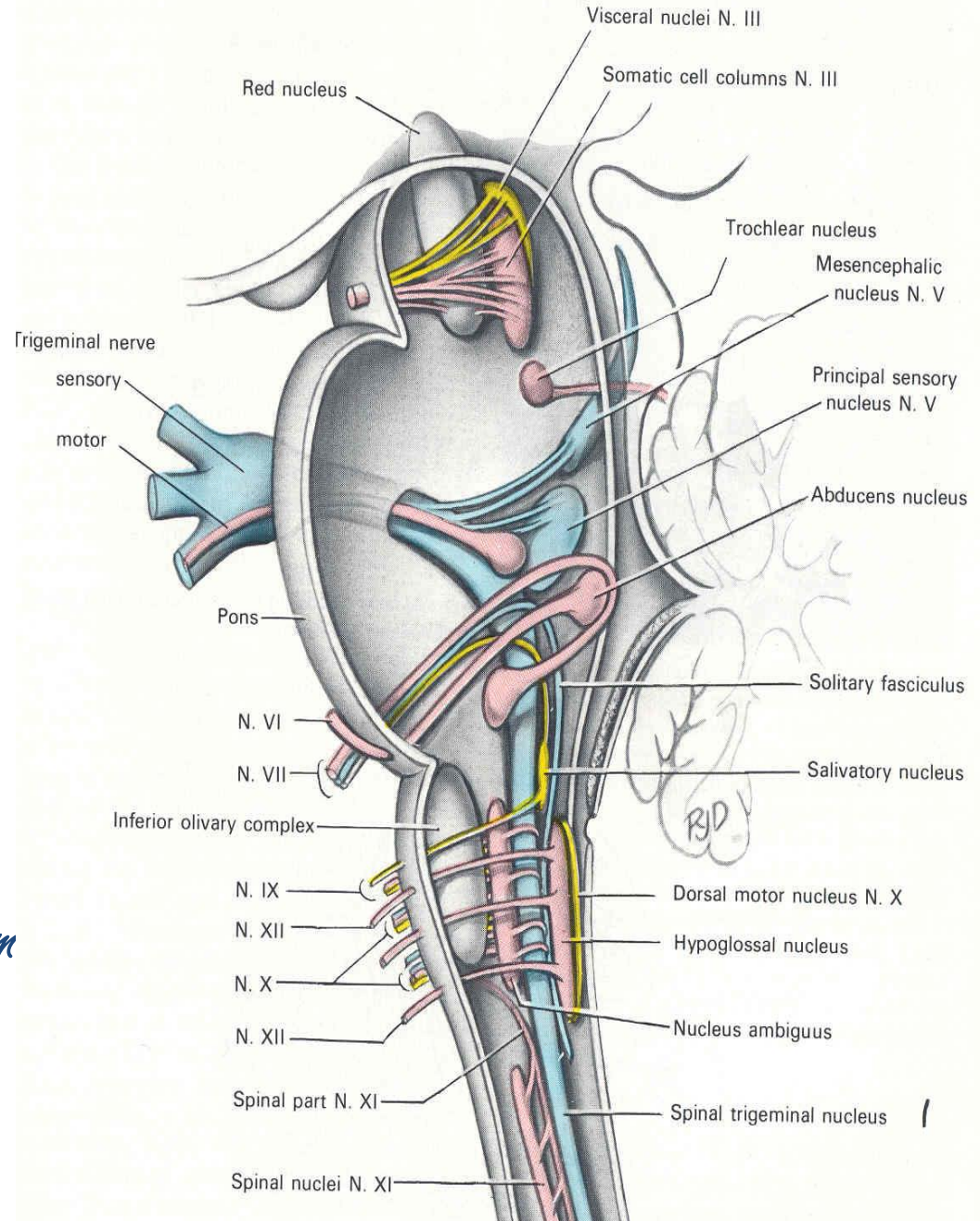


THE CRANIAL NERVES

2, 3, 4, 6



By Prof. Saeed Abuel Makarem

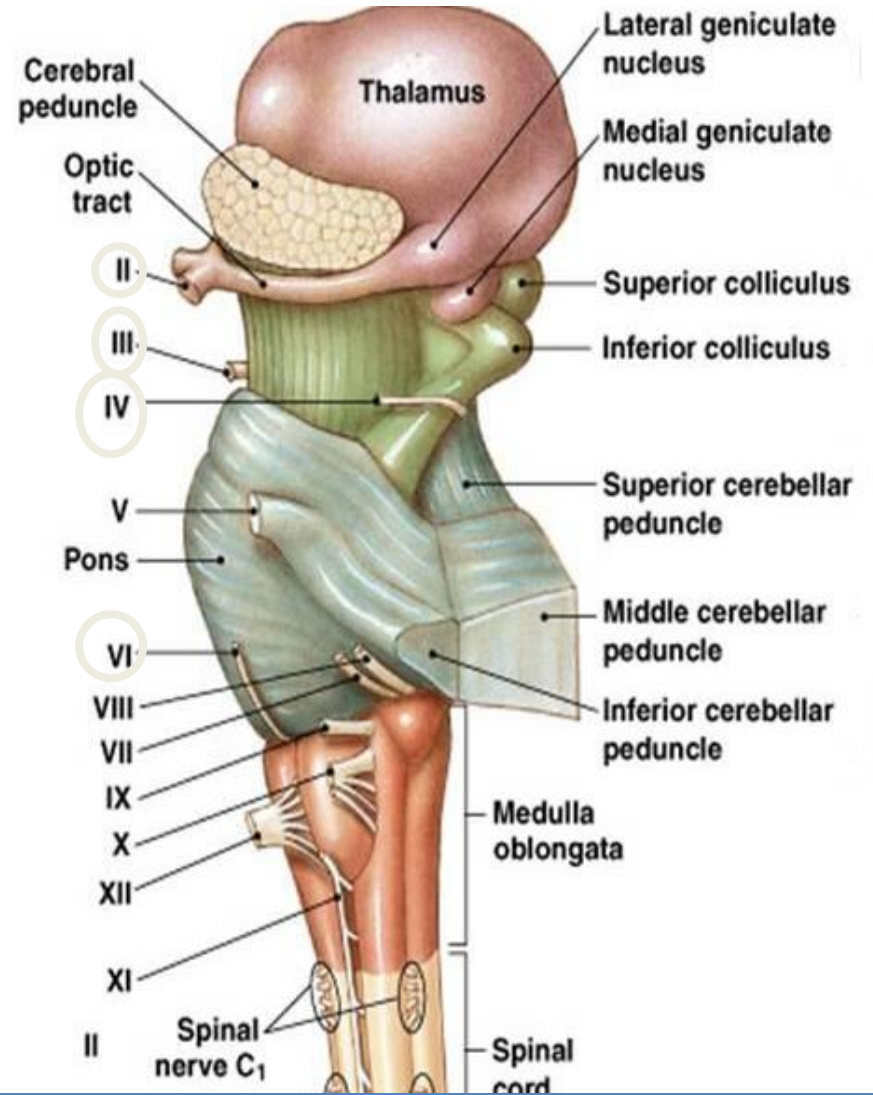
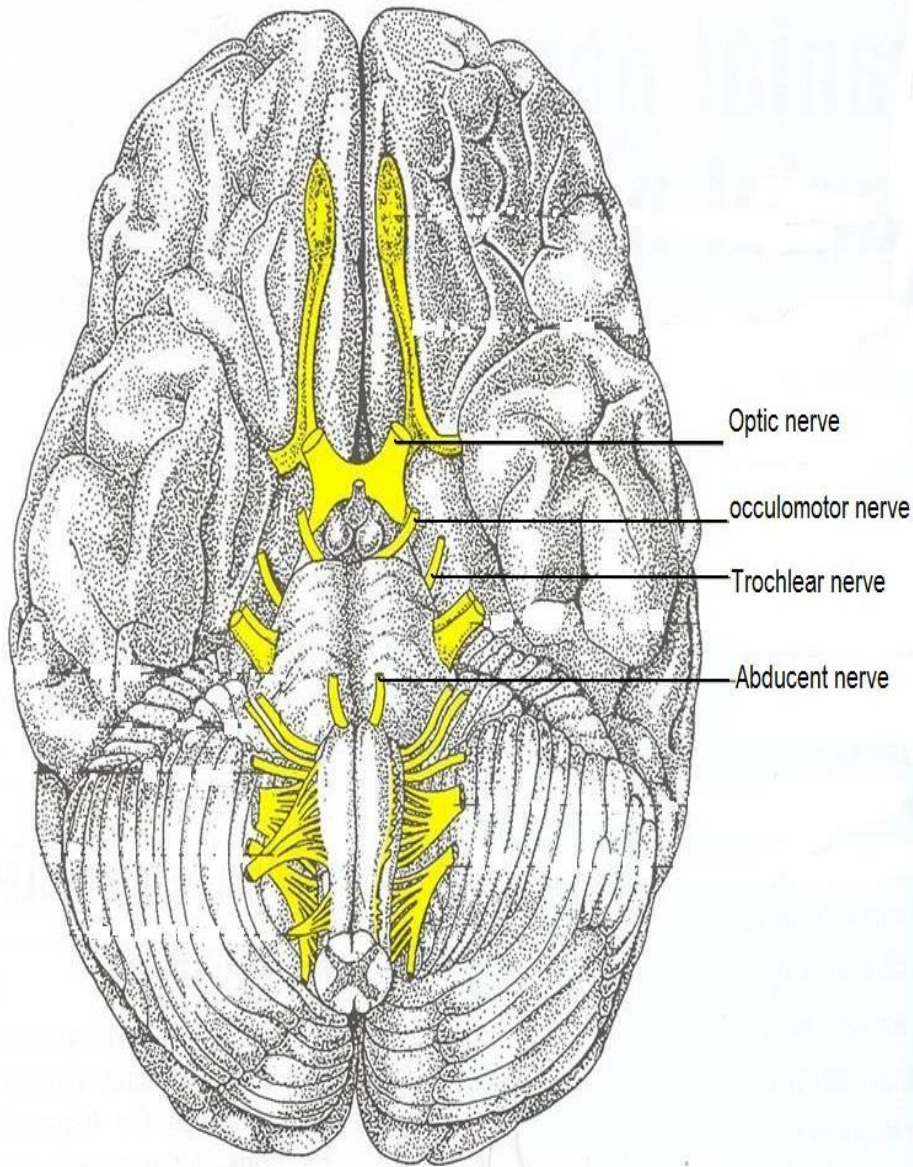
&

Dr. Sanaa Alshaarawy

Objectives

By the end of the lecture, you should be able to:

- List the **cranial nuclei** related to oculomotor, trochlear, and abducent nerves in the brain stem.
- Describe the **type** and **site** of each nucleus.
- Describe the **site of emergence** and **course** of these 3 nerves.
- Describe the **important relations** of oculomotor, trochlear, and abducent nerves **in the orbit**.
- List the **orbital muscles** supplied by each of these 3 nerves.
- Describe the **effect of lesion** of each of these 3 nerves.
- Describe the **optic nerve** and **visual pathway**.



Brain (Ventral view)

Brain stem (Lateral view)

- **EXTRA-OCULAR MUSCLES (7 muscles).**

- **1- Levator palpebrae superioris.** ★

- **4 Recti muscles:** ★

- **Superior rectus,**

- **Inferior rectus,**

- **Medial rectus,**

- **Lateral rectus,**

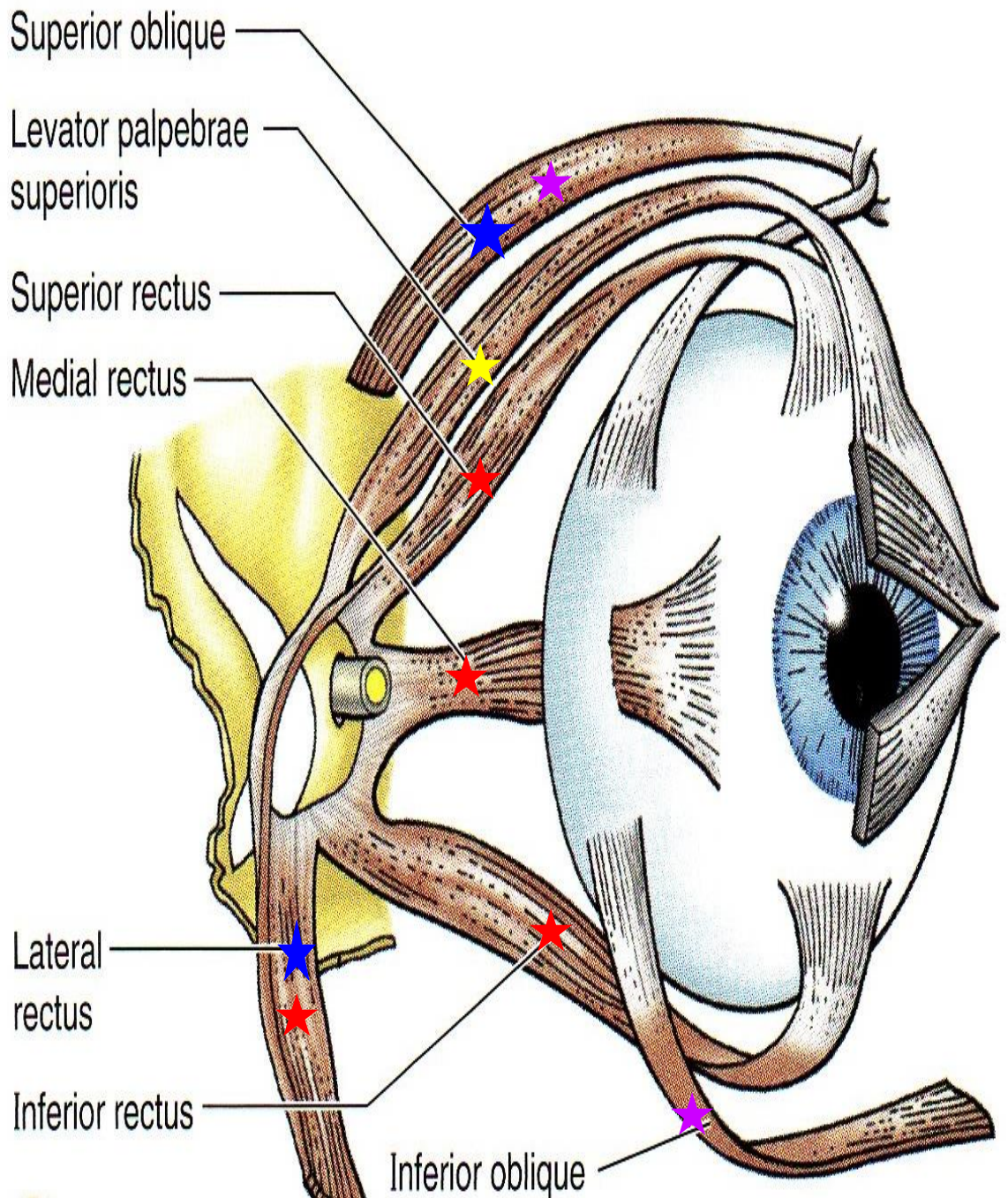
- **2 Oblique muscles:** ★

- **Superior oblique,**

- **Inferior oblique.**

- **NB. All muscles of the eye are supplied by the oculomotor nerve**

EXCEPT LR6 + SO4 ★



Occulomotor Nerve

➤ **Motor** for most of **extraocular muscles**.

➤ Also carries preganglionic **parasympathetic** fibers to the **pupillary constrictor** and **ciliary muscles**.

➤ Has two nuclei:

1- Main oculomotor nucleus;

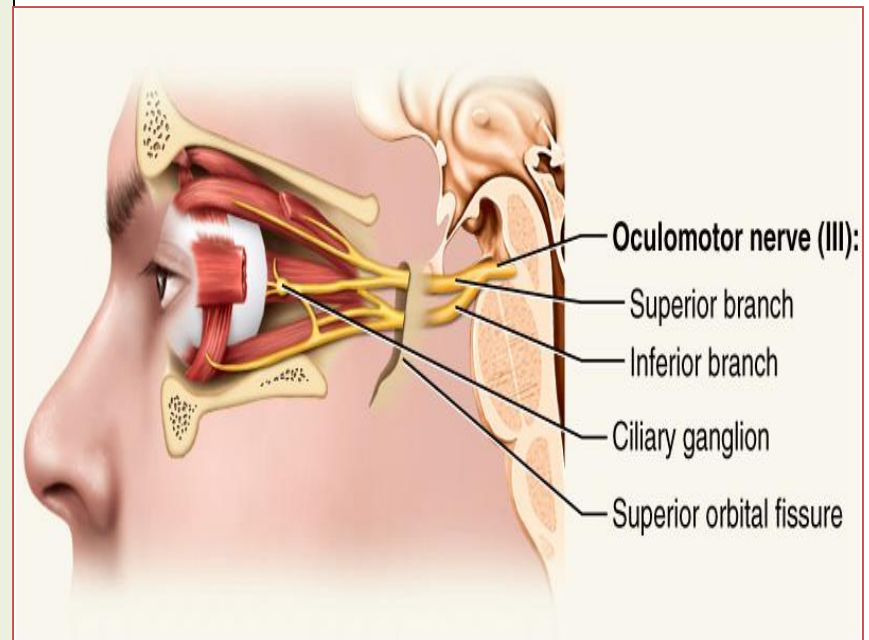
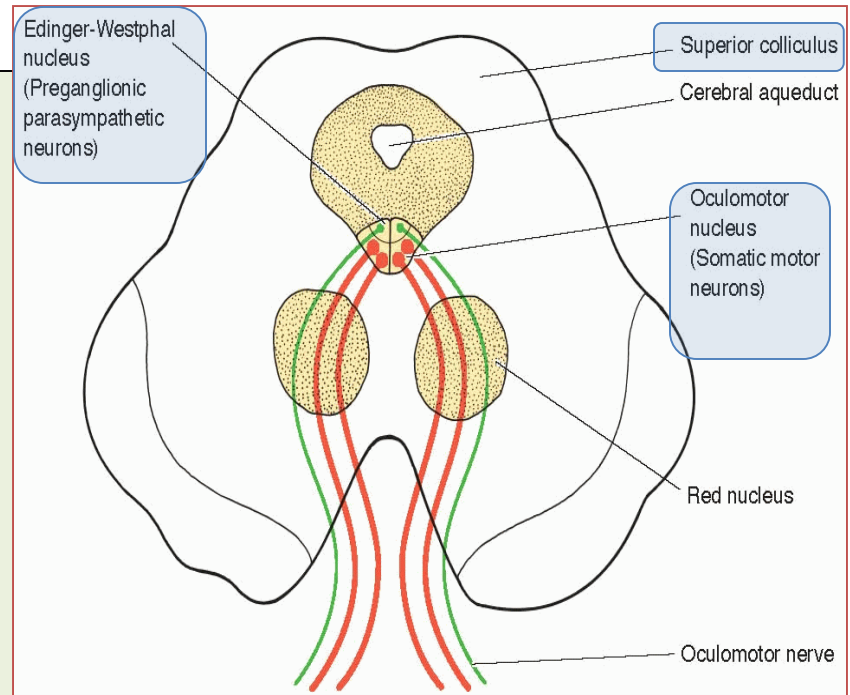
▪ Lies in the mid brain, at the level of superior colliculus, **located in** the **periaqueductal grey matter**

2- Accessory nucleus (Edinger-Westphal nucleus);

▪ Lies dorsal to the main motor nucleus,

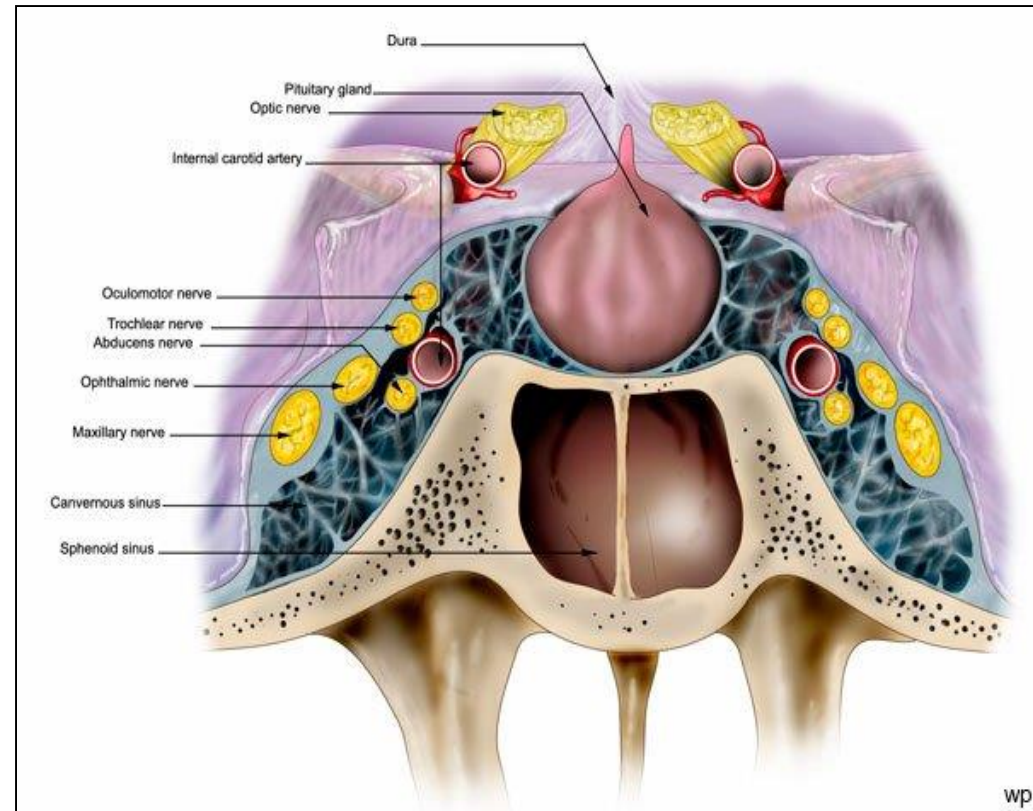
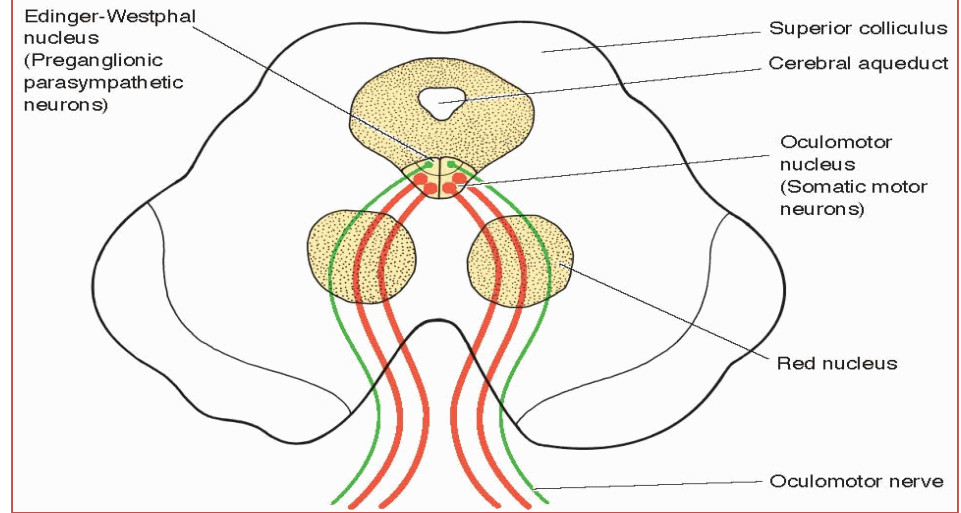
▪ Its cells are **preganglionic parasympathetic neurons**.

▪ It receives; **Corticonuclear fibers** for **accommodation reflex**, and from the **pretectal nucleus** for the direct and consensual **pupillary reflexes**.



Occulomotor Nerve

- **Axons from the oculomotor nucleus curve ventrally** through the tegmentum and the **red nucleus** in the midbrain.
- **The nerve emerges** on the anterior surface of the midbrain in the **interpeduncular fossa**.
- Then it passes forward **between posterior cerebral** and **superior cerebellar arteries**.
- **In the middle cranial fossa** it runs in the **lateral wall of the cavernous sinus**, then it **divides** into **superior and inferior divisions** which pass to the orbit through the **superior orbital fissure**.

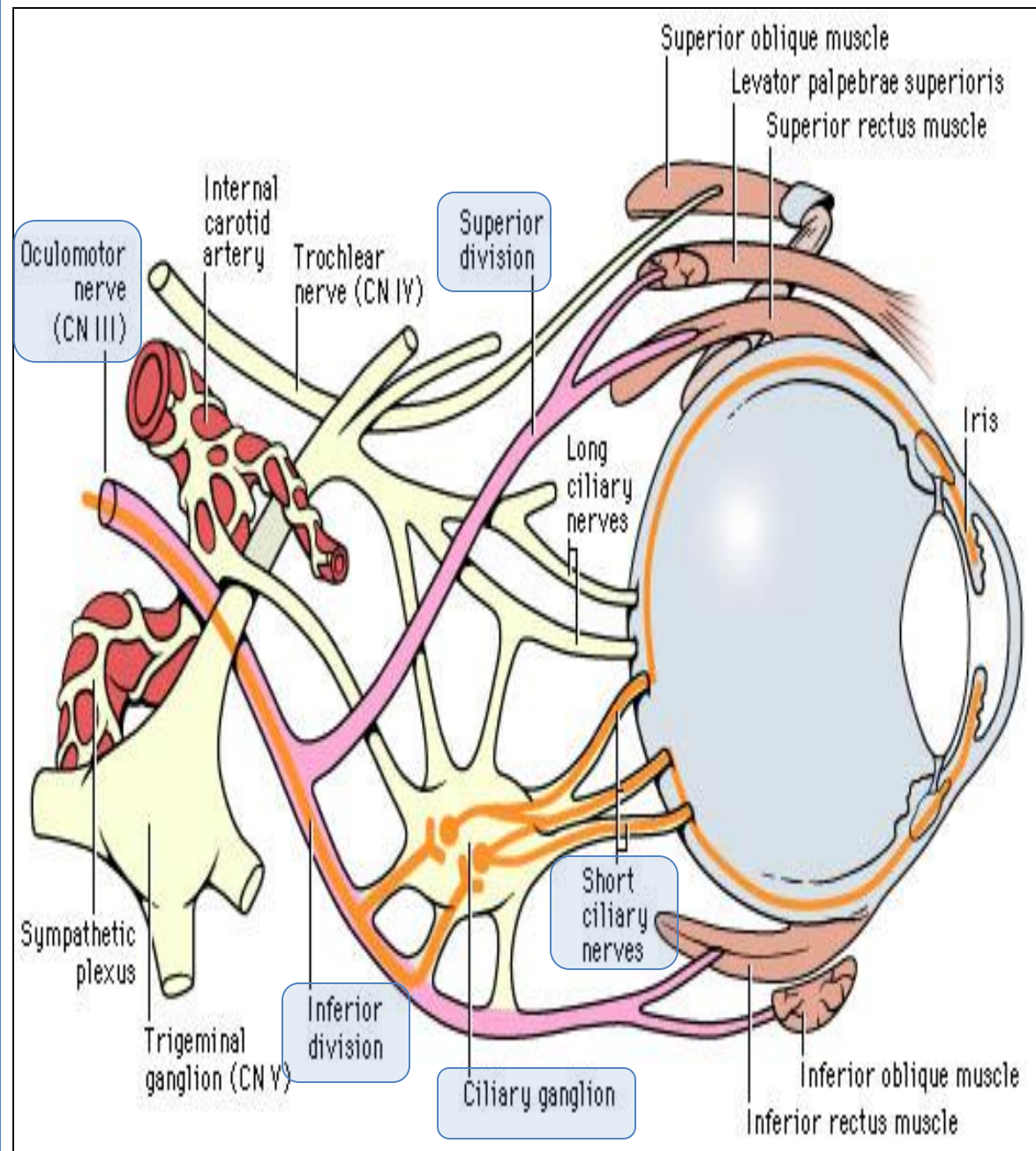


➤ **Axons from the Edinger-Westphal nucleus** accompany the oculomotor nerve fibers to the orbit, where they **terminate** in the **ciliary ganglion**.

➤ Postganglionic fibers pass through the **short ciliary nerves** to the eyeball, where they supply:

➤ **Constrictor pupillae muscle** of the iris and

➤ **Ciliary muscle**.



Occulomotor nerve supplies:

➤ **Motor to:**

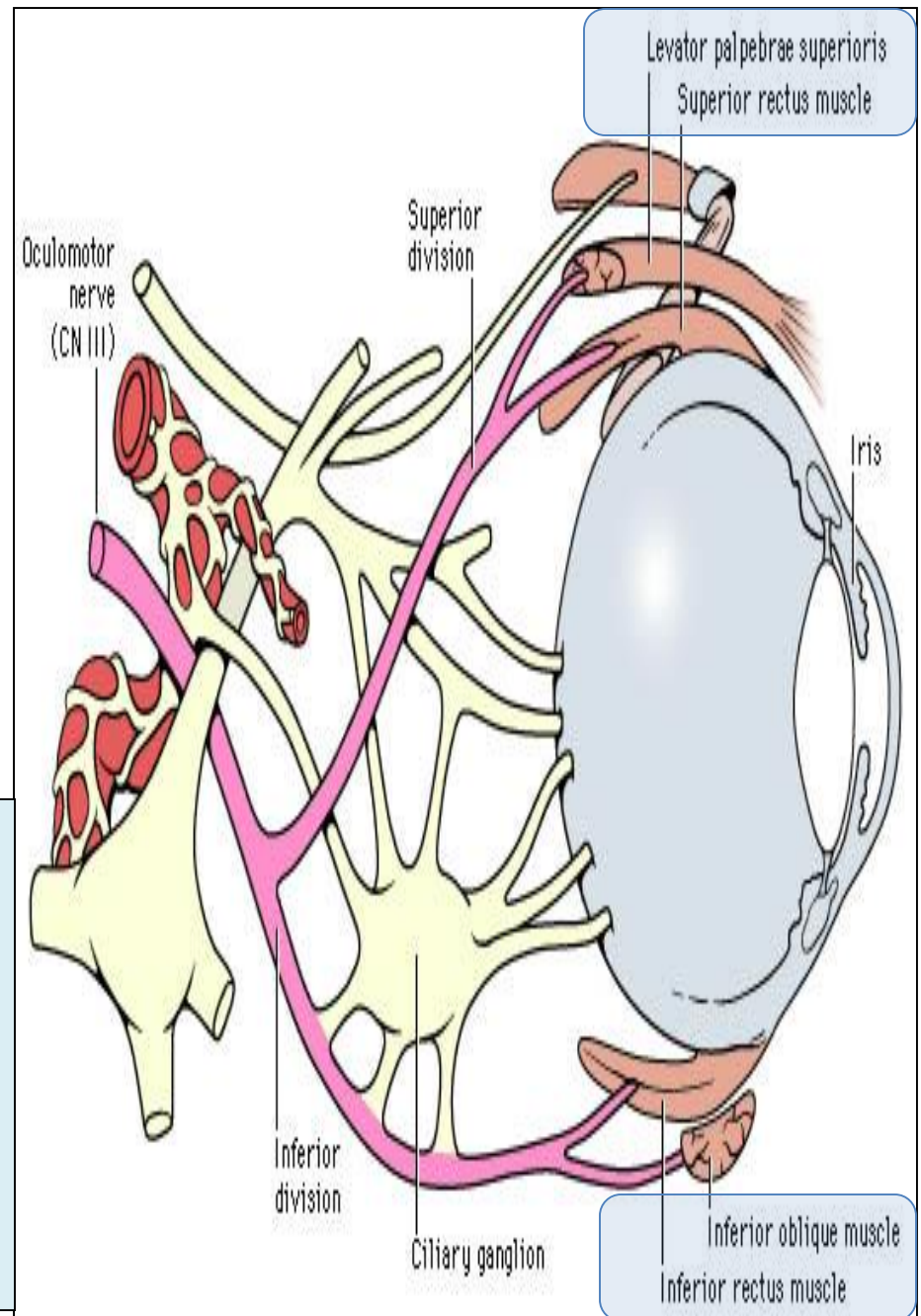
- 1. Levator palpebrae superioris**
- 2. Superior rectus muscle**
- 3. Medial rectus muscle**
- 4. Inferior rectus muscle &**
- 5. Inferior oblique muscle.**

➤ **Parasympathetic fibers to:**

- 1- Constrictor pupillae** and
- 2- Ciliary muscles.**

It is responsible for;

- **Elevation of upper eyelid** (open the eye).
- **Turning the eyeball upward, downwards and medially,**
- **Constriction of the pupil.**
- **Accommodating reflex of the eyes.**



Occulomotor Nerve Lesion

- **Lesion** results in:
 - Lateral squint.
 - Ptosis.
 - Diplopia.
 - Pupillary dilatation.
 - Loss of accommodation.
 - The eyeball is fully abducted and depressed(down and out) because of the unopposed activity of lateral rectus and superior oblique.

The preganglionic parasympathetic fibers run superficially in the nerve and are therefore the first axons to suffer when a nerve is affected by external pressure. Consequently, the first sign of compression of the oculomotor nerve is ipsilateral slowness of the pupillary response to light.



Normal eye alignment



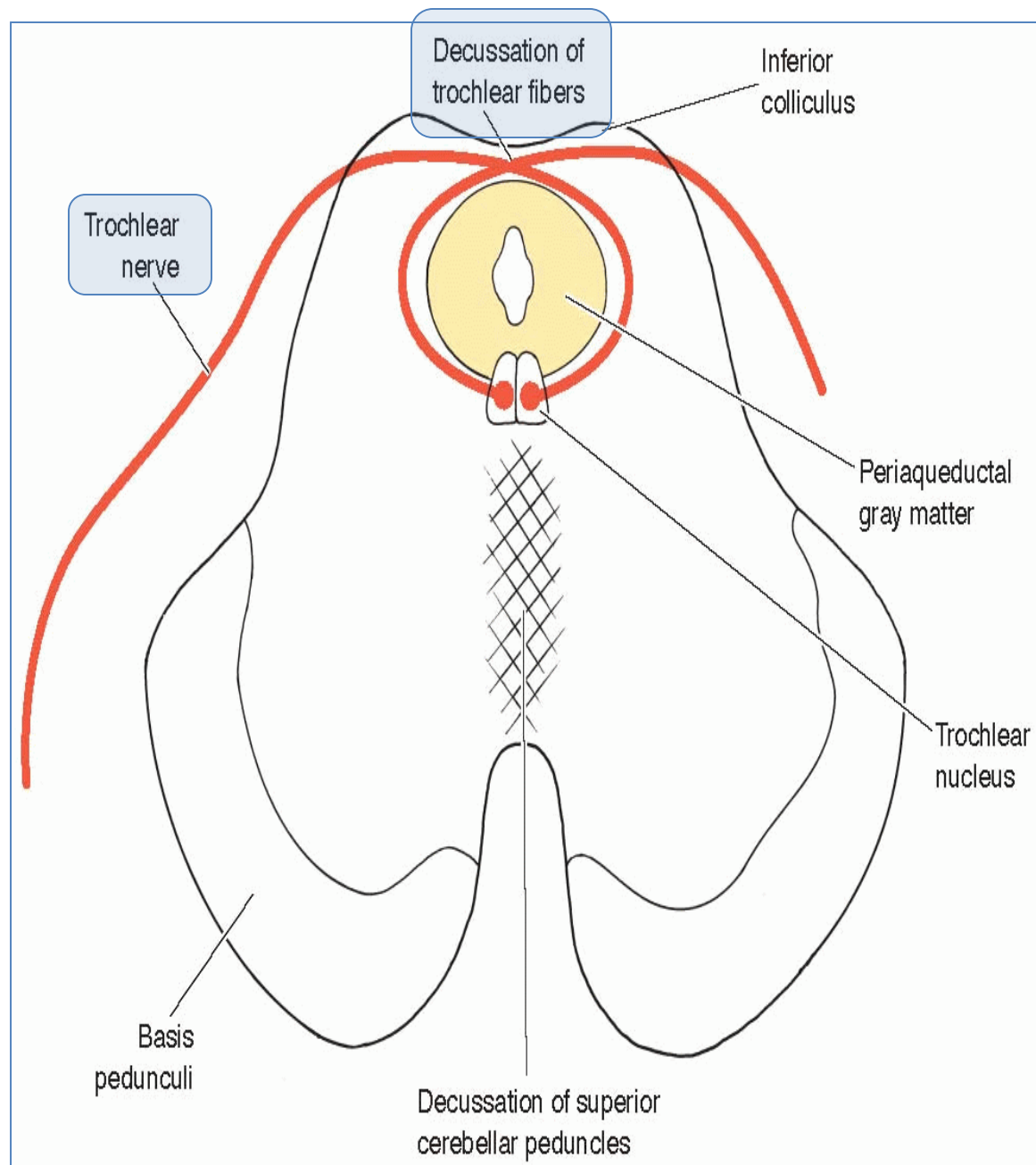
Lateral squint

Ptosis (drooping of the eyelid)



Trochlear Nerve

- ❑ Type: **motor**
- **Small motor nucleus located in the periaqueductal grey matter at the level of inferior colliculus.**
- Fibers curve backwards and decussate.
- The nerve **emerges immediately caudal to the inferior colliculus, on the dorsal surface of brain stem.**



Trochlear Nerve

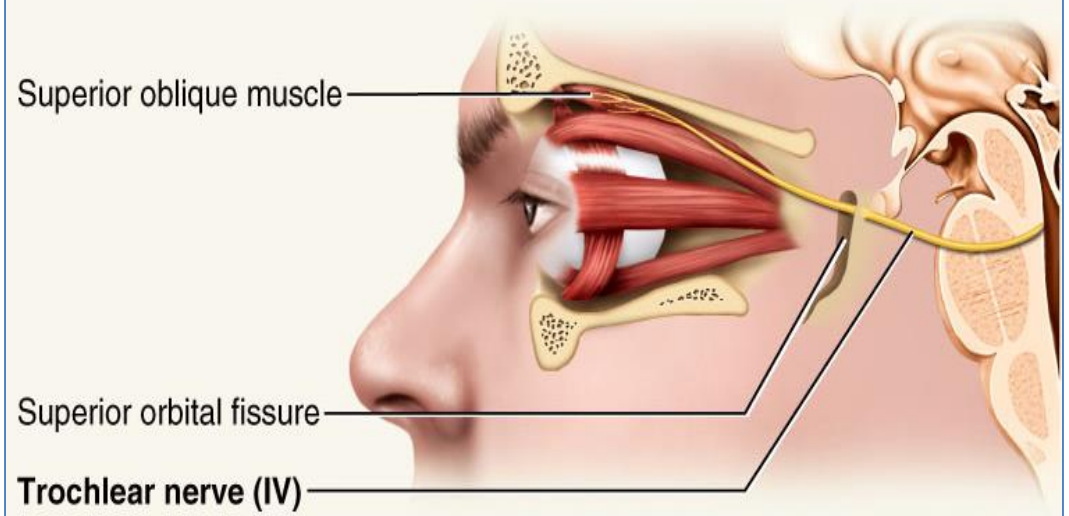
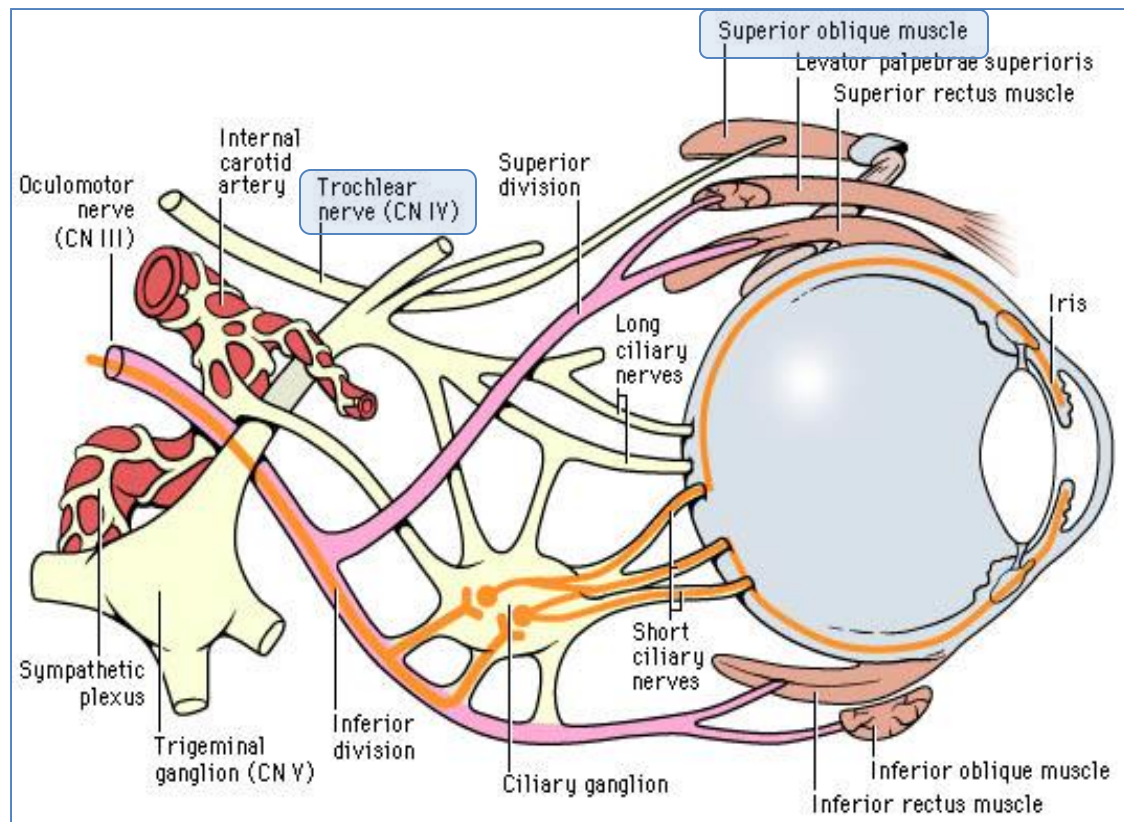
- It passes forward through **middle cranial fossa** in the **lateral wall of the cavernous sinus**.
- The nerve then enters the orbit through the **superior orbital fissure**.

It supplies;

- **Superior oblique muscle**, (only one muscle).

Its function;

- **Rotates the eye ball downwards and laterally.**



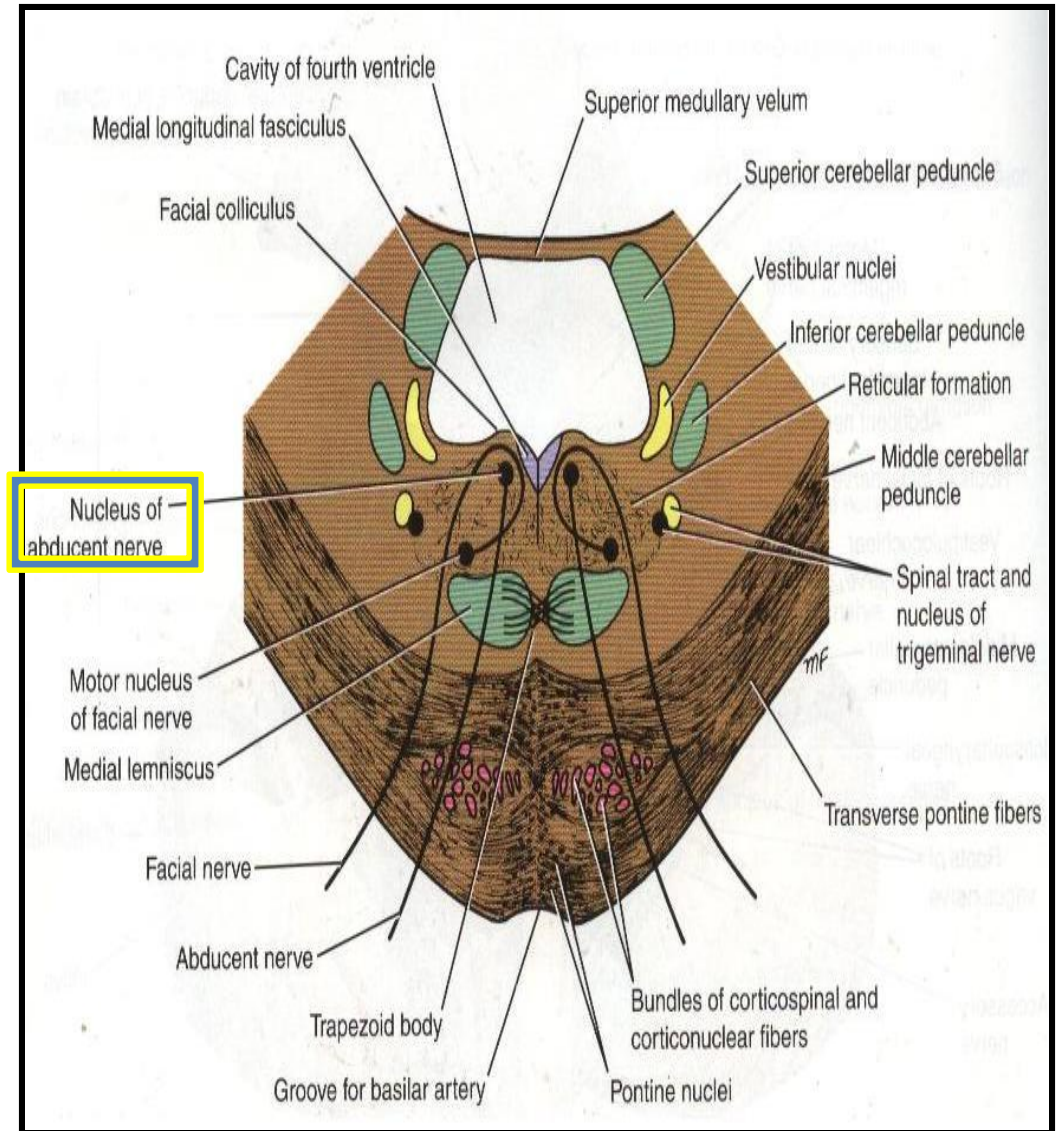
Trochlear Nerve Lesion

- Lesion results in **diplopia &**
- Inability to rotate the eyeball **infero-laterally**.
- So, the **eye deviates; upward and slightly inward (medially)**.
- This person has **difficulty in walking downstairs**



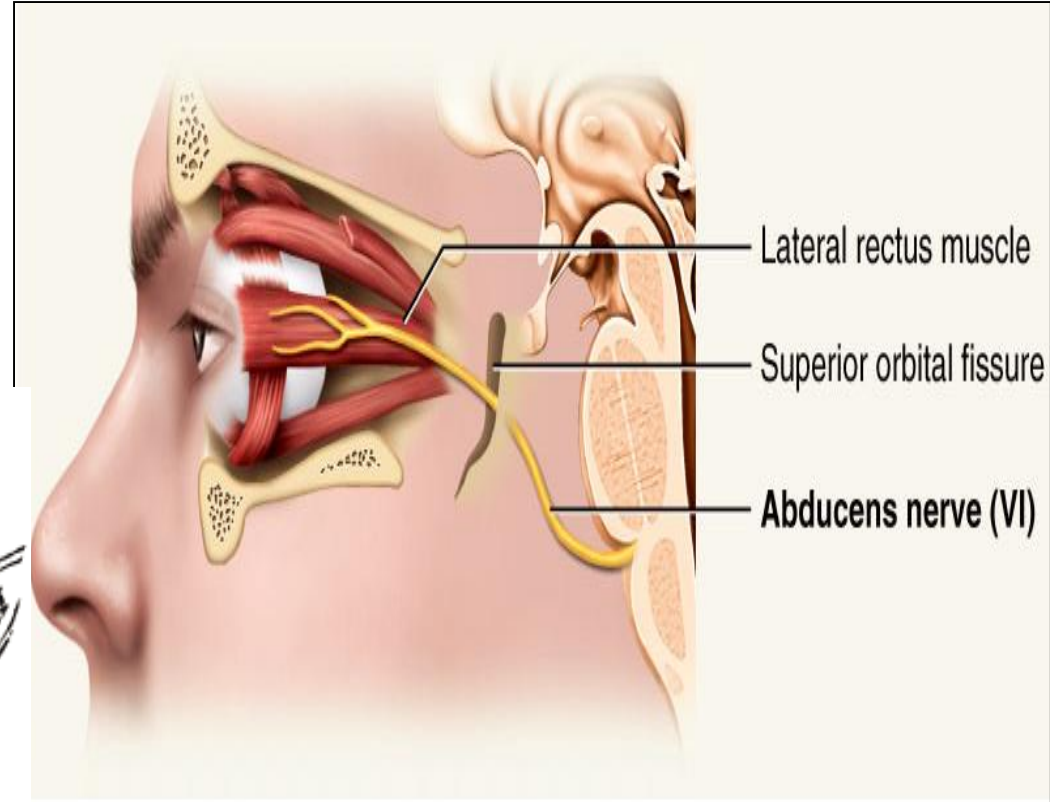
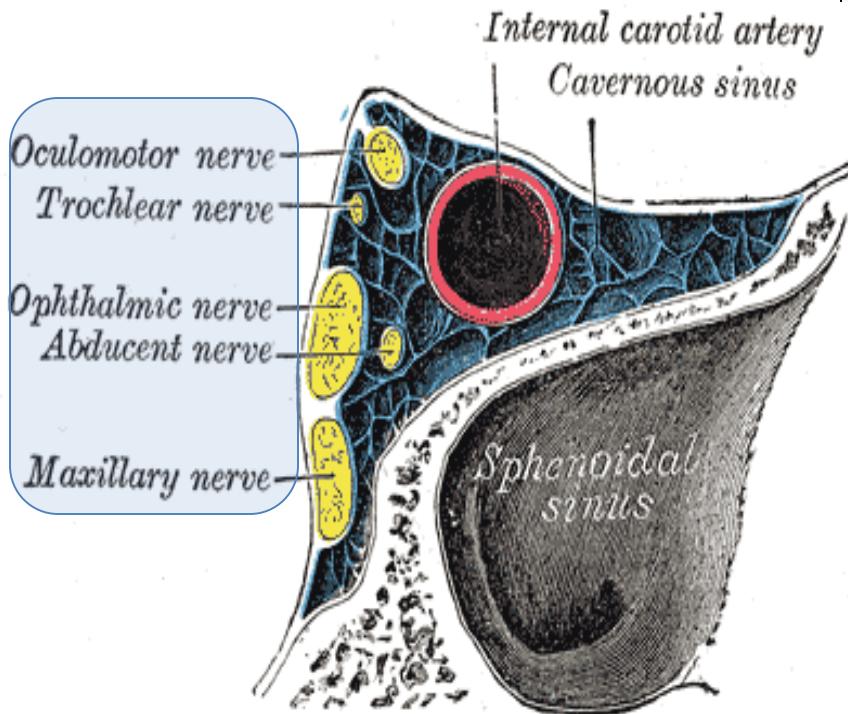
Abducent Nerve

- Only one **motor nucleus**.
- **Lies in caudal pons** in the **floor of the 4th ventricle**.
- Lies **close to the middle line**, in a line with **3rd, 4th & 12th** nerves.
- It forms the **facial colliculus** with the fibers of facial nerve looping around the nucleus.
- **It emerges** from the ventral aspect, at the **junction of the pons and the pyramid of the medulla oblongata**.



- It passes through cavernous sinus, lying **below and lateral** to the **internal carotid artery**
- Then it enters the orbit through the **superior orbital fissure**.
- **It supplies;** the **lateral rectus** muscle which **rotates the eye ball laterally** ; (abduction).

Abducent Nerve



Abducent Nerve Lesion

Lesion results in:

- Inability to direct the affected eye laterally, so it result in **(medial squint)**.
- **A nuclear lesion** may also involve the nearby nucleus or axons of the **facial nerve**, causing paralysis of all facial muscles in the ipsilateral side.



Normal eye alignment



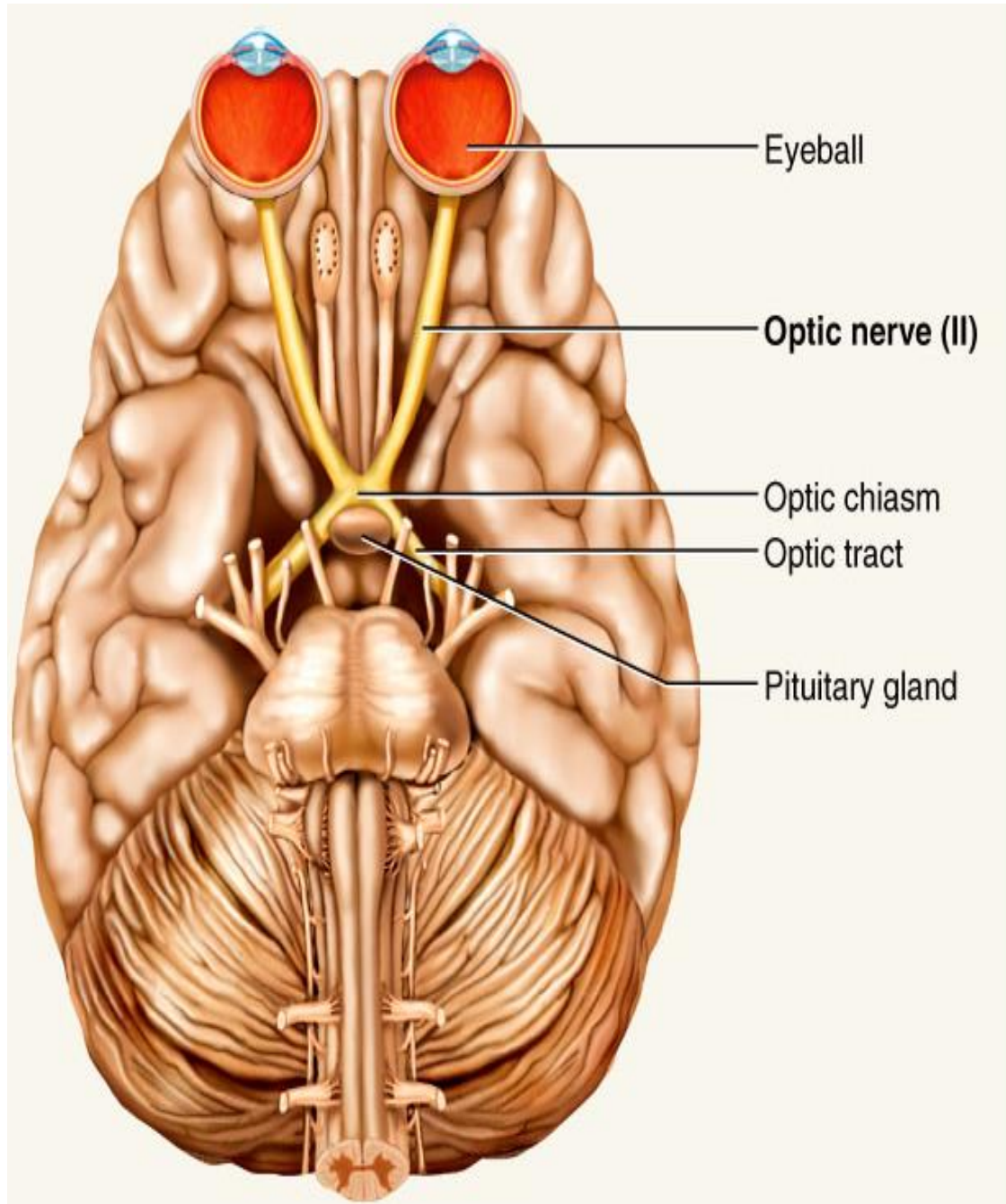
Medial squint

Optic Nerve

Type: Special sensory
N.

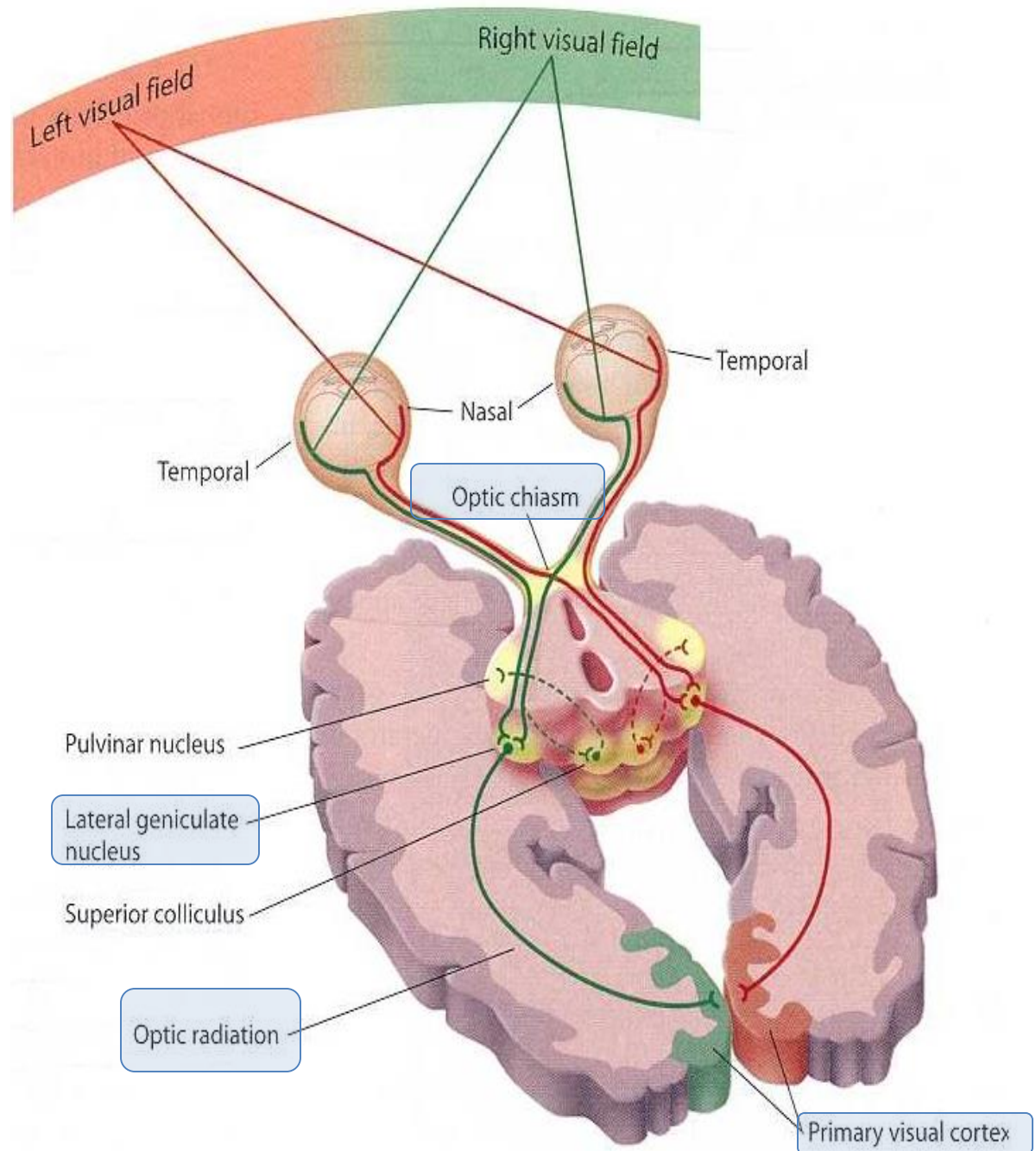
Function: Vision

Lesion results in: visual
field defects and loss
of visual acuity,
a defect of vision is
called **anopsia**.



Visual Pathway

1. **Optic nerve.**
2. **Optic chiasm.**
3. **Optic tract.**
4. **Lateral geniculate body (nucleus).**
5. **Optic radiation.**
6. **Visual cortex.**



Visual Pathway

➤ Photoreceptors:

Rods & Cones of the retina

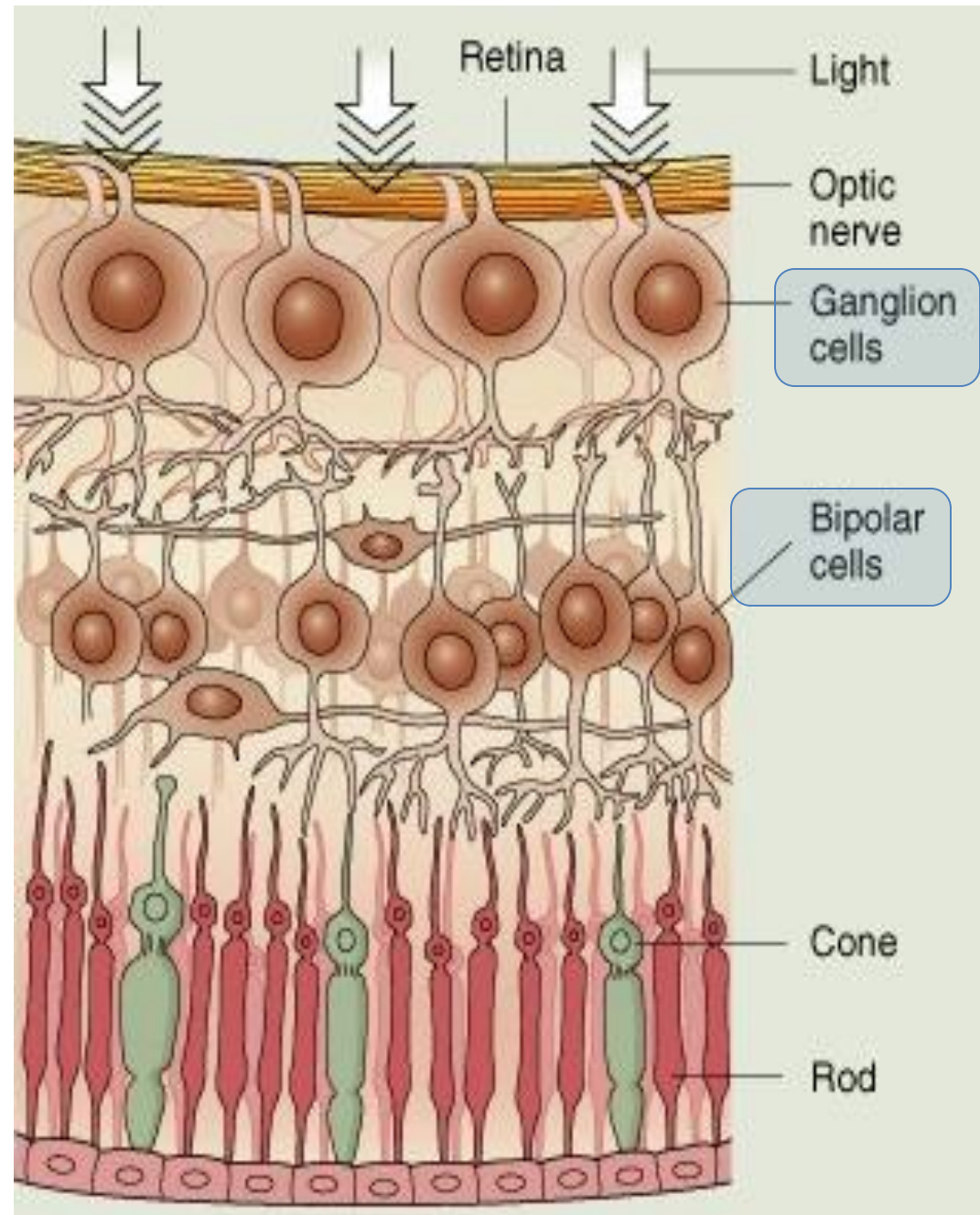
➤ Three neurons pathway

- 1st order neurons:
Bipolar cells of retina
- 2nd order neurons:
Ganglion cells of retina.

Their axons form the **optic nerve**

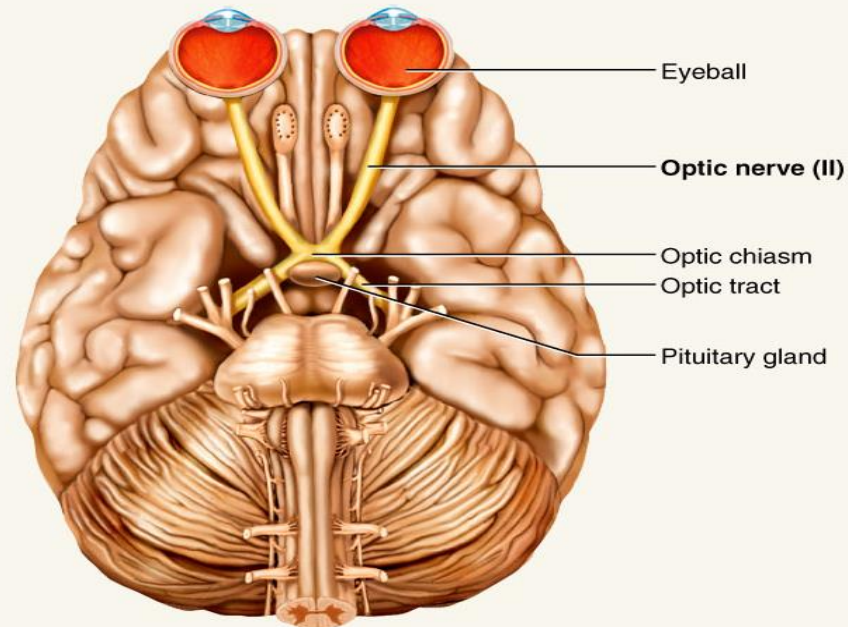
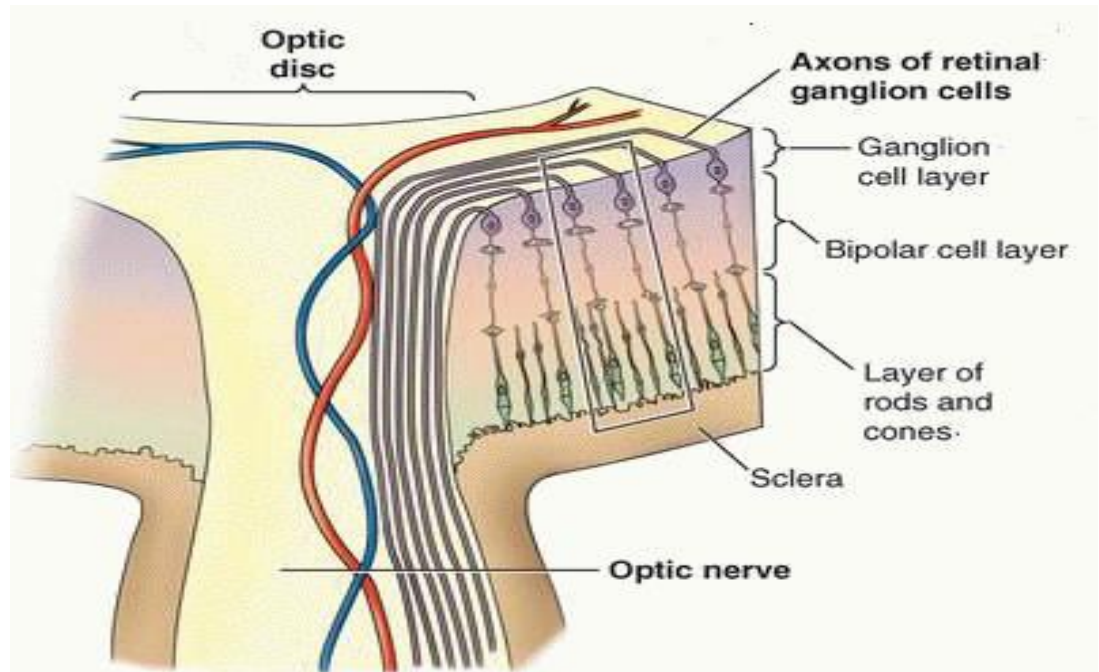
- 3rd order neurons:
Neurons in the lateral geniculate body.

Their axons **terminate** in **primary visual cortex.**



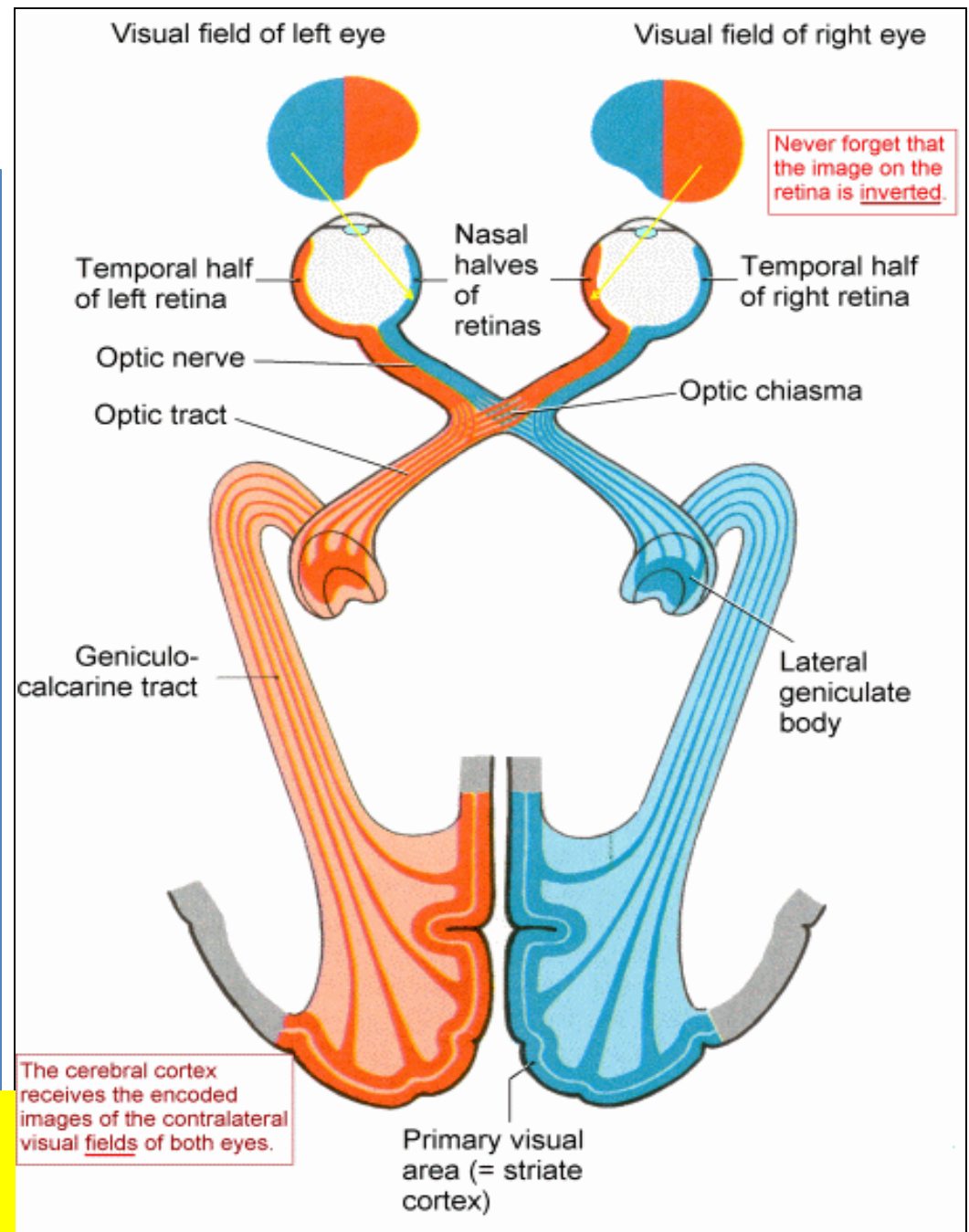
Optic Nerve

- **Axons** of retinal **ganglion cells** converge at the **optic disc** and **pass as the optic nerve**.
- Then the nerve **passes posteromedially in the orbit**.
- Then exits through the **optic canal** to enter the **middle cranial fossa** to form the **optic chiasma**.



Optic Chiasma

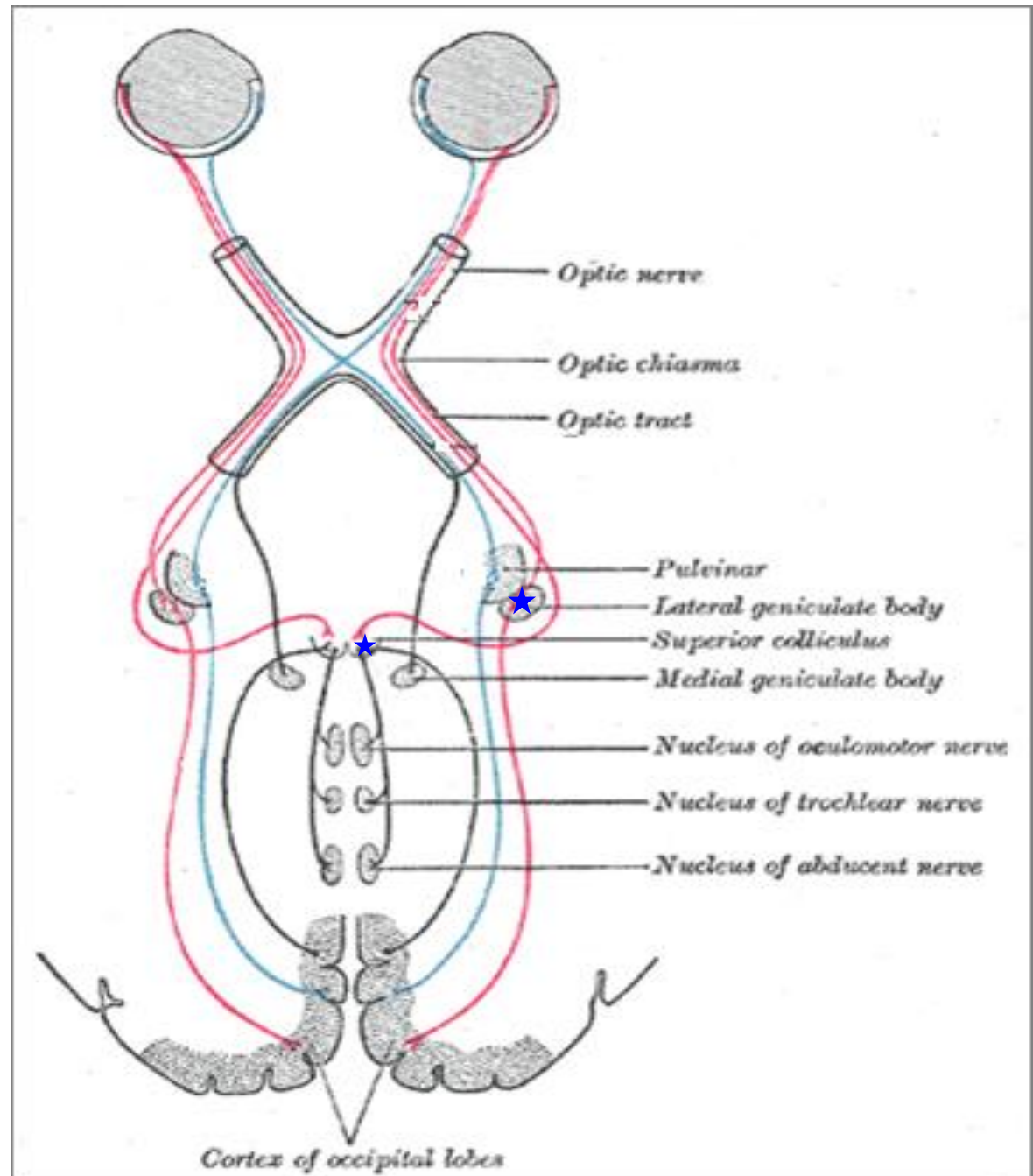
- Fibers from the **nasal (medial) half of retina decussate** in the chiasm and **join uncrossed fibers from the temporal (lateral) half of the retina** to form the **optic tract**.
- **The decussation of nerve fibers in the chiasm** results in the **right optic tract conveying impulses** from the **left visual field** and vice versa.
- **The partial crossing of optic nerve fibers in the optic chiasma** is a requirement for binocular vision.



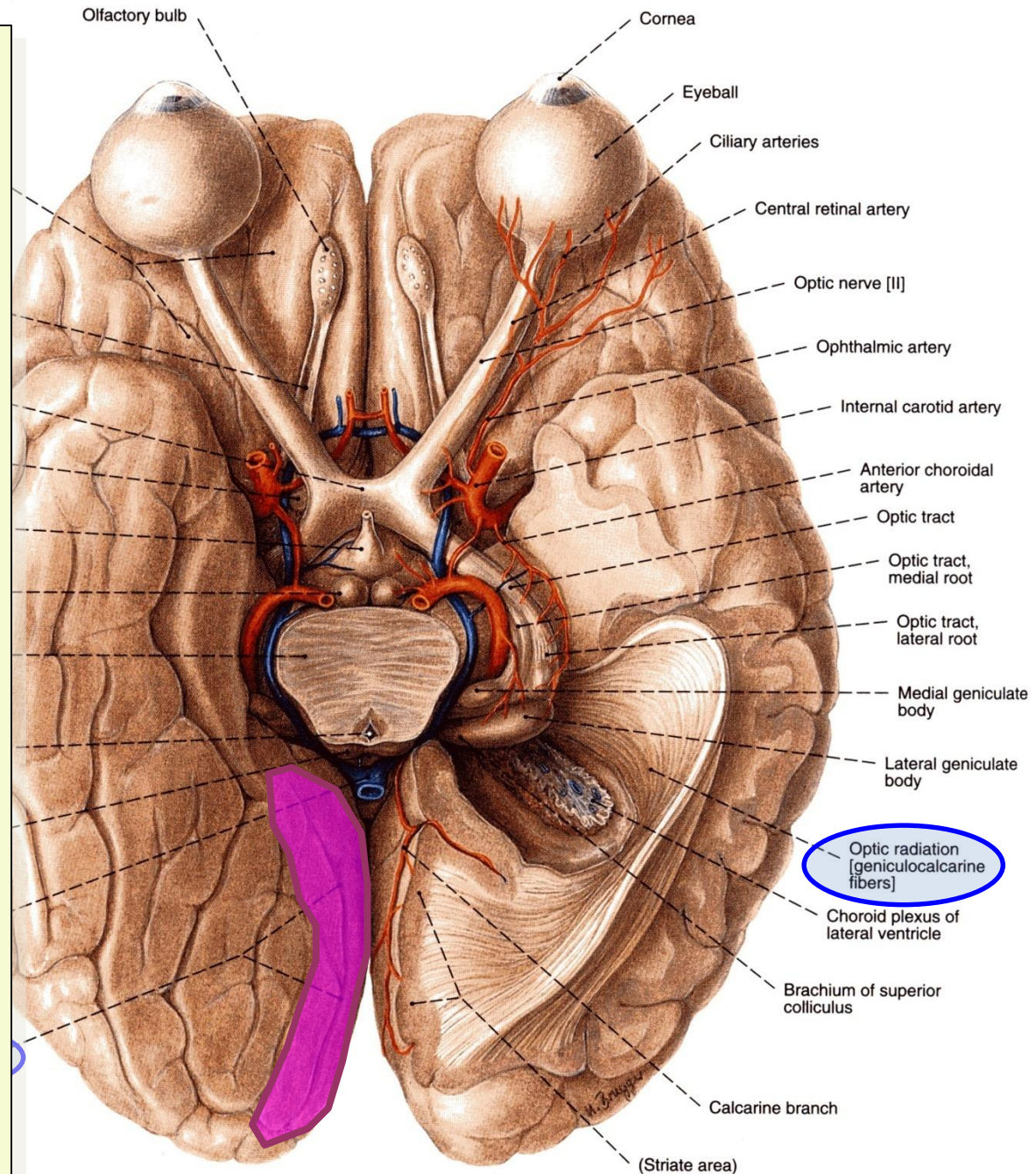
Which retinal fibres are present in the left optic tract??????????

Optic Tracts

- **Fibers in the optic tracts:**
 - **Mainly terminate in the (LGB), lateral geniculate body of the thalamus (3rd order neuron).**
 - **A few fibers terminate in pretectal area and superior colliculus.**
 - **These fibers are related to light reflexes.**



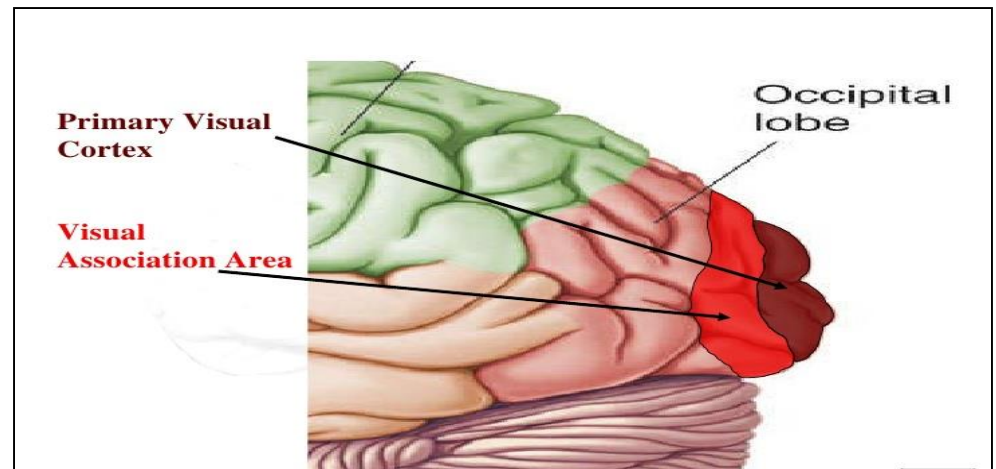
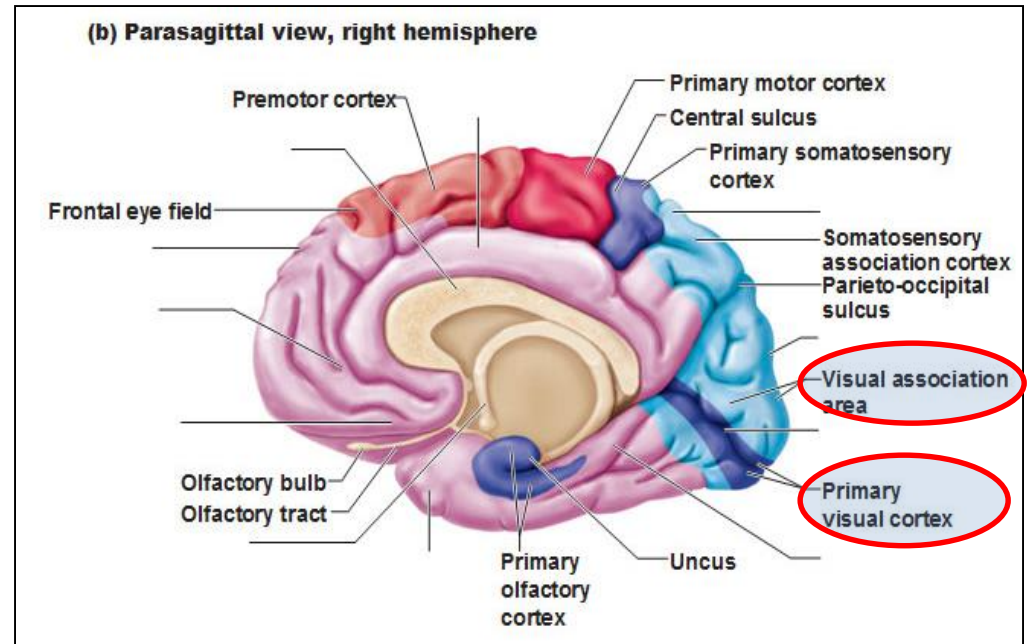
- From the **lateral geniculate nucleus** (third-order neuron), **thalamocortical fibres** project through the **retrolenticular part of the posterior limb of the internal capsule** as the **optic radiation**, which **terminates** in the **primary visual cortex** of the **occipital lobe**.
- The **primary visual cortex** is **located predominantly** on the **medial surface** of the **hemisphere** in the region **above and below the calcarine sulcus**.



- The primary visual cortex (area 17 of Brodmann's) occupies the upper and lower lips of the calcarine sulcus on the medial surface of the cerebral hemisphere.

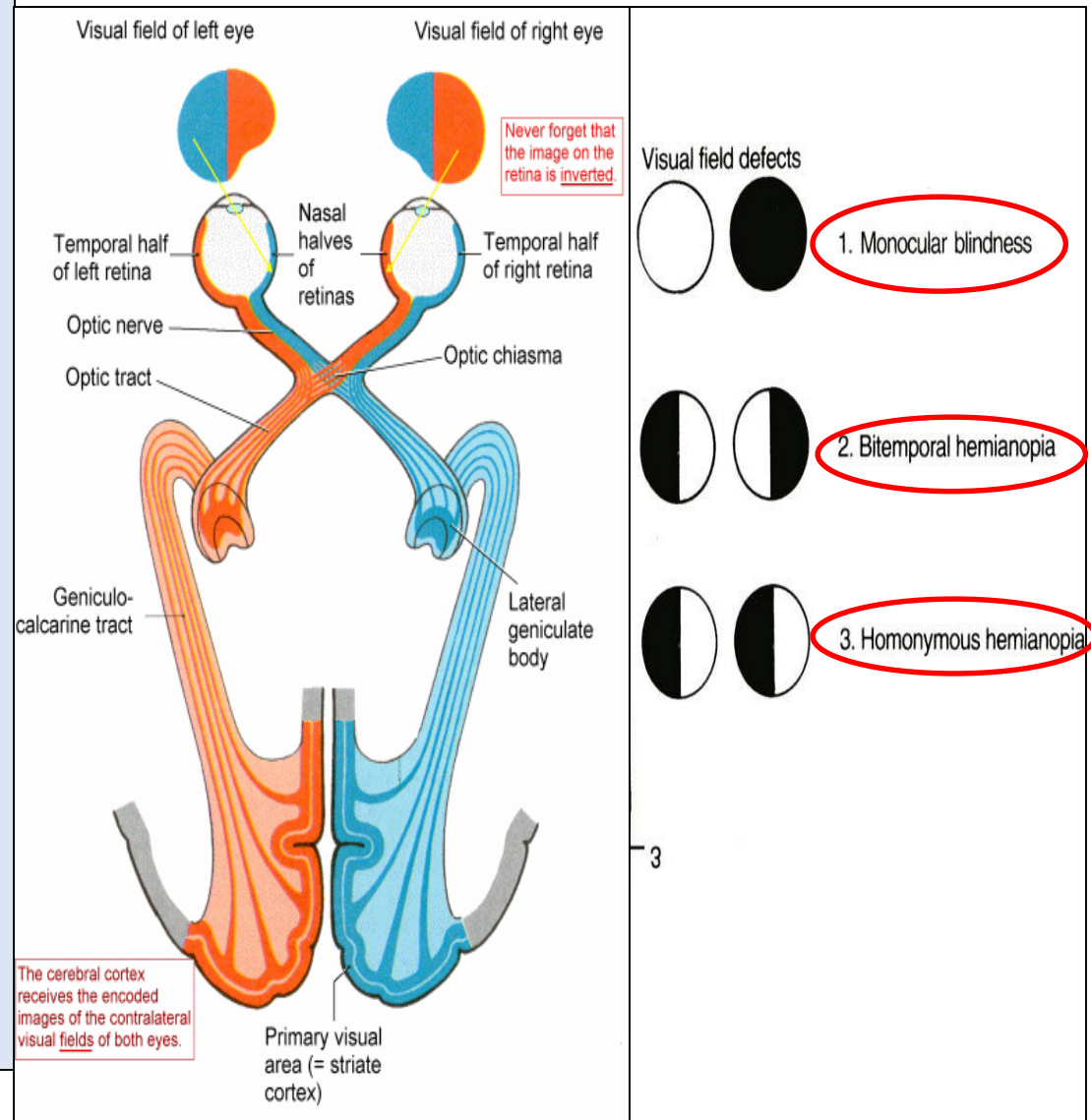
The visual association cortex is extensive, including the whole of the occipital lobe, the adjacent posterior part of the parietal lobe. This cortex is involved in interpretation and recognition of objects and perception of color, depth, motion, and other aspects of vision.

Visual Cortex



Visual field deficits

- 1. Disease of the eyeball** (cataract, intraocular haemorrhage, retinal detachment) **and disease of the optic nerve** (multiple sclerosis and optic nerve tumors) **lead to : loss of vision in the affected eye (monocular blindness).**
- 2. Compression of the optic chiasm** by an adjacent **pituitary tumour leads to : bitemporal hemianopia.**
- 3. Vascular and neoplastic lesions of the optic tract, optic radiation or occipital cortex produce : contralateral homonymous hemianopia.**



THANK YOU

Visual field deficits

- A person may not be able to see objects on their left or right sides (homonymous hemianopsia),
- or may have difficulty seeing objects on their outer visual fields (bitemporal hemianopsia) if the optic chiasm is involved.

- The **pretectal area**, or **pretectum**, is a midbrain structure composed of seven nuclei and comprises part of the subcortical visual system. **Pretectal nuclei are** bilateral group of highly interconnected nuclei located near the junction of the midbrain and forebrain.

FOR THE STUDENT

WHICH DISEASE IS THIS?

Retinitis Pigmentosa

- **Retinitis pigmentosa** is an *inherited metabolic disorder* of the photoreceptor and retinal pigment epithelial cells.
- *It is due to mutation of a key protein in the retinal photoreceptors.*
- *Which protein?*
- **Rhodopsin.**
- There is:
- **Progressive night blindness**
- **Peripheral visual field constriction**
- **Pigmentation of the retina** visible on ophthalmoscopy.
- *Which type of photoreceptor is affected?*
- **Rods.**

