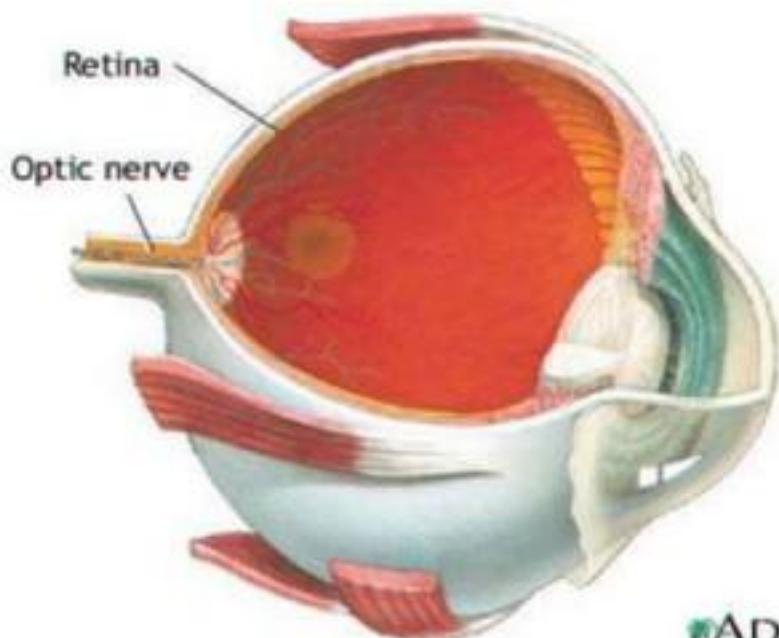


**allows us to see  
objects near and  
far**

# RETINA

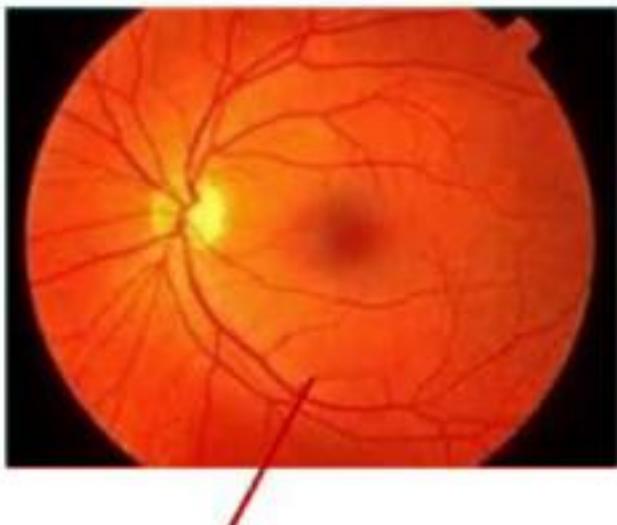


- internal membrane
- contains light-receptive cells (rods and cones)
- converts light to electrical signals

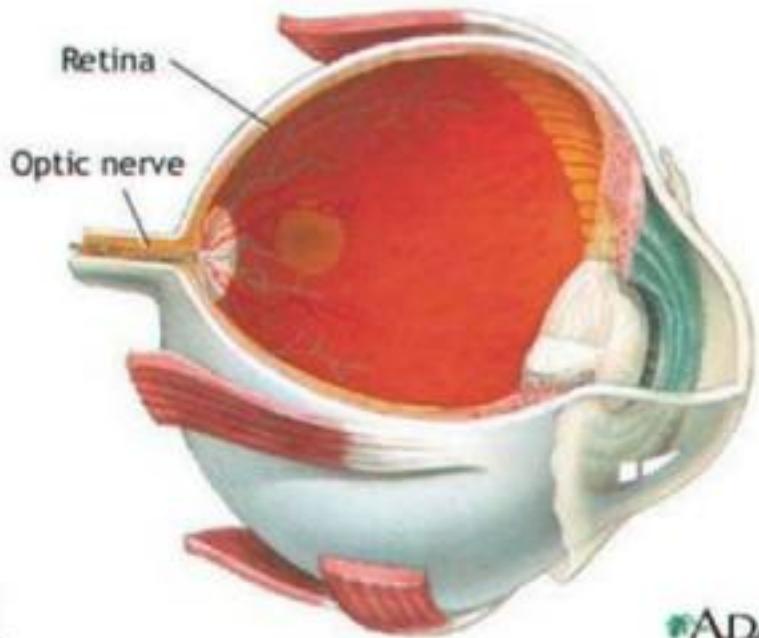


©ADAM

# Function of retina



**converts light  
waves to electrical  
signals**



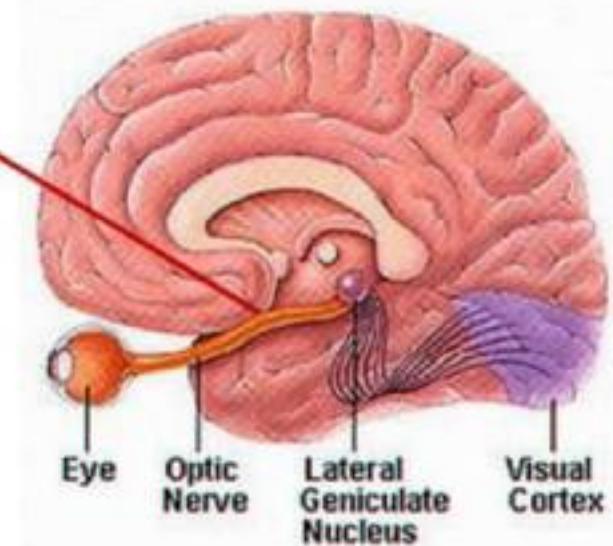
©ADAM

## **Blood supply to the eye**

The eye is supplied with arterial blood by the ciliary arteries and the central retinal artery. These are branches of the ophthalmic artery, one of the branches of the internal carotid artery.

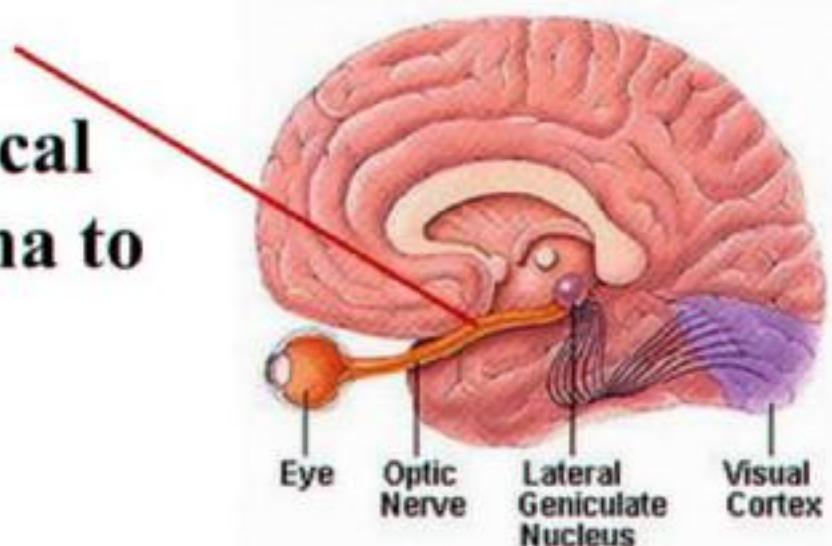
# OPTIC NERVE

- Transmits electrical impulses from retina to the brain
- Creates blind spot
- Brain takes inverted image and flips it so we can see



## Function of optic nerve

Transmits electrical signals from retina to the brain



## BLIND SPOT

- On retina where optic nerve leads back into the brain
- No rod or cone cells
- Other eye compensates for this area



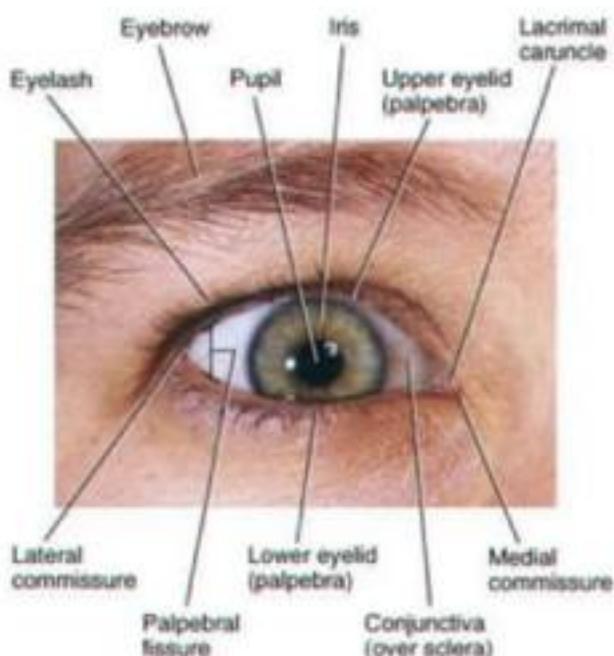
## Function of blind spot

- Small spot on the back of the retina
- Other eye compensates for this area



# Accessory Structures of Eye

- Eyelids
- Eyelashes
- Eyebrows
- Lacrimal apparatus
- Extrinsic eye muscles



## **Eyebrows**

These are two arched ridges of the supraorbital margins of the frontal bone. Numerous hairs (eyebrows) project obliquely from the surface of the skin. They protect the eyeball from sweat, dust and other foreign bodies.

# **Eyelids**

The eyelids are two movable folds of tissue situated above and below the front of each eye. On their free edges there are short curved hairs, the eyelashes

## **Functions of eye lids**

The eyelids and eyelashes protect the eye from injury:-

Reflex closure of the lids occurs when the conjunctiva or eyelashes are touched, when an object comes close to the eye or when a bright light shines into the eye – this is called the corneal reflex blinking at about 3- to 7-second intervals spreads tears and oily secretions over the cornea, preventing drying.

## **Conjunctiva**

This is a fine transparent membrane that lines the eyelids and the front of the eyeball. Where it lines the eyelids it consists of highly vascular columnar epithelium.

# **Lacrimal apparatus**

Each eye this consists of lacrimal gland and its ducts lacrimal

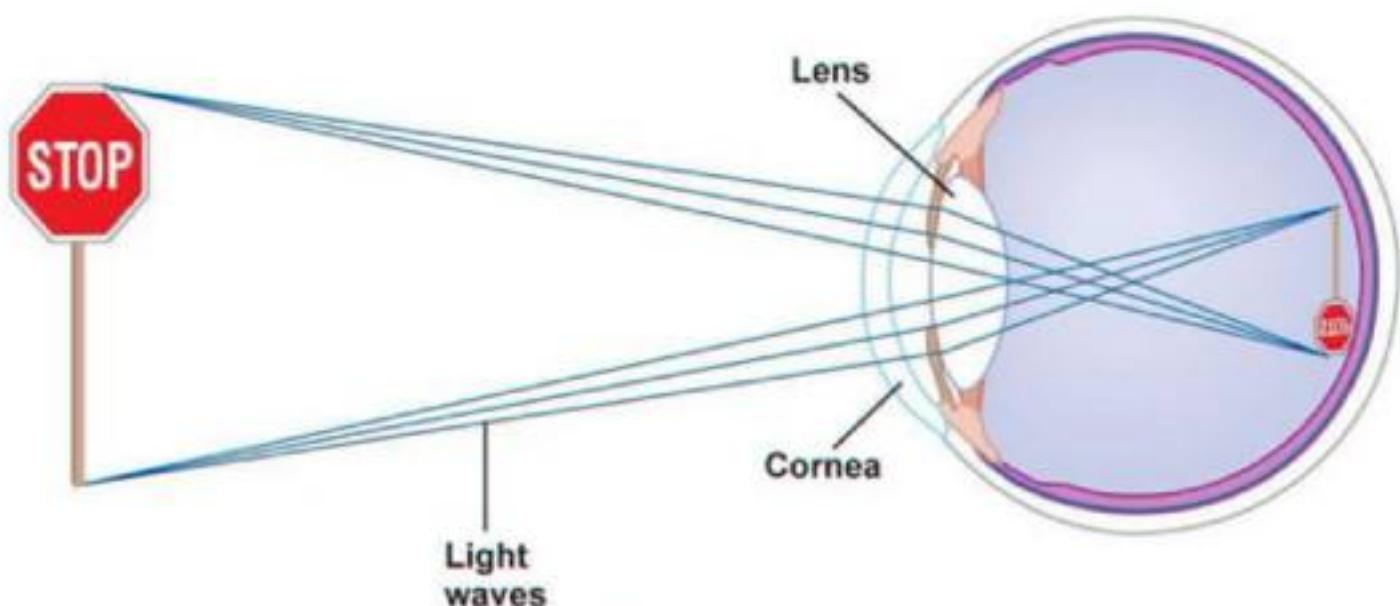
## **Lacrimal sac nasolacrimal duct.**

The lacrimal glands are exocrine glands situated in recesses in the frontal bones on the lateral aspect of each eye just behind the supraorbital margin. Each gland is approximately the size and shape of an almond, and is composed of secretory epithelial cells. The glands secrete tears composed of water, mineral salts, antibodies (immunoglobulin), and lysozyme, a bactericidal enzyme.

## **Functions of lacrimal gland**

- Washing away irritating materials, e.g. dust, grit
- Bactericidal enzyme lysozyme prevents microbial infection
- Prevents drying of the conjunctiva.

## 2 Lenses: Cornea and Lens

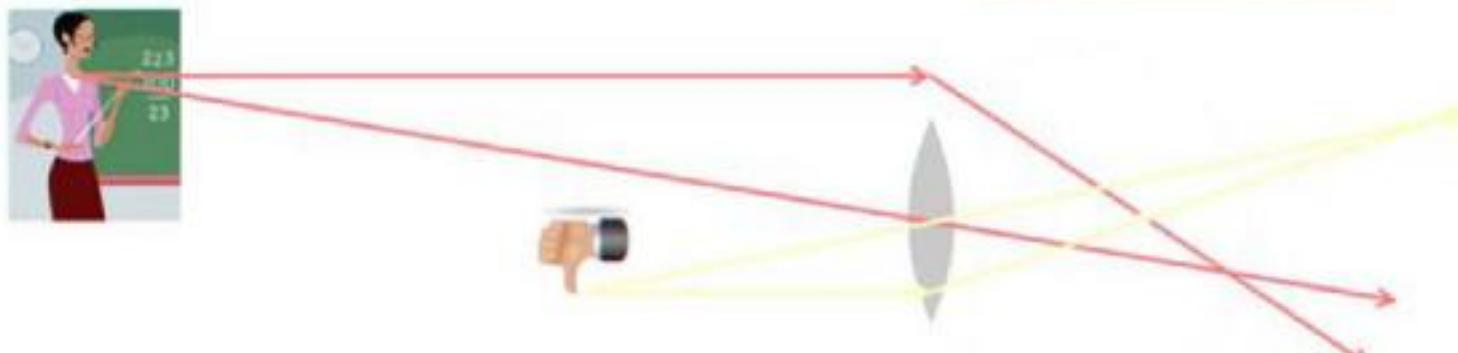


© 2011 Pearson Education, Inc.

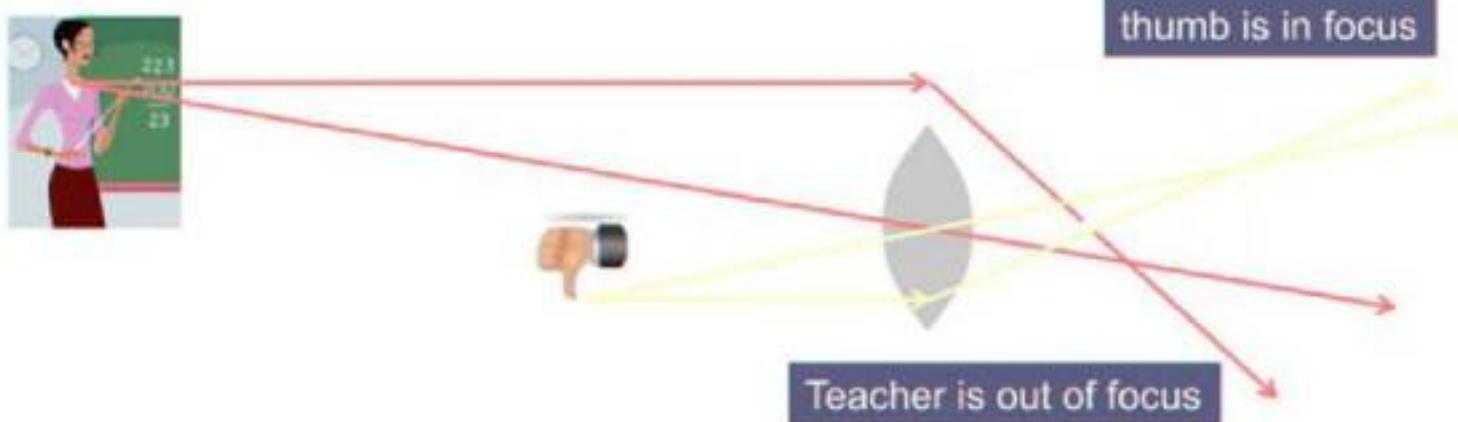
## How Your Lens Focuses

- Your lens has a small depth of field
  - You can't see something close and far with both objects in focus at the same time
- Hold out your thumb about a foot away from your eye
  - Then, alternately focus on thumb and me (right above your thumb)
- Note that you cannot see both me and your thumb sharply (in focus) at the same time
  - You focus on one or the other by changing the bulge of your lens

**thumb is out of focus**



**teacher is in focus**



**Teacher is out of focus**



THANK YOU