



Cranial Nerves

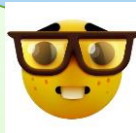
Neurophysiology

By Filip Sadurski

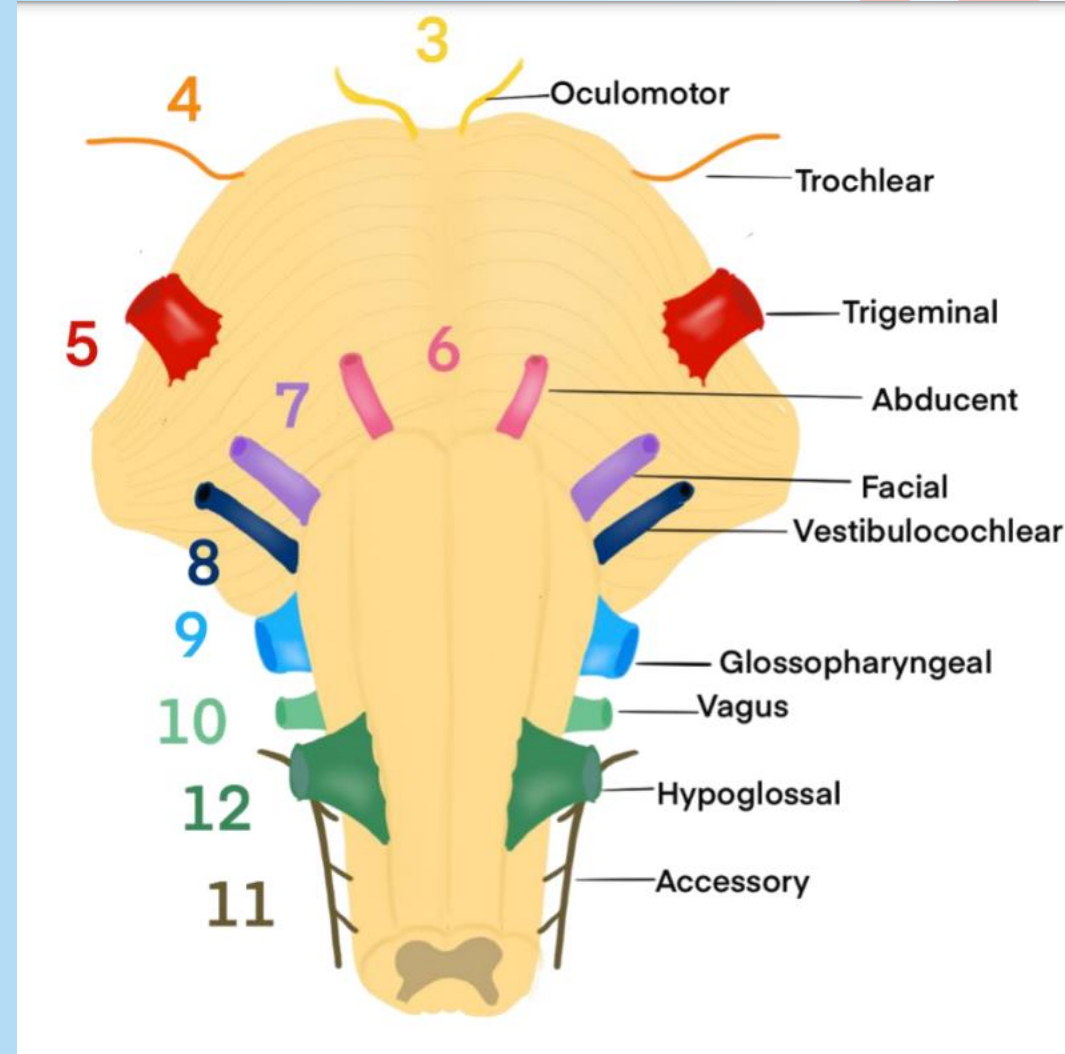
Meet the nerves

- i. Olfactory
- ii. Optic
- iii. Oculomotor
- iv. Trochlear
- v. Trigeminal
- vi. Abducens
- vii. Facial
- viii. Vestibulocochlear
- ix. Glossopharyngeal
- x. Vagus
- xi. Accessory
- xii. Hypoglossal

Neat Trick: Rule of Fours



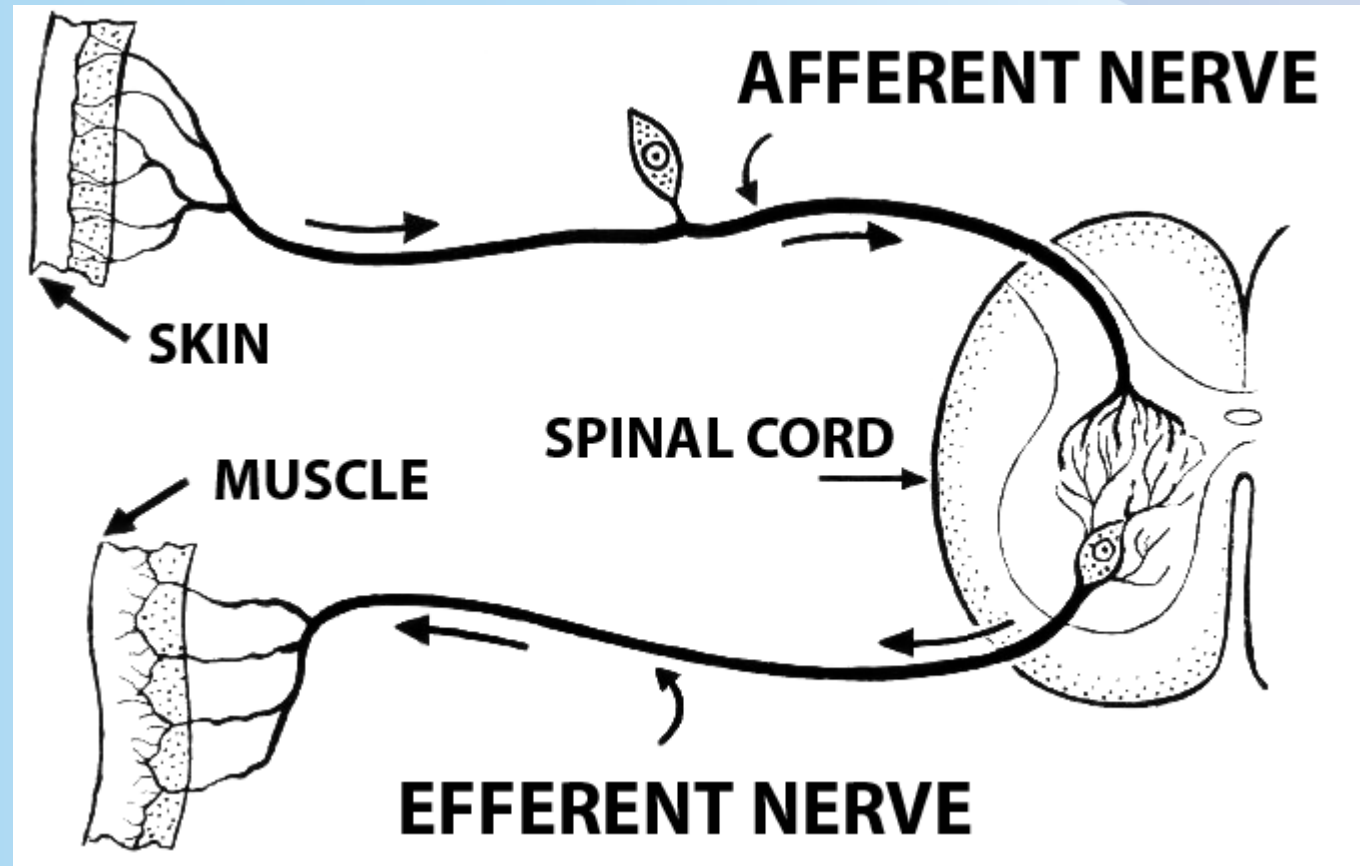
- 4CN from Midbrain -> I,II,III,IV
- 4CN from Pons -> V,VI,VII,VIII
- 4CN from Medulla -> IX,X,XI,XII



Types of fibers

- General **Somatic** **Afferent** (GSA)
- General **Somatic** **Efferent** (GSE)
- General **Visceral** **Afferent** (GVA)
- General **Visceral** **Efferent** (GVE)

- Special **Somatic** **Afferent** (SSA)
- Special **Visceral** **Afferent** (SVA)
- Special **Visceral** **Efferent** (SVE)



CN I - Olfactory N.

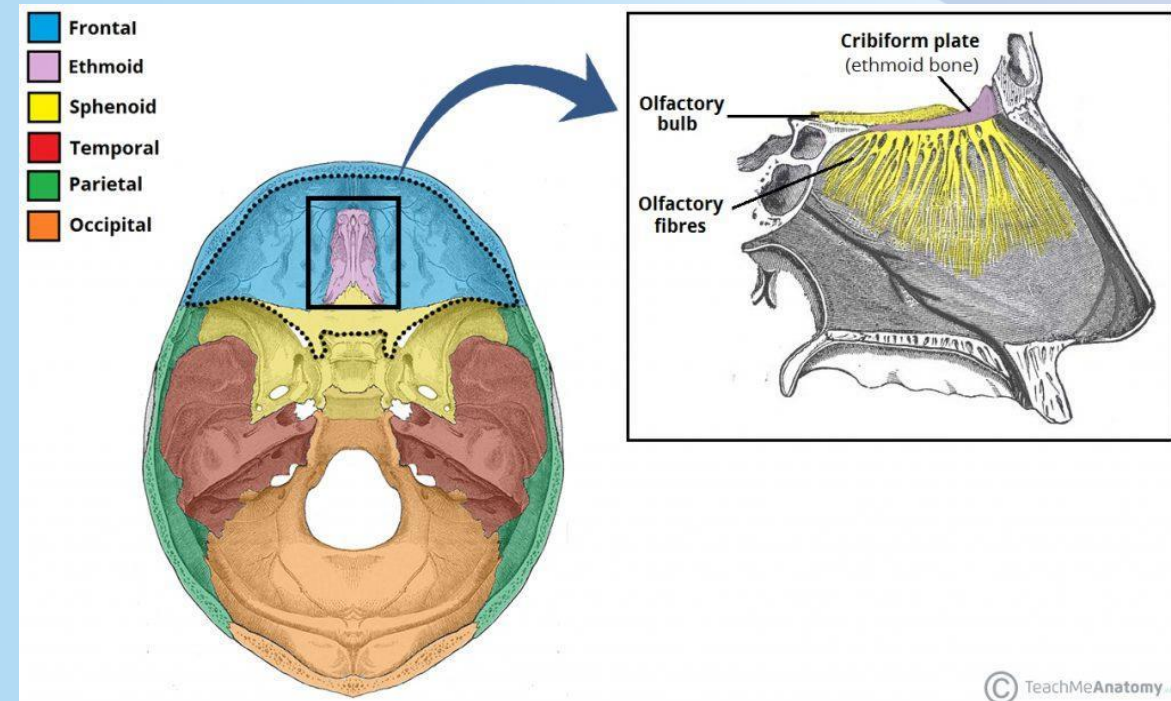
❖ **Sensory (SVA)** -> Olfaction
(Smell)

❖ Site of exit

- Pass through foramina in the Cribriform plate
- Synapse in olfactory bulb

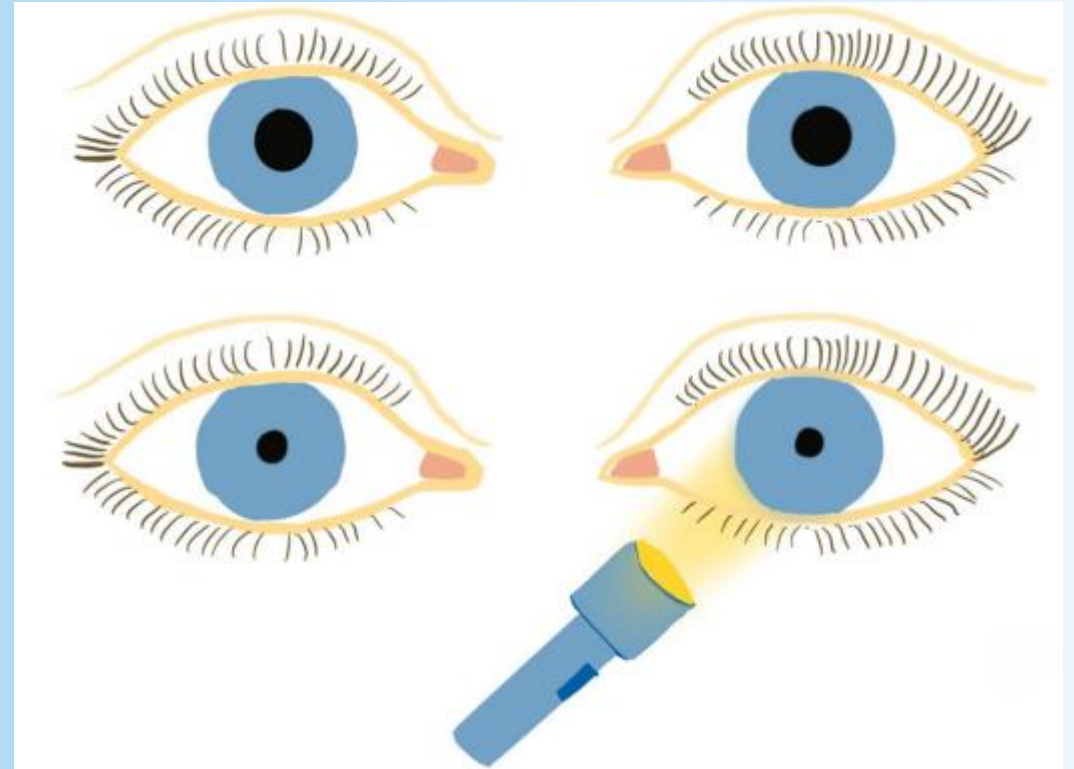
❖ **Lesion**

- Ethmoid bone fracture
- Anosmia (Loss of smell)
- Runny nose from CSF leakage



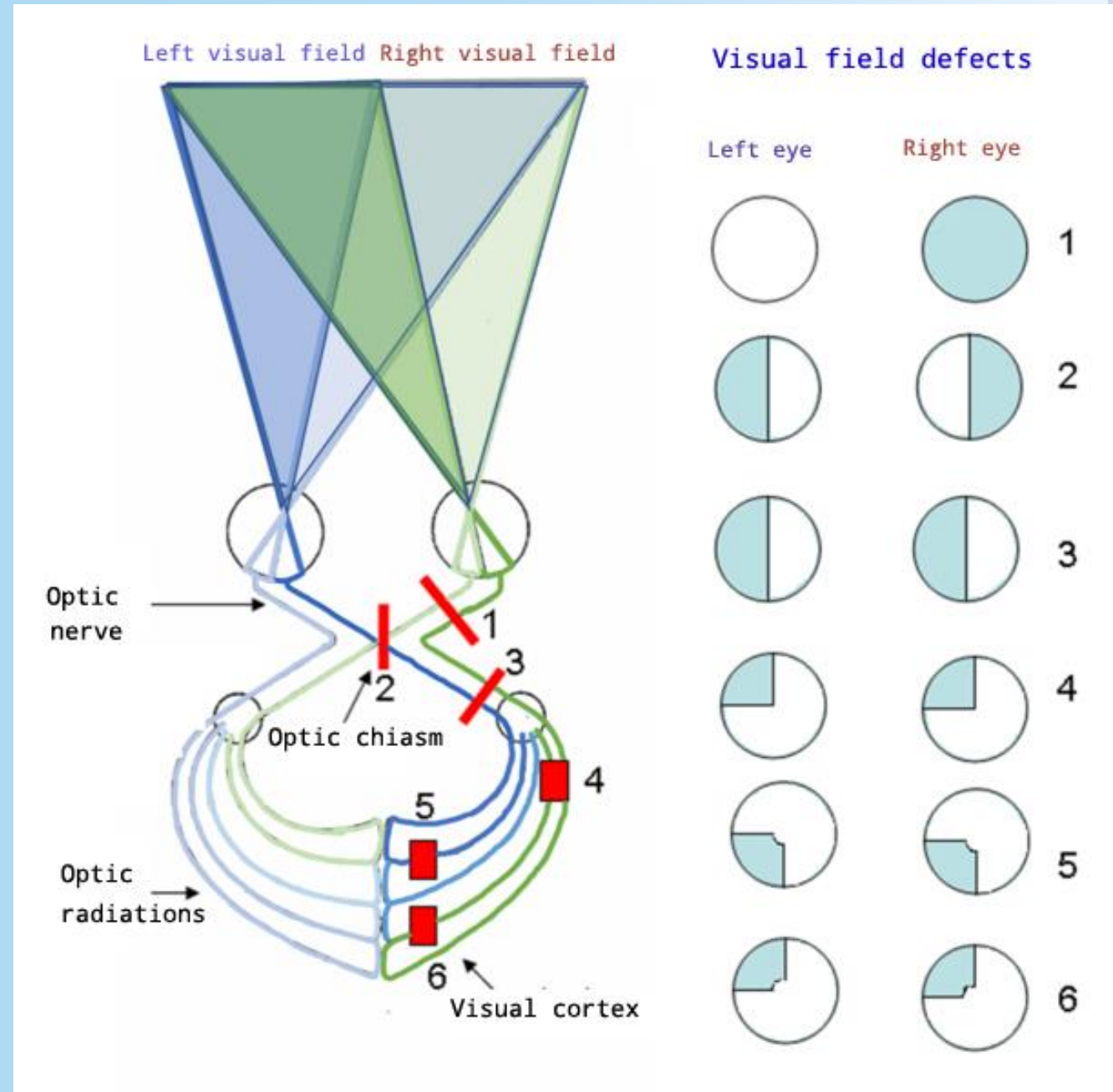
CN II - Optic N.

- ❖ **Sensory** (SSA) -> Vision
- ❖ Afferent portion of Pupillary Light Reflex
- ❖ Travels from Retina to the brain
- ❖ **Lesions**
 - Loss of vision in visual fields with respect to location of the physical lesion.
 - Blurry Vision
 - Loss of pupillary light reflex



Optic tract lesions

1. Ipsilateral monocular anopia
2. Bitemporal hemianopia
3. Contralateral homonymous hemianopia
4. Contralateral upper quadrantanopia
5. Contralateral lower quadrantanopia with macular sparing
6. Contralateral upper quadrantanopia with macular sparing



CN III - Oculomotor N.

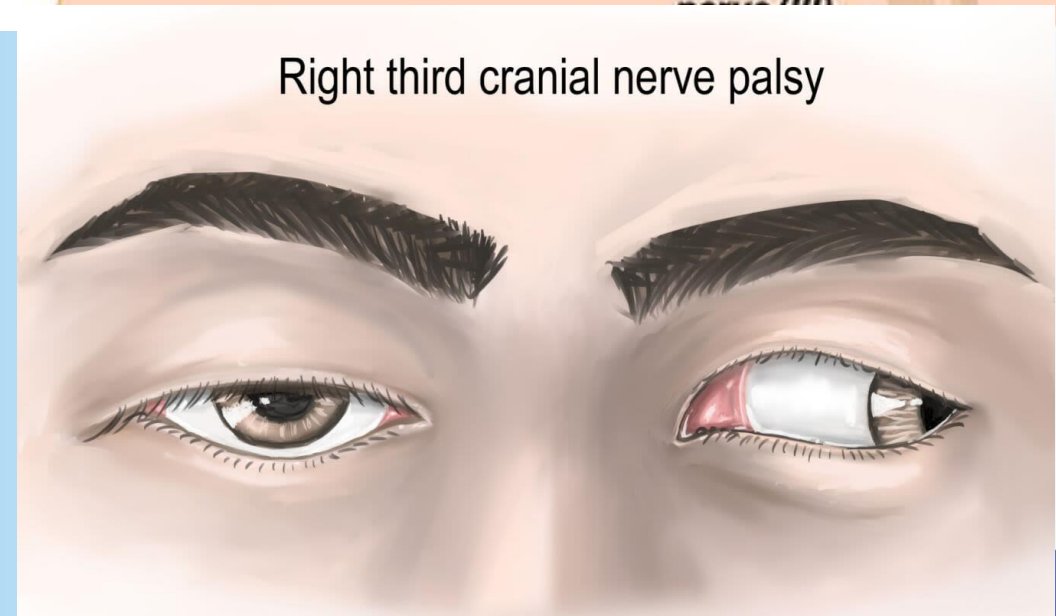
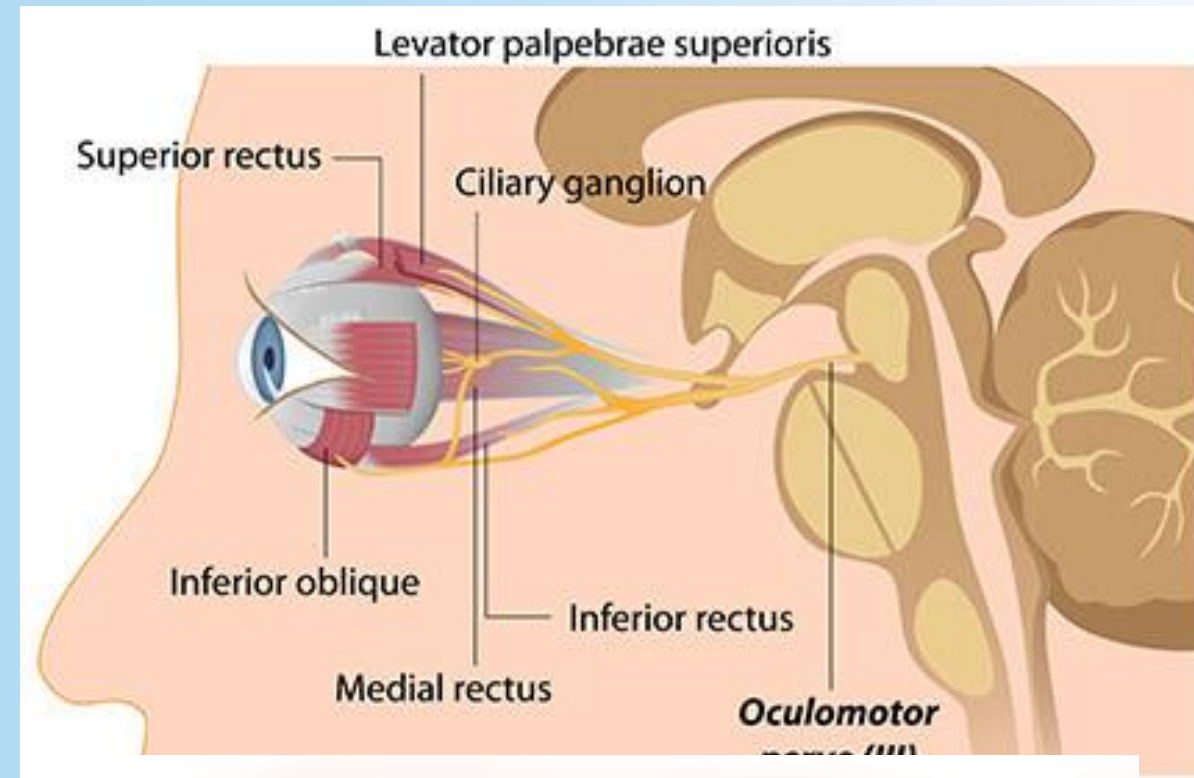
❖ **Motor** (GSE & GVE) = Eye movements and blinking

- **Sympathetic** -> extraocular muscles: superior rectus, medial rectus, inferior rectus, inferior oblique, levator palpebrae superioris.
- **Parasympathetic** -> intraocular muscles:
 - Sphincter pupillae - constricting pupil (miosis)
 - Ciliary m. - accommodation

❖ **Efferent limb of pupillary light reflex**

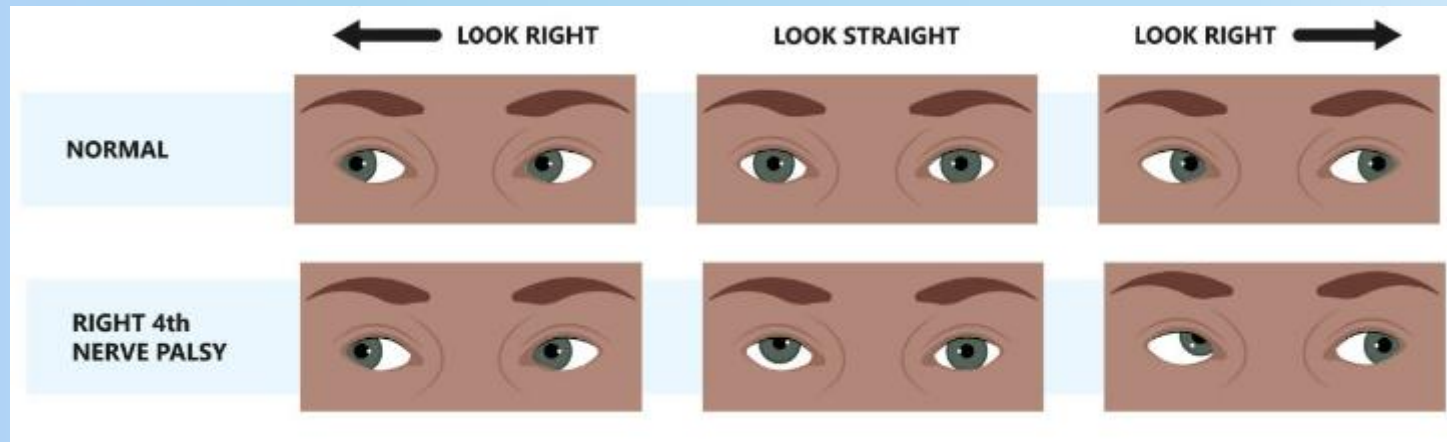
❖ **Lesion = down and out gaze** as superior oblique m. and lateral rectus are not innervated by CN III

- Ptosis (droopy eyelid)
- Loss of pupillary constriction, accommodation and pupillary light reflex and corneal blink reflex.



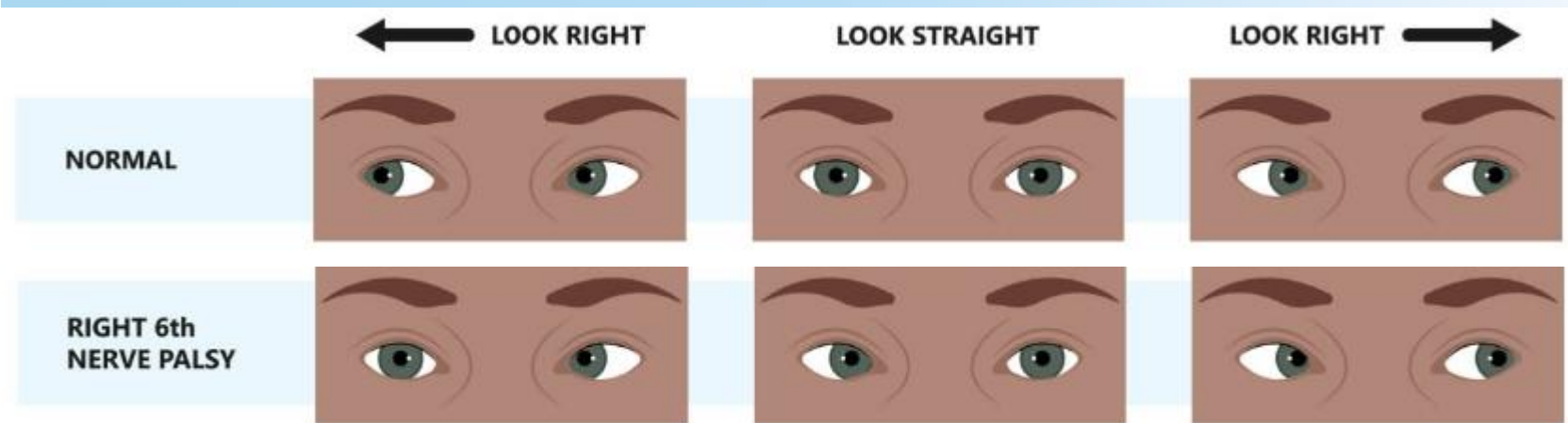
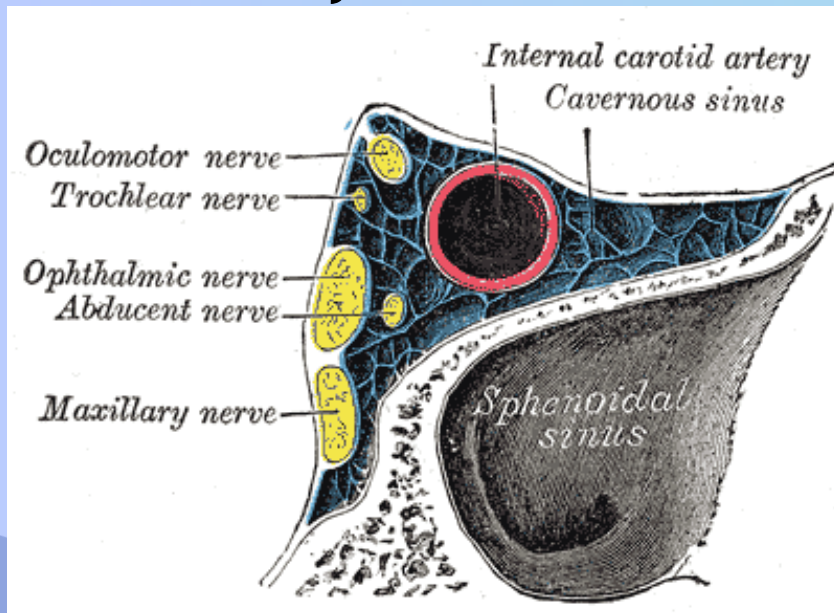
CN IV - Trochlear N.

- ❖ **Motor** (GSE) -> Eye movement (Looking down and in thanks to superior oblique m.)
- ❖ **Lesion:**
 - Diplopia (double vision) when looking down and in (e.g. Walking down the stairs)
 - Patient has slight head tilt away from side of lesion
 - Prone to head injuries as it has longest course out of all cranial n.

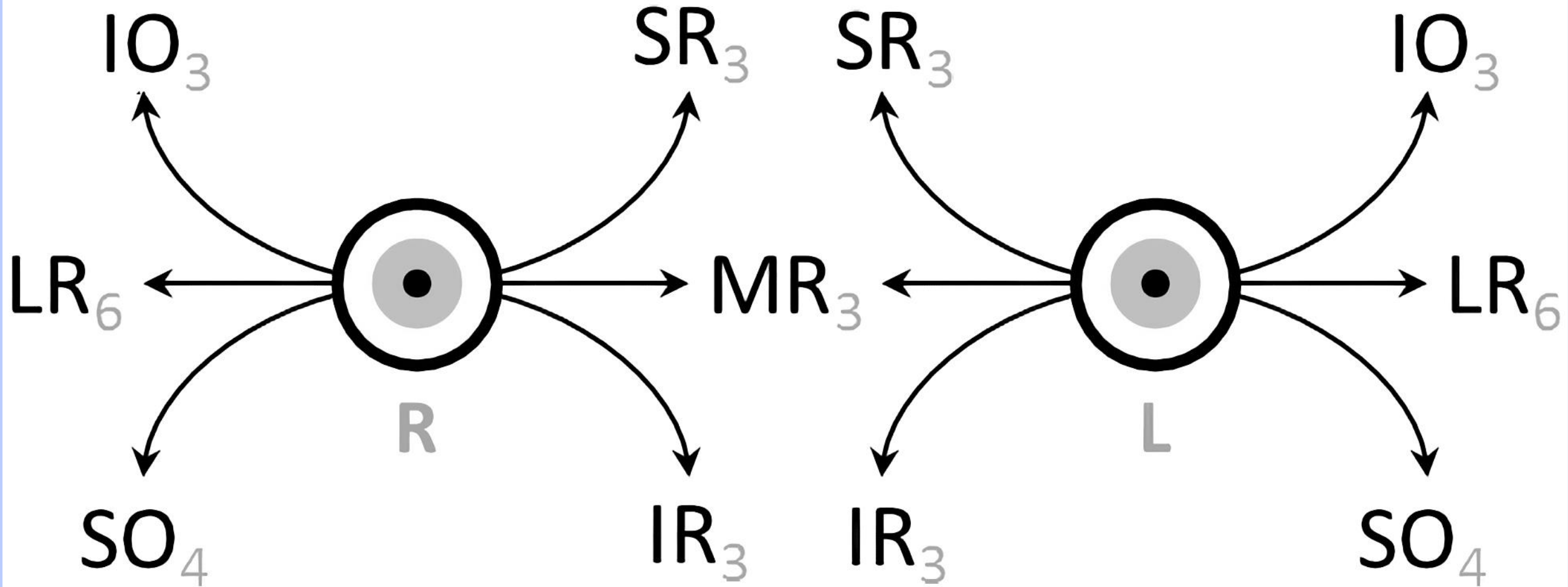


CN VI - Abducens N.

- ❖ **Motor** (GSE) -> Eye movement (provides lateral rectus m. innervation)
- ❖ Abducens “abducts”
- ❖ **Lesion:** Inability to abduct eyeball and possible diplopia. Commonly caused by cavernous sinus thrombosis due to proximity to ICA.

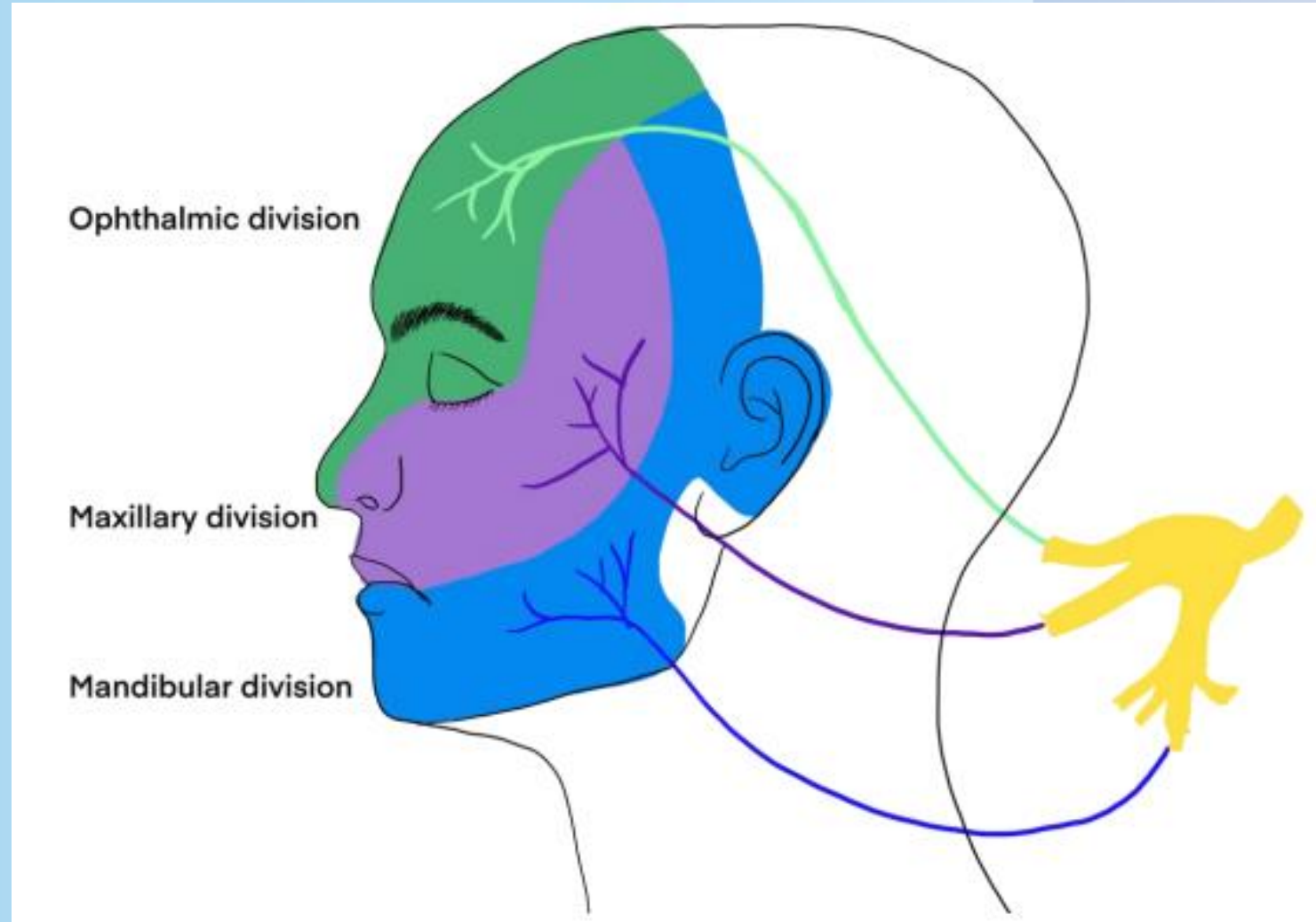




Eye Movement Diagram



CN V - Trigeminal N.

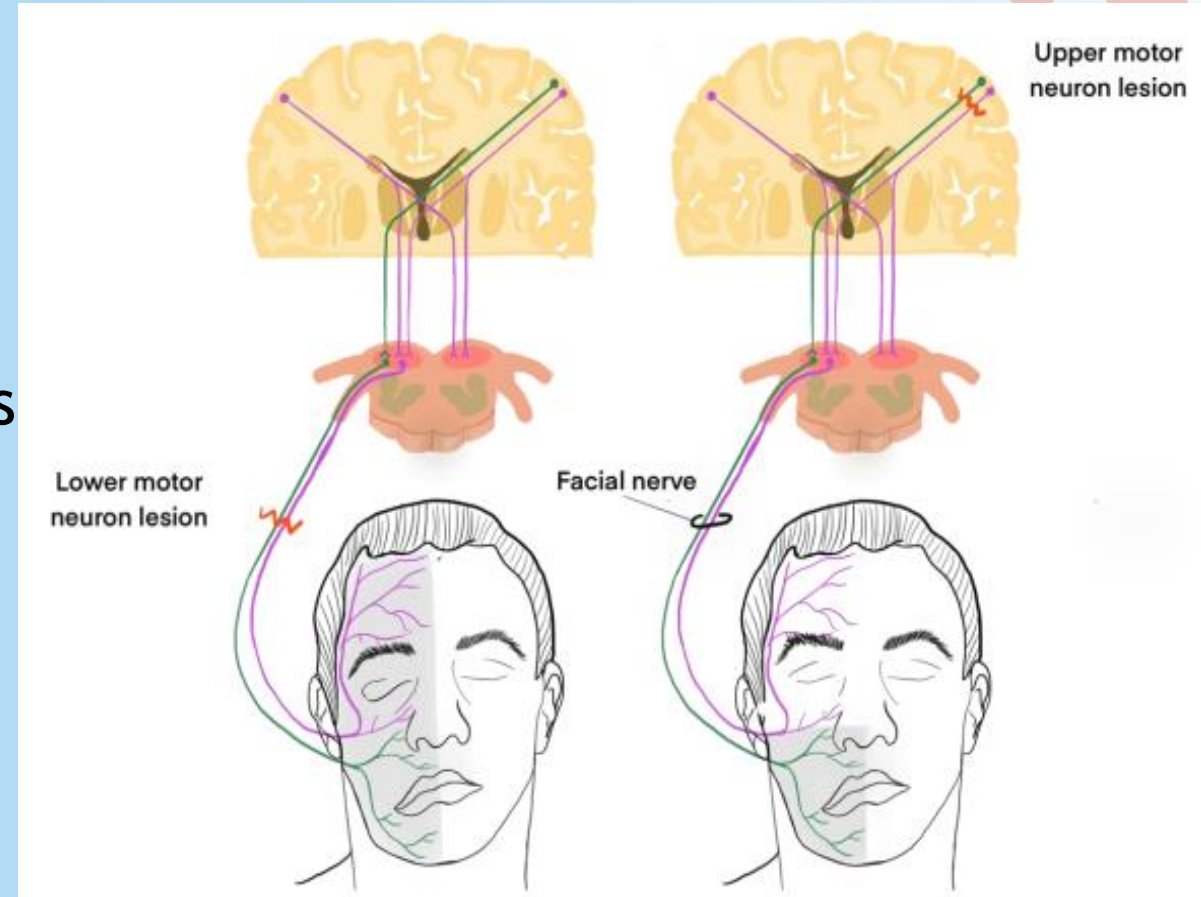
- ❖ “Tri” made up of three distinct nerves
- ❖ **Motor** & **Sensory** (SVE & GSA)
- ❖ Afferent limb (V1) of the corneal blink reflex



	Ophthalmic (V1)	Maxillary (V2)	Mandibular (V3)
Innervation	<p><u>Sensory</u></p> <ul style="list-style-type: none"> • Eyeball • Tip of nose • Skin of face above eyes 	<p><u>Sensory</u></p> <ul style="list-style-type: none"> • Skin of the face between the eyes and the upper lip • Palate • Paranasal sinuses • Maxillary teeth 	<p><u>Sensory</u></p> <ul style="list-style-type: none"> • Anterior ear • Teeth and gums of mandible • Skin of the face below lower lip • Sensation of 2/3 anterior part of the tongue <p><u>Motor innervation of</u></p> <ul style="list-style-type: none"> • Muscles of mastication
Reflex	<p>Afferent limb of the corneal reflex</p> 	<p>Afferent limb of the sneeze reflex</p>	<p>Efferent AND afferent limb of the jaw jerk reflex</p> 

CN VII - Facial N.

- ❖ **Motor & Sensory** (SVE, GVE, SVA, GVA, GSA)
- ❖ **Facial movement** NOT facial sensation
- ❖ Taste from anterior 2/3 of the tongue
- ❖ Parasympathetic = lacrimal glands, submandibular glands, and sublingual glands
- ❖ Efferent limb of corneal blink reflex
- ❖ **Lesion:**
 - Facial muscle weakness ipsilaterally
 - Dry eyes, dry mouth
 - Impairment of taste from ant. 2/3 of tongue





CN VIII - Vestibulocochlear N.



- ❖ Pure **Sensory** (SSA)
- ❖ Two Components:
 - Vestibular n. innervates vestibules responsible for balance
 - Cochlear n. innervates cochleae responsible for hearing
- ❖ **Lesion:**
 - Possibly due to fracture of internal acoustic meatus
 - Hearing loss (partial or complete)
 - Tinnitus
 - Vertigo and nystagmus

CN IX - Glossopharyngeal N.

❖ Motor (SVE)

- Elevation of pharynx (stylopharyngeus m.)

❖ Sensory (GVA, SVA, GSA)

- Innervates the pharynx
- Taste from post. 1/3 of tongue
- Innervates external acoustic meatus
- Innervates the carotid sinus and body

❖ Parasympathetic (GVE)

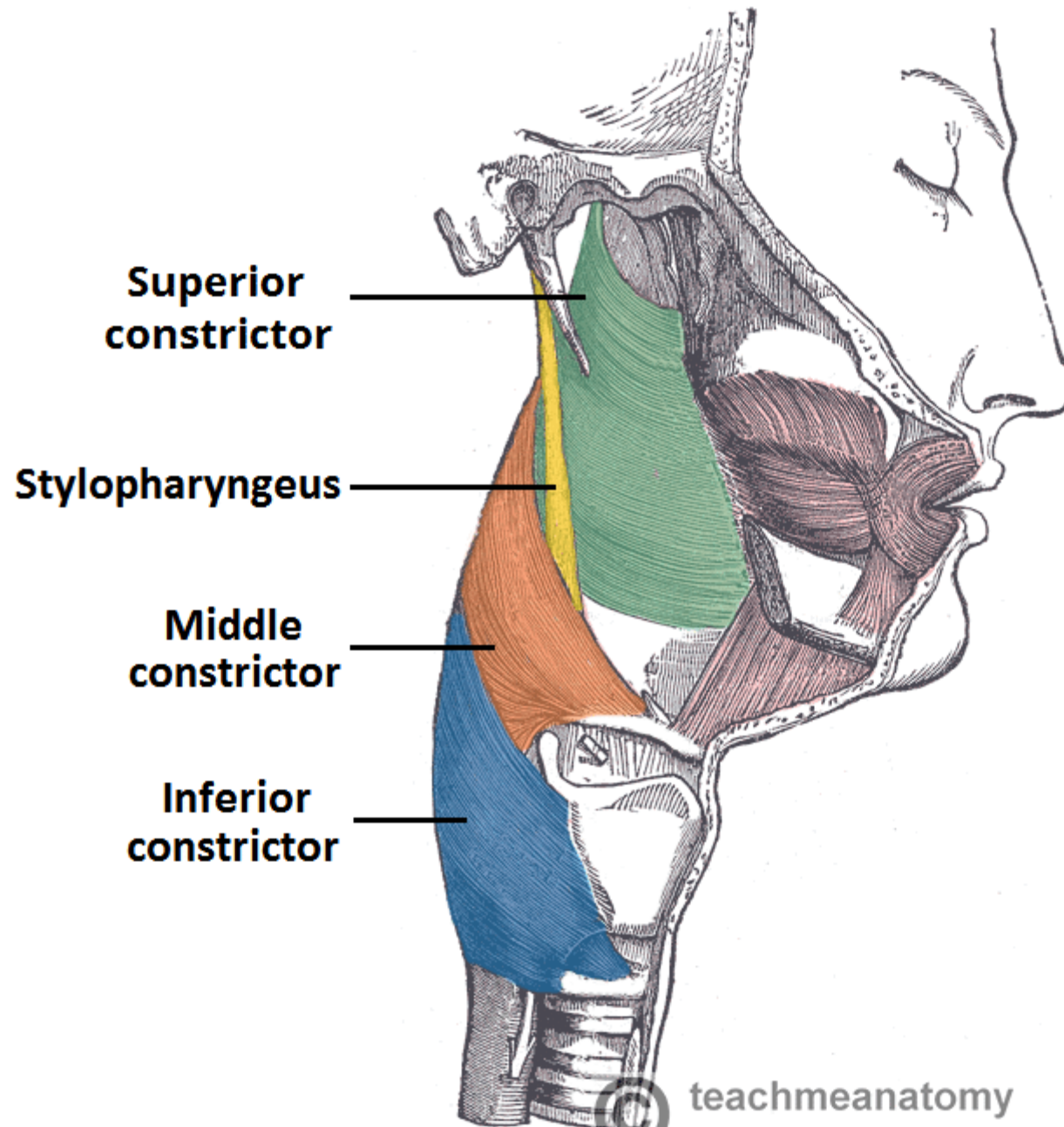
- Secretion of saliva (parotid gland)

❖ Afferent limb of the gag reflex

❖ Afferent limb of the carotid sinus reflex

❖ Lesion:

- Loss of gag reflex
- Loss of carotid sinus reflex
- Loss of taste from post. 1/3 of tongue
- Dry mouth (Xerostomia)
- Difficulty swallowing (Dysphagia)



**Superior
constrictor**

Stylopharyngeus

**Middle
constrictor**

**Inferior
constrictor**



teachmeanatomy

The #1 Applied Human Anatomy Site on the Web.

CN X - Vagus N.

❖ Sensory (GSA, SVA, GVA)

- Larynx, trachea, esophagus: irritation to nerve → coughing
- posterior wall of external auditory meatus
- (skin behind ear, external part of ear canal)
- Innervates aortic body chemoreceptors and baroreceptors.
- **Taste** – on epiglottis
- ❖ **Motor (SVE)**
 - Pharyngeal muscles - swallowing, elevating palate (except stylopharyngeus muscle)
 - Laryngeal muscles - speech [Recurrent laryngeal nerve]

❖ Parasympathetic (GVE)

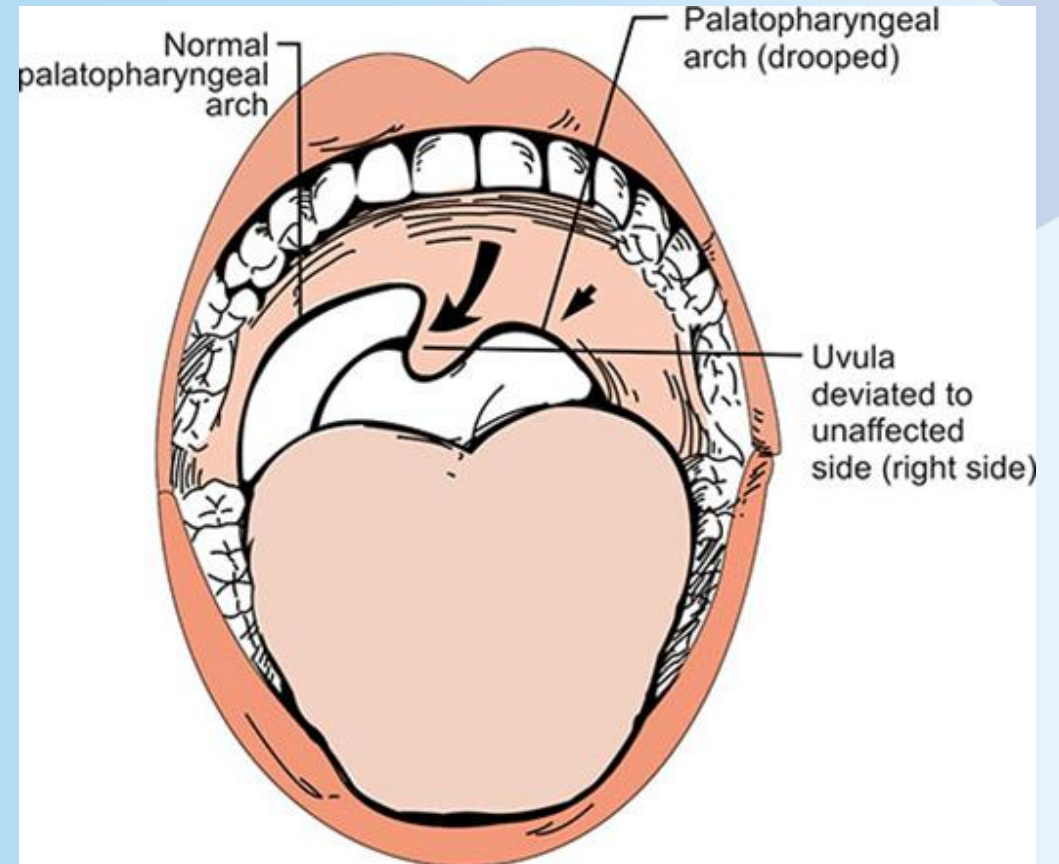
- Smooth muscles and glands in esophagus, stomach, intestines (up to splenic flexure)
- SA and AV nodes: decrease heart rate
- Blood vessels: vasodilation

❖ Reflexes

- Efferent limb of the gag reflex
- Efferent and Afferent limb of cough reflex
- Efferent limb of the sneeze reflex

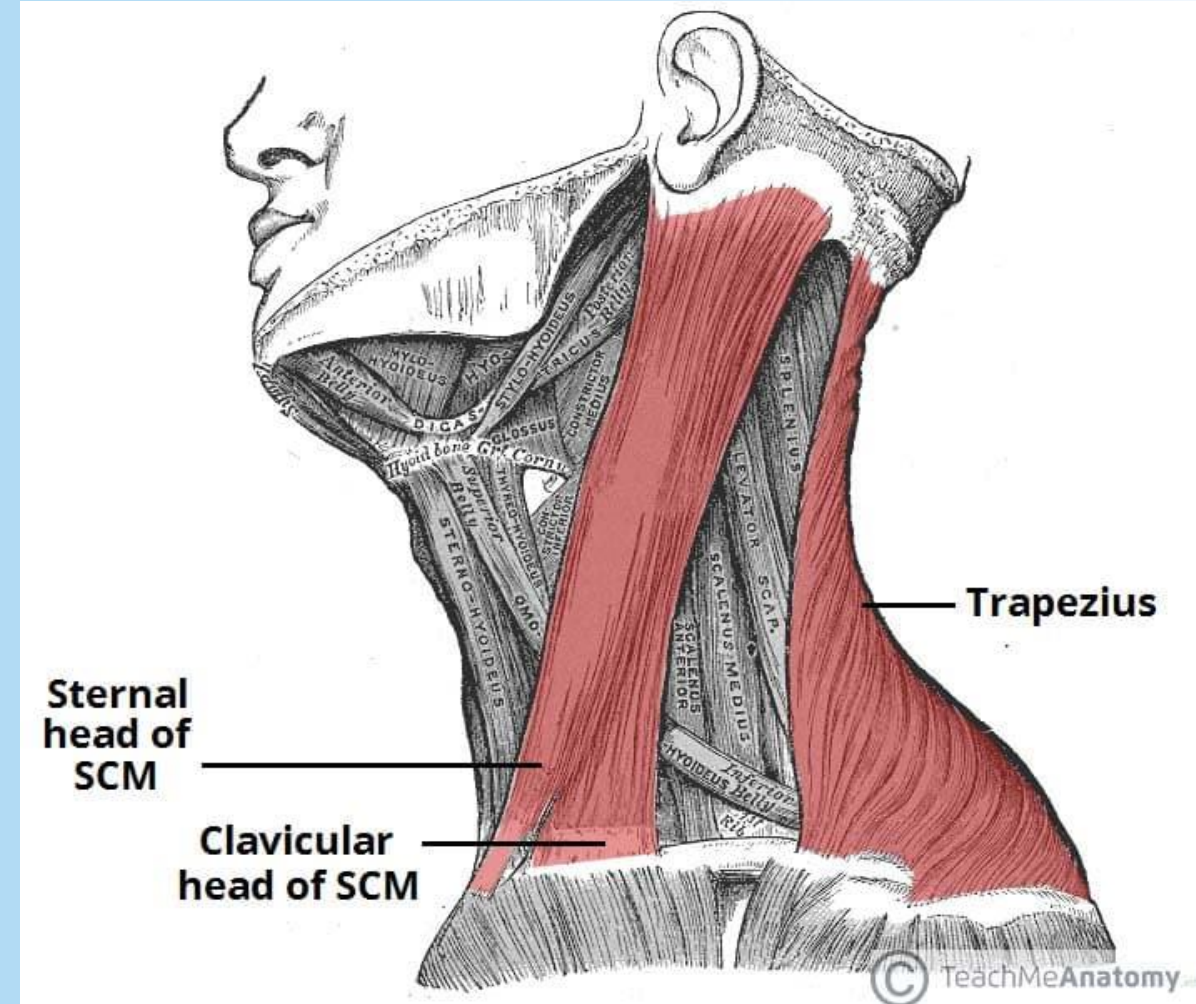
Lesion of CN X

- Dysphonia / aphonia - vocal cord paralysis (Dysarthria)
- Difficulty or impaired swallowing
- Loss of gag reflex
- Uvula deviation away from lesion (impaired palate elevation)
- Loss of cough reflex



CN XI - Accessory N.

- ❖ **Motor (GSE)** - Innervates trapezius m. and sternocleidomastoid m.
- ❖ **Lesion:**
 - Usually due to trauma (sternoclavicular joint dislocation)
 - Ipsilateral shoulder droop and pain
 - Inability to raise shoulders and arms overhead (Above 90 degrees)
 - Difficulty rotating head to contralateral side of lesion



CN XII - Hypoglossal N.

- ❖ **Motor** (GSE) - Innervates Intrinsic and extrinsic muscles of the tongue
 - ❖ **Lesion:**
 - Due to tumors or trauma
 - Dysarthria and difficulty swallowing
 - Deviation of tongue towards the injured side when protruded (“Lick your wounds”)



Nerve	Cranial Exit	Cell Bodies	Components	Chief Functions
I: Olfactory	Cribriform plate	Nasal mucosa	SVA	Smell
II: Optic	Optic canal	Ganglion cells of retina	SSA	Vision
III: Oculomotor	Superior orbital fissure	Nucleus CN III (midbrain)	GSE	Eye movements (superior, inferior, and medial recti, inferior oblique, and levator palpebrae superioris mm.)
		Edinger–Westphal nucleus (midbrain)	GVE	Constriction of pupil (sphincter pupillae muscle) and accommodation (ciliary muscle)
IV: Trochlear	Superior orbital fissure	Nucleus CN IV (midbrain)	GSE	Eye movements (superior oblique muscle)
V: Trigeminal	Superior orbital fissure; foramen rotundum and foramen ovale	Motor nucleus CN V (pons)	SVE	Muscles of mastication, mylohyoid, anterior belly of digastric, tensor veli palatini, and tensor tympani muscles
		Trigeminal ganglion	GSA	Sensation on head (skin and mucous membranes of face and head)
VI: Abducens	Superior orbital fissure	Nucleus CN VI (pons)	GSE	Eye movement (lateral rectus muscle)
VII: Facial	Stylomastoid foramen	Motor nucleus CN VII (pons)	SVE	Muscle of facial expression, posterior belly of digastric, stylohyoid, and stapedius muscles
		Superior salivatory nucleus (pons)	GVE	Lacrimal and salivary secretion
		Geniculate ganglion	SVA	Taste from anterior two-thirds of tongue and palate
		Geniculate ganglion Geniculate ganglion	GVA GSA	Sensation from palate Auricle and external acoustic meatus
VIII: Vestibulocochlear	Does not leave skull	Vestibular ganglion	SSA	Equilibrium
		Spiral ganglion	SSA	Hearing
IX: Glossopharyngeal	Jugular foramen	Nucleus ambiguus (medulla)	SVE	Elevation of pharynx (stylopharyngeus muscle)
		Inferior salivary nucleus (medulla)	GVE	Secretion of saliva (parotid gland)
		Inferior ganglion	GVA	Carotid sinus and body, tongue, pharynx, and middle ear
		Inferior ganglion	SVA	Taste from posterior one-third of tongue
		Superior ganglion	GSA	External ear

X: Vagus	Jugular foramen	Superior ganglion	GSA	External ear
		Nucleus ambiguus (medulla)	SVE	Muscles of pharynx, larynx, and palate
		Dorsal nucleus (medulla)	GVE	Smooth muscles and glands in thoracic and abdominal viscera
		Inferior ganglion	GVA	Sensation in lower pharynx, larynx, trachea, and other viscerae
		Inferior ganglion	SVA	Taste on epiglottis
		Superior ganglion	GSA	Auricle and external acoustic meatus
XI: Accessory	Jugular foramen	Spinal cord (cervical)	SVE	Sternocleidomastoid and trapezius muscles
XII: Hypoglossal	Hypoglossal canal	Nucleus CN XII (medulla)	GSE	Muscles of movements of tongue

GSA, general somatic afferent; GSE, general somatic efferent; GVA, general visceral afferent; GVE, general visceral efferent; SSA, special somatic afferent; SVA, special visceral afferent; SVE, special visceral efferent.

- BRS Gross Anatomy, 10th Edition

MNEMONIC

The cranial nerves

Oh, Oh, Oh To Touch And Feel Very Good Velvet. Ah Heaven!

CN#	Mnemonic
CN I	S ome
CN II	S ay
CN III	M arry
CN IV	M oney
CN V	B ut
CN VI	M y
CN VII	B rother
CN VIII	S ays
CN IX	B ig
CN X	B rain
CN XI	M atters
CN XII	M ore

Memory aid

- ❖ **S** = Pure Sensory
- ❖ **M** = Pure Motor
- ❖ **B** = Both
- ❖ The cranial nerves carrying parasympathetic fibers can be memorized as “**1973**” (CN 10,9,7, and 3)

	1	0		
		9		
			7	
				3
=	1	9	7	3

Reflexes summary

Reflex	Afferent limb	Efferent limb
Pupillary light	CN II	CN III
Corneal (blink)	CN V1 (Nasociliary branch)	CN VII
Sneeze	CN V2	CN X
Jaw jerk	CN V3	CN V3
Gag	CN IX	CN X
Cough	CN X	CN X

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