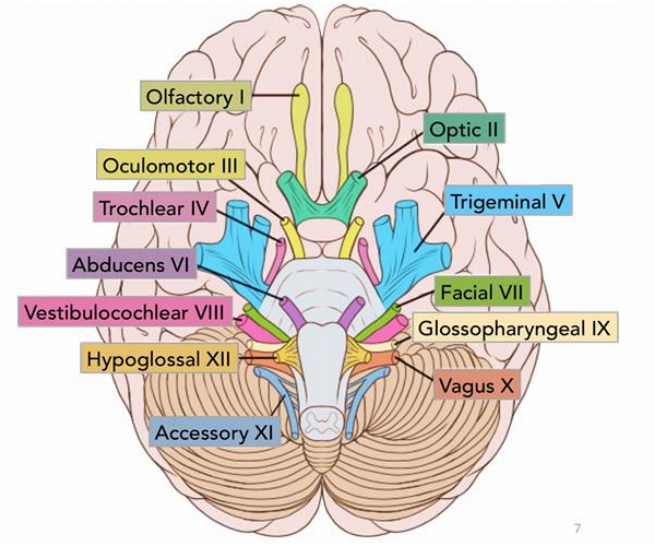
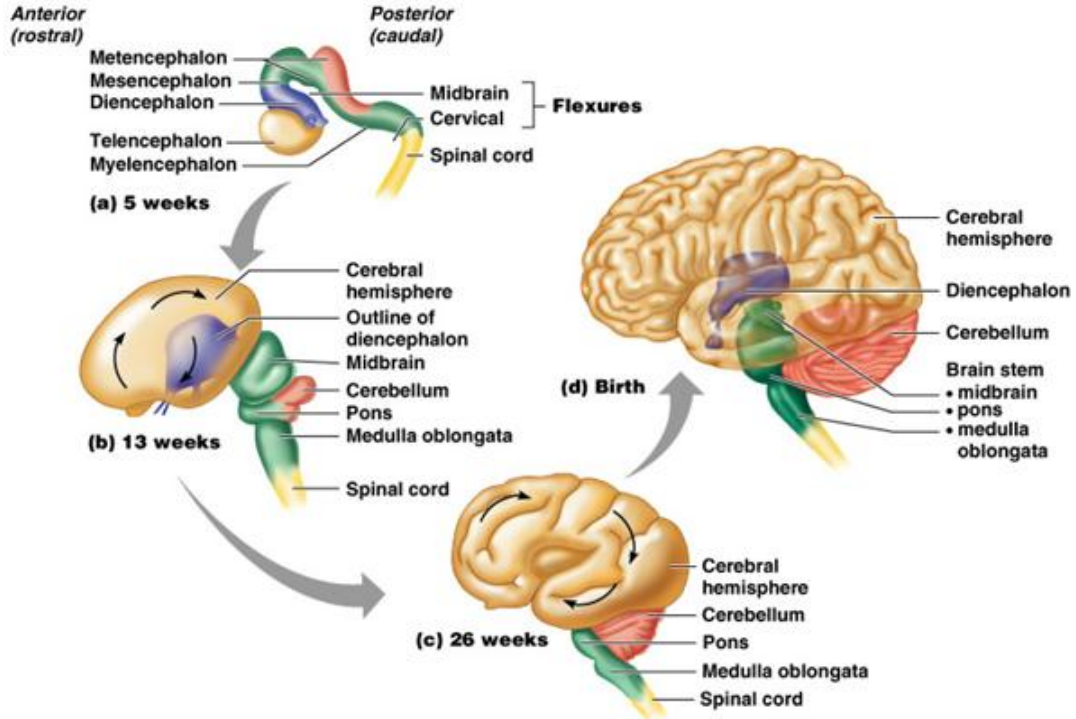
CN I, II, III, IV, VI

1) Cranial Nerves

- There are **12 cranial nerves** in total.
- Origin:
  - The olfactory nerve (CN I) and optic nerve (CN II) originate from the **cerebrum**.
  - Cranial nerves III – XII arise from the **ventral surface of brain stem**.
  - Except, the trochlear nerve (IV) comes from the **posterior side of the midbrain**.



- Developmental origin:
  - Olfactory nerve (I): Developing as an early part of the primitive telencephalon.
  - Optic nerve (II): Developing as an outpouching from the diencephalon.
  - CN III – XII: Originate from the brain stem.



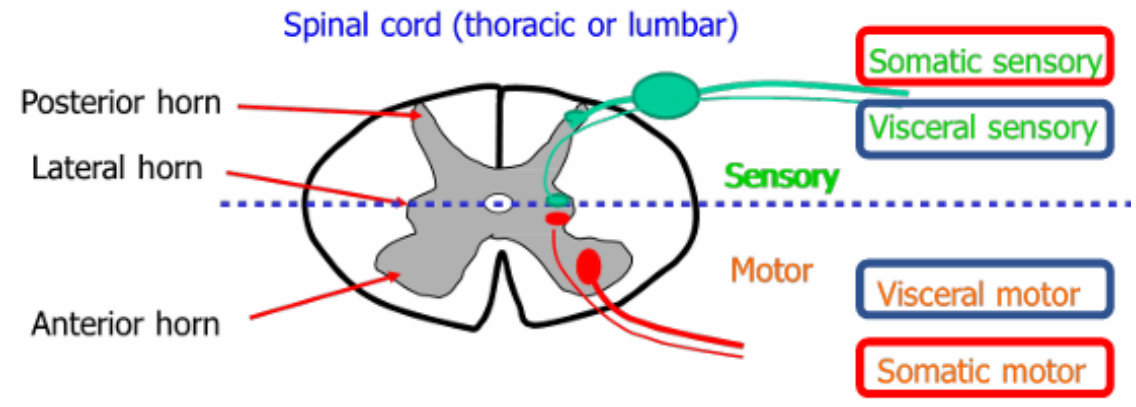
a) Types of sensation

- **Visceral:** In relation to **internal organs** (Heart – Lungs – Intestines)
- **Somatic:** In relation to **skin (sensory)** or **muscles (motor)**

Visceral sensory	General	pain, temperature, touch, vibration, position sense
	Special	Taste, Smell (Mucosa)
Somatic sensory	General	pain, temperature, touch, vibration, position sense
	Special	Hearing, Vision, Balance

b) Functional components of peripheral nerves

Spinal nerves	- General somatic afferents (GSA) - General somatic efferent (GSE) - General visceral afferents (GVA) - General visceral efferent (GVE)	All spinal nerves carry the 4 components.
Cranial nerves	- GSA - GSE - GVA - GVE	NOT all cranial nerves carry all these components
	- Special somatic afferents (SSA) - Special visceral afferents (SVA) - Special visceral efferent (SVE)	



c) Modalities of cranial nerves

Sensory (afferent)	GSA	general sensation from ectoderm (skin).
	GVA	general sensation from endoderm (viscera).
	SSA	**Special** senses derived from ectoderm (e.g. vision, sound, balance).
	SVA	**Special** senses derived from endoderm (e.g. taste, smell).
Motor (efferent)	GSE	skeletal muscles.
	GVE	smooth muscles of gut and **autonomic**.
	SVE	muscles derived from **pharyngeal arches**.

d) Classification of cranial nerves

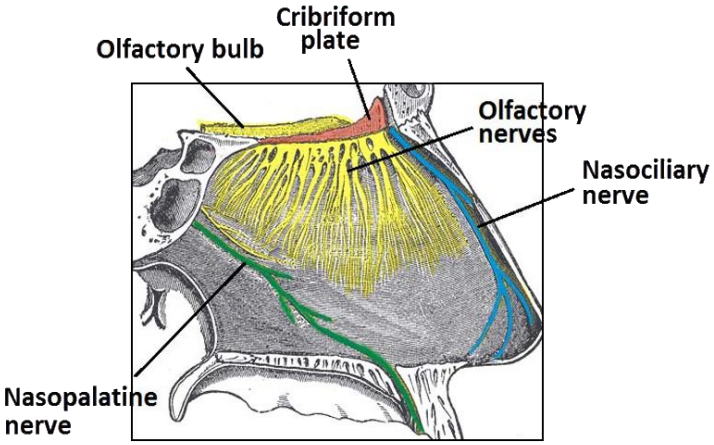
Sensory (1,2,8)	CN I (Olfactory)	Contain only afferent (sensory) fibers
	CN II (Optic)	
	CN VIII (Vestibulocochlear)	
Motor (3,4,6,11,12)	CN III (Oculomotor)	contain only efferent (motor) fibers.
	CN IV (Trochlear)	
	CN VI (Abducens)	
	CN XI (Accessory)	
	CN XII (Hypoglossal)	
Mixed (5,7,9,10)	CN V (Trigeminal)	contain sensory, motor and parasympathetic fibers. (1975)
	CN VII (Facial)	
	CN IX (Glossopharyngeal)	
	CN X (Vagus)	

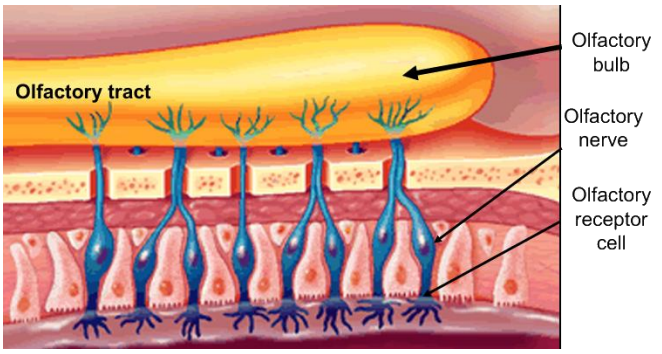
2) CN I (Olfactory N.)

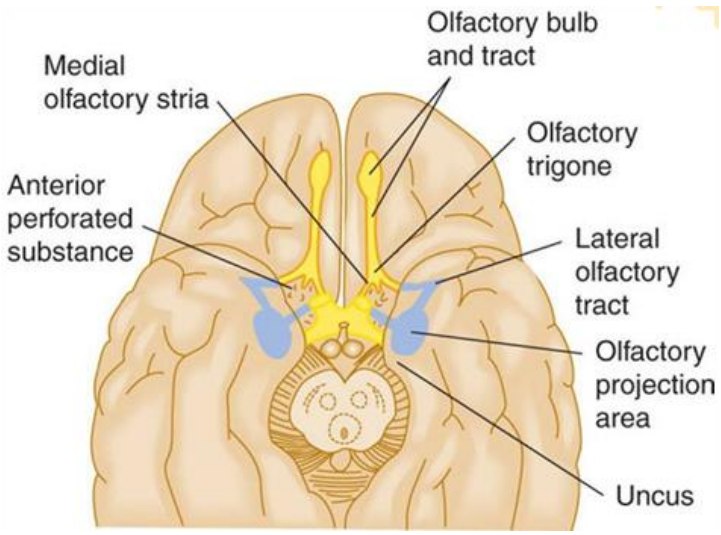
Description	The first and **shortest** cranial nerve
Modality	SVA → Transmits information related to smell
Course	Arise from **olfactory epithelium** → Passes through the **cribriform plate** of the ethmoid bone → Its fibers run through the **olfactory bulb** → Terminate in the **primary olfactory cortex**.
Function	Smell

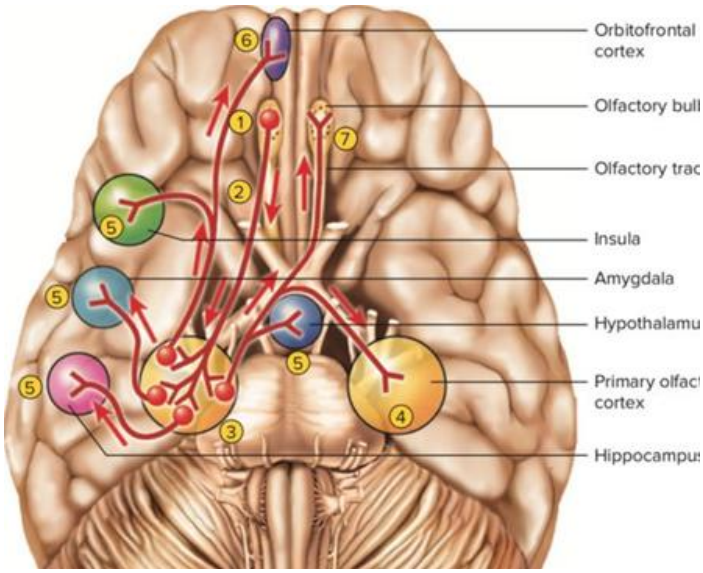
- **Olfactory tract**:
  - As the tract reaches the **anterior perforated substance** (an area at the level of the optic chiasma) it divides into **medial and lateral stria**:

Medial Stira	**cross** the median plane, where they meet the olfactory bulb of the opposite side.
Lateral Stria	to the **primary olfactory cortex**, located within the uncus of temporal lobe.





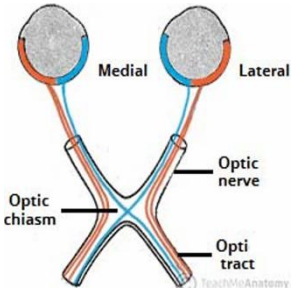




3) CN II (Optic N.)

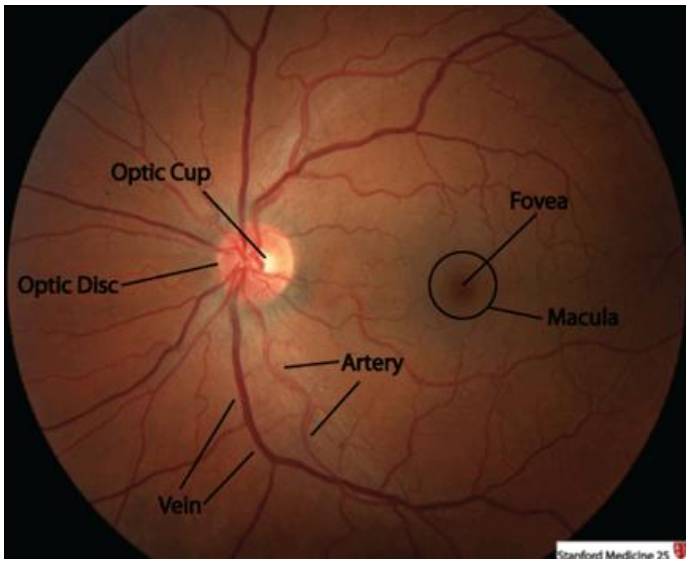
Description	- The optic nerve is considered a **part of the central nervous system** and examination of the nerve enables an assessment of **intracranial health**. - Due to its unique anatomical relation to the brain, the optic nerve is **surrounded by the cranial meninges**.
Modality	SSA ➔ Transmits information related to vision.
Course	Arises from the **retinal ganglion** cells of the eye ➔ pass through the **optic canals** and **converge at the optic chiasma** (close to the pituitary gland) ➔ continues as **Optic tract** to the thalamus (**LGB**) ➔ continues as **optic radiation** fibers that runs to the visual cortex.
Function	Vision

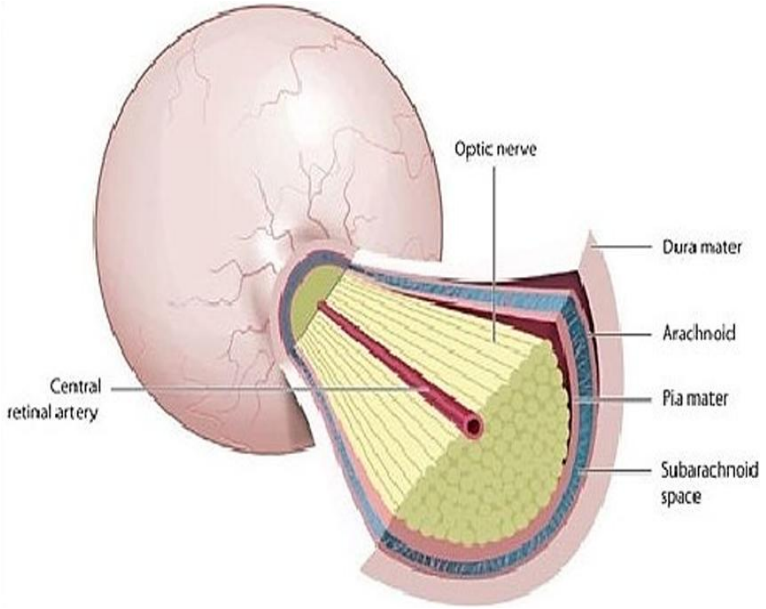
- **The Visual Pathway**:
  - Within the middle cranial fossa, the **optic nerves** from each eye unite to form the **optic chiasma**.
  - At the chiasma, fibers from the **nasal (medial)** half of each retina **crossover** to the contralateral optic tract, while fibers from the **temporal (lateral)** halves remain **ipsilateral**.

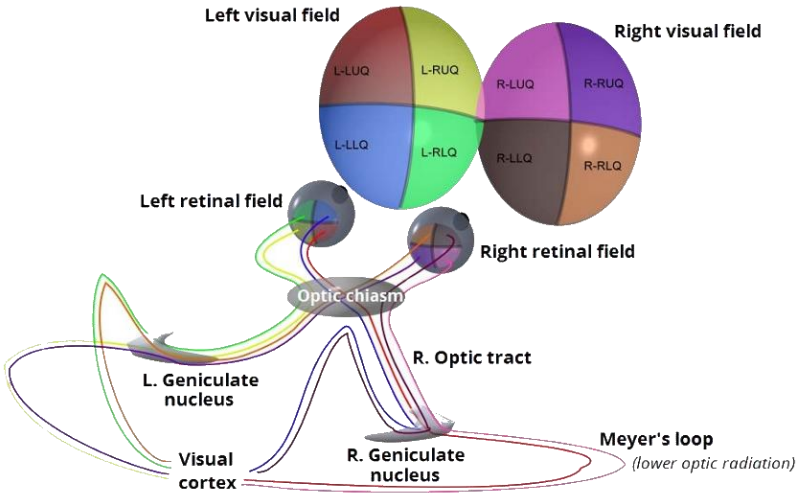


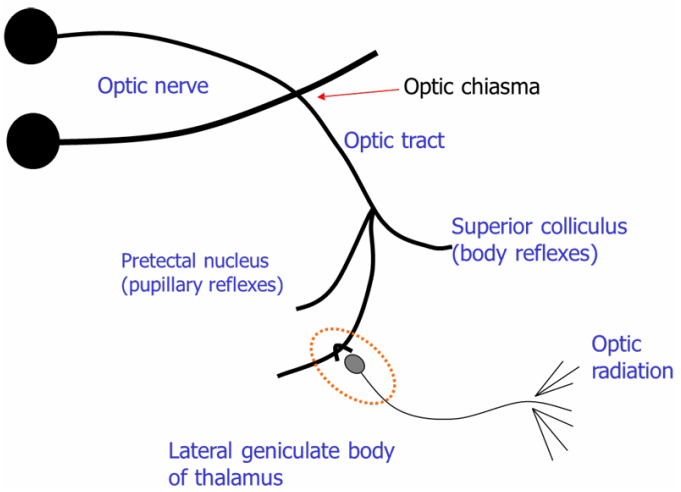
  - Continues as **optic tracts**, where:
    - **Left optic tract**: fibers from left temporal and right nasal retina.
    - **Right optic tract**: fibers from left nasal and right temporal retina
  - Each optic tract travels to its corresponding cerebral hemisphere to reach the lateral geniculate nucleus (**LGN**), a relay system located in the thalamus
  - Axons from the LGN then carry visual information via a pathway known as the optic radiation, where:

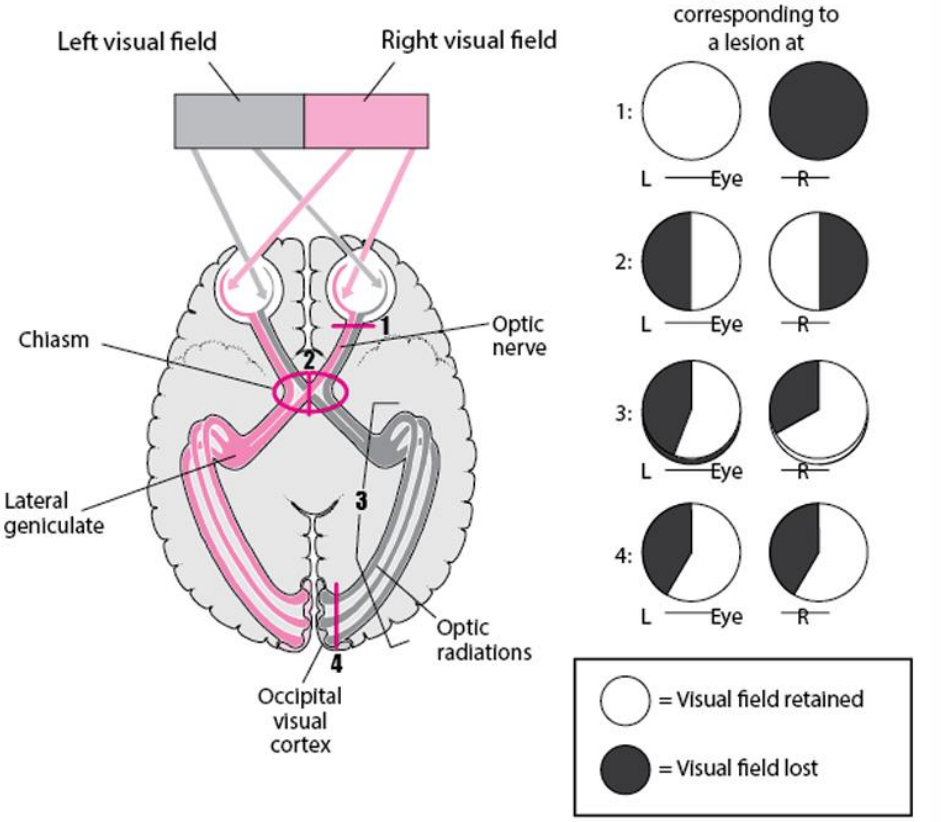
Upper optic radiation	- Carries fibers from the **superior retinal quadrants** (inferior visual field) - Travels through the **parietal lobe** ➔ visual cortex
Lower optic radiation	- Carries fibers from the **inferior retinal quadrants** (superior visual field). - Travels through the **temporal lobe** ➔ visual cortex.


Optic Cup
Fovea
Optic Disc
Macula
Artery
Vein


Optic nerve
Dura mater
Arachnoid
Central retinal artery
Pia mater
Subarachnoid space

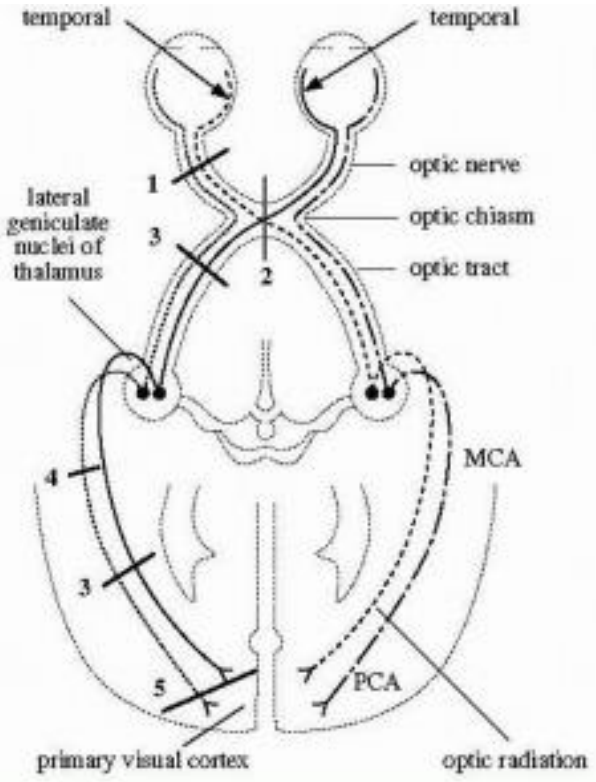

Left visual field
Right visual field
L-LUQ
L-RUQ
R-LUQ
R-RUQ
L-LLQ
L-RLQ
R-LLQ
R-RLQ
Left retinal field
Right retinal field
Optic chiasm
R. Optic tract
L. Geniculate nucleus
Meyer's loop
(lower optic radiation)
Visual cortex
R. Geniculate nucleus

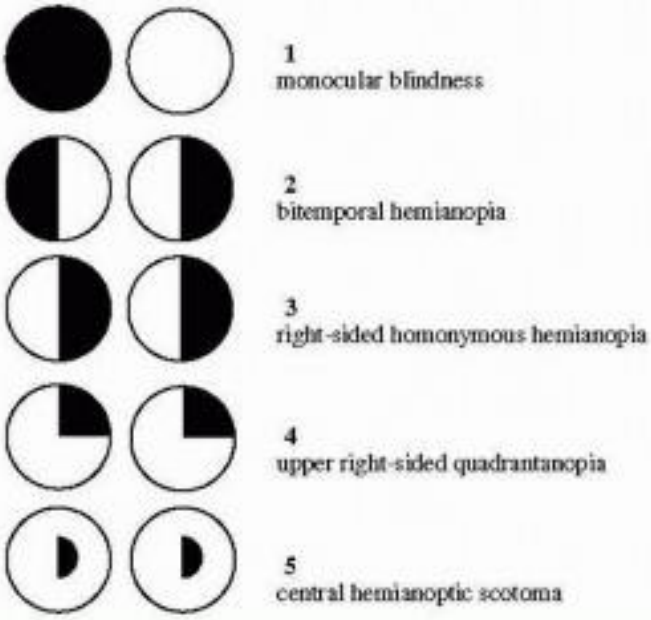

Optic nerve
Optic chiasma
Optic tract
Superior colliculus
(body reflexes)
Pretectal nucleus
(pupillary reflexes)
Optic radiation
Lateral geniculate body
of thalamus


Left visual field
Right visual field
Chiasm
Optic nerve
Lateral geniculate
Optic radiations
Occipital visual cortex
1
2
3
4
Field defect corresponding to a lesion at
1:
2:
3:
4:
L
Eye
R
= Visual field retained
= Visual field lost

- [Lesion in the Visual Pathway]:

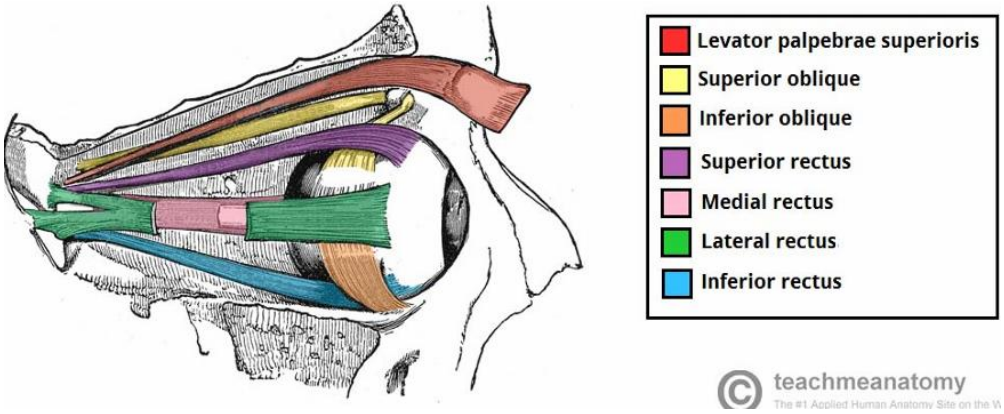
Optic N.	total blindness of the same eye.	
Optic Chiasma	Midline (central) lesion	bitemporal hemianopia (from pituitary tumor)
	Peripheral lesion on the two sides	binasal hemianopia.
Optic tract	contralateral homonymous hemianopia.	
LGB & Optic radiation	contralateral homonymous hemianopia.	
Visual area	Total lesion	contralateral homonymous hemianopia with macular sparing (from anastomoses between branches of the MCA & PCA).
	Above calcarine sulcus (cuneus)	contralateral homonymous lower quadrantic anopia.
	Below calcarine sulcus (lingual gyrus)	contralateral homonymous upper quadrantic anopia.



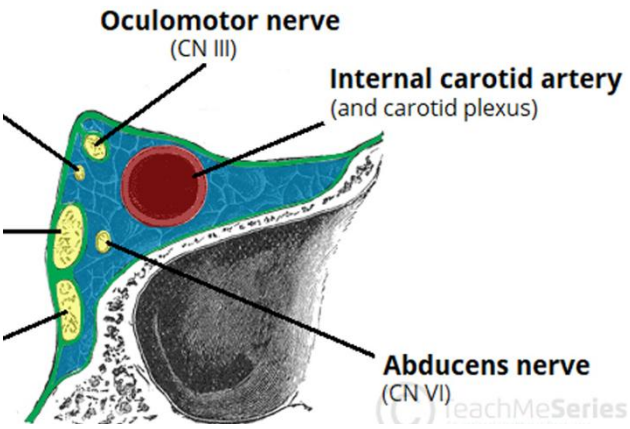


4) CN III (Oculomotor N.)

- *The **third** cranial nerve (CN III).*
- *It provides **motor** and **parasympathetic** innervation to structures within the bony orbit:*
  - *Motor: all extraocular muscles except superior oblique & lateral rectus.*
  - *Parasympathetic: Sphincter pupillae and the Ciliary muscles of the eye.*



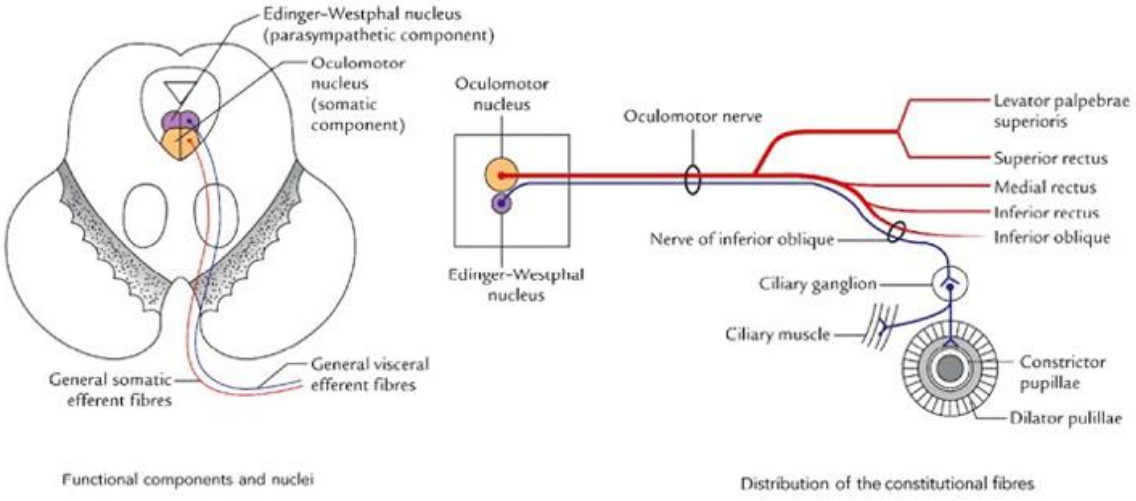
- *Origin: Oculomotor nucleus in **midbrain**.*
- *Course:*
  - *It pierces the **dura mater** and enters the **lateral wall of the** cavernous sinus.*
  - *It exits the **cranial cavity** via the superior orbital fissure; dividing into **superior and inferior branches.***



    - *Superior branch → superior rectus & levator palpabrae superioris.*
    - *Inferior branch → inferior rectus, medial rectus & inferior oblique.*

- *Parasympathetic Functions:*
  - *Sphincter pupillae → constricts pupil, reducing amount of light entering the eye.*
  - *Ciliary muscles → contracts; making lens more spherical (accommodation).*
- *Parasympathetic pathway:*
  - ***Pre-ganglionic fibers** travel in the **inferior branch** of CN III.*
  - *They synapse in the **ciliary ganglion** within the orbit.*
  - ***Post-ganglionic fibers** reach the eye via the **short ciliary nerves**.*

Oculomotor Nerve (CN III) - Pupillary Constriction



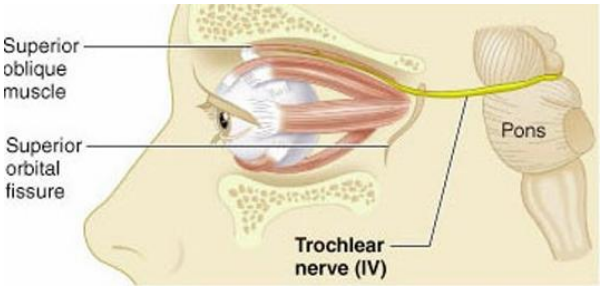
Functional components and nuclei

Distribution of the constitutional fibres

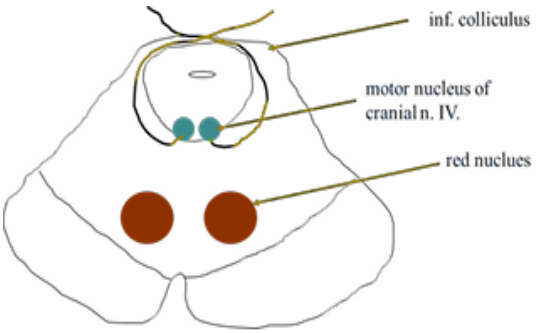
Oculomotor paralysis

5) CN IV (Trochlear N.)

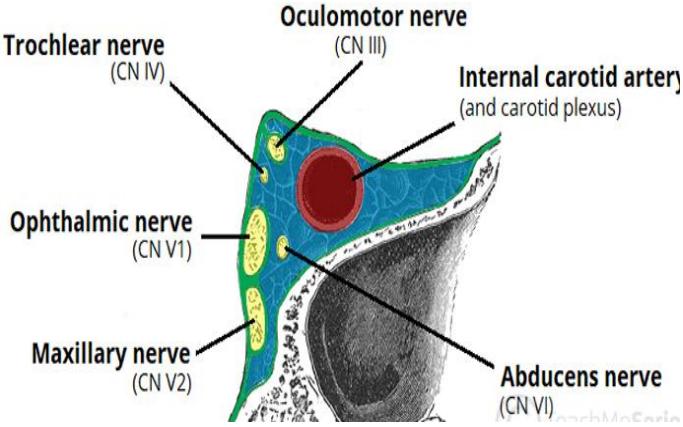
- It's the 4th cranial nerve.
- It has the longest intracranial course of all cranial nerves.
- It is **purely motor** in function.



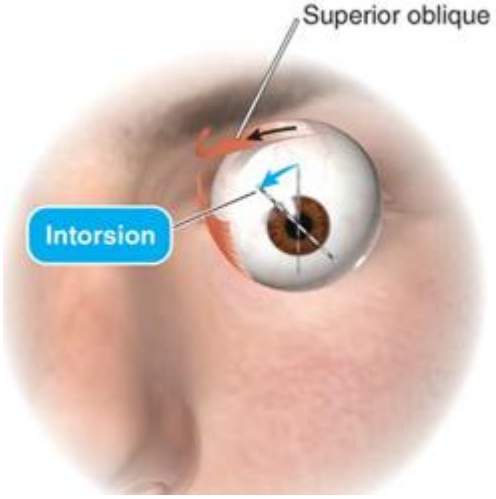
- Origin:
  - The trochlear nerve arises from the **trochlear nucleus** in the **midbrain**.
  - It is the only cranial nerve that emerges from the posterior midbrain.



- Course:
  - The nerve moves along the **lateral wall of the cavernous sinus**.
  - It enters the orbit via the **superior orbital fissure**.

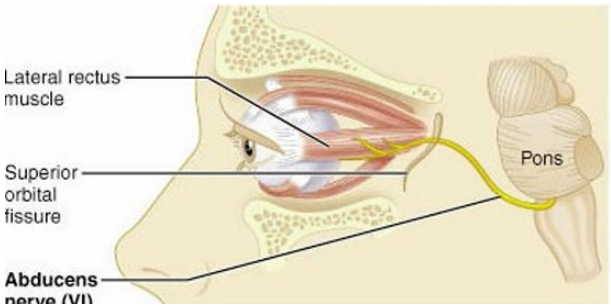


- Motor function:
  - Innervates contralateral superior oblique muscle (used in going down stairs).
  - Action of Superior oblique muscle:
    - Depress eyeball
    - Intort eyeball

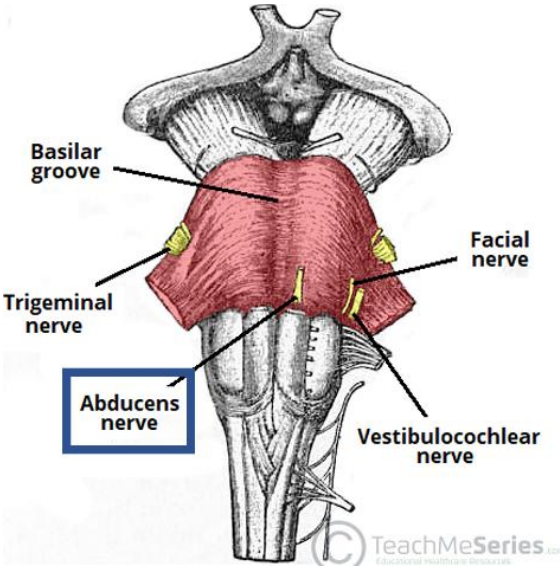


6) CN VI (Abducens N.)

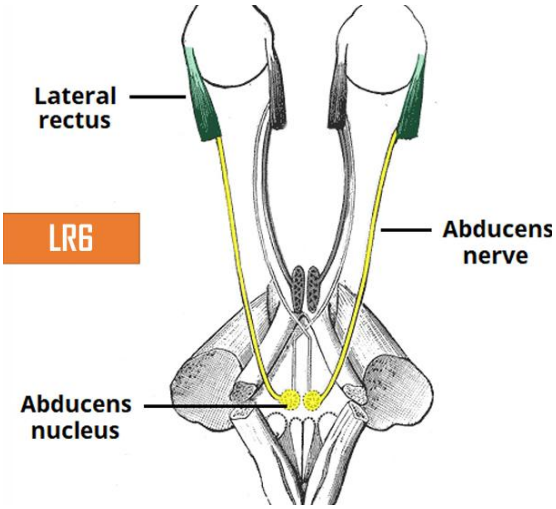
- *It's the 6th cranial nerve.*
- *It has a **purely somatic motor** function.*



- *Origin:*
  - *The abducent nerve arises from the **abducens nucleus** in the **pons** of the brainstem.*



- *Course:*
  - *The nerve **enters the cavernous sinus** and travels through it.*
  - *It then enters the **bony orbit via the superior orbital fissure**.*
  - *Terminates within the **orbit**, the nerve terminates by innervating the **lateral rectus muscle**.*



Abducens N. injury

- *Summary table:*

No	Name	Exit	Modality	Function
CN I	Olfactory	Cribriform plate	SVA	Smell
CN II	Optic	Optic canal	SSA	Vision
CN III	Oculomotor	Superior Orbital Fissure	GSE & GVE	GSM → Extraocular muscles GVM → Pupillary sphincter
CN IV	Trochlear		GSE	SO ms
CN VI	Abducens		GSE	LR ms