

وَقُلْ رَبِّ زِدْنِي عِلْمًا



PERIPHERAL NERVOUS SYSTEM



SUBJECT : Anatomy

LEC NO. : 1

DONE BY : Batool Alzubaidi + Hashem Ata

#كَلِينِيكَال_إِلَا_شَحْطَة



Central pathways for special senses

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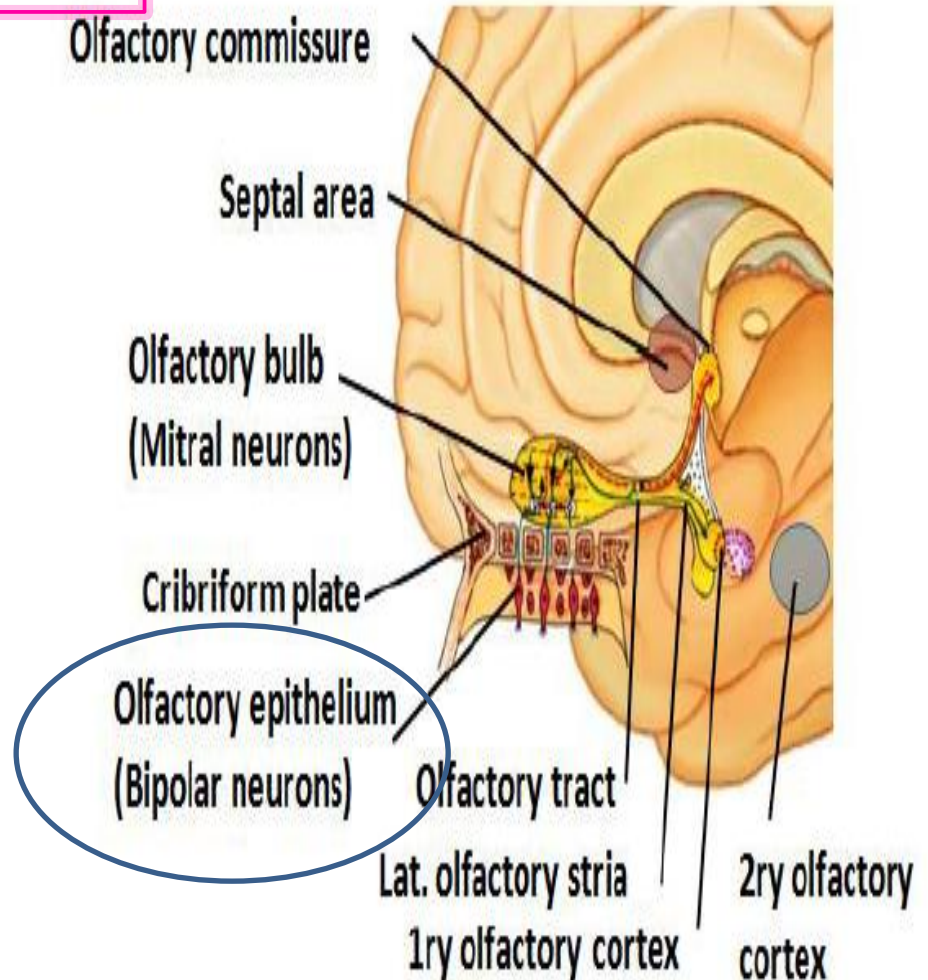
Objectives

- Describe olfactory pathway.
- Describe taste pathway.
- Describe visual pathway.
- Describe auditory pathway.
- Describe vestibular pathway.

OLFACTORY PATHWAY

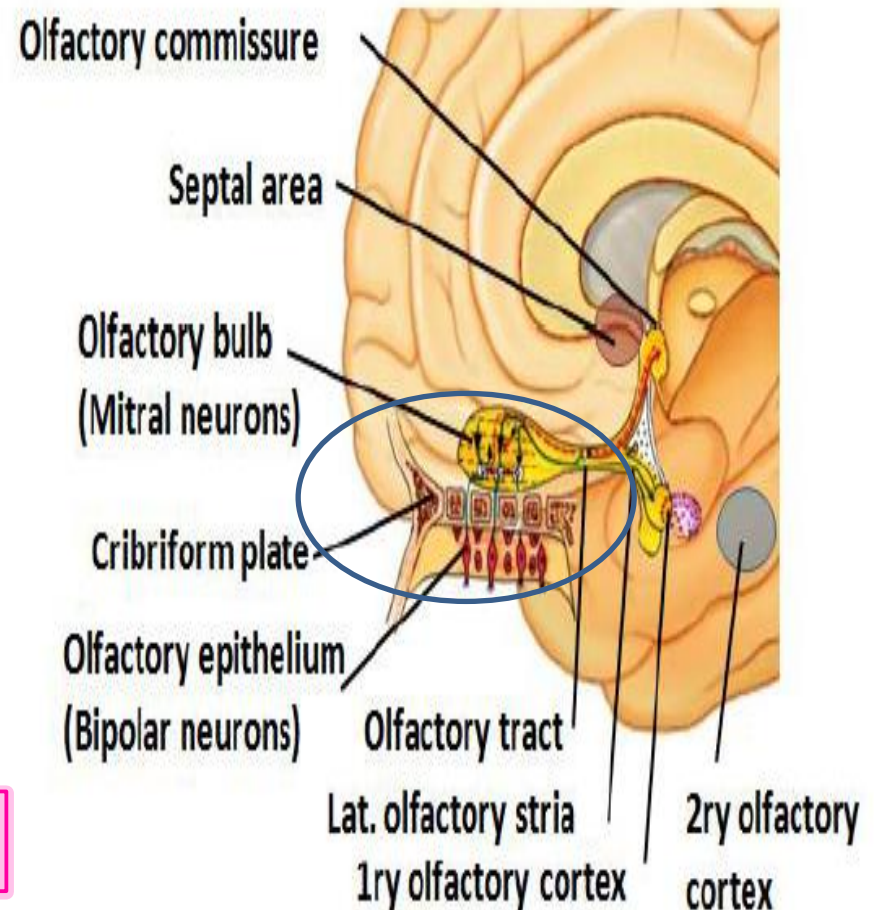
Roof of the nose formed by cribriform plate of ethmoid bone

- The **olfactory epithelium** lines the roof of the nose extending slightly on the medial and lateral walls. It contains **bipolar neurons** whose peripheral processes are the **olfactory receptors**.

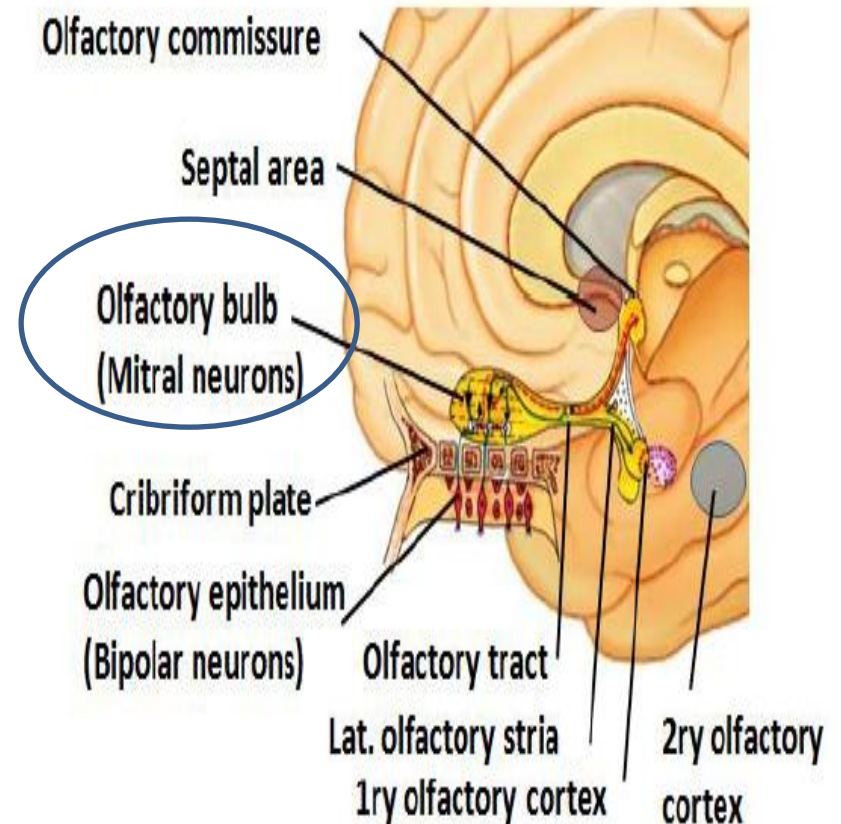


The **olfactory nerve** is formed by the **central processes** of the **bipolar neurons** which **collect into 20 filaments** that **traverse the cribriform plate** of **ethmoid bone** to **end in the olfactory bulb**. ↴

In the inferior surface of the brain, in olfactory sulcus



- The **olfactory bulb** lies in the **orbital sulcus** on the **orbital surface** of the **frontal lobe**. The olfactory nerve fibers **synapse** with the **mitral and tufted cells** whose **axons** run in the **olfactory tract**.



The olfactory tract

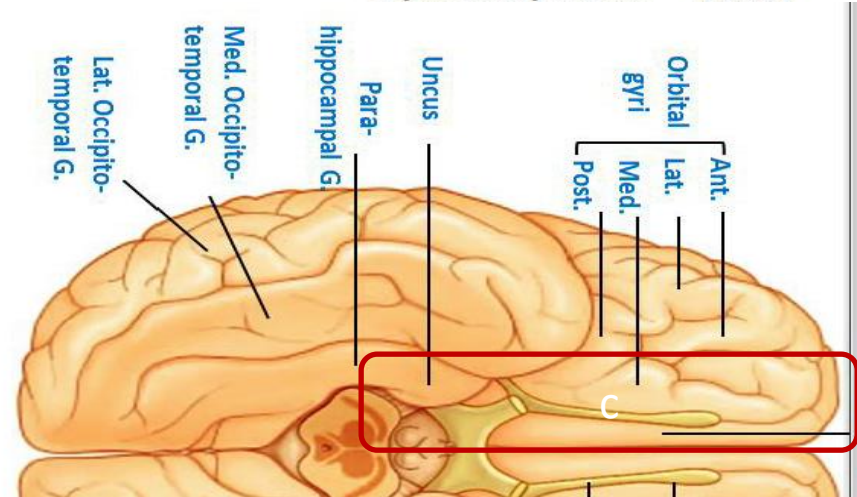
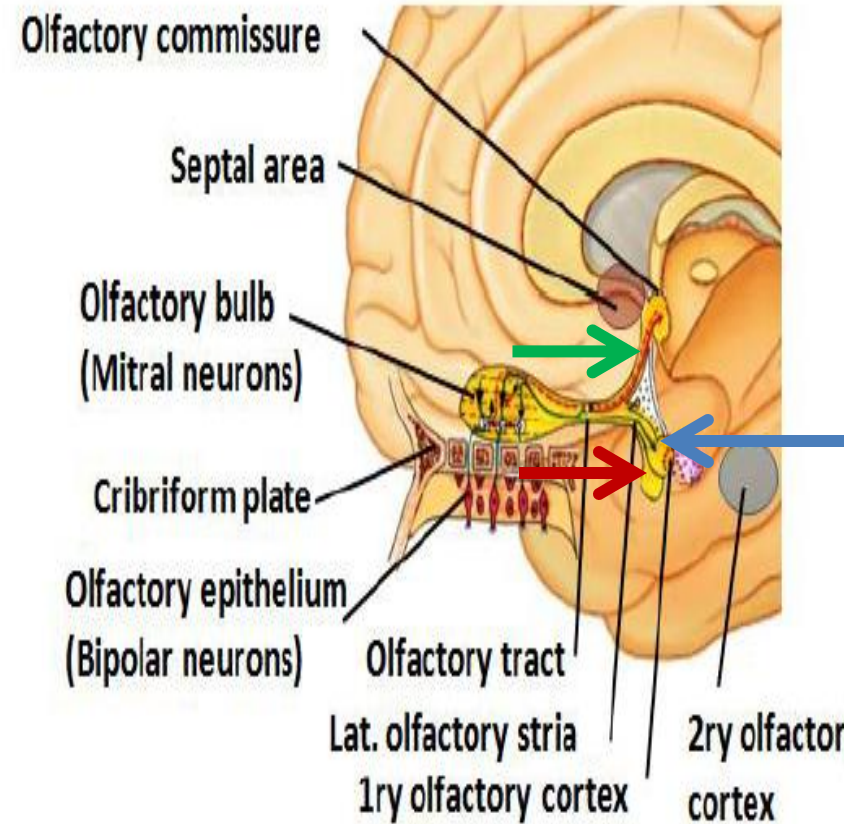
extends till the anterior perforated substance which is located lateral to the optic chiasma where it forms

3 olfactory stria which terminate as follows:

1. Lateral olfactory stria to **1ry olfactory cortex** →

2. Intermediate olfactory stria (small) ends in a **small tubercle** (olfactory tubercle) in the **anterior perforated substance**. →

3. Medial olfactory stria to **paraterminal gyrus & paraolfactory gyrus** (parts of the **septal area**) & **anterior commissure**. →



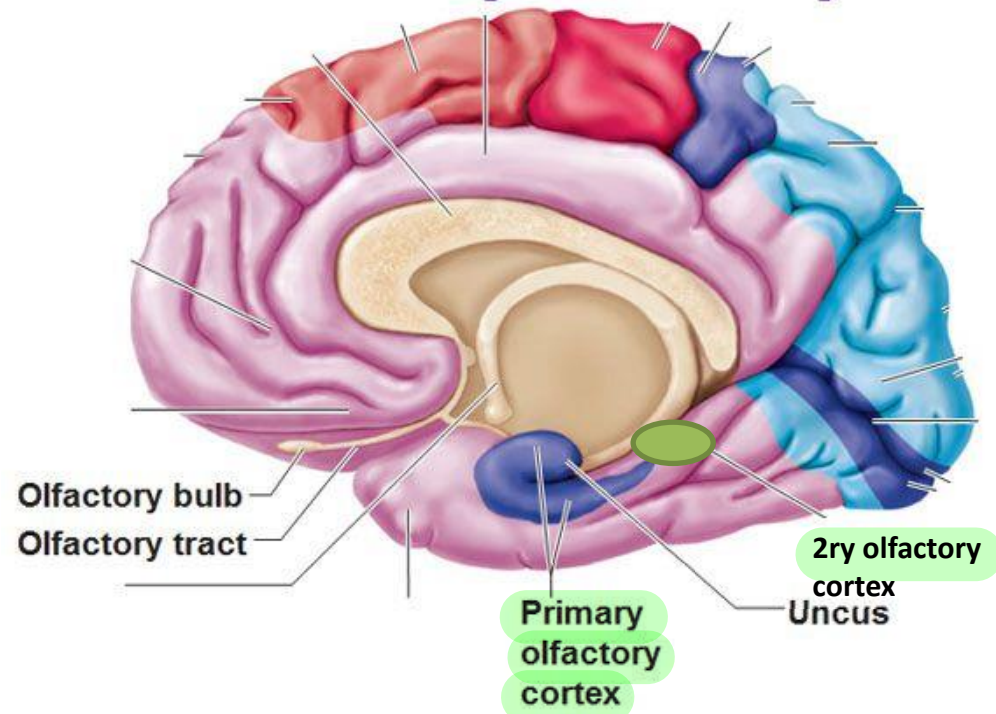
- **The 1ry olfactory cortex** lies in 3 regions: uncus + part of amygdala + apex of insula) to
- **2ry olfactory cortex** (entorhinal area or area 28 in the anterior part of the parahippocampal gyrus).
- The olfactory pathway is linked to the limbic system.

- It is the only sensation that reaches the cortex without relaying in the thalamus

Applied anatomy: Anosmia (loss of smell) may be:

- - Unilateral: due to frontal lobe tumor.
- - Bilateral: due to fracture of the cribriform plate of ethmoid

Olfactory Pathway



Parasagittal view, right hemisphere

■ Primary motor cortex	■ Motor association cortex
■ Primary sensory cortex	■ Sensory association cortex
■ Multimodal association cortex	

مربوط فيه بال emotion and memory عشان هيك
 بنربط الروائح بالذاكرة سواء منيحة او لا، و الذكريات
 السيئة و ال anger and fear مربوطين بال amygdala

Most of respiratory infections damage olfactory neurons resulting with anosmia like corona virus

TASTE PATHWAY

- Taste receptors are present on **the tongue**, the **epiglottis** & the **lingual surface of soft palate**. Taste sensation is carried by 3 cranial nerves: **facial, glossopharyngeal & vagus. (7.9.10)**

First Neuron

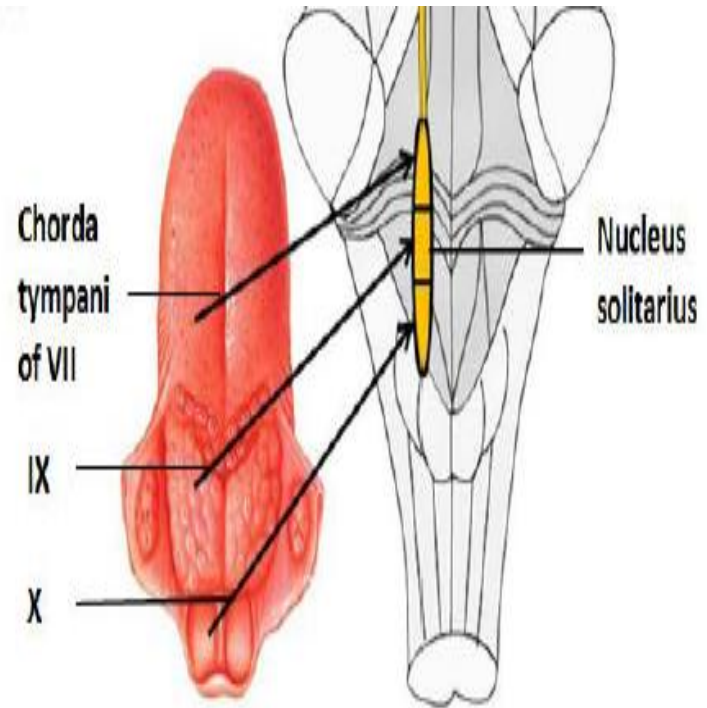
Pseudounipolar cells of:

1. Geniculate ganglion of facial nerve: receiving taste from anterior 2/3 of tongue + soft palate

2. Inferior ganglion of glossopharyngeal: receiving taste from posterior 1/3 of tongue

3. Inferior ganglion of vagus: receiving taste from most posterior part of tongue & epiglottis.

و حكينا عن قصة ال epiglottis قبل لانه supplied بال vagus لو كان فيه disease زي epiglottitis مثلا بكون hydrasensitive فانت لو كشفت و عملت tongue depression ممكن تسبب cardiac arrest للمريض



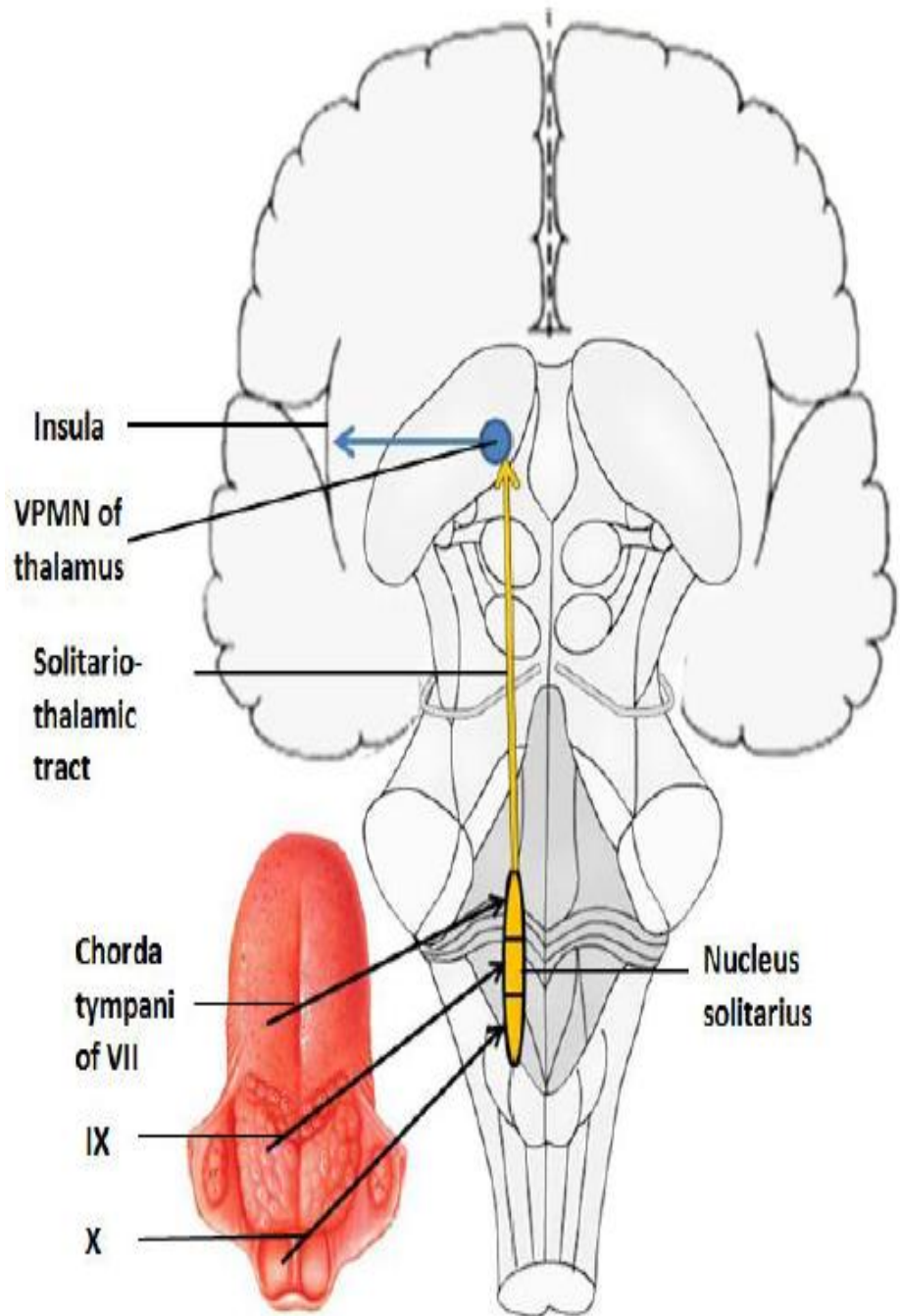
هاد هو المسؤول عن ال gag reflex لما يدخل اشئ بتمك كبير راح تحس بشعور ال vomiting زي لما تكون عند دكتور الاسنان

Second Neuron: Neurons of nucleus solitarius.

Their axons ascend in the solitariothalamic tract of the same side to the VPMN.

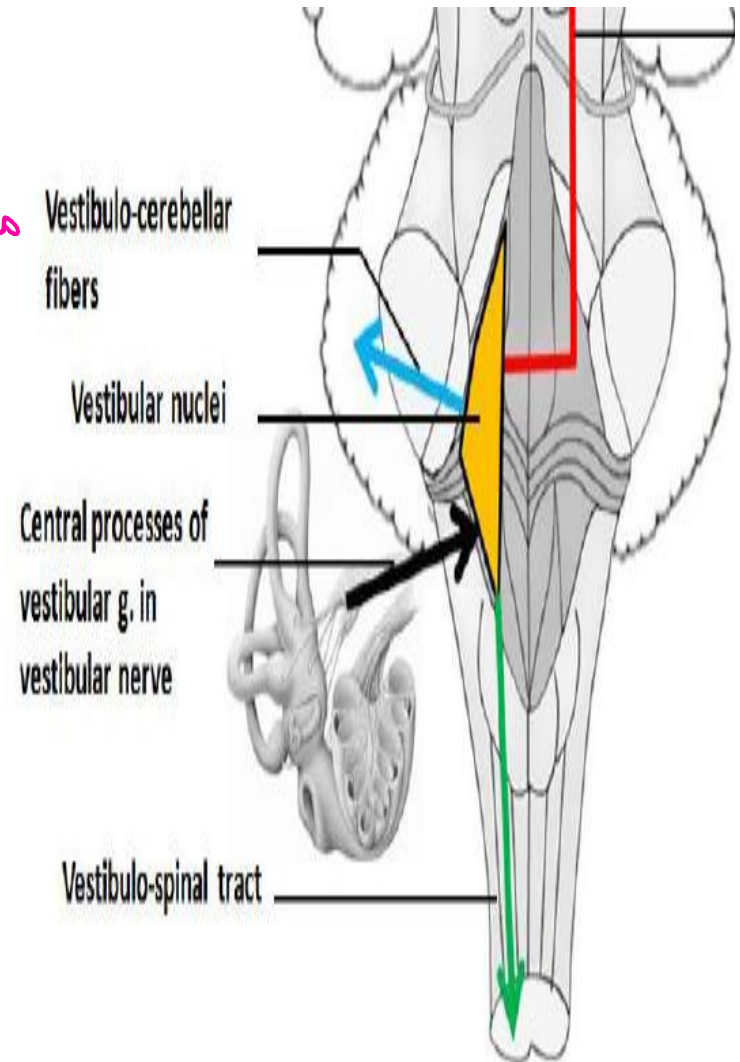
Third Neuron: Neurons of VPMN of thalamus whose axons project to the insula.

Both smell & taste end on the cortex of the same side.



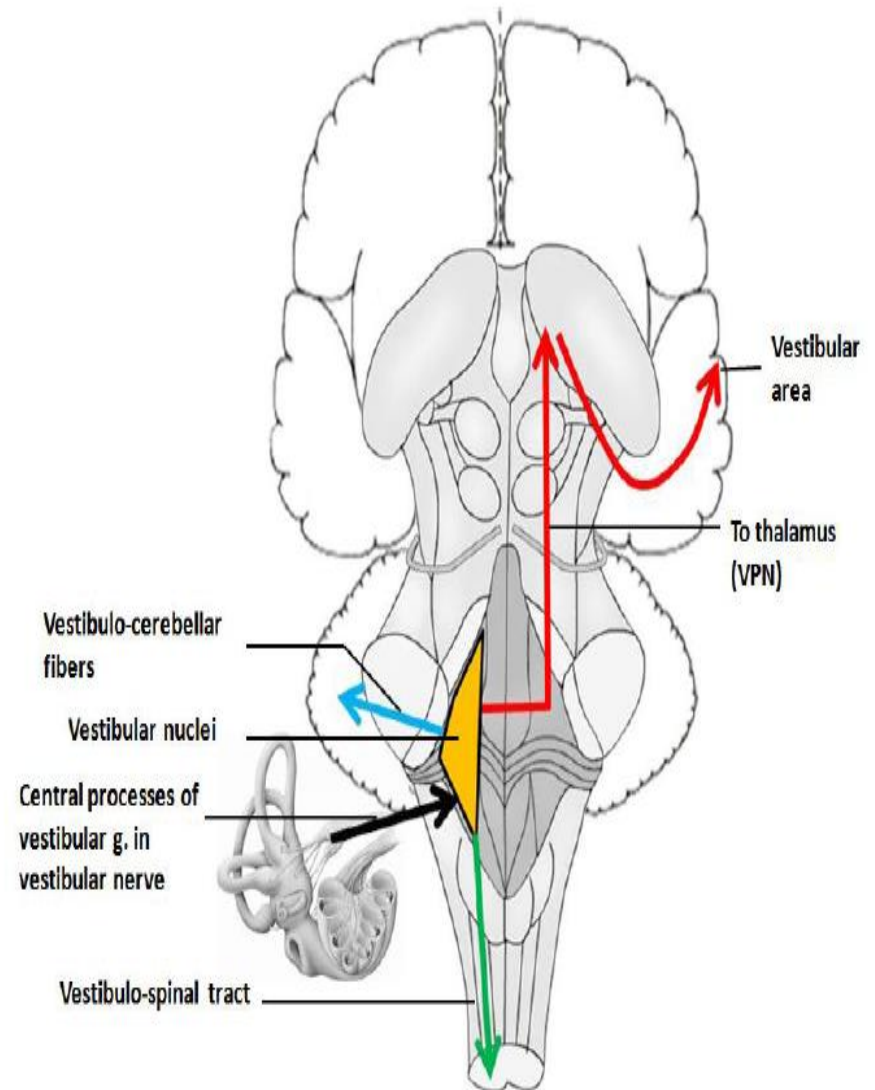
VESTIBULAR PATHWAY

- **Receptors** are present in Semicircular canals (Ampullae) "Crista Ampularis" and in Saccule and Utricle (maculae) مسئول الاتزان
- From these receptors impulses pass to the **vestibular ganglion**
- Central processes of vestibular ganglion form **vestibular nerve** that passes through internal auditory meatus to enter Pons where they end on the vestibular nuclei in Pons and Medulla
- There are four **vestibular nuclei**: superior, inferior, medial and lateral vestibular nuclei; all located beneath the lateral part of floor of fourth ventricle in Pons and Medulla



Connections of the vestibular nuclei

1. **To cerebellum** through ICP; vestibulo-cerebellar fibers end in the flocculonodular lobe to affect equilibrium
2. **To spinal cord** form vestibulo-spinal tracts to influence motor neurons concerned with control of posture and balance.
3. **To Medial Longitudinal Bundle (MLB)** to connect with nuclei of III, IV, VI for coordination of head and eye movement.
4. **To Thalamus**; Ventral Posterior Nucleus then to cerebral cortex "vestibular area"

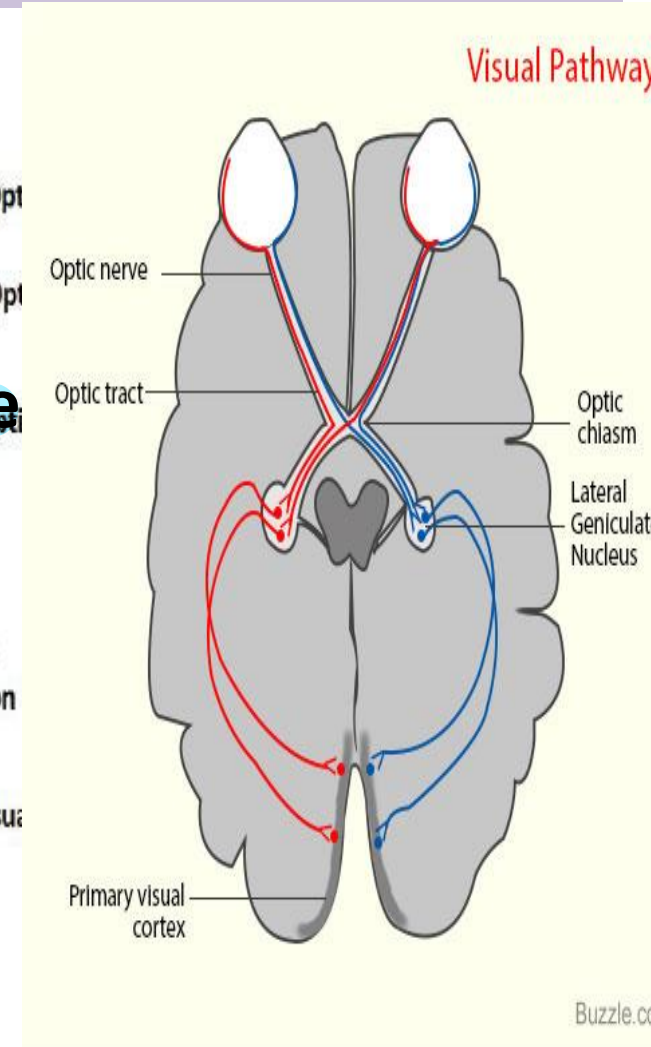


Visual Pathway

Visual Pathway

It is formed of 3 neurons, the first and second neurons are in the retina while the third one is formed by cells of LGB.

- 1st order neuron: bipolar nerve cells of retina
- 2nd order neuron: ganglion cells of retina whose axons form the optic nerve
→ optic chiasma → optic tract
↳ Decussation
- 3rd order neuron: cells of lat. geniculate body, their axons form the optic radiation that passes in the retrolentiform part of internal capsule
→ visual cortex.



Visual Pathway

➤ Photoreceptors:

Rods & Cones of retina

➤ 3 neuron pathway

▪ 1st order neurons:

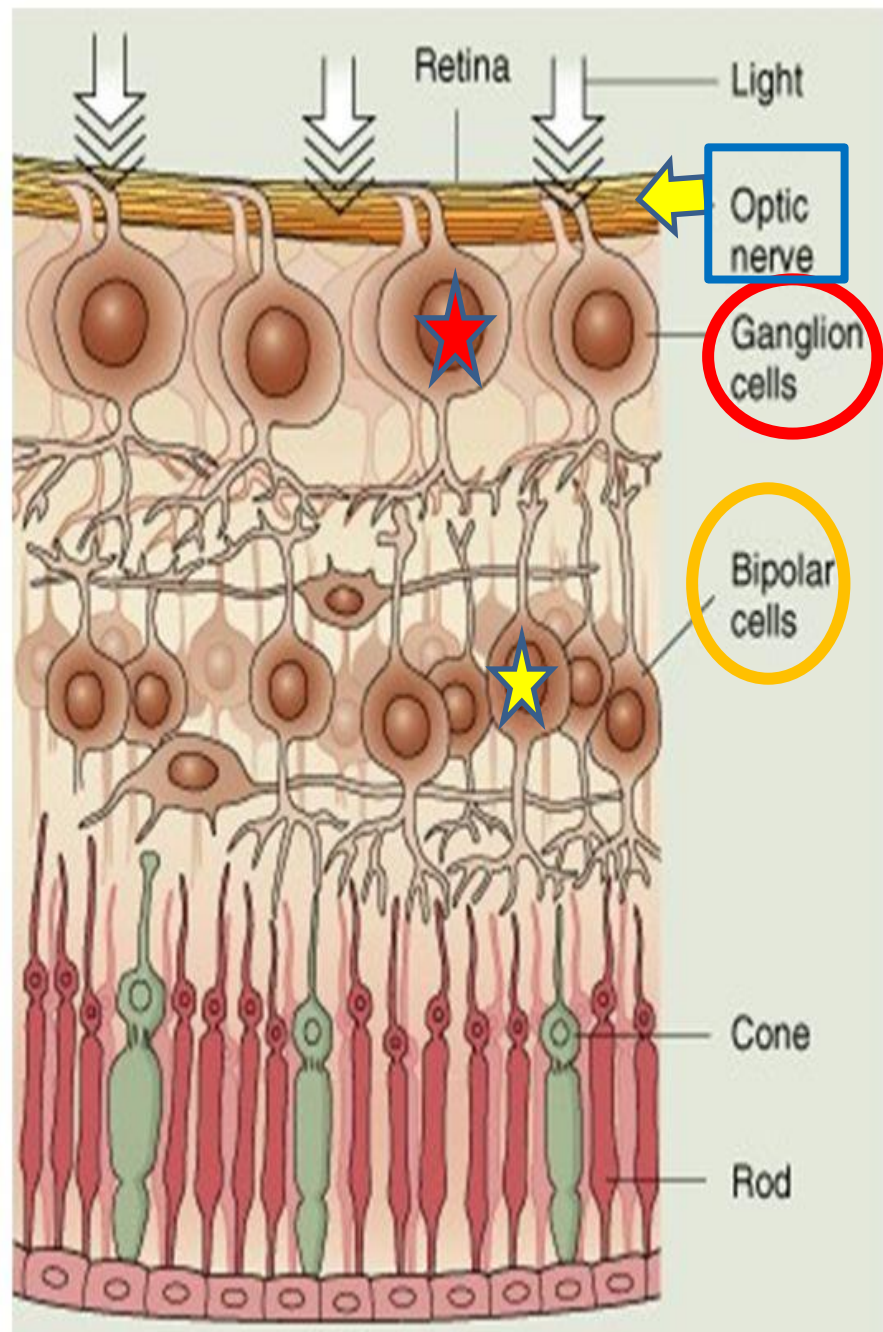
Bipolar cells of retina.

▪ 2nd order neurons:

Ganglion cells of retina. Their axons form the **optic nerve**

▪ 3rd order neurons:

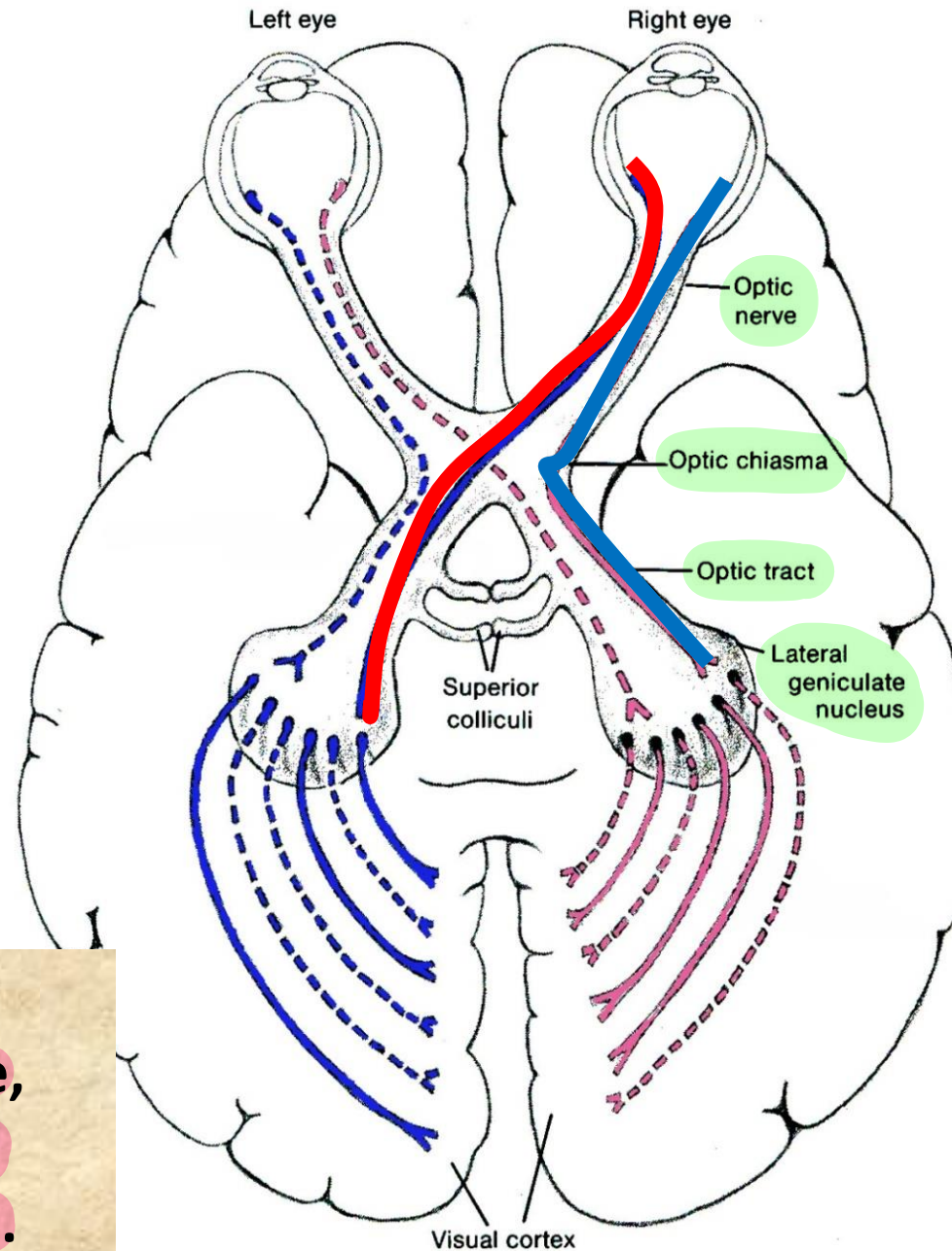
Neurons in the lateral geniculate body. Their axons terminate in **primary visual cortex**.



2nd order neuron:

- Axons of ganglionic cells in the retina form the optic nerve fibers.
- The two optic nerves join together in the optic chiasma.
- In the optic chiasma, fibers from the ^{1.}nasal ½ of the retina **decussate** into the contralateral optic tract whereas the ^{2.}temporal fibers pass uncrossed to the ipsilateral optic tract. The ^{3.}macular fibers partially decussate in the chiasma and pass into the optic tracts of both sides.

Accordingly, the optic tract carries temporal fibers from the same side, nasal fibers from the opposite side and macular fibers from both sides.



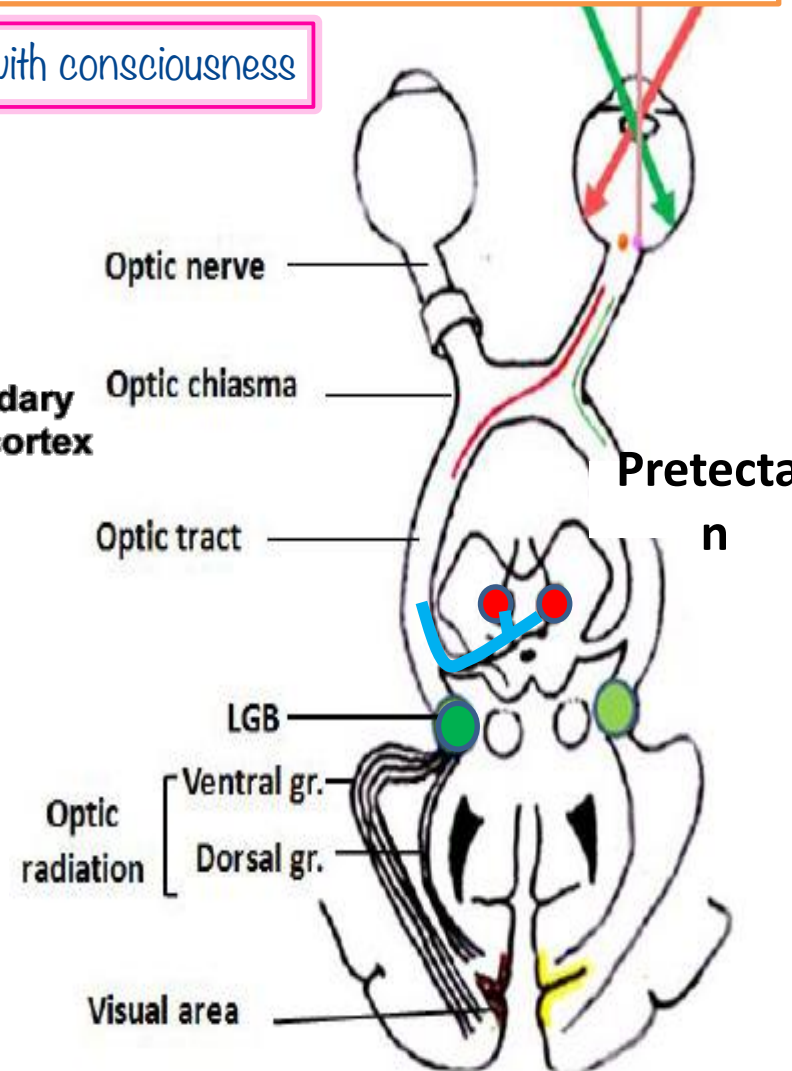
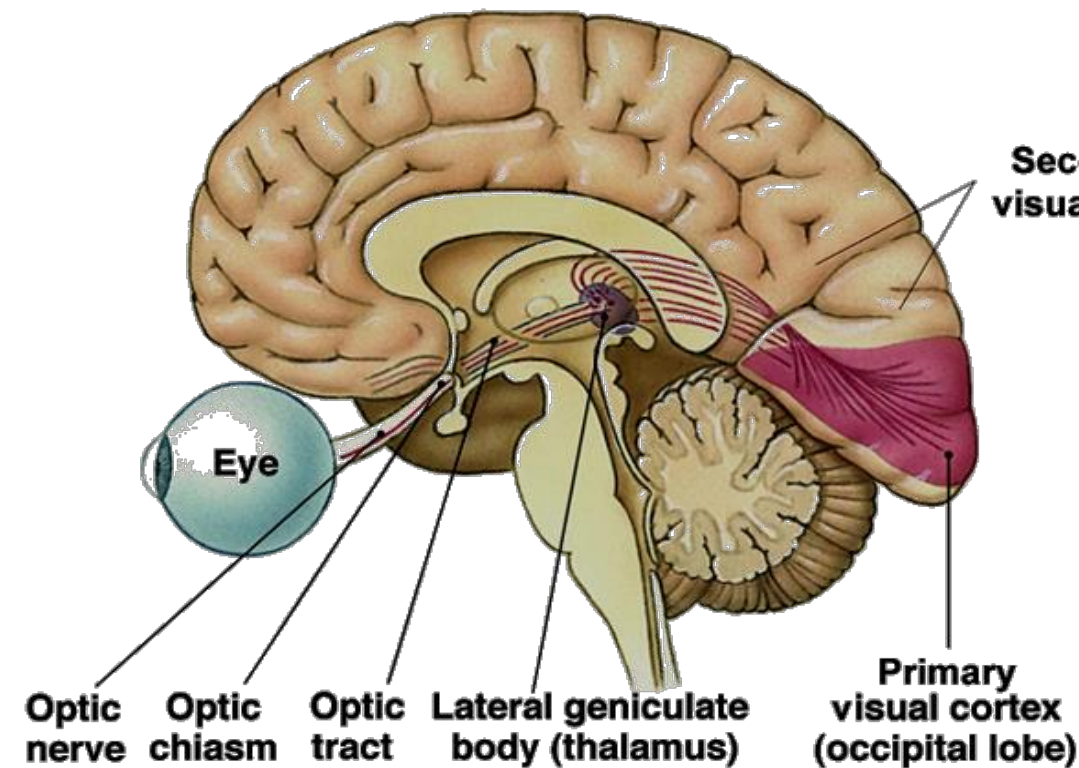


ال macula هي نقطة حدة الابصار، النقطة الاساسية
للابصار عنا .. انت لما تتطلع على اشى هل كل اجزاء
عينك بتشوف بنفس القوة؟؟ اكيد لا الجزء الي بالنص
central area of the retina هو الي بشوف بقوة اما
ال lateral of the eye field الجزء ال
بشوف اضعف ما
بتقدر تقرأ فيه مثلاً و بياخد double blood supply

ال optic nerve يكون طالع من ال retina ل optic chiasma يكون ماشي
فيه ال nasal and temporal بس يوصلوا ال chiasma ال nasal will
decussate اما ال temporal will not decussate و راح يمشوا بال
ال optic tract الي هي المنطقة من ال chiasma لحد ال lateral geniculate
body، بالنسبة لل macular بتعمل partial decussation يعني جزء من
ال fibers بروحوا contra lateral و جزء منهم بضل ipsilateral و هيك
بكونوا ال macular fibers من التنتين اليمين و الشمال ماشيين ب both
of optic tracts .. فهيك يكون بال tract ماشي contralateral nasal
and ipsilateral temporal and macular from both sides

The optic tract contains visual fibers that terminate in the **LGB**. Some fibers pass to the superior colliculus of midbrain and the pretectal nucleus (these fibers are concerned with light reflexes).

For pupil constriction » responsibility of brain stem, isn't affected with consciousness



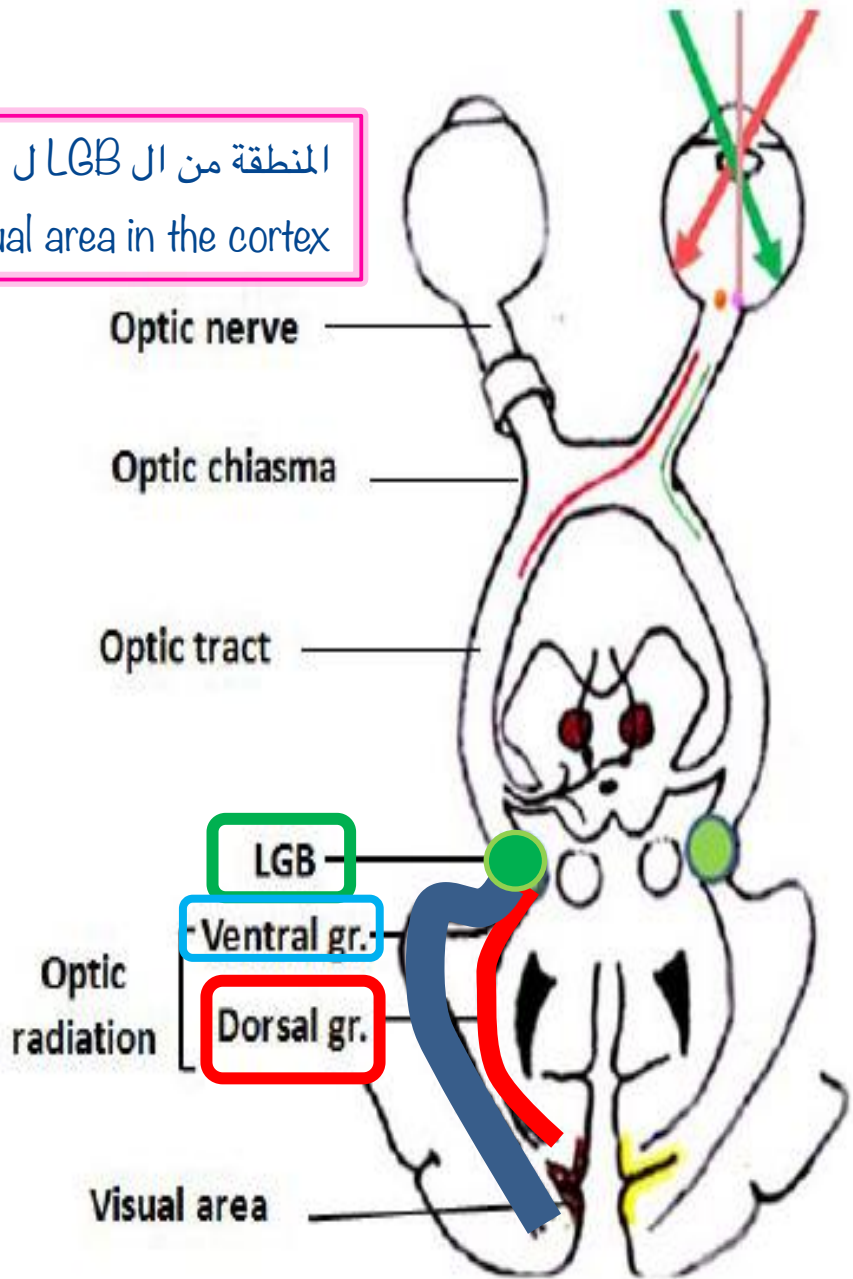
3rd order neuron:

□ Is formed by **neurons of the LGB**. Their axons form the **optic radiation** which passes through the **retrolentiform part of internal capsule**, splitting into two groups:

1. **Dorsal group** from the **upper quadrant of retina**
2. **Ventral group** from the **lower quadrant of retina**

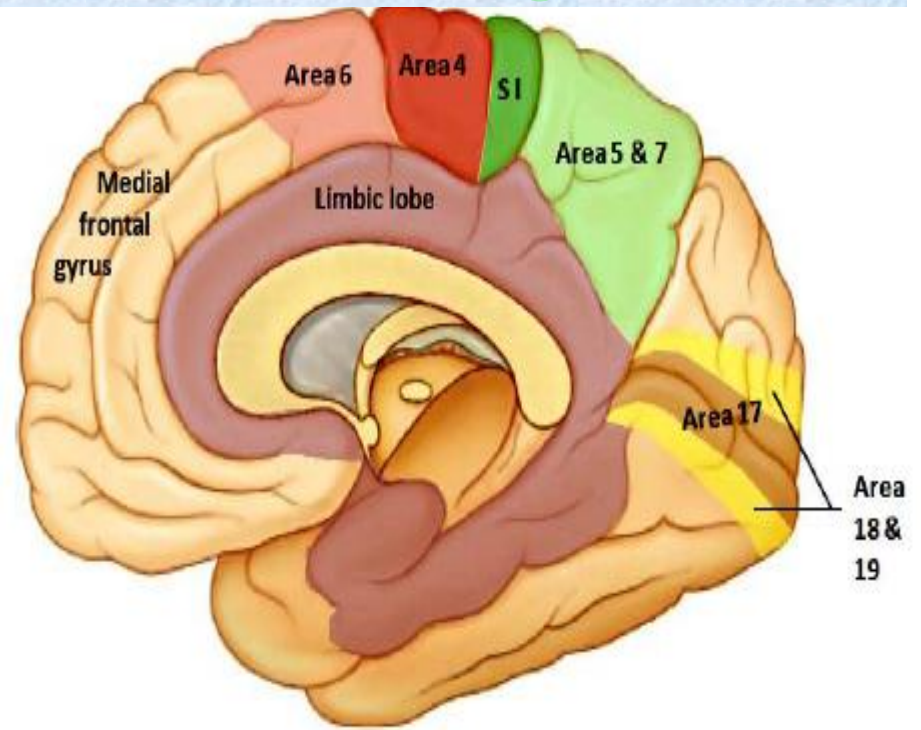
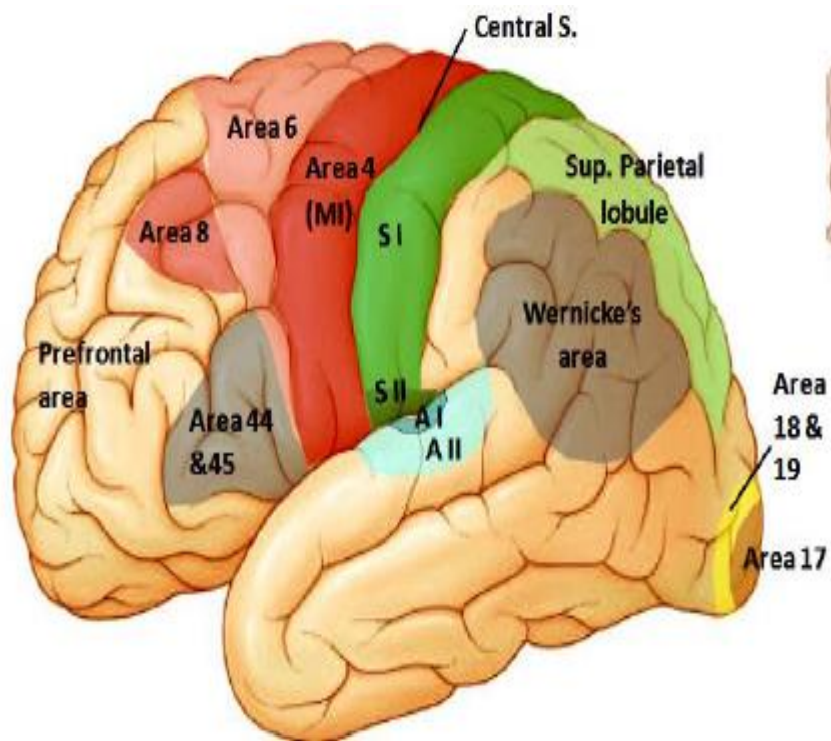
□ Both groups **join together in the occipital lobe to end in the cortical visual area**.

المنطقة من ال LGB ل
visual area in the cortex



■ Visual cortex:

Lies in the **occipital lobe**, **below precalcarine sulcus** & **on both sides of the postcalcarine sulcus**, extending to the occipital pole. It is supplied by the **posterior cerebral artery**.

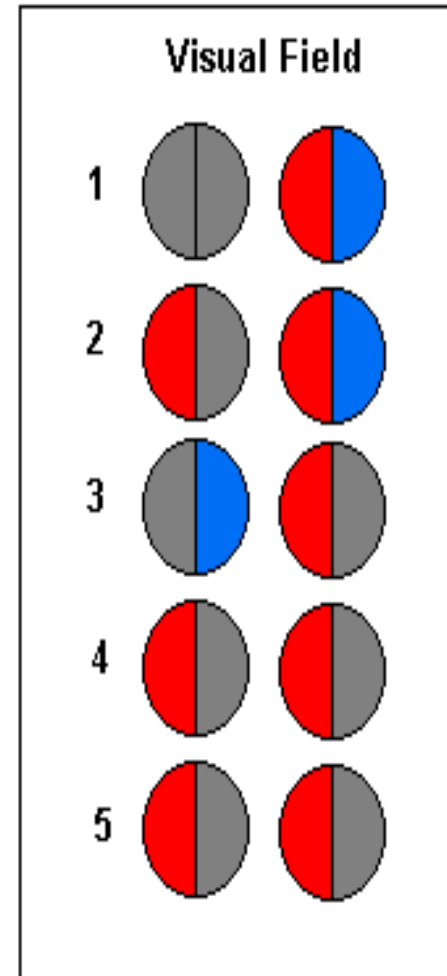
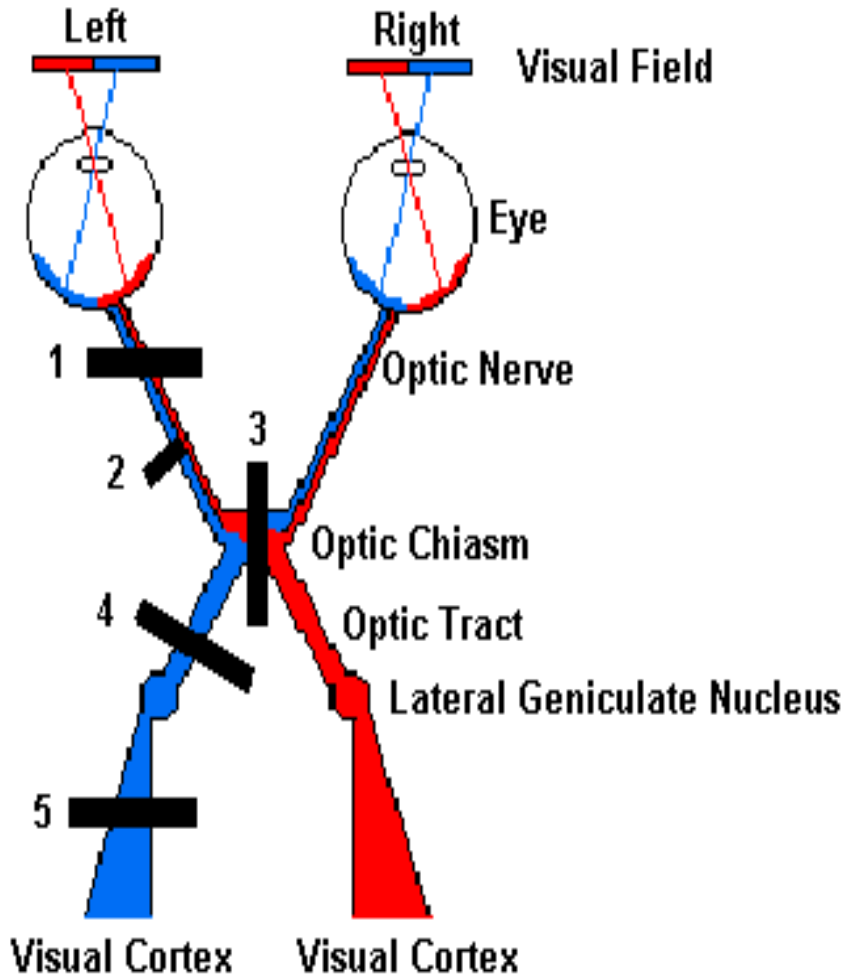


ال macula يتاخذ supply من ال middle and posterior cerebral arteries عشان هيك مش سهل يصير فيها lesion

مهم جداً

LESIONS of VISUAL PATHWAY

تبعوا على النوتس تحت



نتذكر شغلة عدسة العين مع القرنية بتعمل زي العدسة ال convex lense
 الي بتقلب الصورة بمعنى انه الجزء ال temporal الي لونه احمر جاي
 lateral مسؤول عن مجال الرؤية تاع ال medial و الجزء ال medial تاع
 ال nasal من ال retina باللون الازرق مسؤول عن مجال الرؤية ال
 lateral .. يعني جزء temporal تاع ال retina بتشوف ال nasal eye field
 و جزء ال nasal تاع ال retina بتشوف ال temporal eye field الصورة
 بتكون مقلوبة لانها عدسة محدبة .. لو حدا كان واقف قدامك من الجنب
 راح تشوفه بال nasal fibers of the retina و لو واحد قدامك بالنص راح
 تشوفه بال temporal fibers of the retina

رقم ١: لو قطعت ال optic nerve يعني ما في اشي راح يوصل الدماغ
 بالتالي الصورة عند واحد لونها رمادي يعني ما في رؤية
 رقم ٢: ال lesion lateral to optic nerve طيب مين الي بقدر يعمل
 هاي ال lesion؟ ال internal carotid artery لو فيه aneurysm راح
 يضغط على optic nerve او optic chiasma من ناحية ال lateral و
 التنين راح يكون الهم نفس ال effect، ال lateral part في ال fibers of
 ipsilateral temporal الي بتشوف ال nasal و هاد الجزء الي ما راح
 تشوف فيه، لو ضغطت على ال optic chiasma laterally برضه ما راح
 يشوف بالجزء ال nasal

رقم ٣ (مهمة): لو ضربت ال optic chiasma من النص، متى بتصير؟ لما تكبر ال pituitary gland و تضغط عليها و تعمل bitemporal hemianopia لانك بتكون ضربت ال nasal fibers المسؤولين عن الرؤية تاعت ال temporal و التين راح تخسر فيهم الرؤية

رقم ٤ : لو كانت ال lesions in optic tract (تذكروا هو حامل ال ipsilateral temporal and contralateral nasal contralateral homonymous hemianopia الي هي

رقم ٥ : ال visual cortex فيها sparing of macula و يكون bilateral presentation (حكي مش كثير مهم نعرفها و انها تقريبا زي ٤ مؤقتا)

Lesions in the Optic Pathway

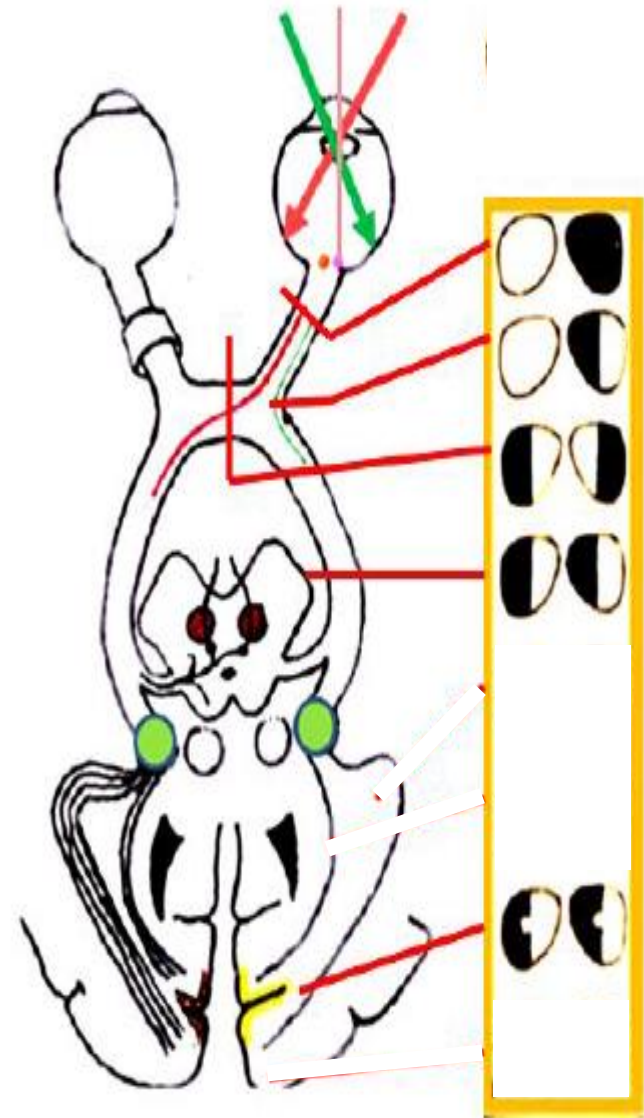
➤ Optic nerve → ipsilateral total blindness

➤ Optic chiasma:

1. Pressure on its lateral side (as in aneurysm of internal carotid artery) → ipsilateral nasal hemianopia

2. Pressure on its central part (as in pituitary tumors) → bitemporal hemianopia

➤ Optic tract or optic radiation
Total lesion → contralateral homonymous hemianopia ↙

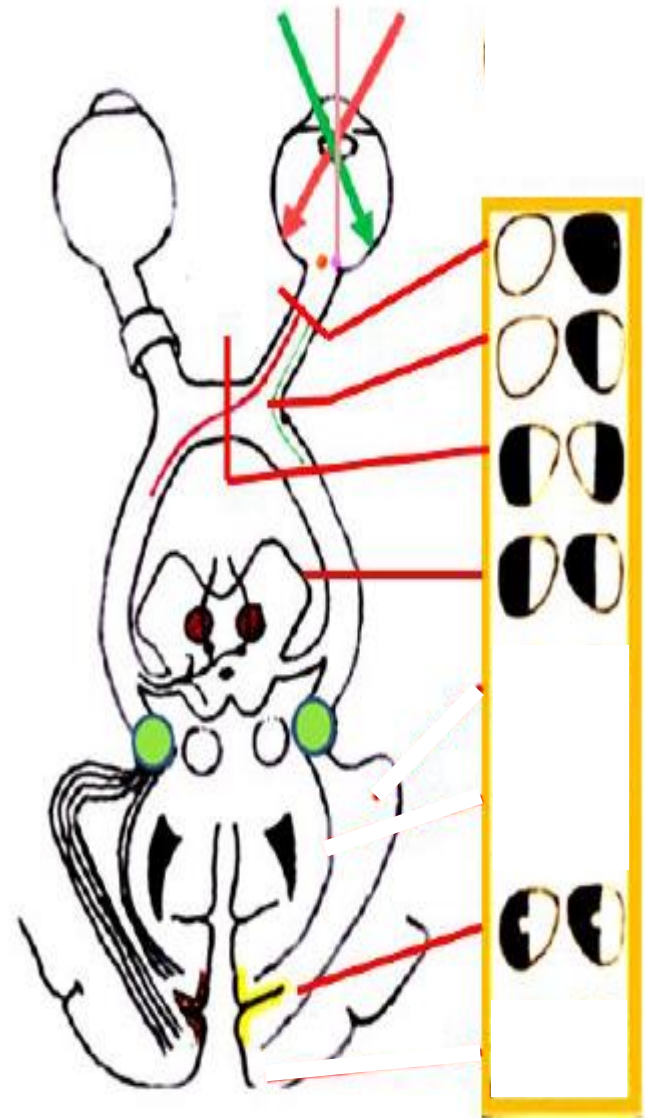


لو ال lesion كانت على جهة اليمين الجزء الشمال من العينتين راح اخسر فيه البصر

Lesions in the Optic Pathway

➤ visual cortex:

Total lesion → **contralateral homonymous hemianopia with macular sparing**



Visual Reflexes

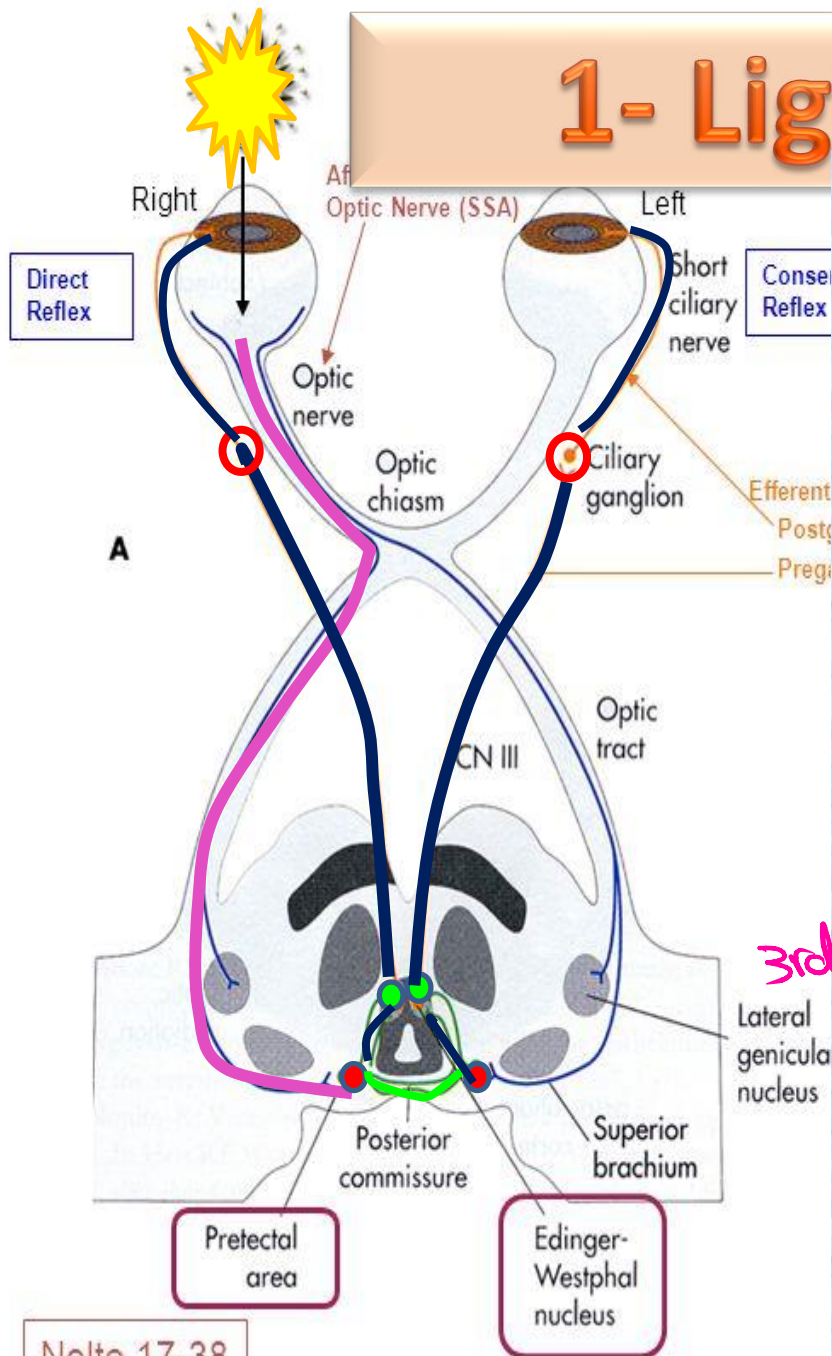
1) Light Reflex

**2) Accomodati
on Reflex**

3) Corneal Reflex

- Light stimulation of one eye → constriction of ipsilateral pupil (direct light reflex) & contralateral pupil (indirect light reflex)

1- Light Reflex



Pathway: Impulses from retina pass through optic nerve → optic chiasma → optic tract → pretectal nuclei of both ipsilateral side (for direct reflex) and contralateral side for indirect reflex. Axons of neurons of pretectal nuclei → Edinger Westphal nucleus of oculomotor n → its inferior division → nerve to inferior oblique → relay in ciliary ganglion → short ciliary nerves to sphincter pupillae muscle.

2- Accomodation Reflex:

خلال التخدير او الغيبوبة ما
بصير لانه واصل ال cortex

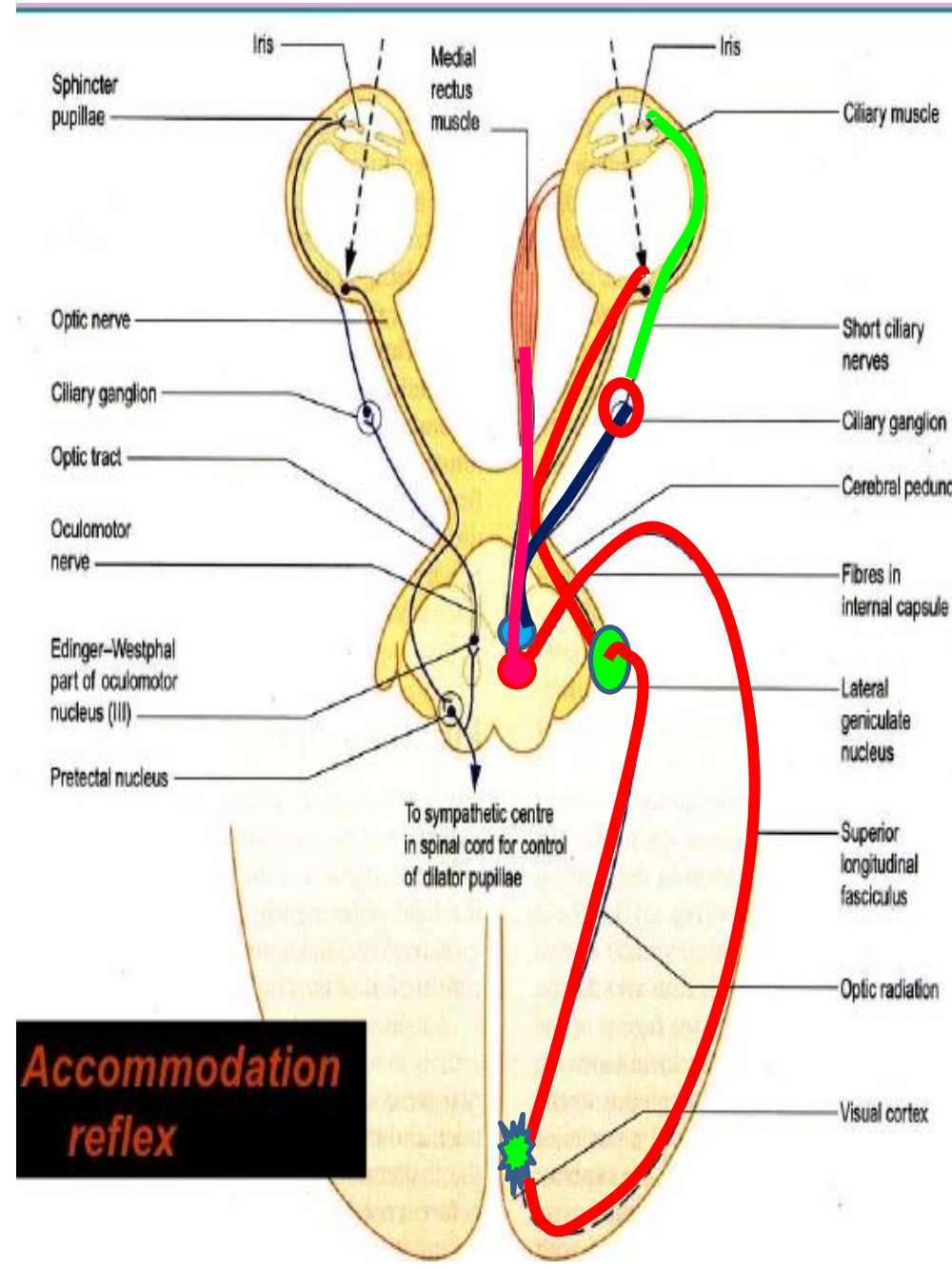
Looking at near objects leads to:

- 1) Convergence of both eyes (medial recti)**
- 2) Lens becomes more convex (ciliary muscle)**
- 3) Pupillary constriction (sphincter pupillae muscles)**

Pathway: Impulses from retina → optic nerve → optic chiasma → optic tract → LGB → optic radiation → visual area in the occipital lobe → frontal eye field in the frontal lobe → oculomotor nuclei:

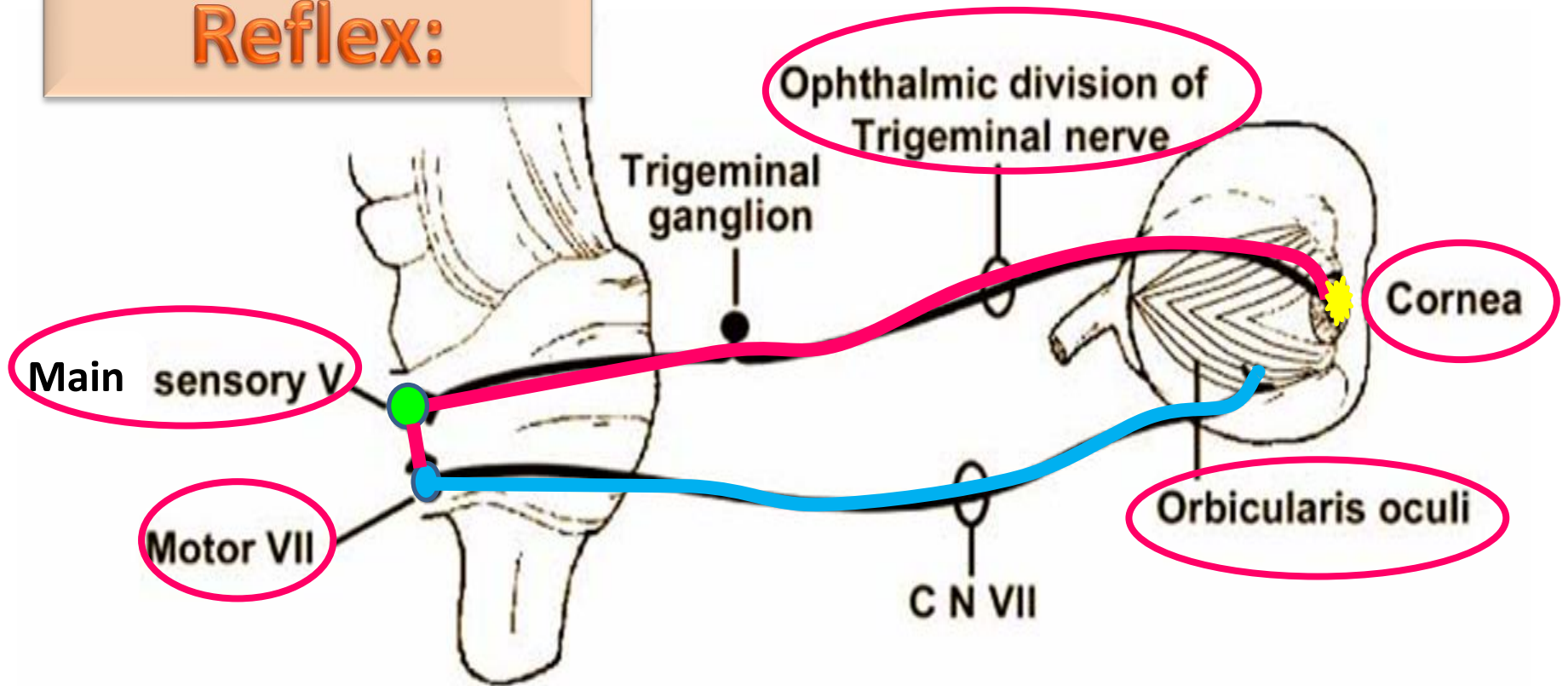
*Edinger Westphal nucleus → sphincter pupillae and ciliary muscles.

*Motor Nucleus of III → medial recti.



3) Corneal Reflex:

خلال التخدير او الغيبوية بصير لانه مش واصل ال cortex



❑ Light touch of cornea as by a delicate piece of cotton results in blinking of eyelids.

❑ Pathway: along ophthalmic n → main sensory n of V → motor n of facial n on both sides → orbicularis oculi → closure of eyelids.

Auditory pathway

1st order neuron:

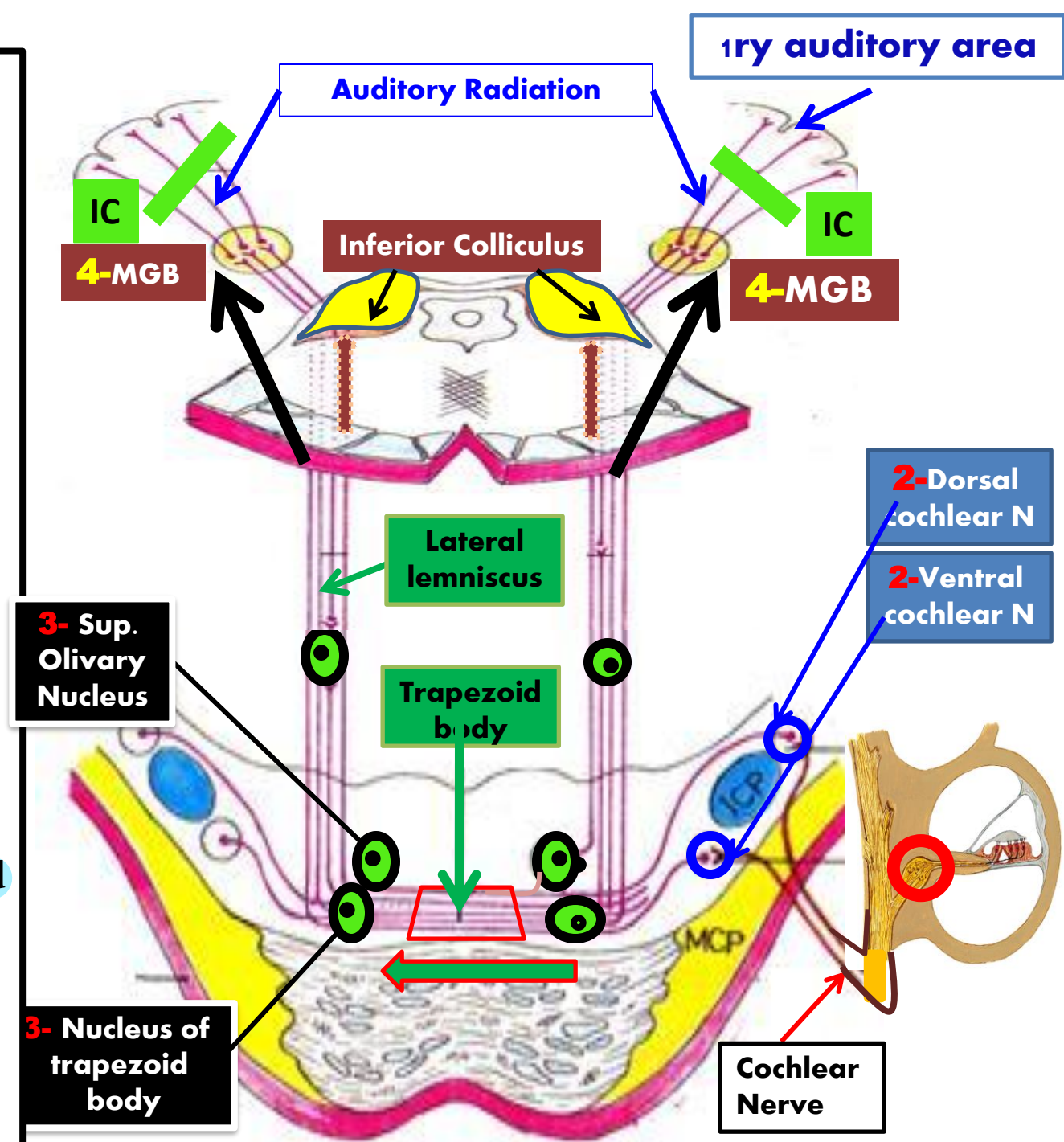
bipolar Cells of the spiral ganglion

2nd order neuron:

neurons of the dorsal & ventral cochlear Nuclei.

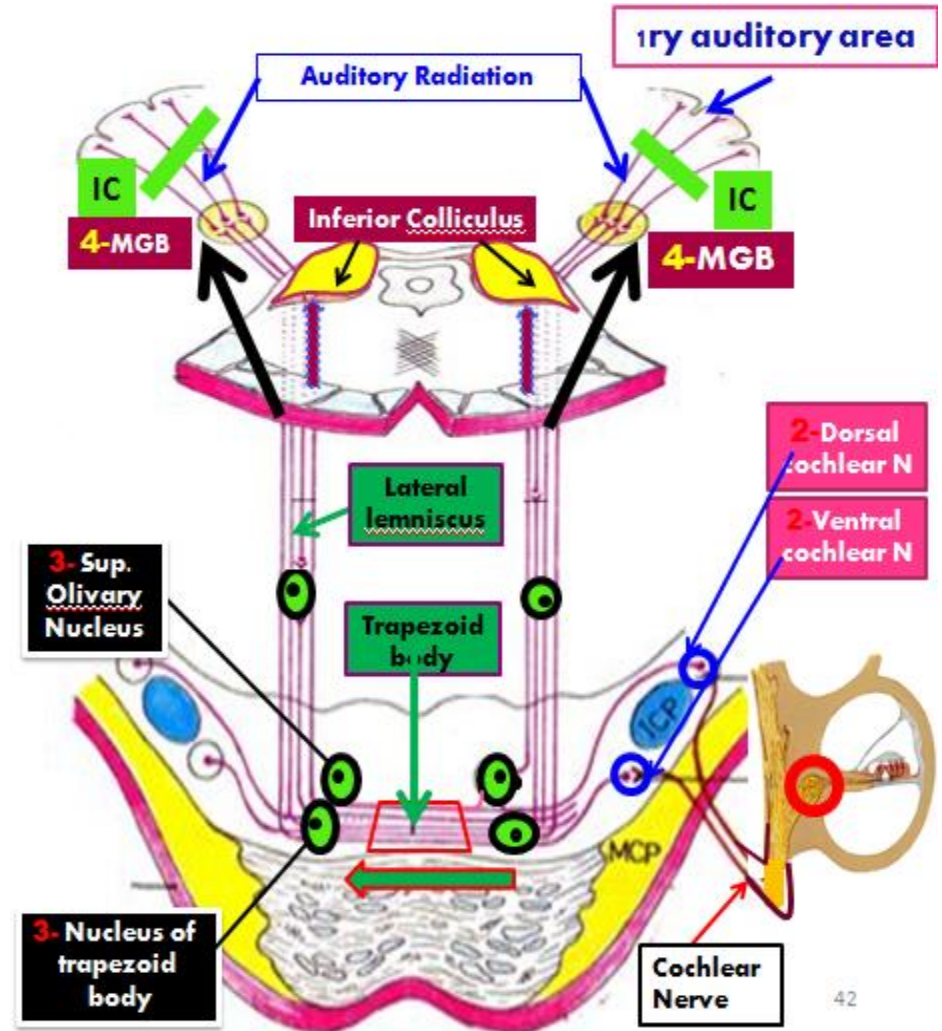
3rd order neuron:

neurons of Superior olivary nucleus Or nucleus of trapezoid body of both sides mainly at the opposite side



Lesions of the auditory pathway

- ❖ **Lesion in the cochlea, cochlear nerve or cochlear nuclei: complete ipsilateral deafness.**
- ❖ **Lesion in the lateral lemniscus, MGB or auditory area: bilateral partial deafness mainly on the opposite side.**



79-year-old man is brought to a family practice office by his wife because he "keeps running into things" on his right side. His wife also reports that he seems

to ignore objects on his right. Testing his vision in each eye his physician determines that the patient cannot see anything in the right visual field of either eye. The physician orders a head MRI because he suspects which one of the following?

- a. A pituitary tumor compressing his optic chiasm
- b. A tumor in the medial wall of the right orbit compressing the optic nerve
- c. An aneurysm of the left middle cerebral artery compressing the left optic tract
- d. A tumor in the middle cranial fossa compressing the right optic tract
- e. An aneurysm in the arterial supply to the visual cortex



Thank you!

