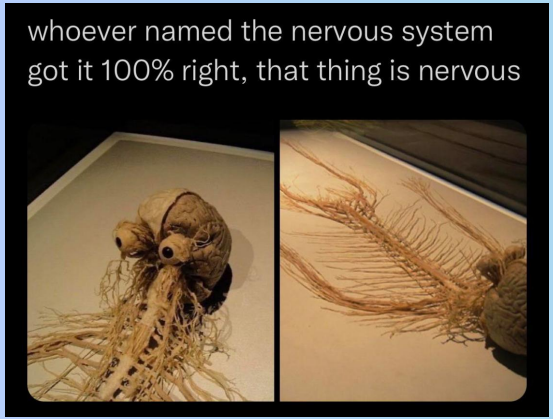
Cranial Nerves

By Elmira Imadova and Jacob Guzior

Ooh, Ooh, Ooh, to touch and feel very good velvet. Such (Ah) heaven!

O: olfactory nerve (CN I)
O: optic nerve (CN II)
O: oculomotor nerve (CN III)
T: trochlear nerve (CN IV)
T: trigeminal nerve(CN V)
A: abducens nerve (CN VI)

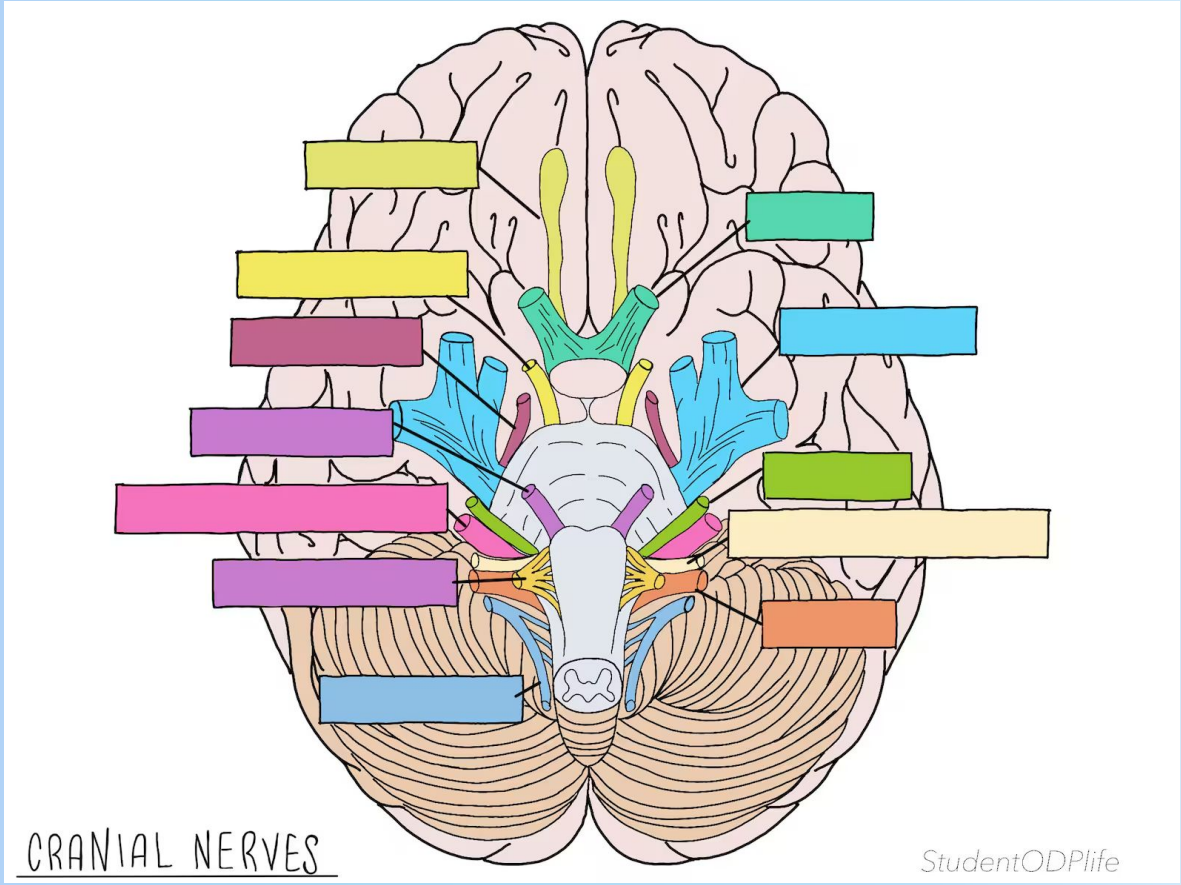


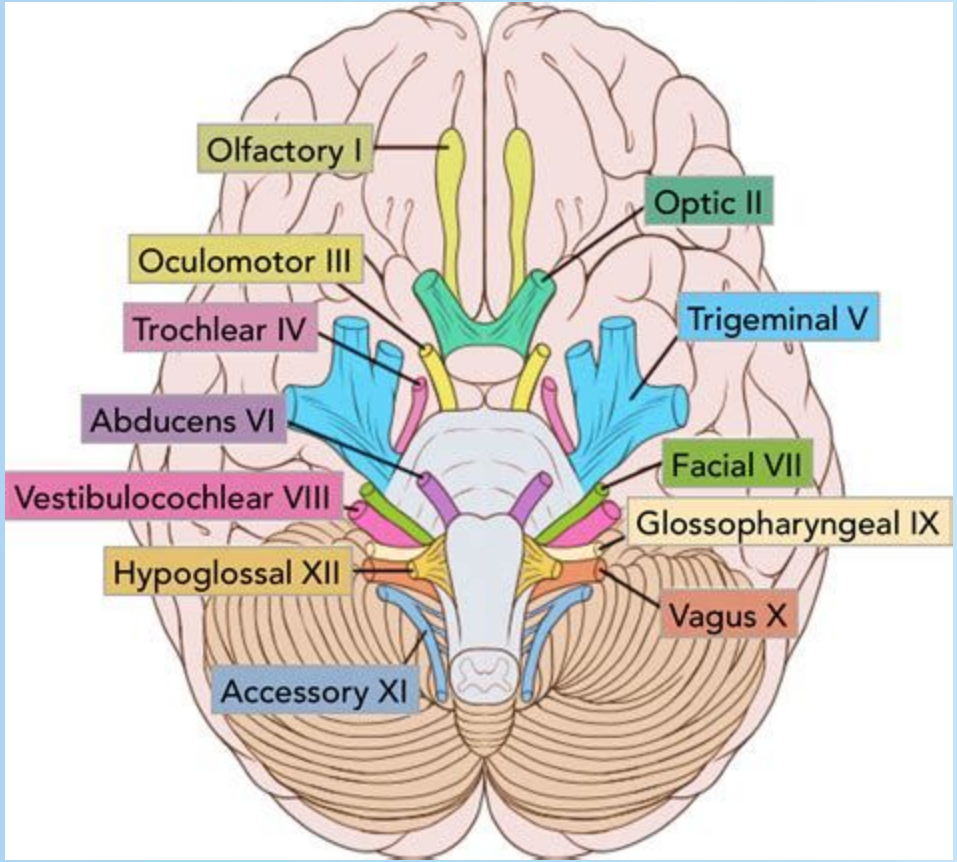
F: facial nerve (CN VII)
V: auditory (or vestibulocochlear) nerve (CN VIII)
G: glossopharyngeal nerve (CN IX)
V: vagus nerve (CN X)
S/A: spinal accessory nerve (CN XI)
H: hypoglossal nerve (CN XII)

Afferent Arrives, Efferent Exits

Cranial nerve reflexes

REFLEX	AFFERENT	EFFERENT
Accommodation	II	III
Corneal	V_1 ophthalmic (nasociliary branch)	Bilateral VII (temporal and zygomatic branches—orbicularis oculi)
Cough	X	X (also phrenic and spinal nerves)
Gag	IX	X
Jaw jerk	V_3 (sensory—muscle spindle from masseter)	V_3 (motor—masseter)
Lacrimation	V_1 (loss of reflex does not preclude emotional tears)	VII
Pupillary	II	III



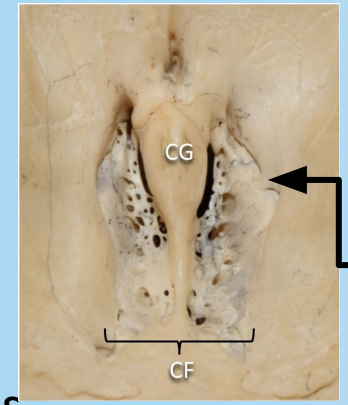

Olfactory I
Optic II
Oculomotor III
Trochlear IV
Trigeminal V
Abducens VI
Facial VII
Vestibulocochlear VIII
Glossopharyngeal IX
Hypoglossal XII
Vagus X
Accessory XI

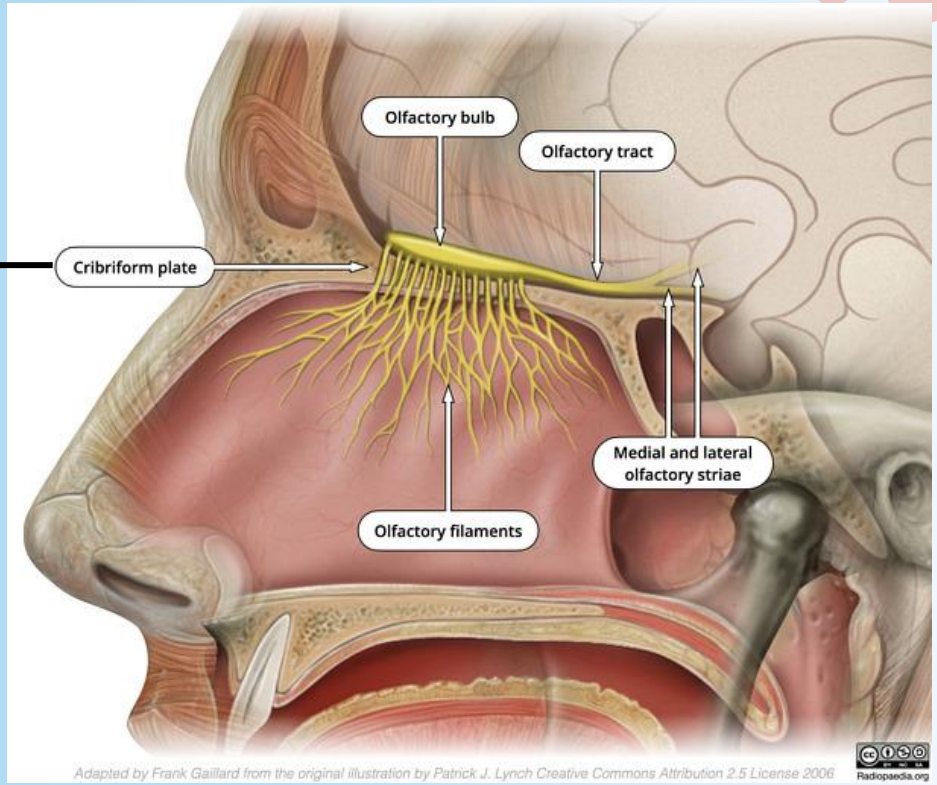
Cranial Nerve #1-Olfactory

-enters cribriform (small holes) plate of ethmoid

-olfactory bulb located in anterior cranial fossa

-olfactory mucosa contains pseudostratified columnar epithelium





Problem with smelling=problem with the nerve

↓

Anosmia

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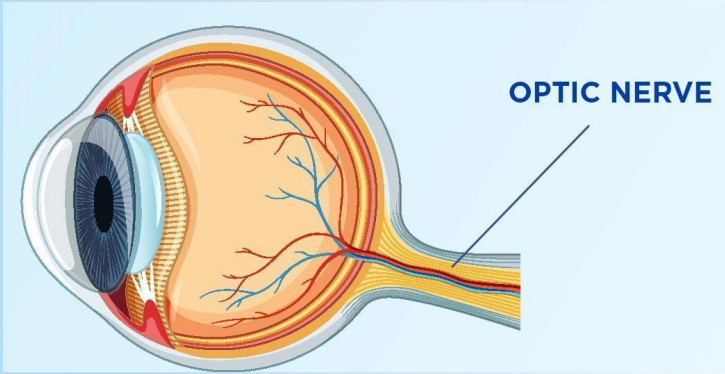
Cranial Nerve #2-Optic



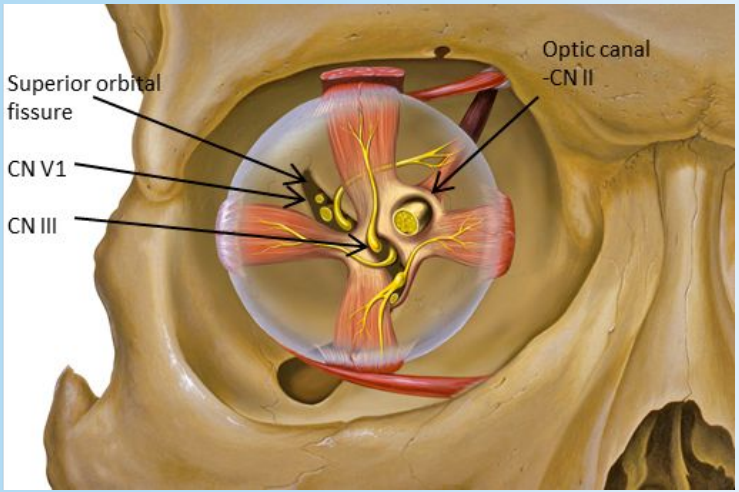
-vision

-exits through optic canal

-pass through tendinous ring

-consensual constriction together with IIIrd

-afferent limb of pupillary reflex and accommodation (changing shape according to objects distance)
    -lesion to the nerve=no accommodation



❗ NOT IV ❗

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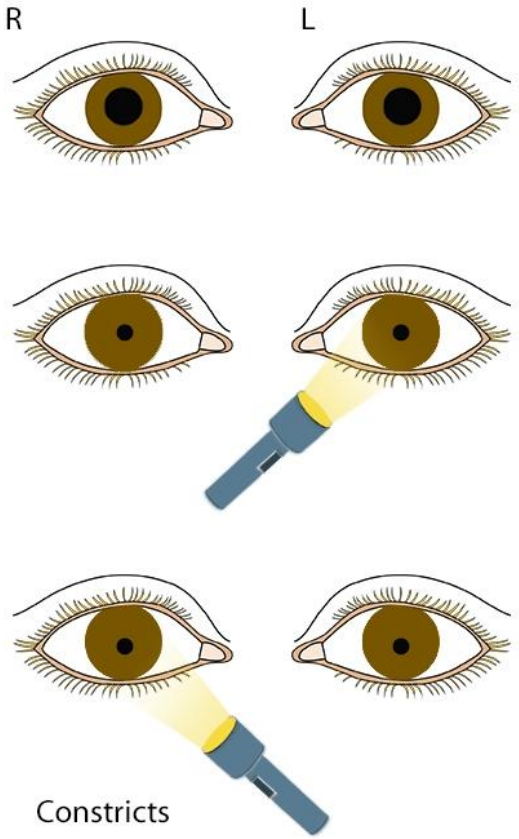
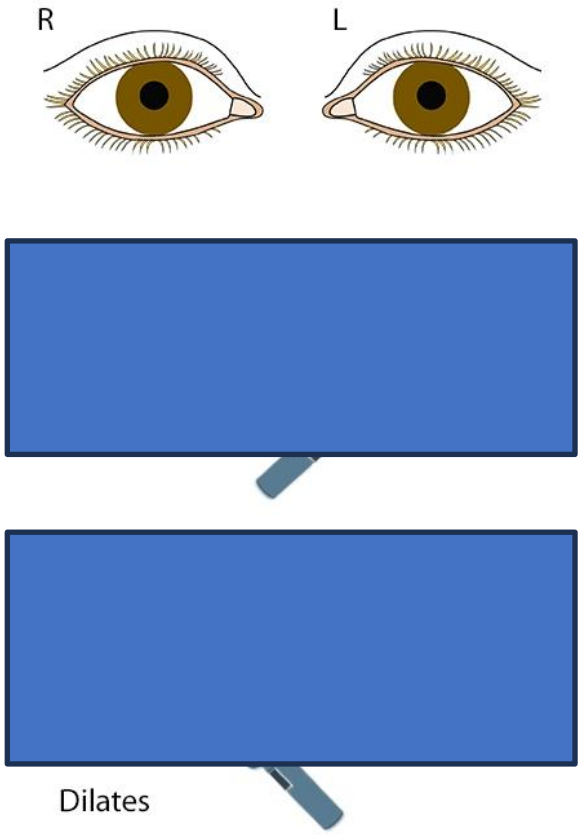
Normal

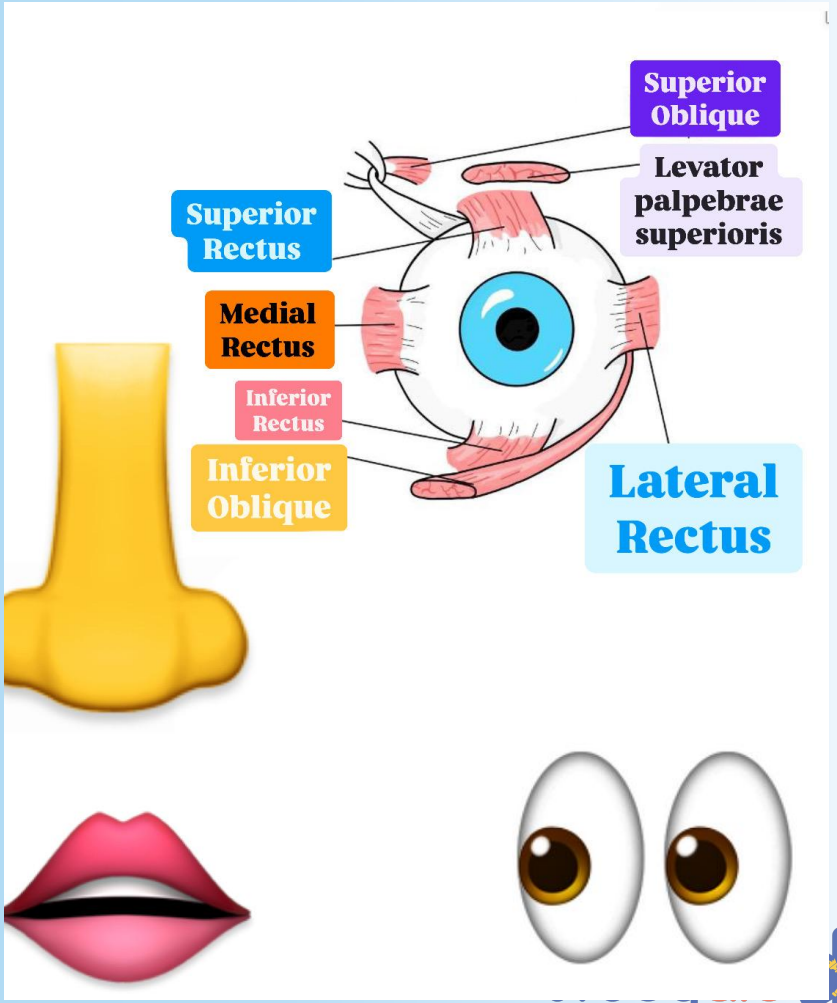


Right relative afferent pupillary defect

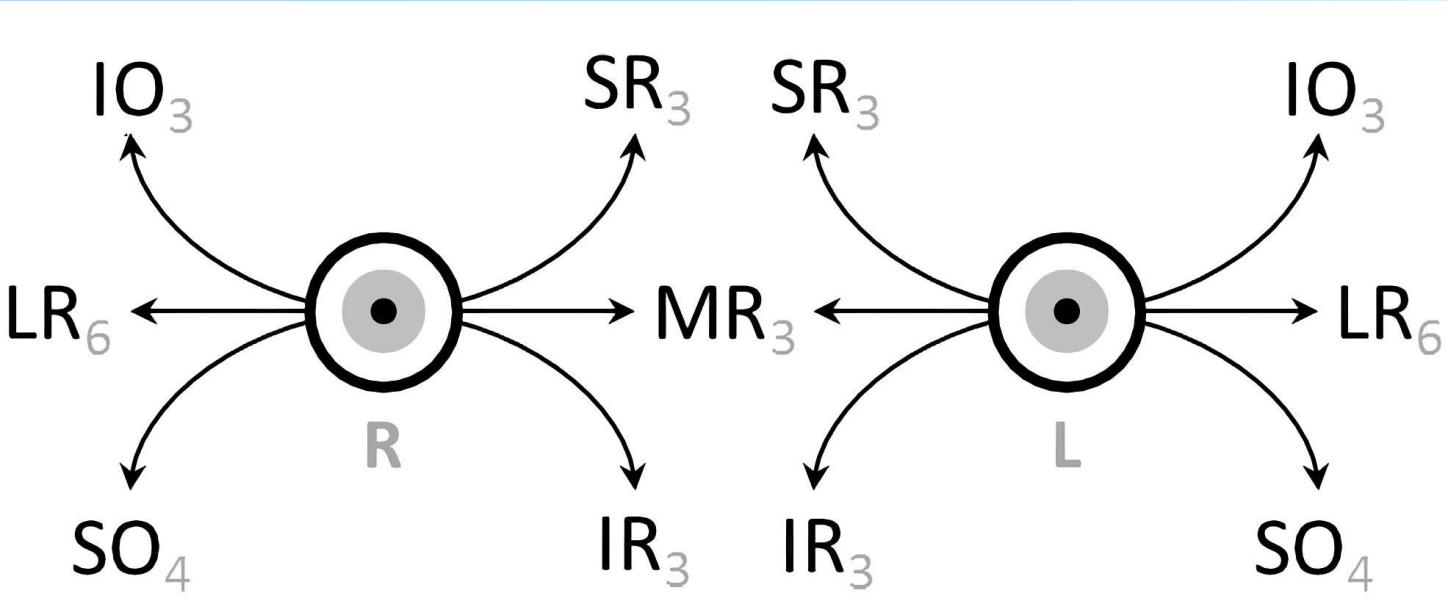


Muscles of the Eye

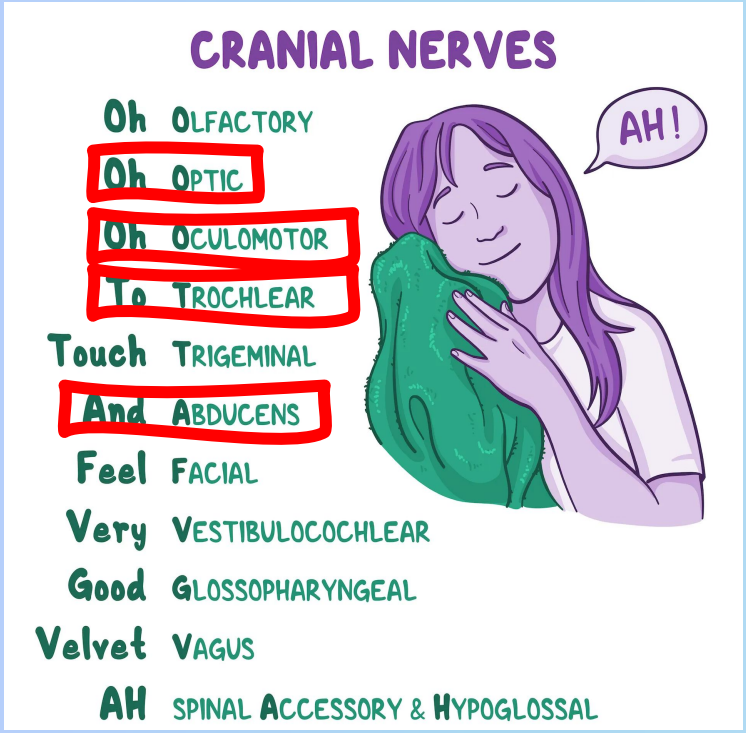
- 7 muscles
- Rectus=Right way
- Oblique=Opposite
- Superior Oblique=Opposite
  - =>down and in
- Inferior Oblique=Opposite
  - =>up and out



Muscles, Innervations & Directions



Nerves Of The Eye



Formula: **LR6 SO4 O3**

What does it mean?

Lateral Rectus	6th Cranial N	*Abducent*
Superior Oblique	4th Cranial N	*Trochlear*
Others	3rd Cranial N	*Oculomotor*

-Down out - oculomotor III nerve affected
-Eye going towards nose -abducens VI affected
-Up and out- trochlear IV affected

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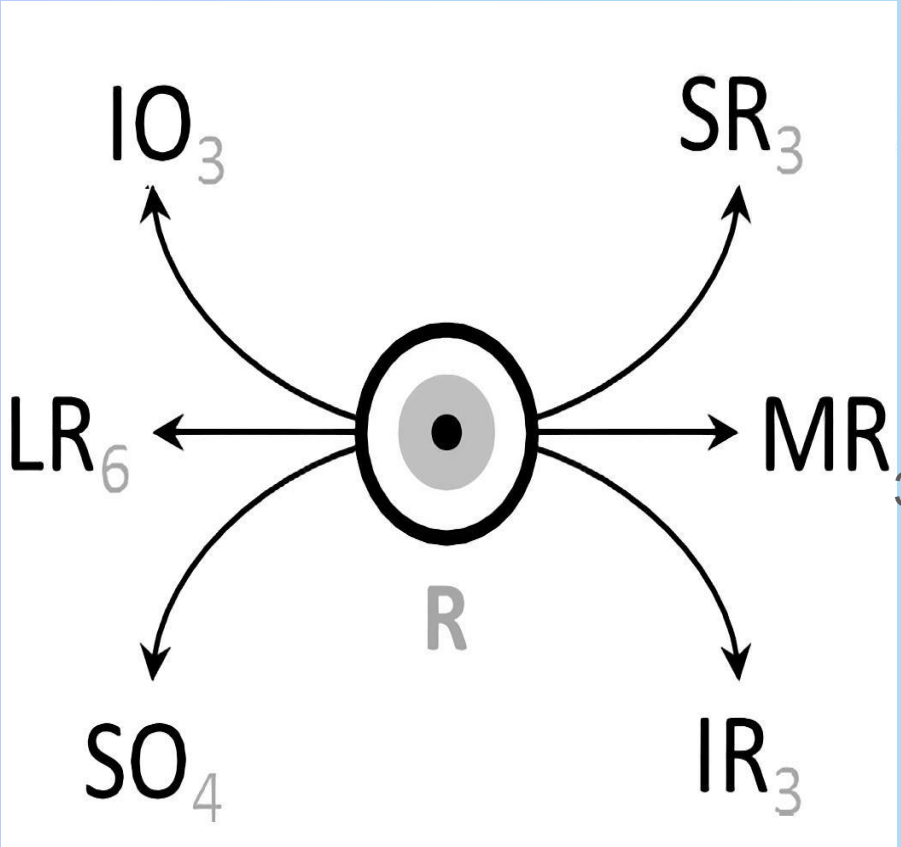
Cranial Nerves & Muscles



Lateral Rectus, Medial Rectus, Superior Rectus, Inferior Rectus, Superior Oblique, Inferior Oblique

LR, MR, IR, SR, SO, IO

LR6, MR3, SR3, IR3, SO4, IO3

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Cranial Nerve #3-Oculomotor

-Efferent limb of pupillary reflex

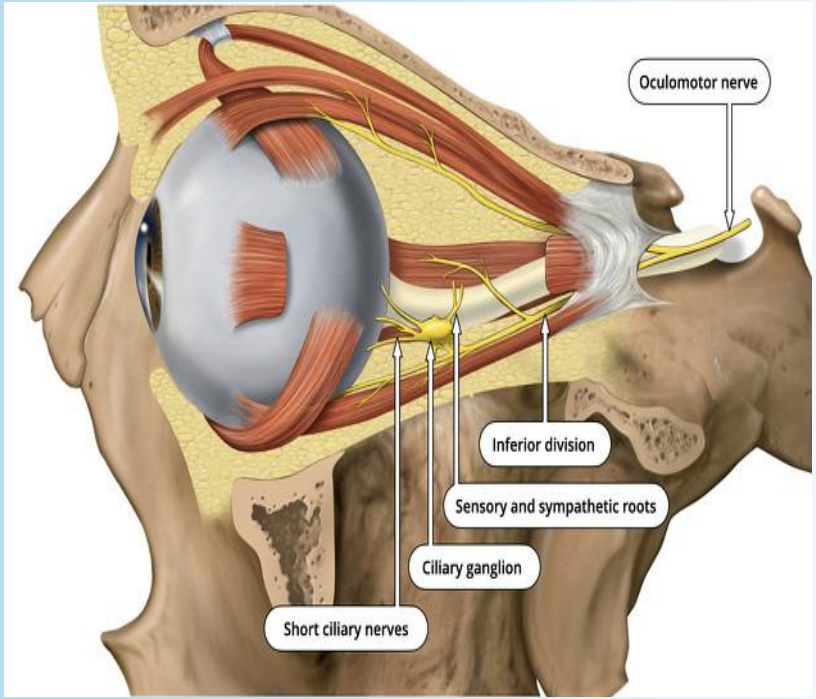
-Ciliary muscles-accommodation (efferent)

-Sphincter pupilae and dialator pupilae

-Levator palpebrae superioris (ptosis)

-levator=elevates

-Edinger-Westphal ganglion (parasympathetic root of the ciliary ganglion)



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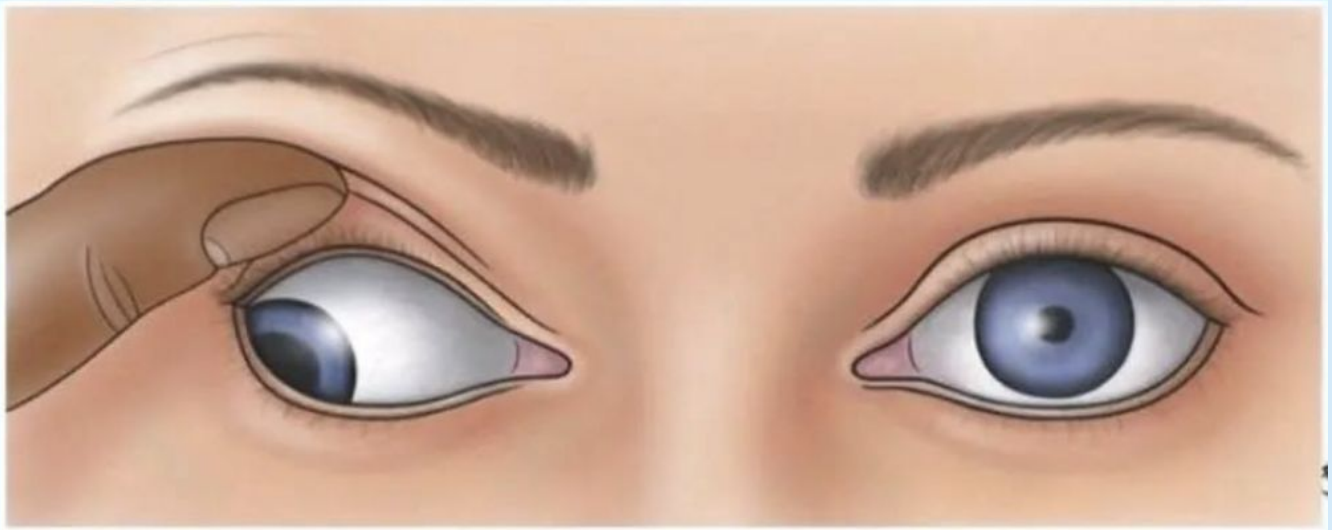
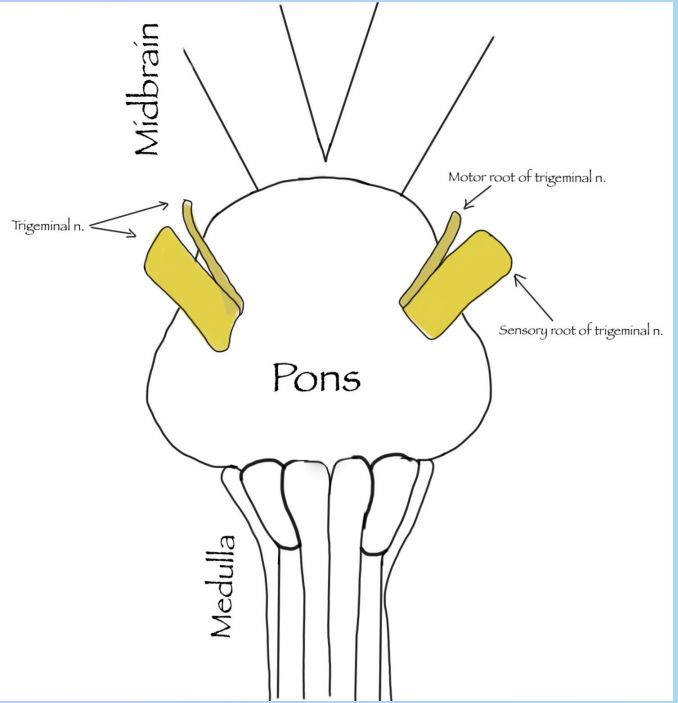


Right eye: Downward and outward gaze, dilated pupil, eyelid manually elevated due to ptosis

Left: Normal

Trigeminal Nerve (CN5)



Divided into 3 branches:
- V1 ophthalmic (S)
- V2 maxillary (S)
- V3 mandibular (M)

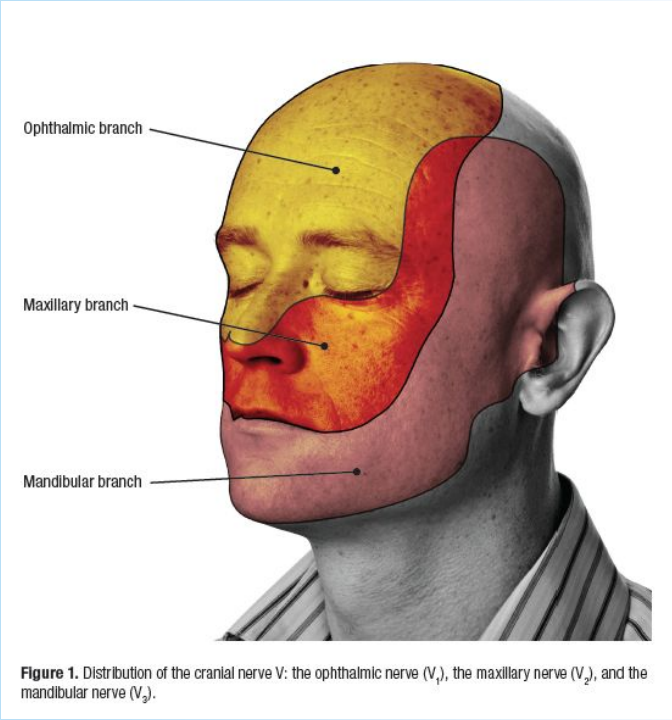


Figure 1. Distribution of the cranial nerve V: the ophthalmic nerve (V_1), the maxillary nerve (V_2), and the mandibular nerve (V_3).

Trigeminal Nerve (CN5)

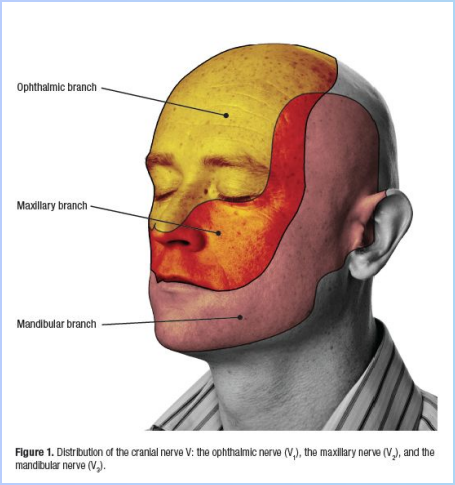


Figure 1. Distribution of the cranial nerve V: the ophthalmic nerve (V_1), the maxillary nerve (V_2), and the mandibular nerve (V_3).

Cranial Exit- **Single Room Occupancy**

V1 Ophthalmic -Superior Orbital Fissure

V2 Maxillary -Rotundum (Foramen Rotundum)

V3 Mandibular -Ovale (Foramen Ovale)

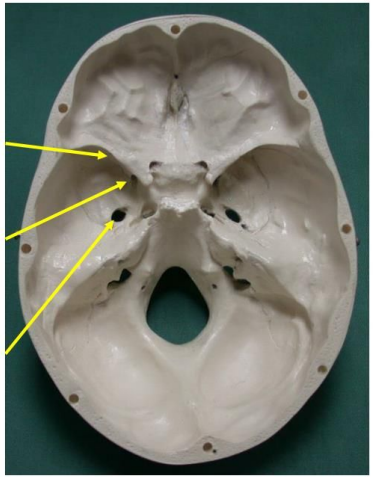
3 divisions of Trigeminal nerve:

Ophthalmic nerve (V_1)
(Superior orbital fissure)

Maxillary nerve (V_2)
(Foramen rotundum)

Mandibular nerve (V_3)
(Foramen ovale)

Cranial cavities seen from above



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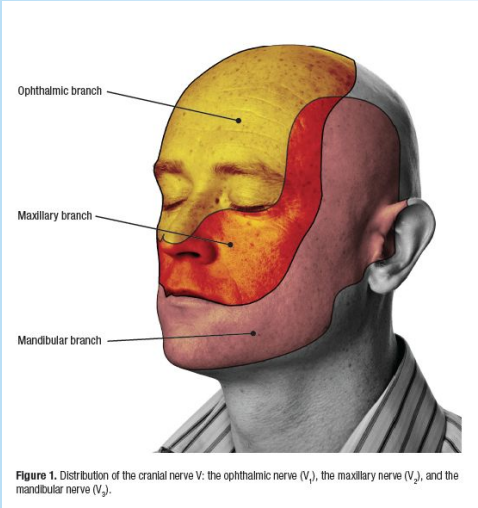
Function:
- **V1**: Sensory innervation eyeball, tip of nose, skin of face above the eyes
- **V2**: Sensory innervation palate, paranasal sinuses, maxillary teeth, skin of face between eye and upper lip
- **V3**: Motor innervation muscles of mastication, mylohyoid, anterior belly of digastric, tensor veli palatini, and tensor tympani muscles

Brainstem exit:
Pons anteriorly to the pyramidal eminence
Functional Component: GSA(V1, V2, V3), SVE (V3)



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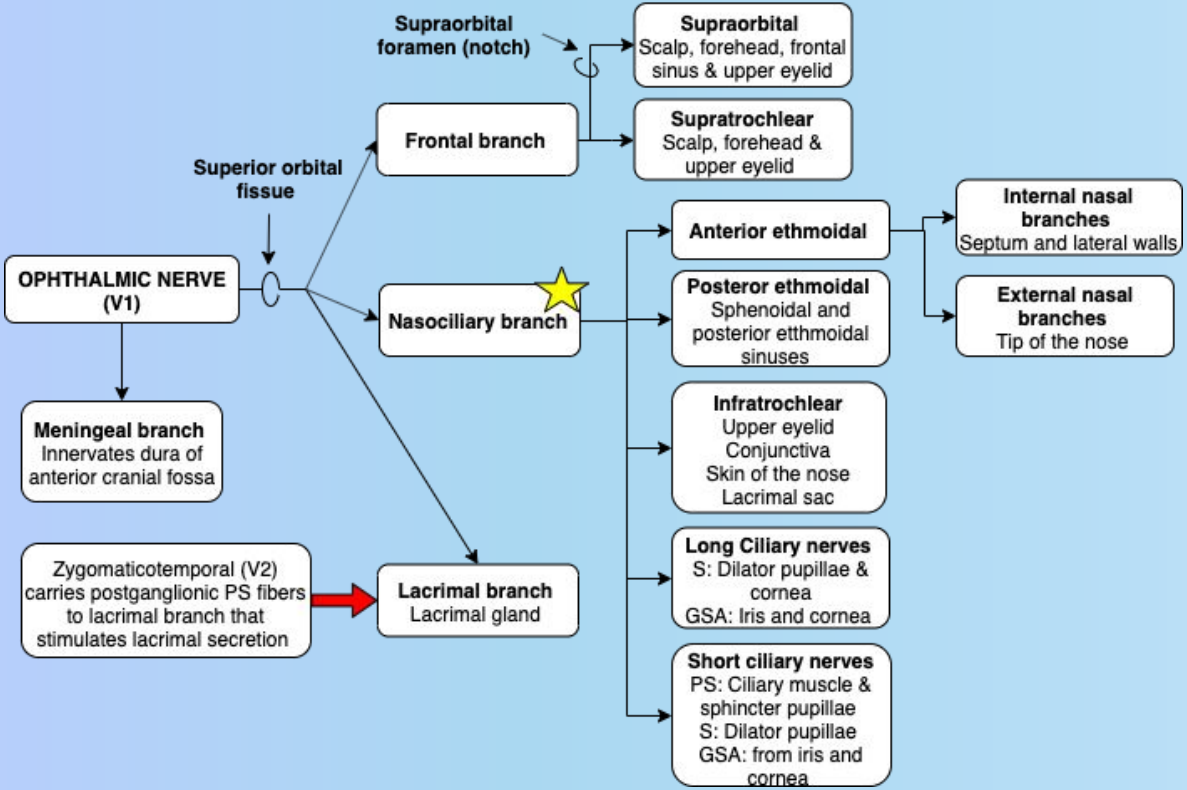
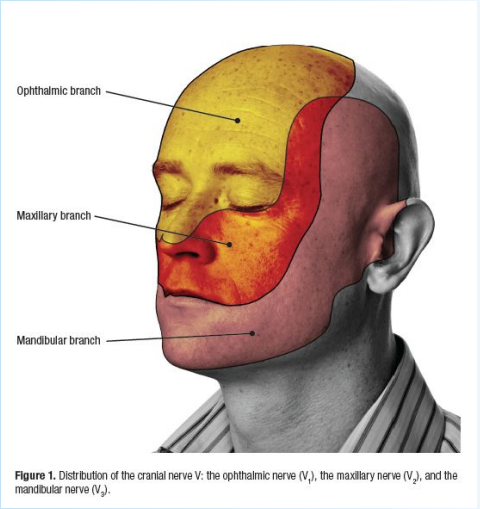
Masseter **M**edial Pterygoid Te**m**poralis	**M**oves Mandible Up
Lateral Pterygoid	**L**owers Mandible down

Cranial Nerve #5-Trigeminal





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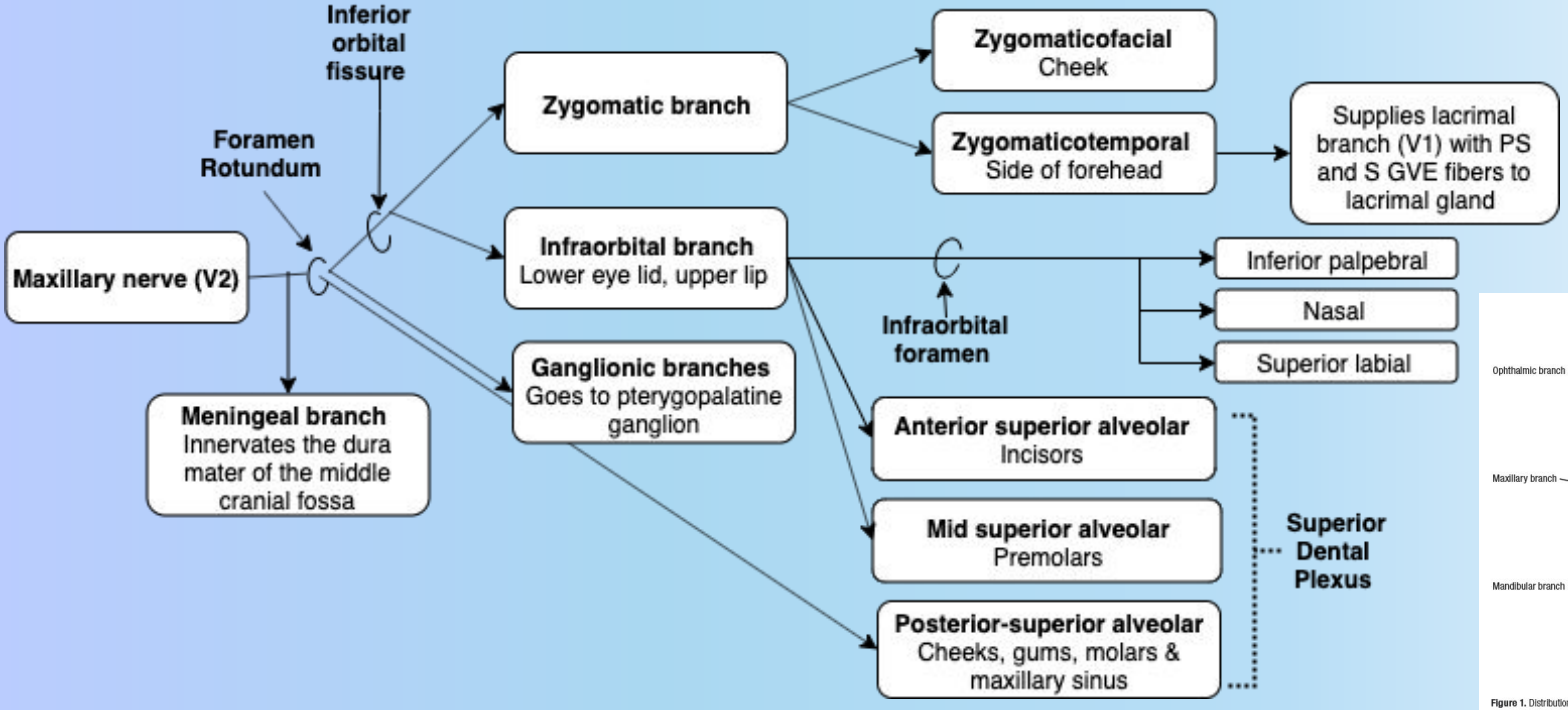

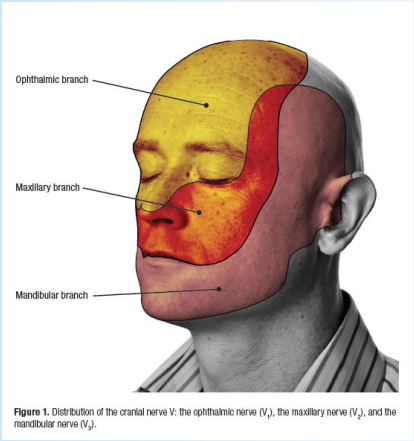

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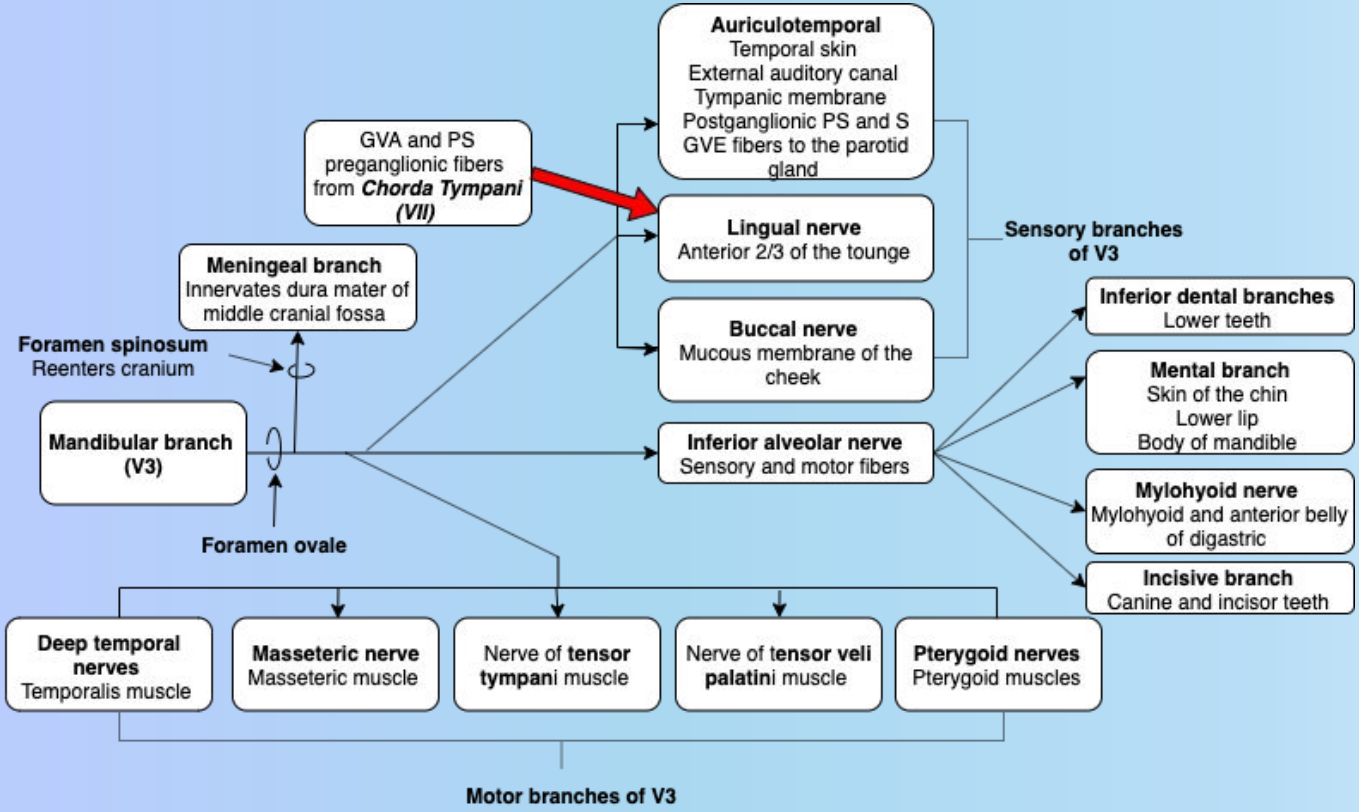
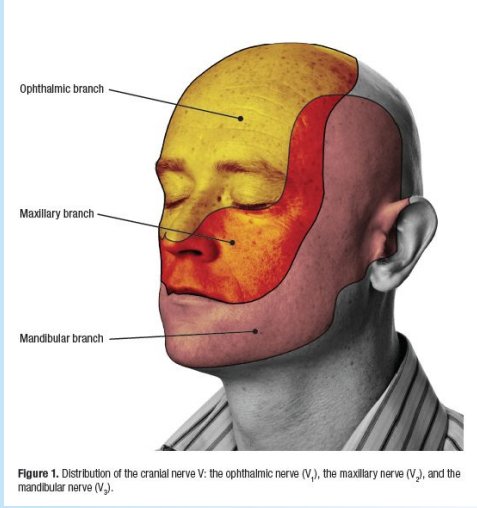
Cranial Nerve #5-Trigeminal





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Trigeminal Nerve (CN5)

Effect of nerve injury SENSORY:
- Sensory loss on face
-Loss of general sensation from the face and mucous membranes of the oral and nasal cavities.
- Trigeminal neuralgia

Effect of nerve injury MOTOR:
- Loss of mastication
- Jaw deviation toward side of lesion
- Loss of afferent limb of corneal and sneeze reflexes
- Paralysis of tensor tympani leading to **hypacusis** (esp. partial deafness to low-pitched sounds)

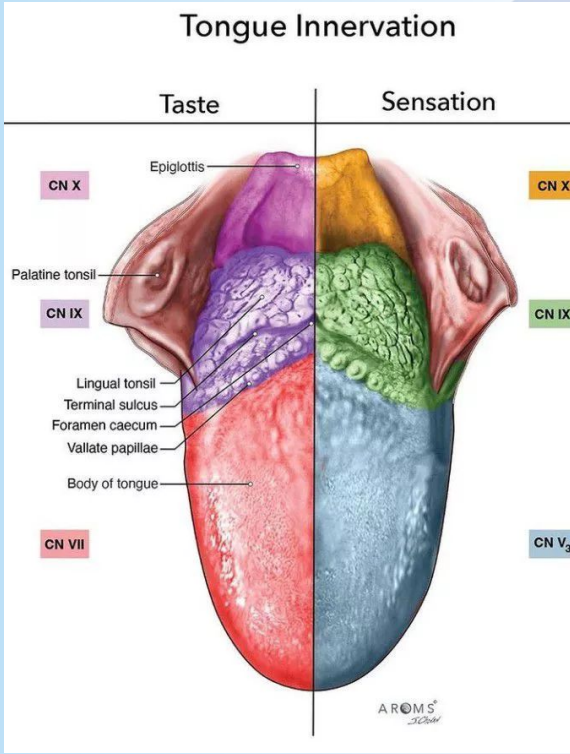
Facial Nerve (CN 7)

Sensory innervation
- TASTE (SVA) - 2/3 anterior part of the tongue
- Palate and nasal mucosa
- External acoustic meatus, auricle.

Motor innervation
- Muscles of facial expression

Parasympathetic innervation
- Lacrimal, submandibular, sublingual, nasal and palatine glands

Reflex
Efferent limb of the corneal (blink) reflex

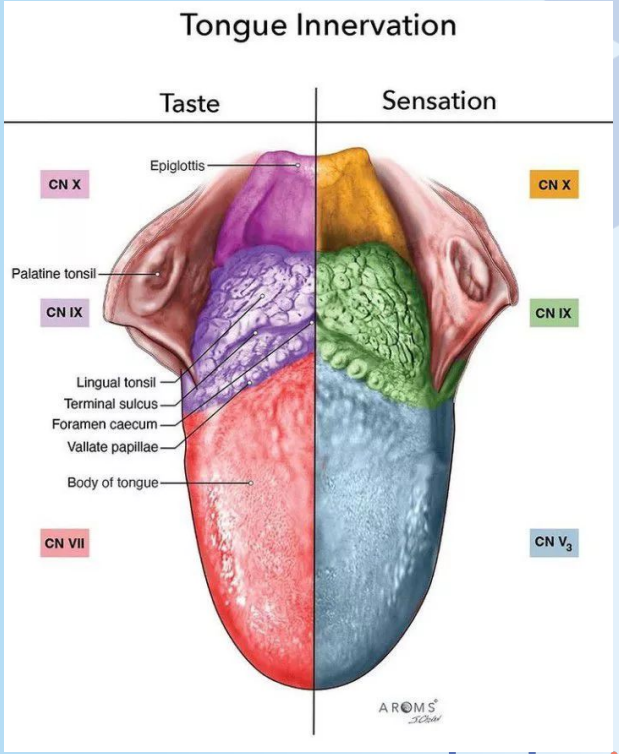


Facial Nerve (CN 7)

Important Muscles which are innervated by facial nerve:
Posterior belly of digastric, stylohyoid, and stapedius muscle

Cranial exit: Stylomastoid foramen, internal auditory meatus

Functional Component: GSA, GVA, GVE, SVA, SVE



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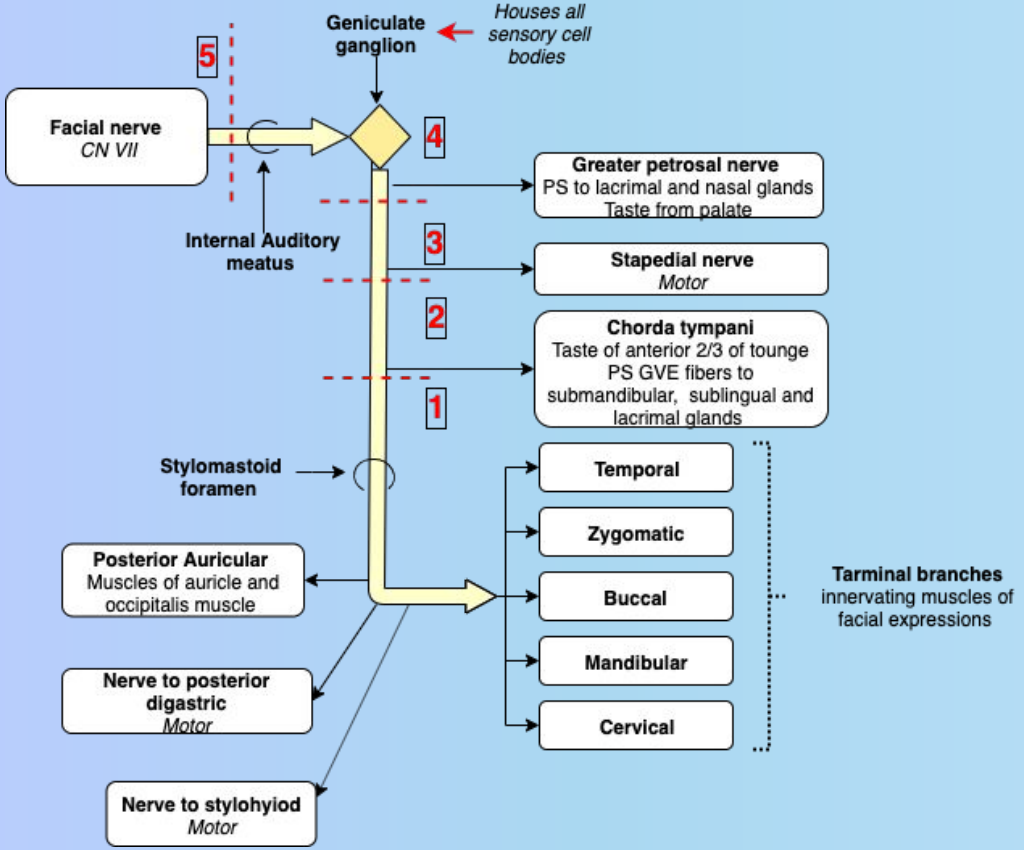

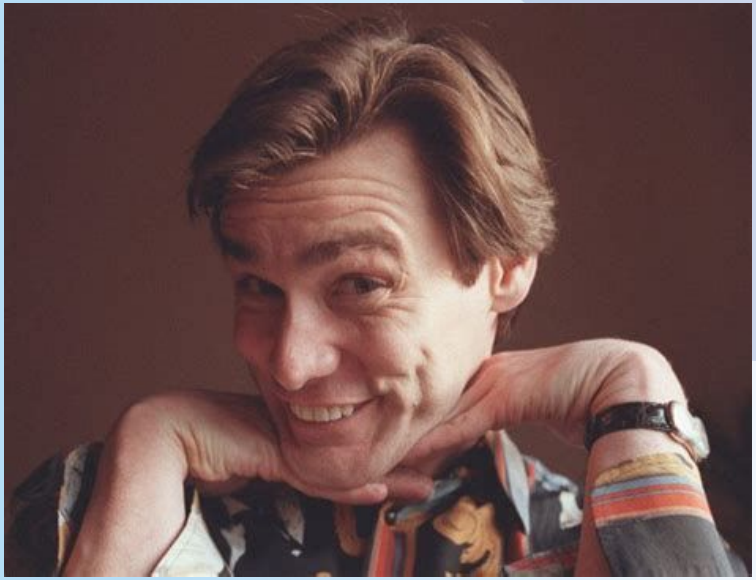

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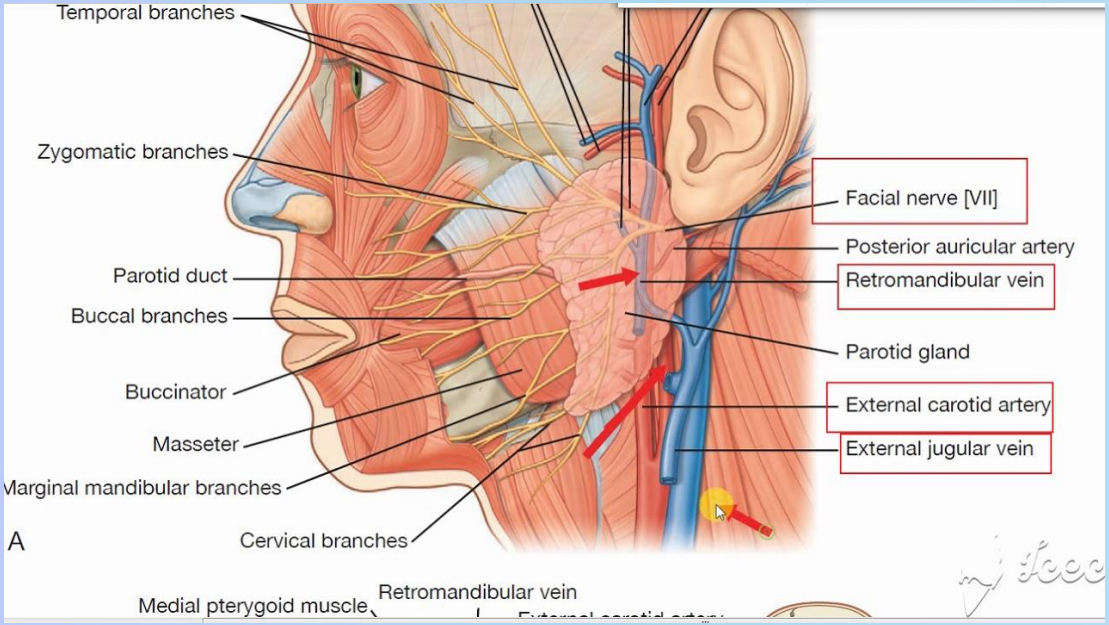


CLINICAL CORRELATION

Facial nerve passes through the parotid gland after exiting from the stylomastoid foramen. BUT it does not innervate the parotid gland.

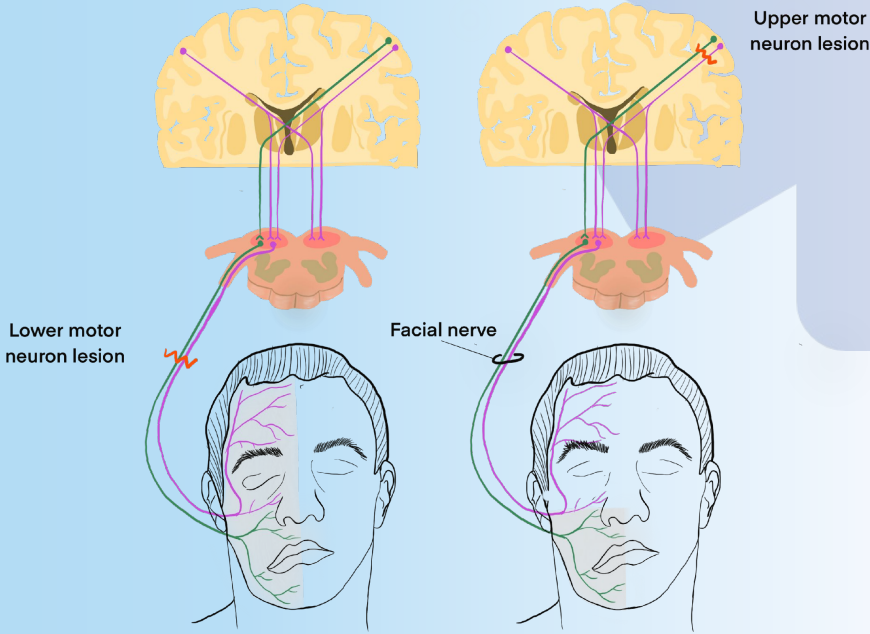
This means that damage to the parotid gland, or a tumor of the parotid can damage the facial nerve. Other structures that can be damaged is highlighted in red.

NB! Posterior Auricular does not enter the parotid gland. Runs immediately behind the auricle.

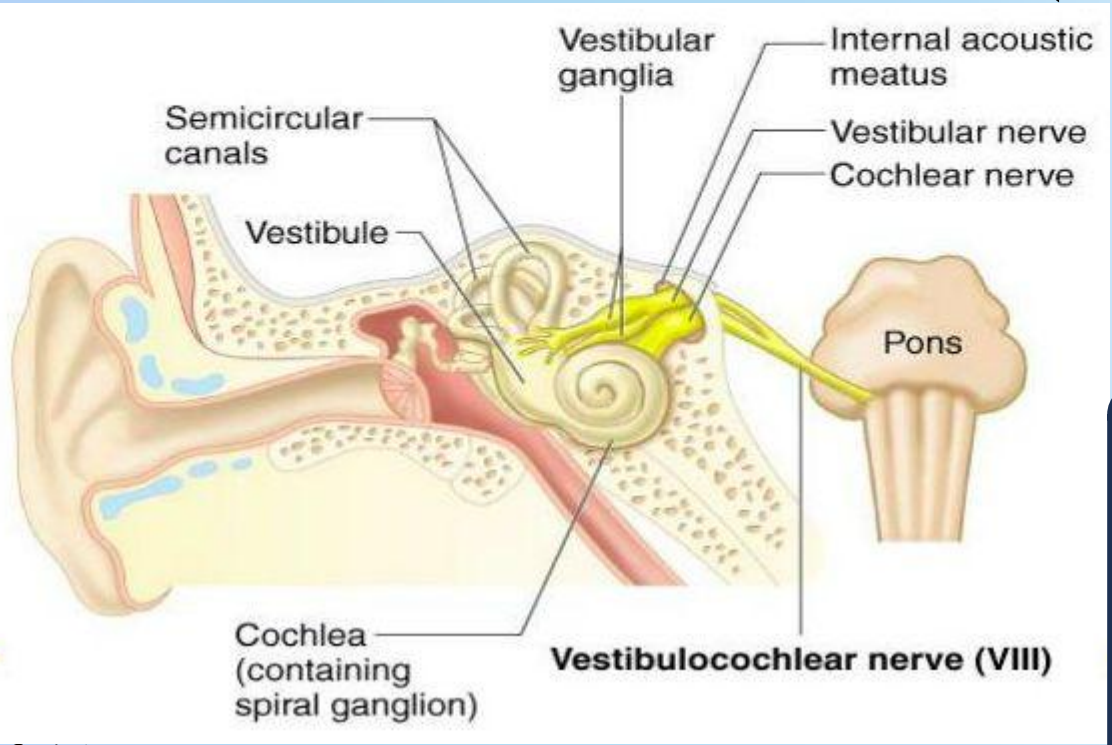
Facial Nerve (CN 7)

Effect of nerve injury:

- Facial paralysis (Bell palsy) (upper and lower face)
- Loss of efferent limb of corneal reflex
- Loss of taste to anterior ⅔ of tongue
- Loss of secretion of lacrimal, submandibular, sublingual, nasal and palatine glands
- **Hyperacusis** (increased acuity to sound), due to stapedius paralysis



Cranial Nerve #8-Vestibulocochlear (Auditory)



-sound and equilibrium (balance) information from the inner ear to the brain

Ear,
Equilibrium=
Eight

-pons (rule of 4s)
-exit the brainstem at the cerebellopontine angle
-internal auditory meatus
-LOSS of balance

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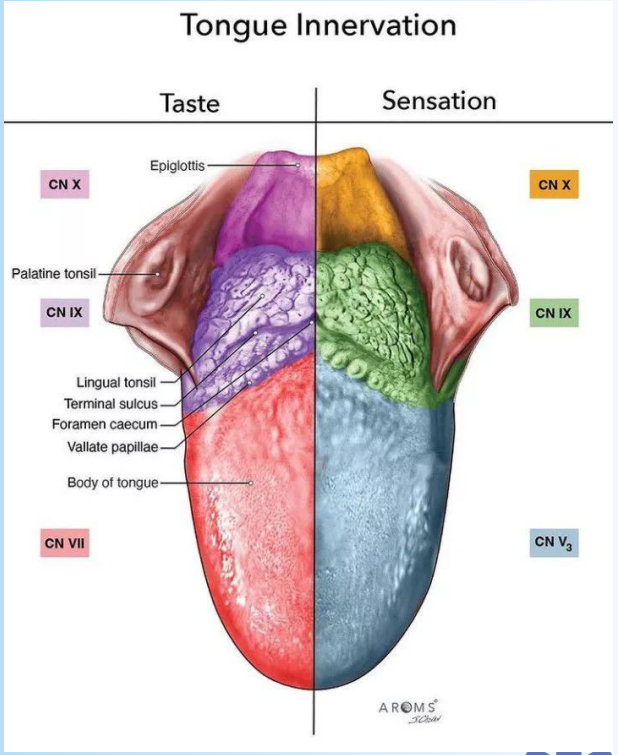
Cranial Nerve #9-Glossopharyngeal

Function: Elevation of pharynx (stylopharyngeus muscle); Secretion of saliva (parotid gland); Carotid sinus and body, tongue, pharynx, and middle ear; Taste from posterior ⅓ of tongue; External ear.

Cranial exit: Jugular foramen

Brainstem exit: Medulla (postolivary sulcus)

Functional Component: GSA, GVA, GVE, SVA, SVE



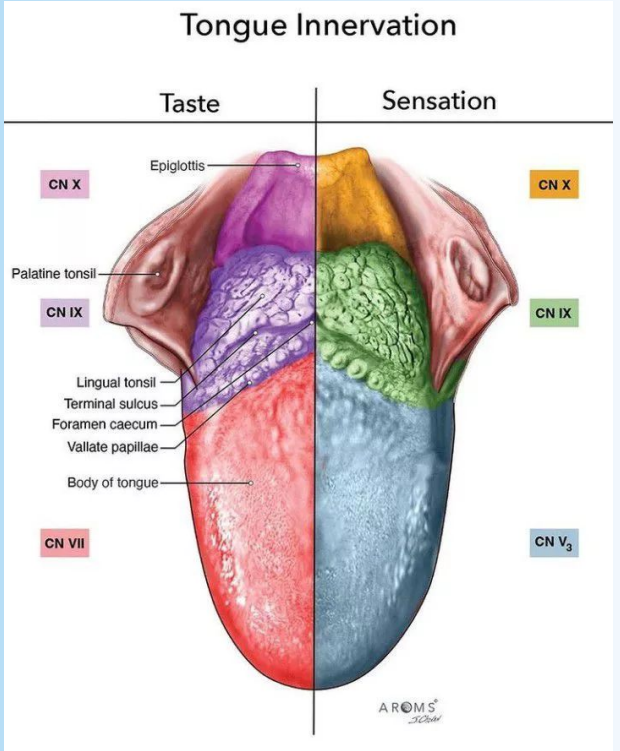
Cranial Nerve #9-Glossopharyngeal

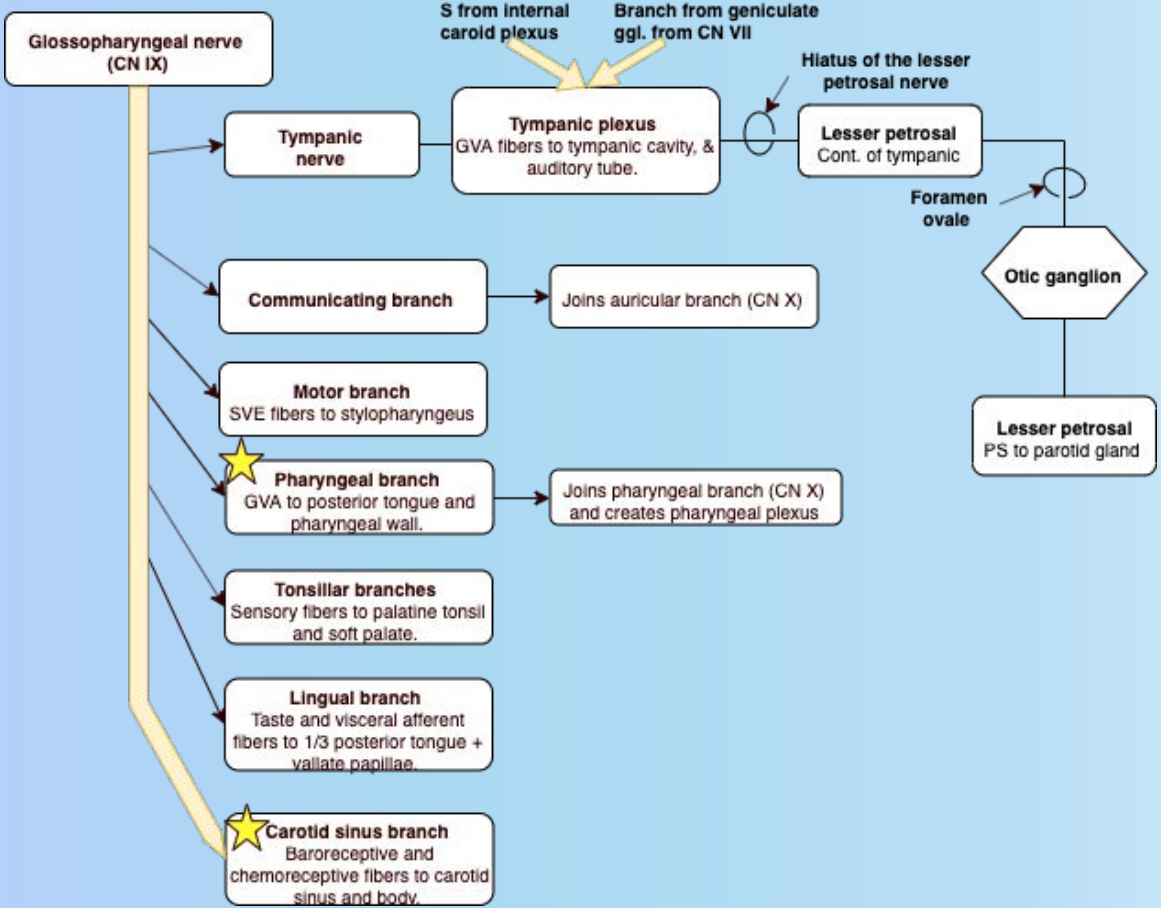
Sensory
-Taste and sensation of posterior 1/3 part of the tongue
-Somatosensation of pharyngeal wall

Motor
-Innervates stylopharyngus

Parasympathetic
-Parotid gland (salivation)

Reflex
-Afferent limb of the gag reflex
-Afferent limb of the carotid sinus reflex




Glossopharyngeal nerve (CN IX)
S from internal caroid plexus
Branch from geniculate ggl. from CN VII
Hiatus of the lesser petrosal nerve
Tympanic nerve
Tympanic plexus
GVA fibers to tympanic cavity, & auditory tube.
Lesser petrosal
Cont. of tympanic
Foramen ovale
Otic ganglion
Communicating branch
Joins auricular branch (CN X)
Motor branch
SVE fibers to stylopharyngeus
Lesser petrosal
PS to parotid gland
Pharyngeal branch
GVA to posterior tongue and pharyngeal wall.
Joins pharyngeal branch (CN X) and creates pharyngeal plexus
Tonsillar branches
Sensory fibers to palatine tonsil and soft palate.
Lingual branch
Taste and visceral afferent fibers to 1/3 posterior tongue + valiate papillae.
Carotid sinus branch
Baroreceptive and chemoreceptive fibers to carotid sinus and body.

Cranial Nerve #9-Glossopharyngeal

Effect of nerve injury:

- Loss of taste to posterior ⅓ of tongue
- Loss of receptors in carotid body and sinus
- Loss of parotid gland secretion
- Paralysis of stylopharyngeus muscle
- Loss of afferent limb of gag reflex
- Glossopharyngeal neuralgia

Cranial Nerve #10-Vagus

Function: Muscle of pharynx, larynx, and palate; Smooth muscles and glands in thoracic and abdominal viscera; Sensation in lower pharynx, larynx, trachea, and other viscerae, Taste on epiglottis; Auricle and external acoustic meatus.

Cranial exit: Jugular foramen

Brainstem exit: Medulla (postolivary sulcus)

Functional Component: GSA, GVA, GVE, SVA, SVE

Cranial Nerve #10-Vagus

Exit the skull through the jugular foramen

Sensory
-Mucous membranes of lower pharynx, larynx, trachea
-Taste: supraglottic region
-Visceral sensation from lung, liver, kidneys, stomach, and a large part of the intestines
-Aortic body: baroreceptors for blood pressure and chemoreceptors for PaO_2 and $PaCO_2$

Motor
-Swallowing - most muscles of pharynx (not stylopharyngus) and soft palate (palatoglossus)
-Speech - Larynx through reccurent laryngeal nerve

Parasympathetic
-Promotes motility in smooth muscles the esophagus, stomach and most of the intestines
-Innervates SA and AV node and causes decrease in heart rate ♥

Reflexes
-Afferent and efferent limb: cough reflex
-Efferent limb: Sneeze and gag reflex

CN VII

CN IX

Auricular branch
External acustic meatus

Meningeal branch
Dura matter of poserior cranial fossa

Pharyngeal branch
Muscles of pharynx (except stylopharyngus) and palate (except tensor veli palatini)

Vagus nerve
CN X

Superior, middle and Inferior cardiac branches
PS &sensory to cardiac plexuses

Superior laryngeal nerve

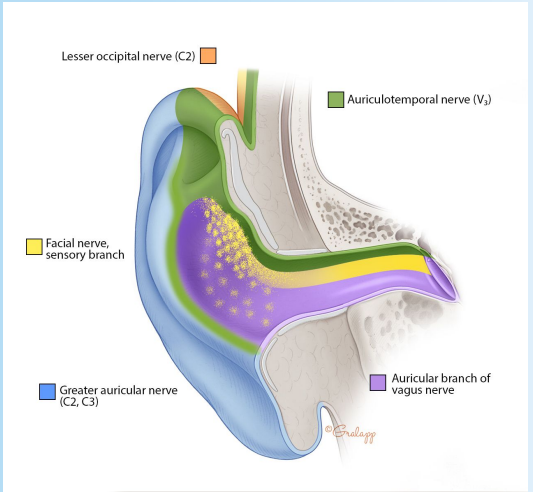
Internal laryngeal nerve
Sensory: larynx above vocal cords, lower pharynx and epiglottis
Taste: root of tounge **and epiglottis**

External laryngeal nerve
Motor fibers to cricothyroid and pharyngeal constrictor muscles

Recurrent laryngeal
Sensory to the larynx below vocal cord
Muscles of larynx (except cricothyroid)

Inferior laryngeal
Continuation of Recurrent laryngeal

Lower border of cricoid cartilage



Cranial Nerve #10-Vagus

Effect of nerve injury:

- Loss of efferent limbs, gag, sneeze, and both limbs of cough reflex
- Deviation of uvula toward normal side
- Vocal cord paralysis (left recurrent laryngeal nerve)
- **Thyroidectomy**
- Paralysis of palate, pharynx, and larynx
- Loss of receptors in aortic body and arch

Cranial Nerve #11-Accessory

Function: SCM and trapezius muscle

Cranial exit: Jugular foramen

Brainstem exit: Cranial - Medulla (postolivary sulcus)

Spinal - Passes through the foramen magnum and joins the cranial root

Functional Component: SVE

Cranial Nerve #11-Accessory

Effect of nerve injury:
- Inability to shrug shoulder
- Difficulty in turning head to opposite side

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Cranial Nerve #12-Hypoglossal

Function: Muscles of movement of tongue

Cranial exit: Hypoglossal canal

Brainstem exit: Medulla (preolivary sulcus)

Functional Component: GSE

Cranial Nerve #12-Hypoglossal

Effect of nerve injury:

- Loss of tongue movements
- Tongue deviation toward lesion side (genioglossus m.)

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