NeuroAnatomy

Brainstem 2

OCTOBER 2ND, 2025

Objectives

At the end of this lecture you will be:

- Familiarized with names and global functions for the Cranial nerves
- Understand the organizing rules determining location of the different CN in brainstem
- Familiarized with CN associated with single sensory or motor functions
- Understand effects of damage to these nuclei and their corresponding nerves

Features Present at all Levels

- ***Ventricular space*** (names differ by level)

- Core containing ***Reticular Formation*** (arousal, muscle tone…)

- ***Long tracts*** (axonal systems) including
  - Ascending somatosensory projections (e.g., from spinal cord to thalamus)
  - Descending motor projections (e.g., from cerebral cortex to spinal cord)

- ***Cranial nerve nuclei and nerves***
  - CN are comparable to spinal nerves but for head and neck

Mastering the CN

Memorize the 12 CN and their functions

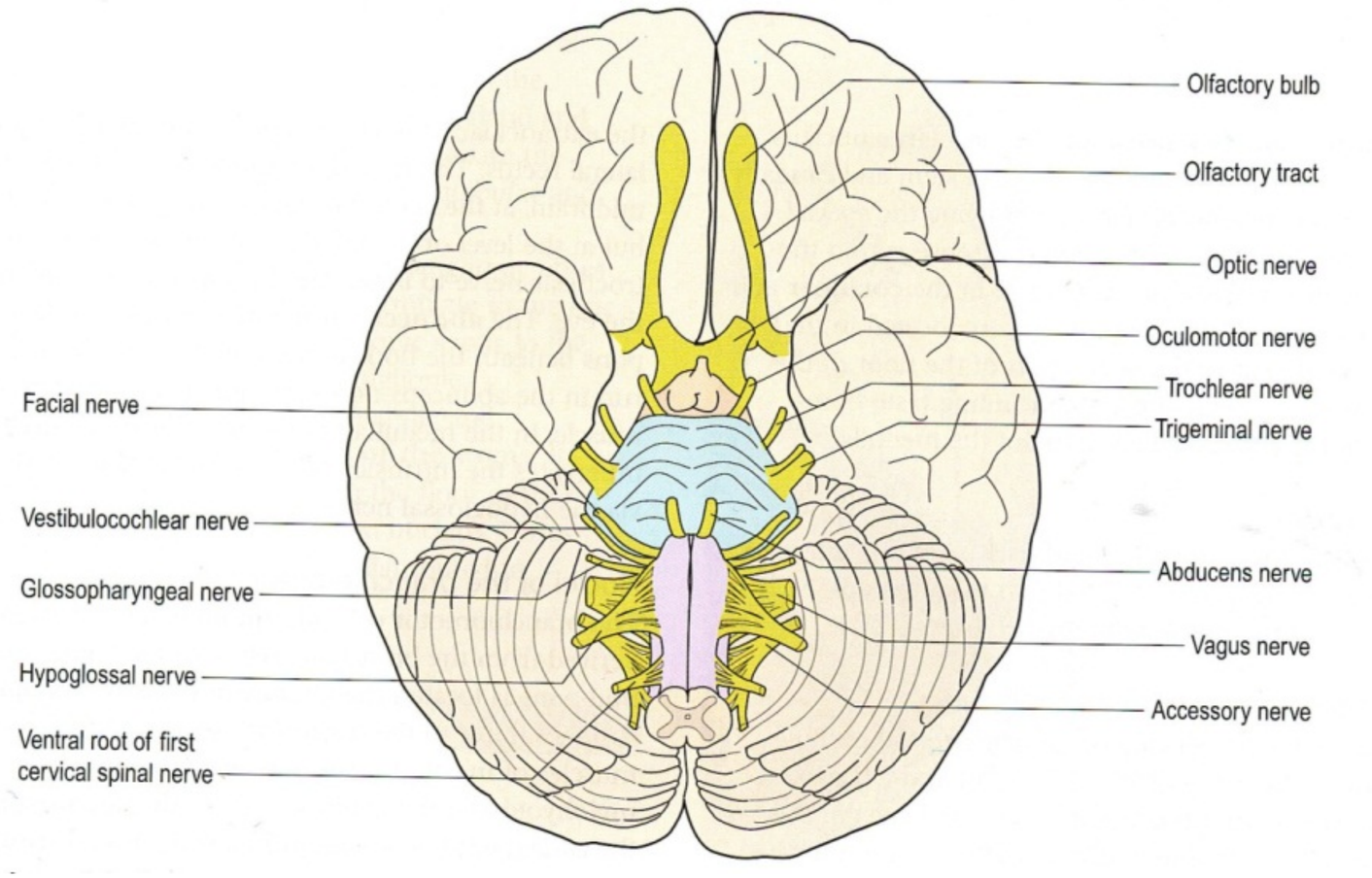
Ribald mnemonics will not help much

Goal: To know the individual CN and their functions in instant recall

CN	Functions
I	Smells
II	Sees
III, IV, VI	Moves eyes and constricts pupils (III)
V	Feels from the head and chews
VII	Moves the face, tastes, salivates, cries
VIII	Hears, regulates balance
IX	Tastes, salivates, swallows
X	Tastes, swallows, talks, communication to/from viscera
XI	Turns head, lift shoulders
XII	Moves tongue

Nomenclature for CNs

CN	CN	Name
1	I	**O**lfactory
2	II	**O**ptic
3	III	**O**culomotor
4	IV	**T**rochlear
5	V	**T**rigeminal
6	VI	**A**bducens
7	VII	**F**acial
8	VIII	**V**estibulochoclear
9	IX	**G**lossopharyngeal
10	X	**V**agus
11	XI	**A**ccessory
12	XII	**H**ypoglossal



THEY GO BY NAME OR NUMBER

Twelve bilaterally paired CNs

Oh, Oh, Oh, To Touch And Feel A Girl's Very Admirable Hands

On Old Olympus' Towering Top, A Friendly Viking Grew Vines And Hops

Oh, Oh, Oh, To Touch And Feel Very Good' Velvet Aah Hah

Oh, Oh, Oh, To Touch And Feel Very Good Vibes AHhhh

Oh, Oh, Oh, To Touch And Fondle A Gorgeous Very Amazing Human

Oh, Oh, Oh, To Touch And Feel Very Green Vegetables, Such Heaven

Oh, Once One Takes The Anatomy Final A Good Vacation Seems Heavenly!

On Occasion, Our Trusty Truck Acts Funny--Very Good Vehicle Any How

Careful: “A” in CN VIII stands for “Auditory” one of its functions. Do not reflect the name

Ribald Mnemonics

Don't worry about this table

CN I-VI	Sensory Function	Motor Function	PS* fibers
I Olfactory	Smell		No
II Optic	Vision		No
III Oculomotor		Eye movements	Yes
IV Trochlear		Eye movements	No
V Trigeminal	General Sensation	Mastication	No
VI Abducens		Eye Movements	No

CN VII-XII	Sensory Function	Motor Function	PS* fibers
VII Facial	Taste	Face expressions	Yes
VIII Vestibulo-cochlear	Hearing Balance		No
IX Glossopharyngeal	Taste	Swallowing	Yes
X Vagus	Taste	Speech, swallowing	Yes
XI Accessory		Head movements	No
XII Hypoglossal		Tongue movements	No

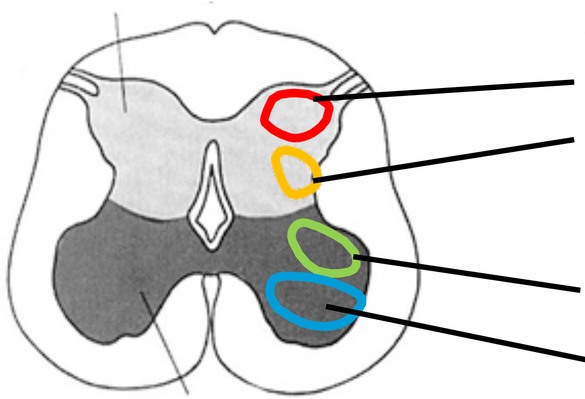
NOT RECC

Some Say Marry Money But My Brother Says Big Brains Matter More

FUNCTION OK - NUCLEI LOCATION NOT OK

The Goldberg Approach

Let’s organize the CNs in functional groups

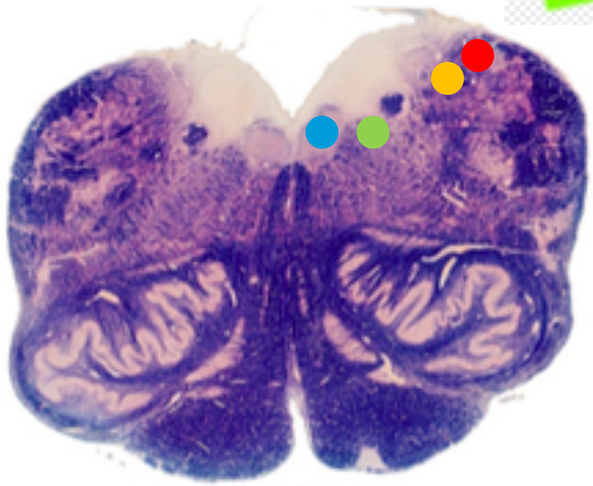


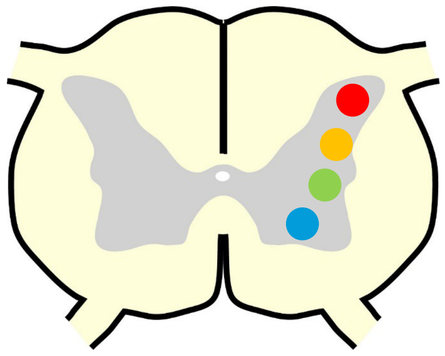
Alar plate - Dorsal horn

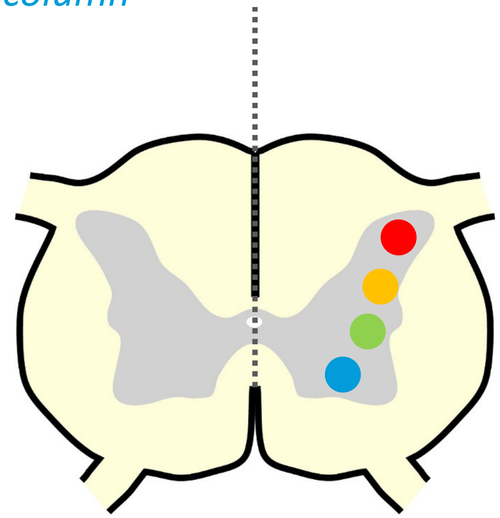
- *Somatic sensory column*
- *Visceral sensory column*

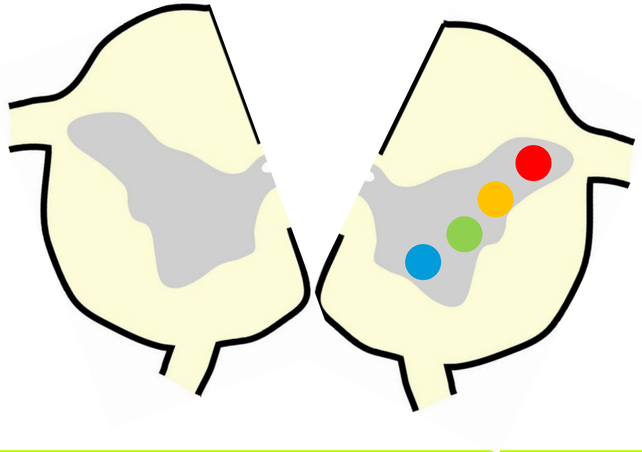
Basal plate - Ventral horn

- *Visceral motor column*
- *Somatic motor column*



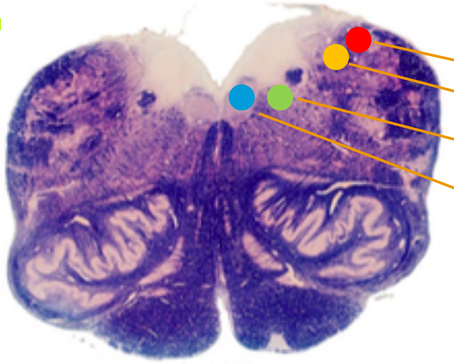


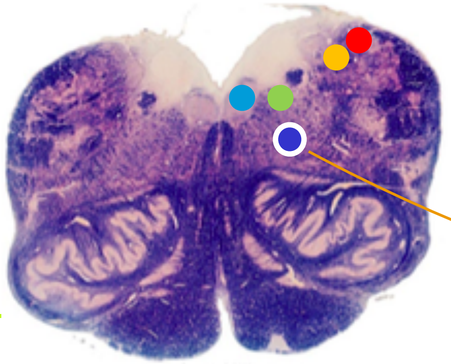




FUNCTION AND LOCATION OF NUCLEI OK!

Life saving





			Somatic motor	*Visceral motor*	*Visceral sensory*	*Somatic sensory*
Sensory	CN I	Olfactory	Not in brainstem			
	CN II	Optic				
	CN VIII	Vestibulocochlear				
Motor	CN III	Oculomotor				
	CN IV	Throclear				
	CN VI	Abducens				
	CN XI	Accessory				
	CN XII	Hypoglossal				
Mixed	CN V	Trigeminal	Motor n			Sensory n V
	CN VII	Facial	Facial n	Sup salivary n	N solitarius	
	CN IX	Glossopharyngeal	N ambiguus	Inf salivary n		
	CN X	Vagus		Dorsal motor n		

“Somatovisceral”

The good News

Knowing the CN functions will be easy if you memorize the previous chart that includes the same information as the first list but rearranged.

Unlike the spinal nerves, which are nerves containing motor and sensory components, the CN are much simpler.

The **cranial nerves (CN)** are associated with nuclei in the brainstem. Some are purely motor, others purely sensory and only few, are mixed

- Efferent (motor) nerves arise from nuclei in the brainstem.
- Afferent (sensory) nerves terminate within nuclei in the brainstem.

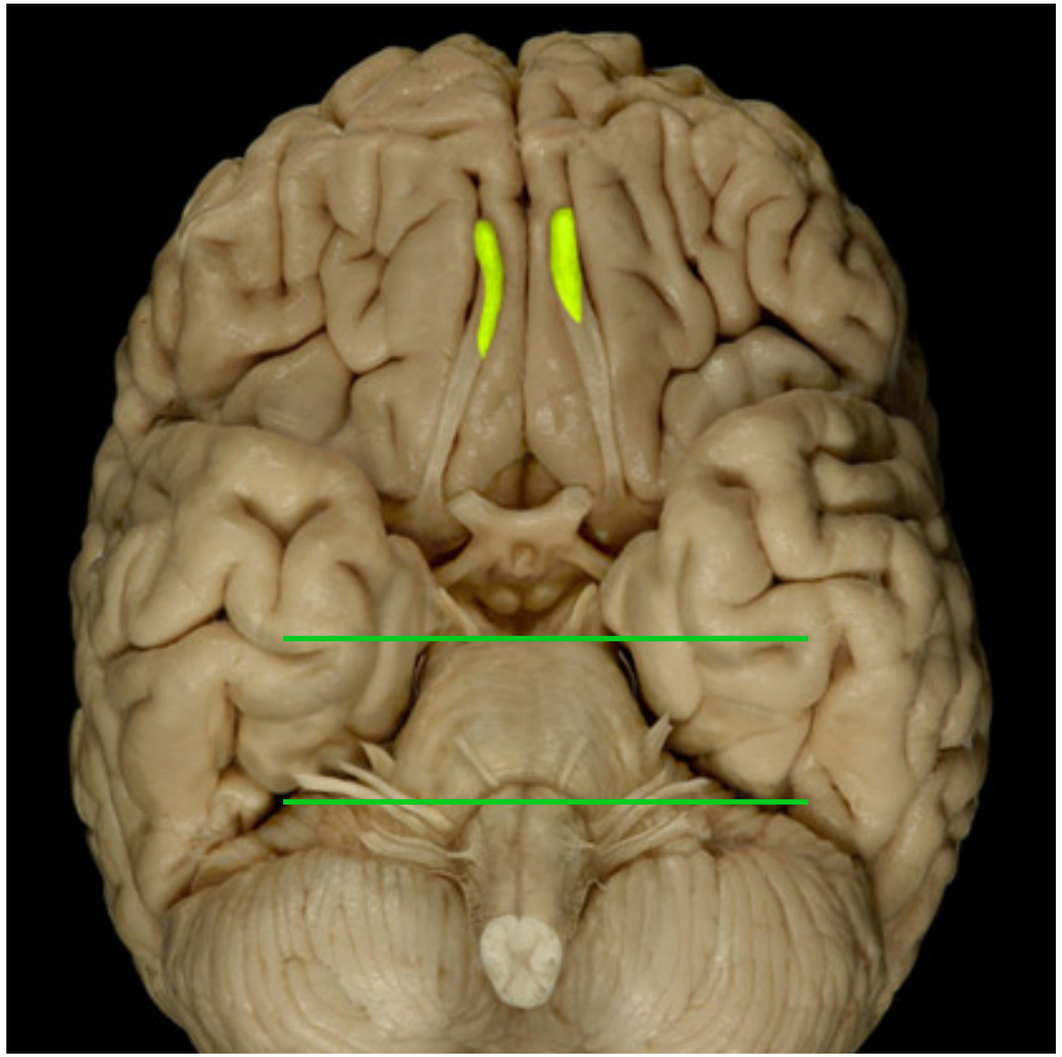
General Location

I-II

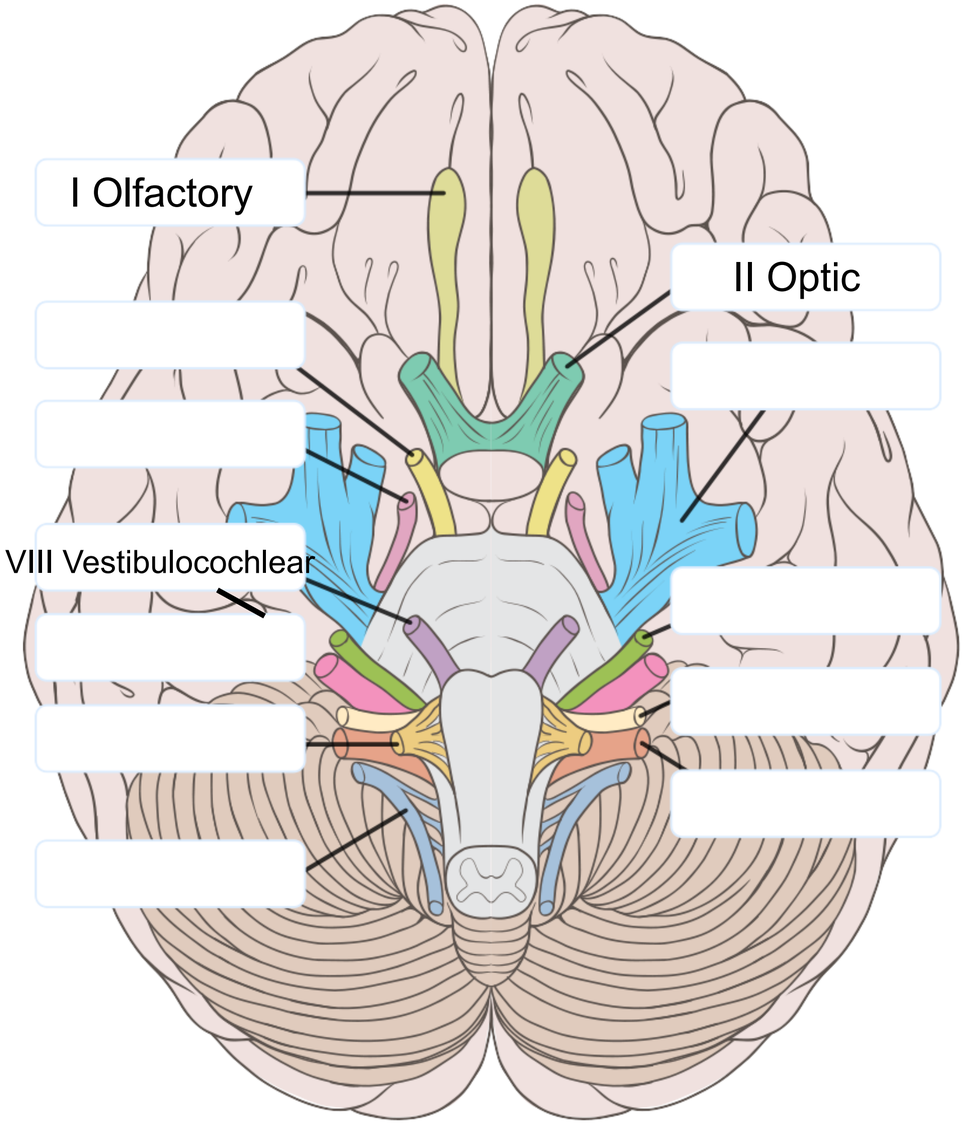
III-IV (V) I-IV Midbrain

V-VIII V-VIII Pons

IX-XII (V, VII, VIII) IX-XII Medulla



Sensory CN



CN Associated with Sensory Functions

Rostral

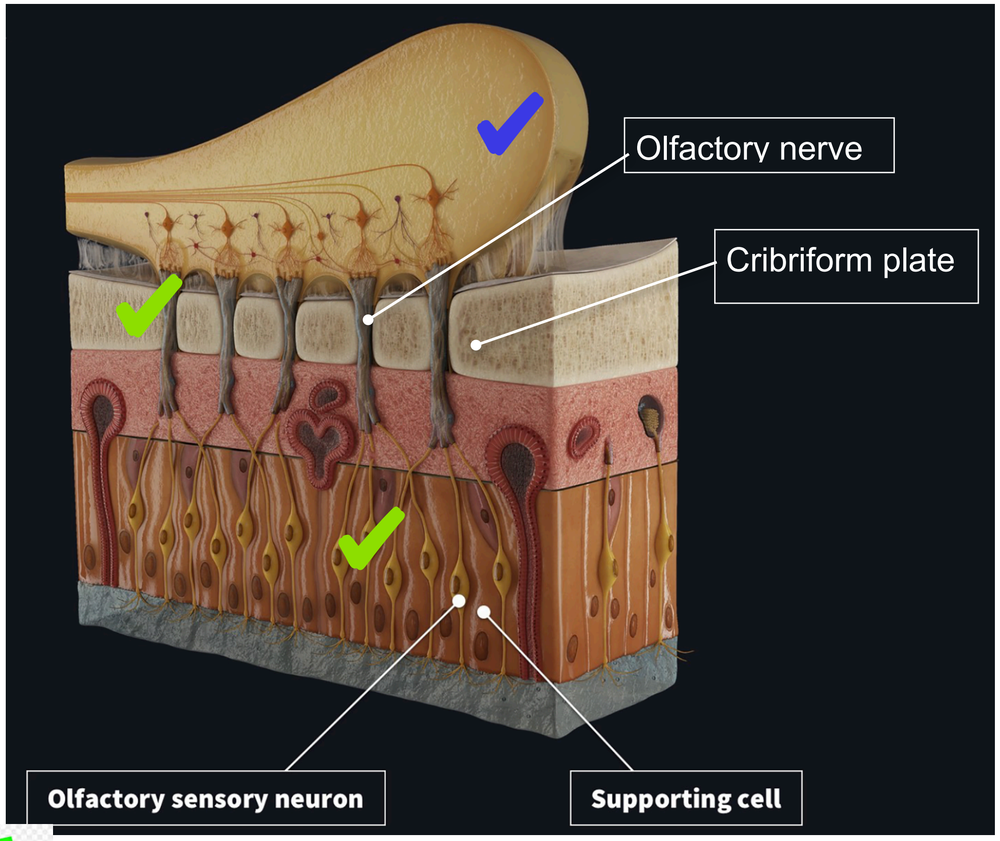
1. Olfactory
2. Optic

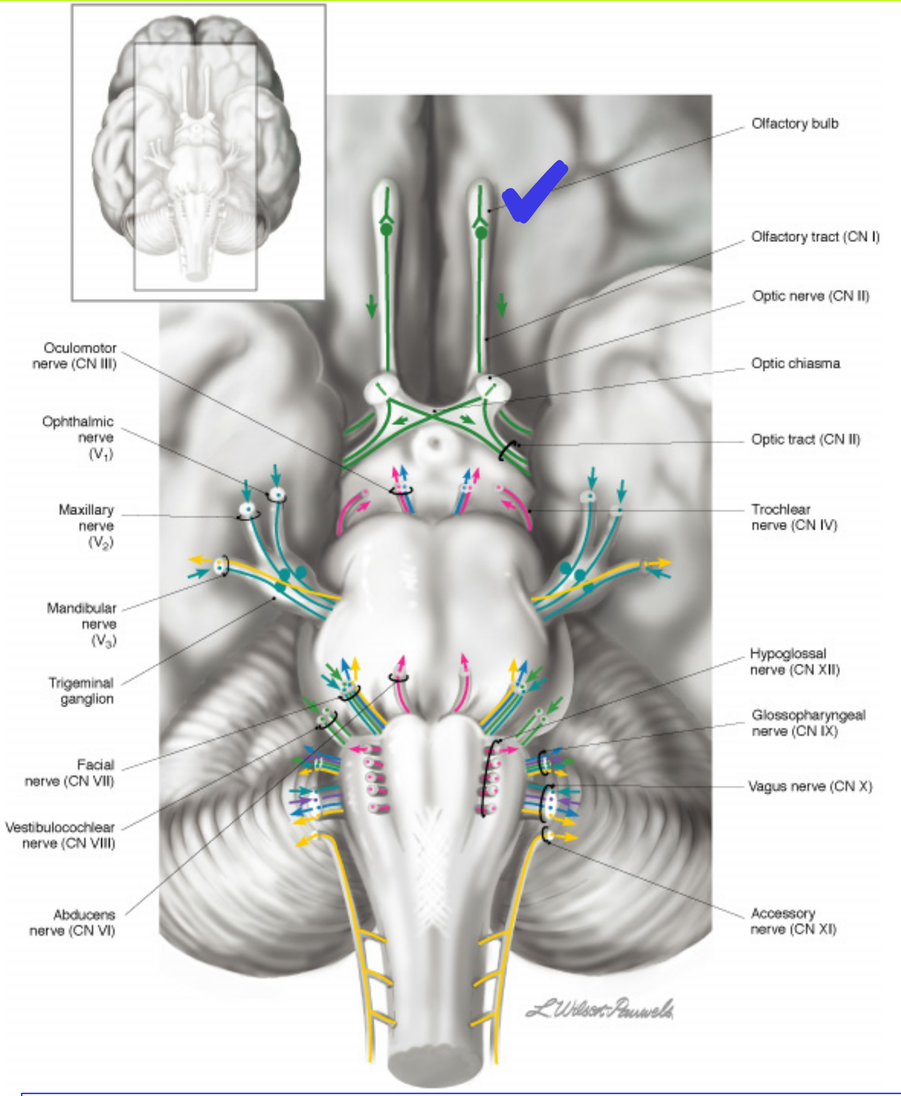
Not in brainstem!

3. Oculomotor
4. Trochlear
5. Trigeminal
6. Abducens
7. Facial
8. Vestibulocochlear
9. Glossopharyngeal
10. Vagus
11. Accessory
12. Hypoglossal

Caudal

CN I - Olfactory





Shows olfactory bulb: the target of the first cranial nerve. The nerve itself is not visible.

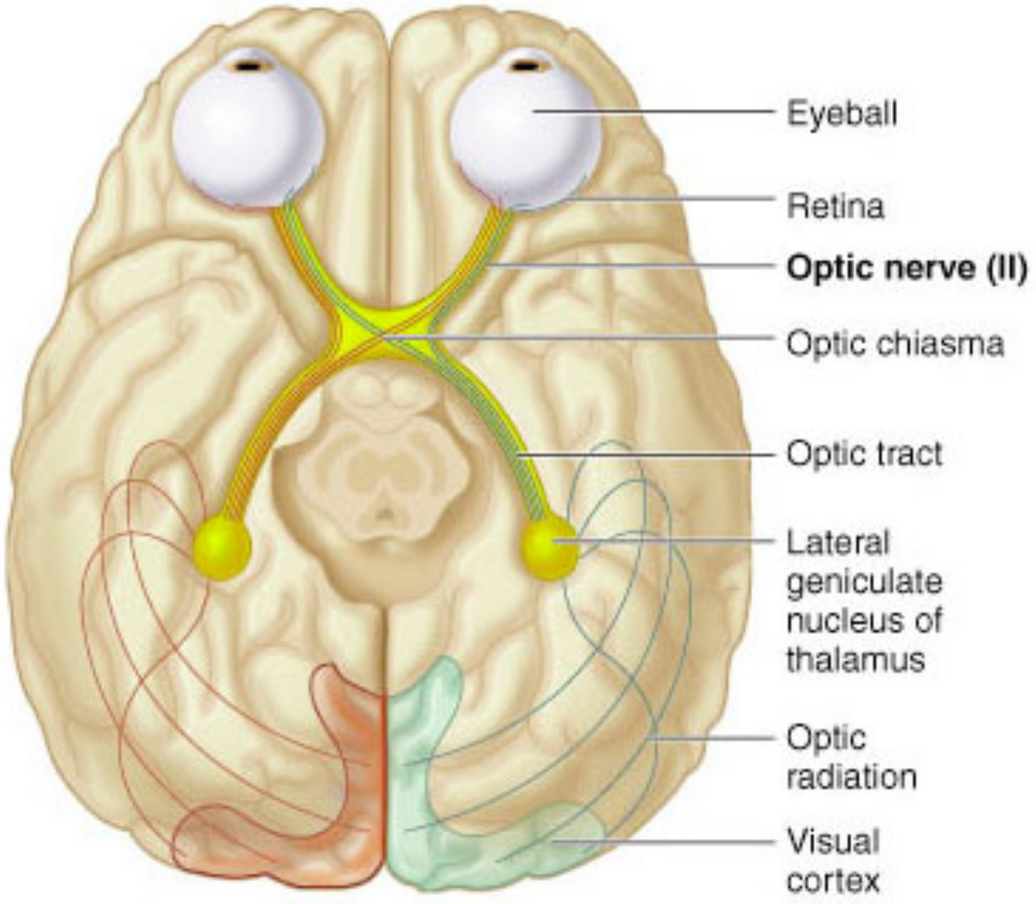
CRIBRIFORM PLATE EASILY FRACTURES IN HEAD TRAUMA = ANOSMIA

CN II - Optic

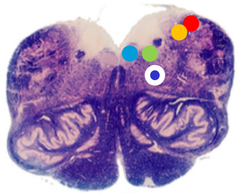
Optic nerve via optic canal to optic chiasm

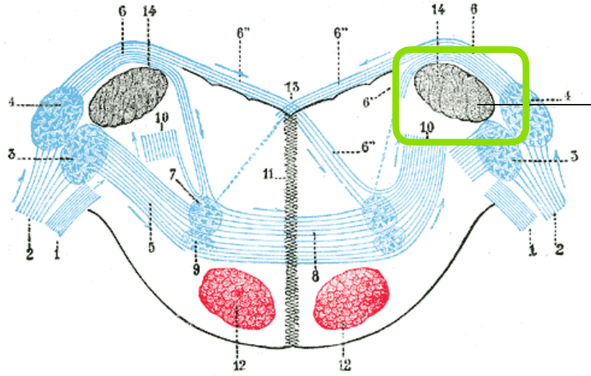
Synapse at thalamus then proceeds to visual cortex

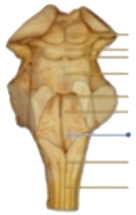
Function: Vision

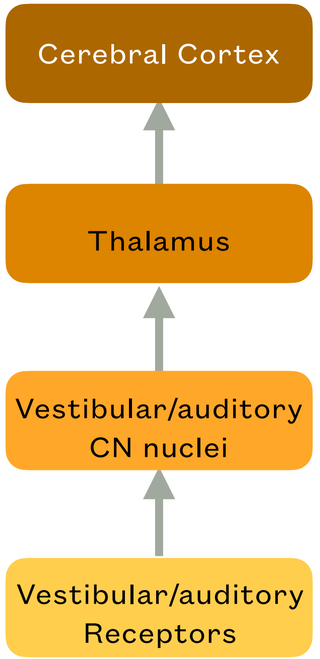


CN VIII - VestibuloCochlear









Auditory cortices

Somatosensory cortices

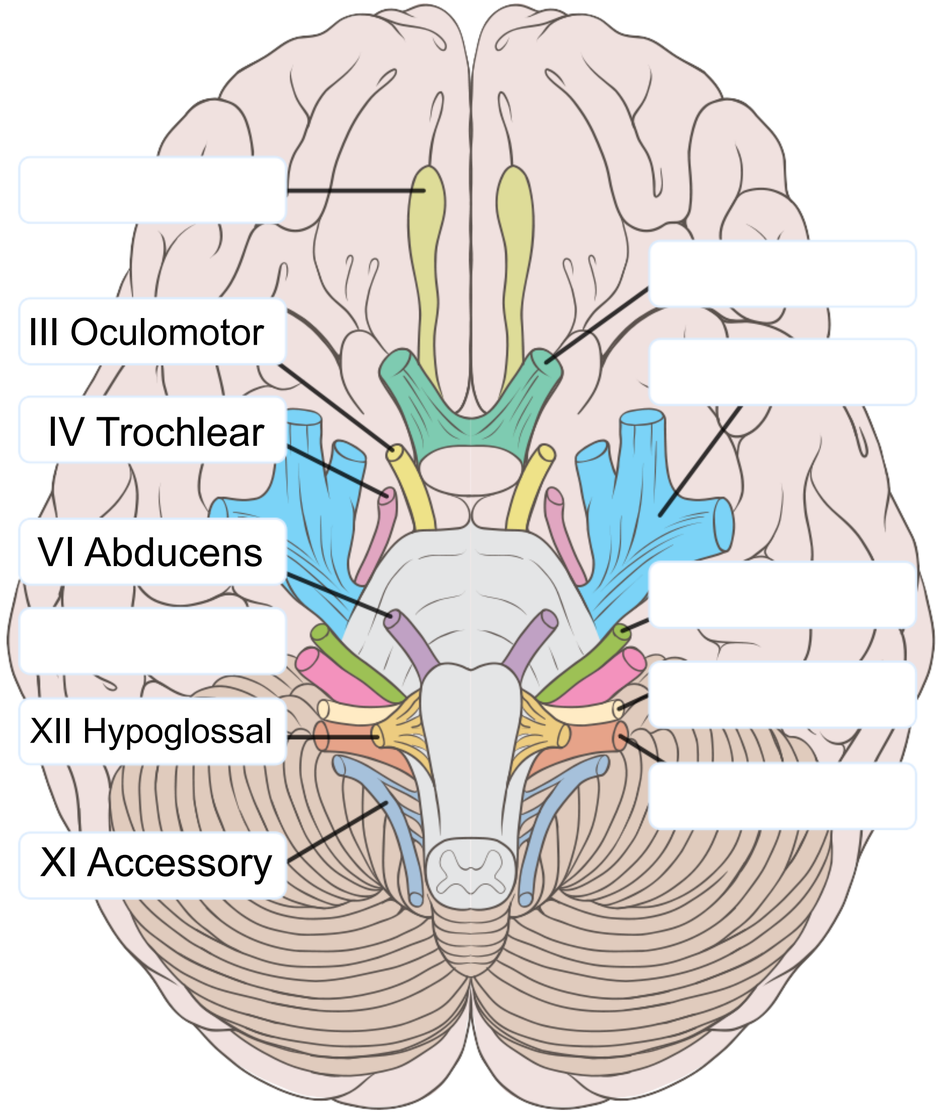
Diencephalon

Caudal Pons/rostral medulla

Inner ear

TWO SENSORY DOMAINS: BALANCE (VESTIBULO-) AND AUDITORY (COCHLEAR)

Motor CN



III, IV, VI, XI, XII

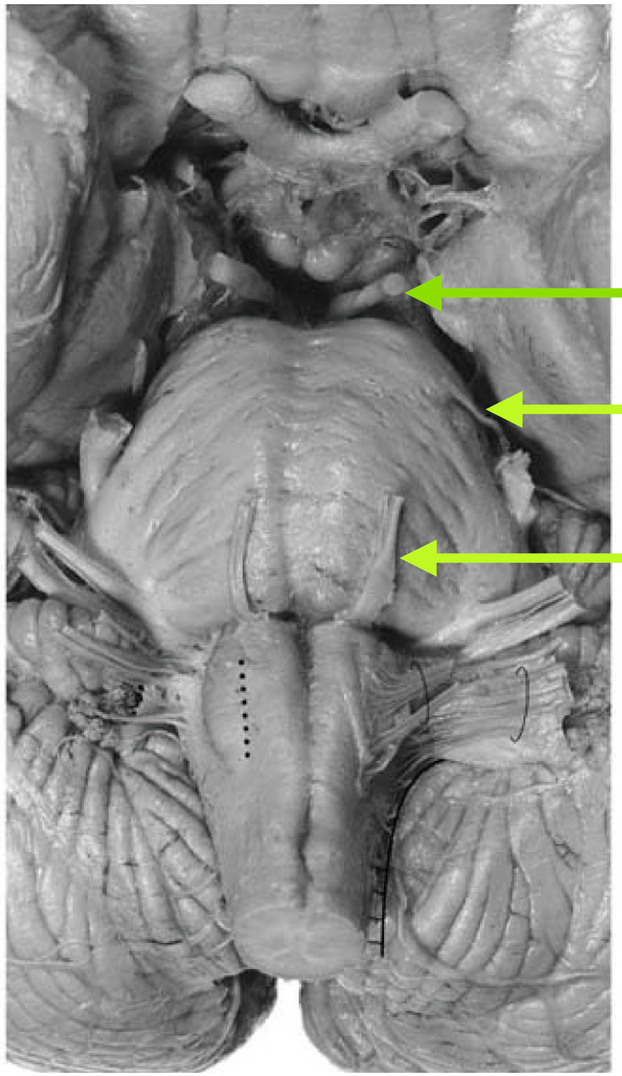
CN associated with Eye Movements

Rostral

Caudal

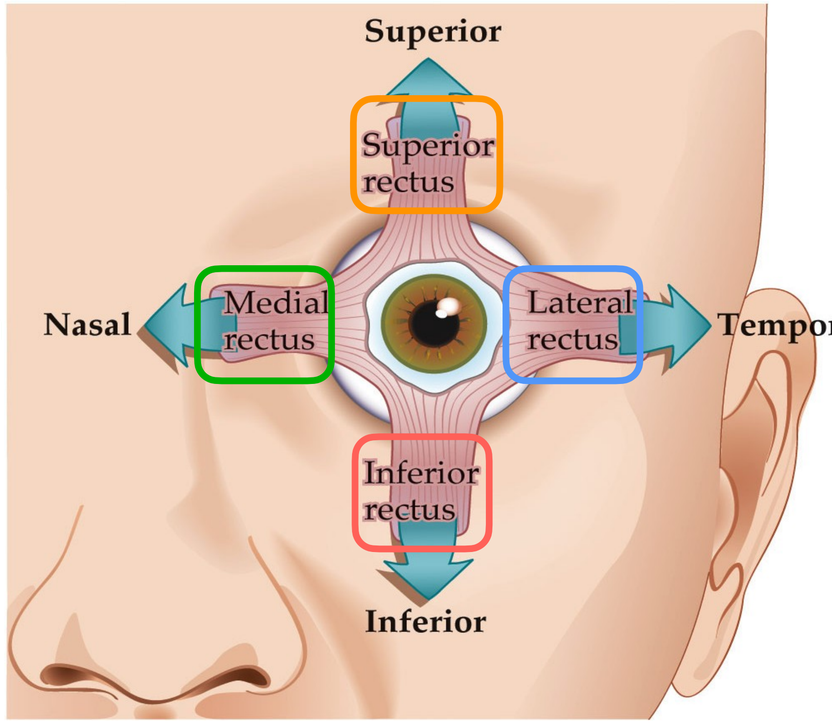
1. Olfactory
2. Optic
3. Oculomotor
4. Trochlear
5. Trigeminal
6. Abducens
7. Facial
8. Vestibulocochlear
9. Glossopharyngeal
10. Vagus
11. Accessory
12. Hypoglossal

Location



Extraocular Muscles

Elevation

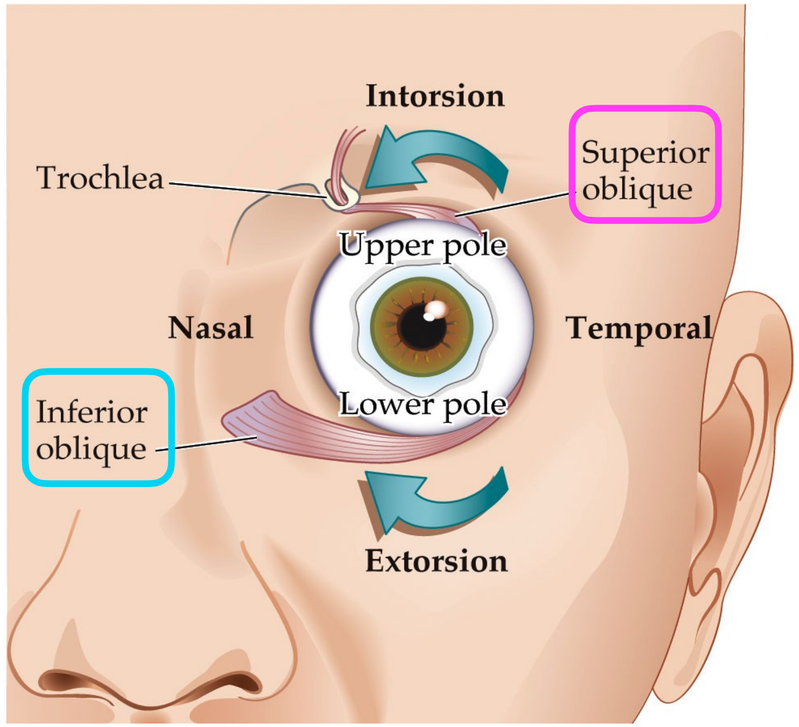


Adduction

Abduction

Lowering

Trochlea: a pulley-shaped structure

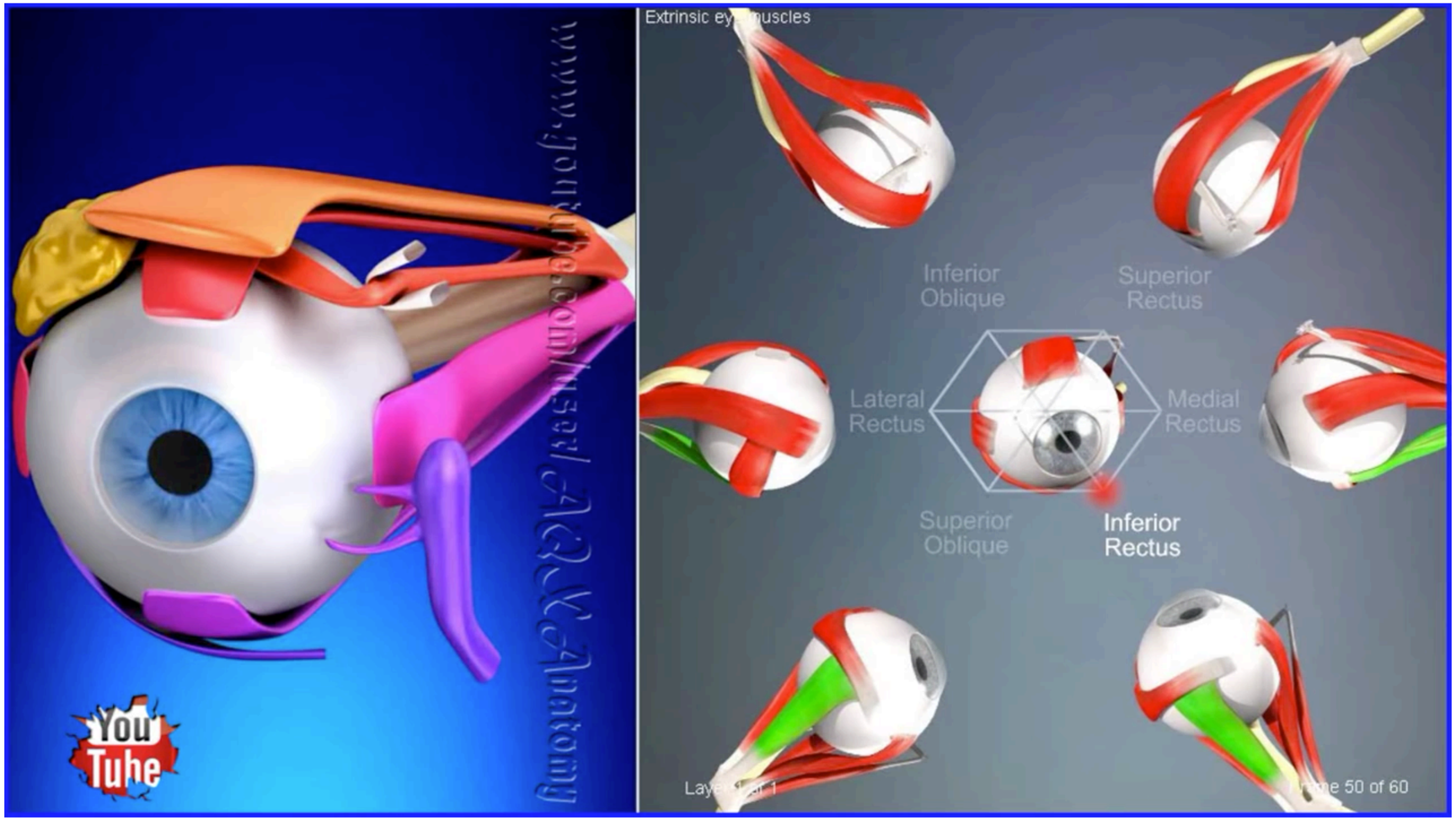


Intorsion: movement of upper pole of eye inward

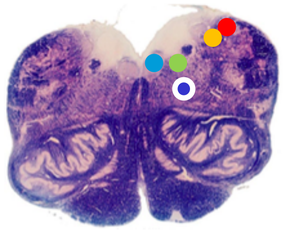
Extorsion: movement of upper pole of eye outward

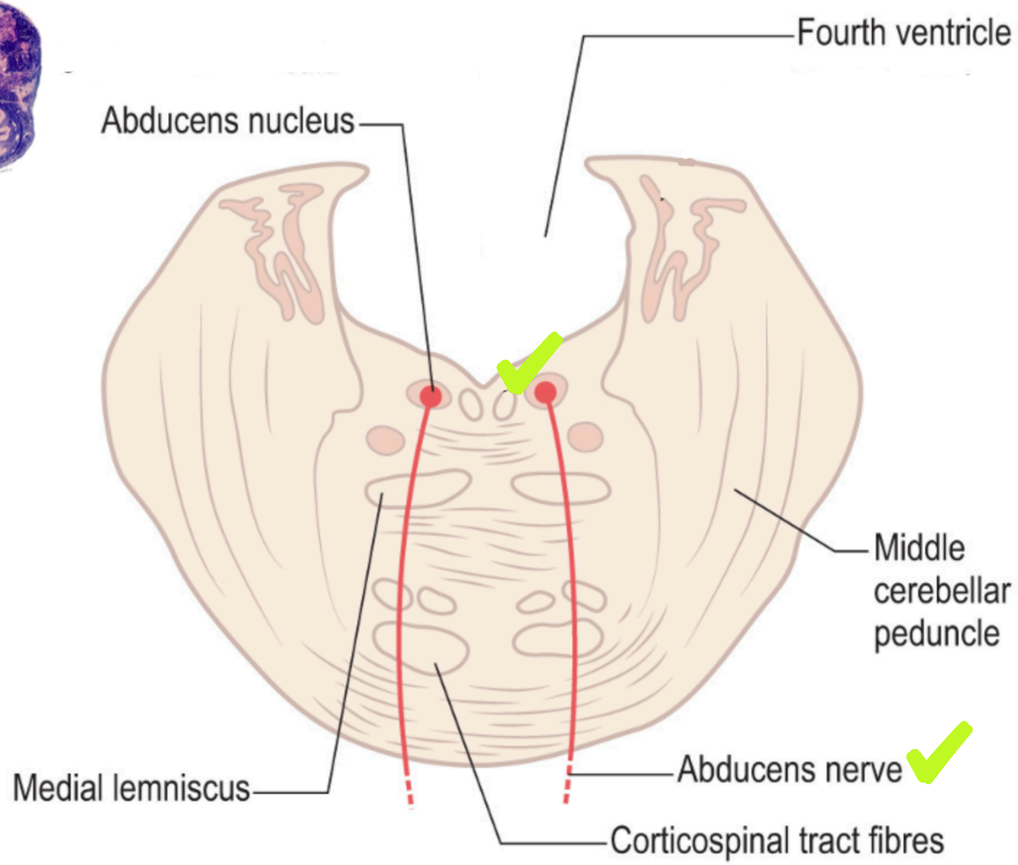
GOAL: CONJUGATED MOVEMENTS!

Eye Movements

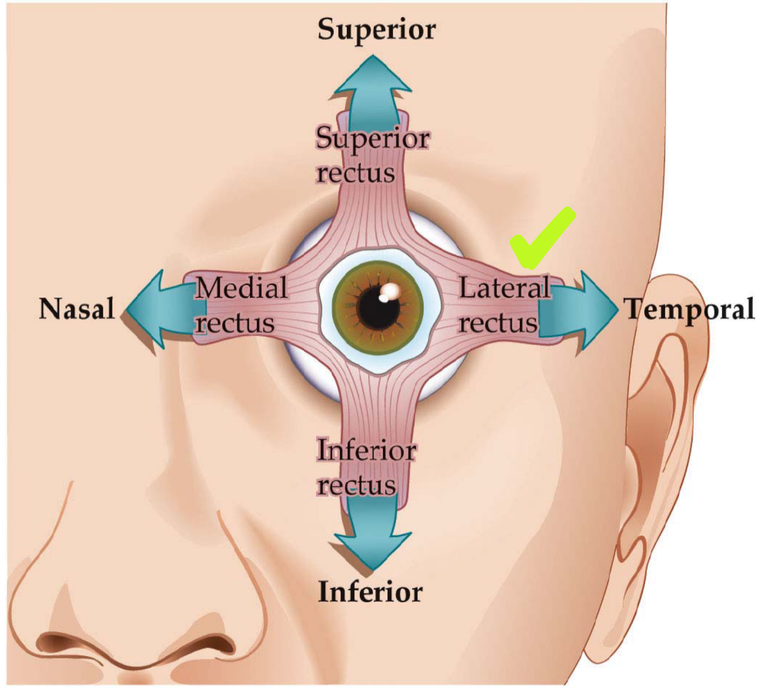


CN VI - Abducens





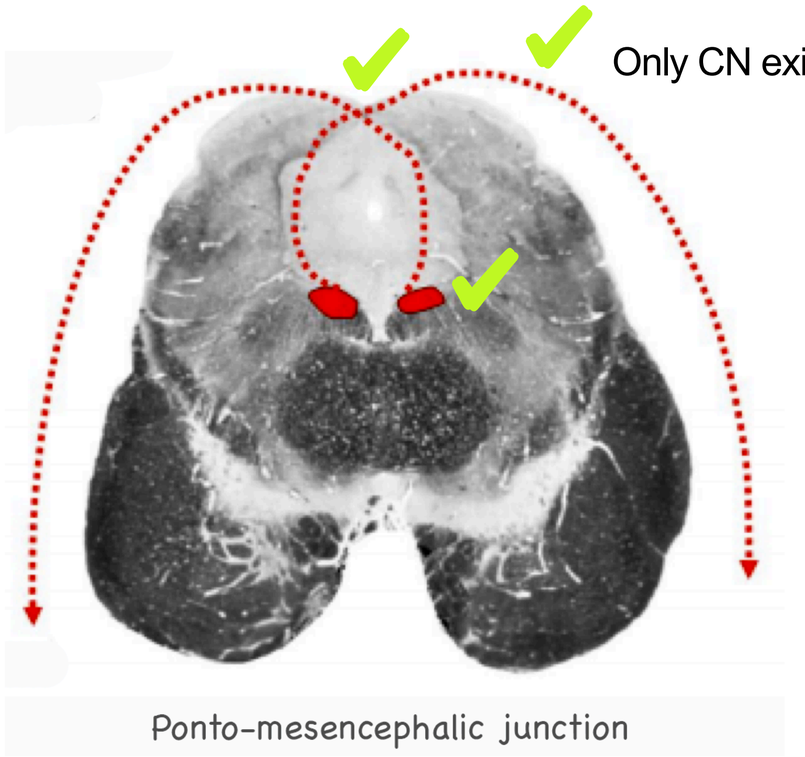
Ipsilateral (motor) efferents to:



Control over eye movements: **Abduction** (outwards)

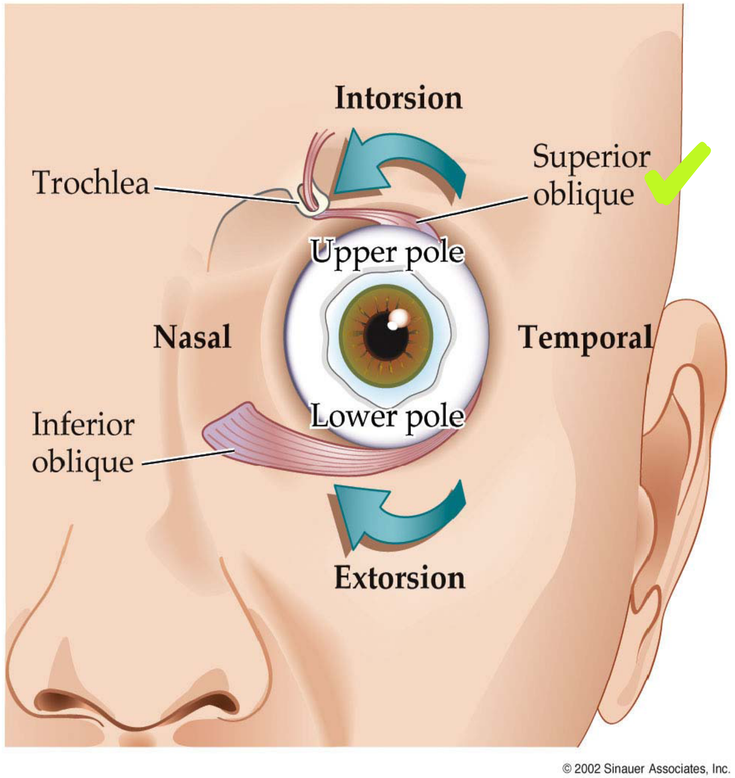
EXITS VENTRALLY AND DOES NOT DECUSSATE

CN IV - Trochlear: The Dumb Nerve



Only CN exiting dorsally

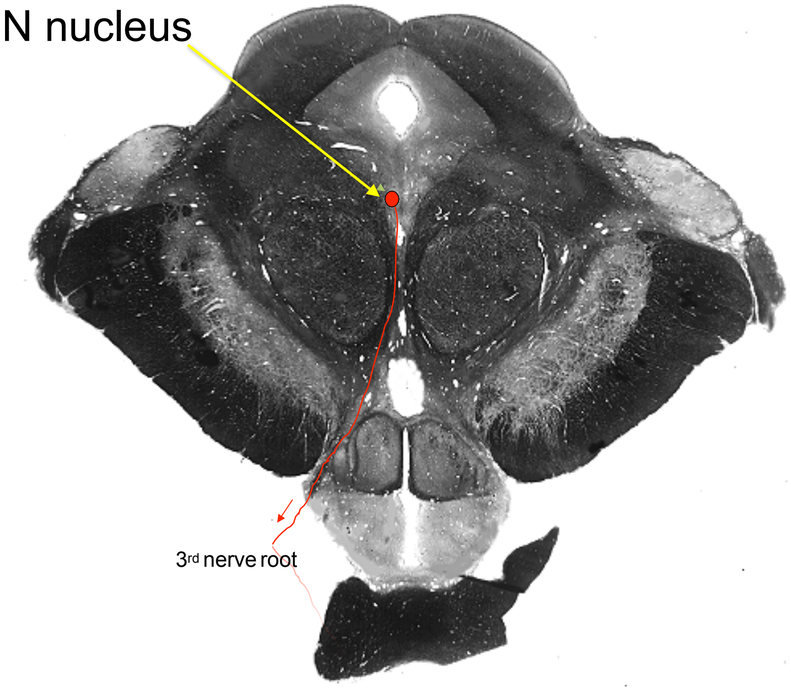
Ponto-mesencephalic junction



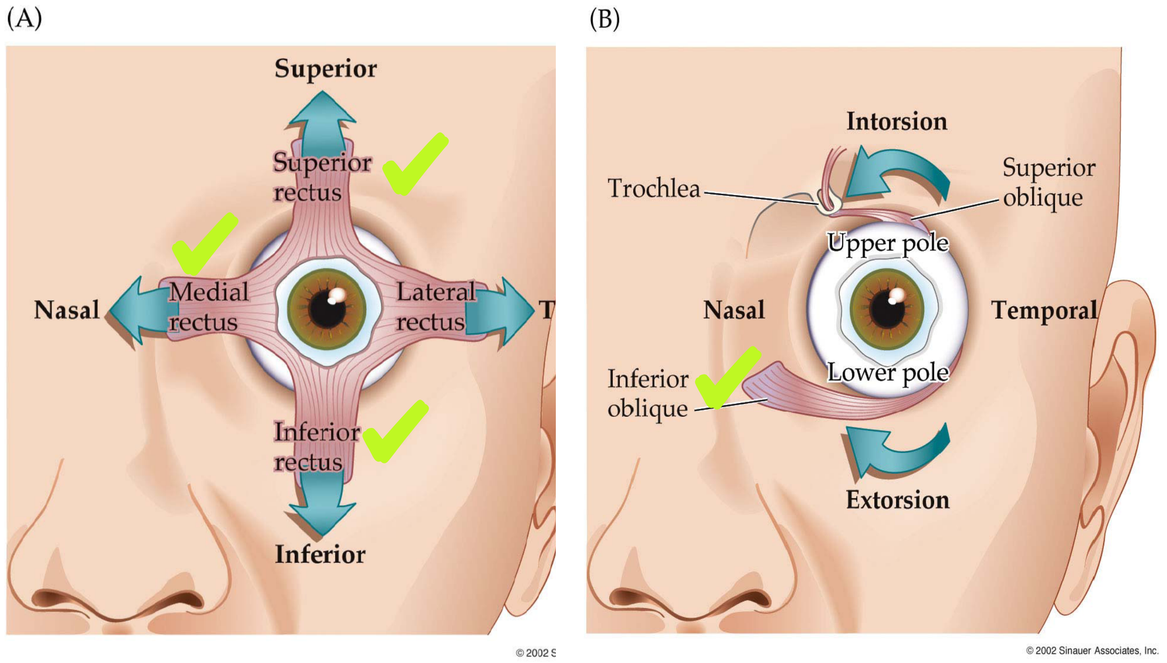
Control over eye movements: **Intorsion**
(the humble movement)

AT LEAST THE NUCLEUS IS LOCATED IN THE EXPECTED PLACE

CN III - Oculomotor: The Imperialistic



Ipsilateral (motor) efferents to:



Somatic Motor:
Adduction (inwards)
Elevation
Lowering
Extorsion

\+ Visceral motor = Pupillary constriction

Opening eyelid

CN 3 IS EVERYWHERE!

Mnemonics

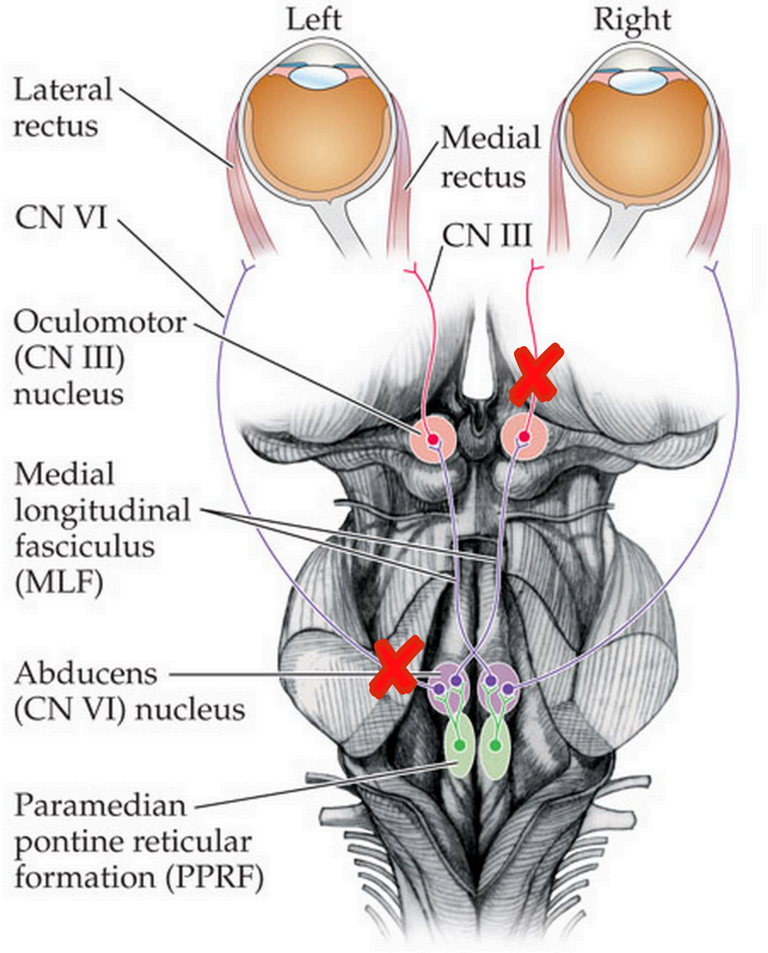
FourSOme ⋯⋯▶ **4th S**uperior**O**blique

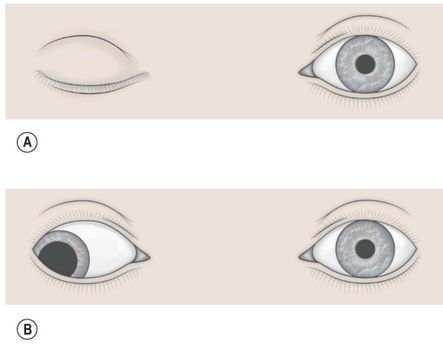
In

Sexy Ladies **R**oom ⋯⋯▶ in **6th L**ateral **R**ectus

At **3** am ⋯⋯▶ **All** others **3rd**

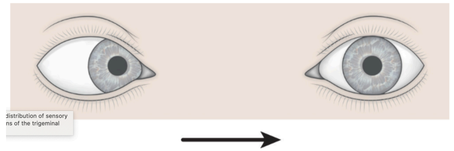
What can go Wrong?





R oculomotor palsy

Eye does not adduct
Diplopia
Ptosis
Pupil dilation



L abducens palsy

Eye does not abduct
Diplopia

CN associated with tongue, head and shoulders

Cranial

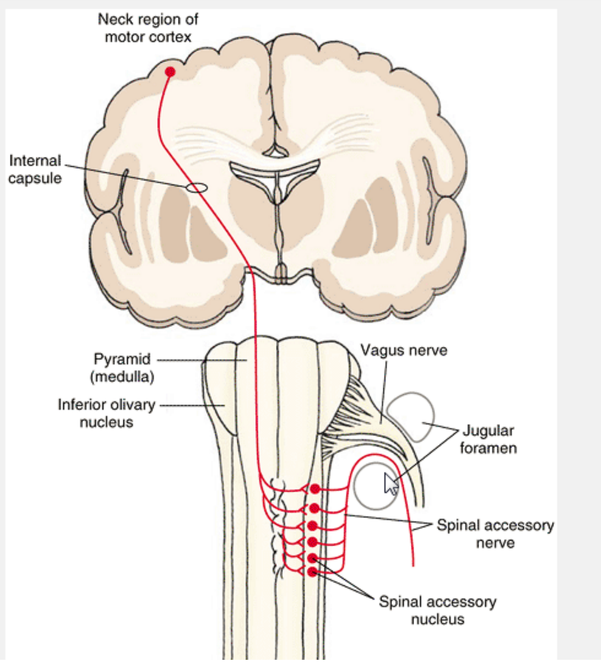
1. Olfactory
2. Optic
3. Oculomotor
4. Trochlear
5. Trigeminal
6. Abducens
7. Facial
8. Vestibulocochlear
9. Glossopharyngeal
10. Vagus
11. Accessory
12. Hypoglossal

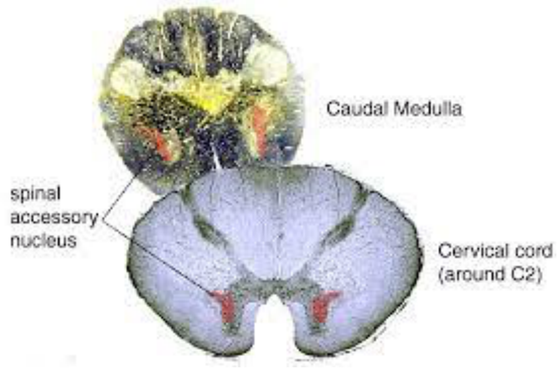
Caudal

LAST MOTOR CN

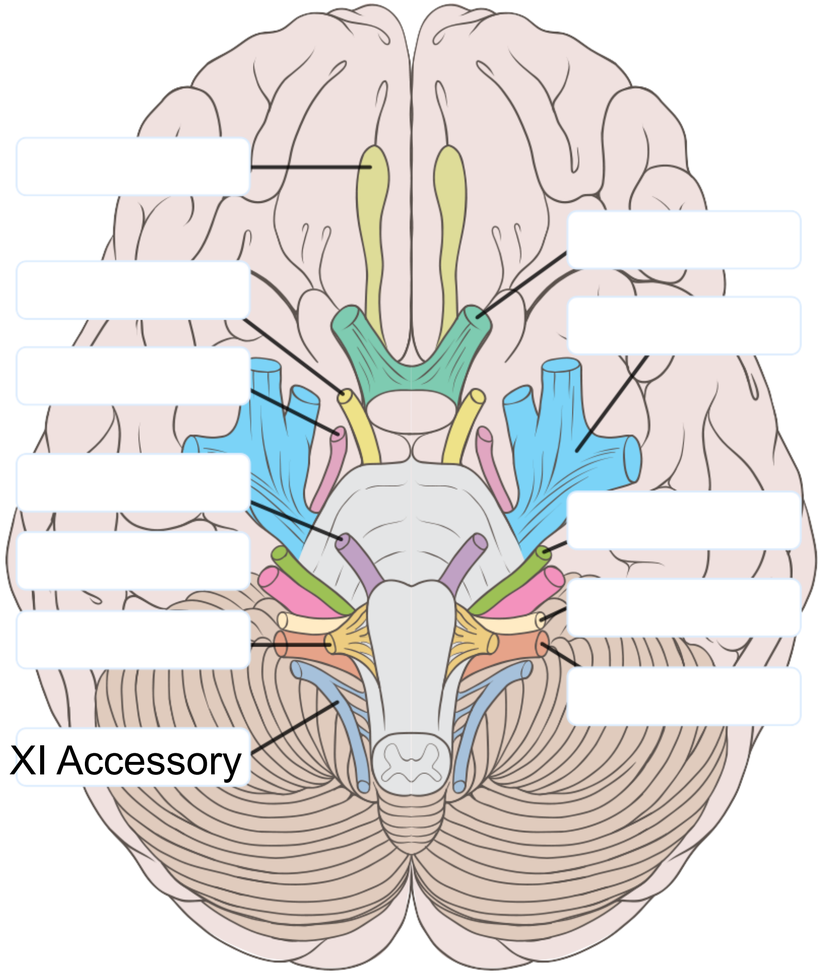
CN XI - Accessory: The Social Climber

Social climber pretending to be a CN… It is a spinal nerve that creeped through the *foramen magnum* to medulla
Innervates trapezius and sternocleidomastoid, which **turns head and lifts shoulders**.



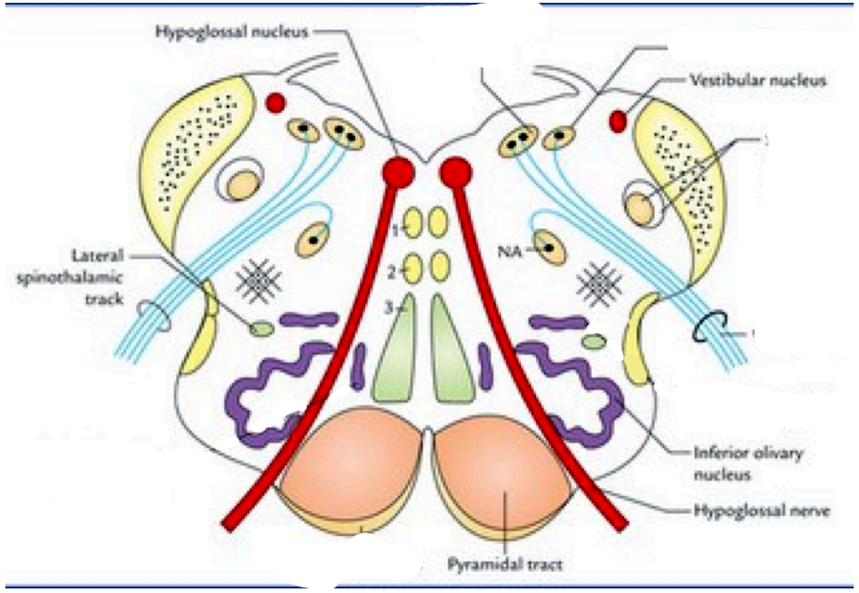


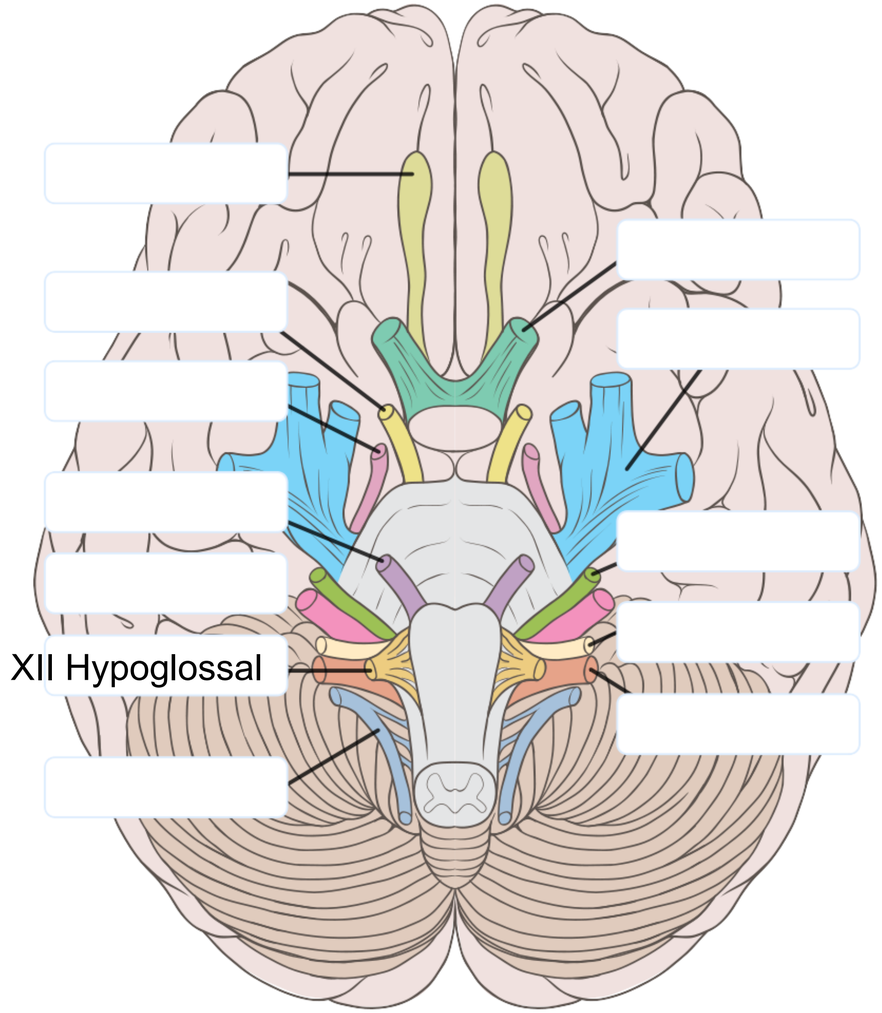
Extensive spread down into the cervical cord



LOCATED IN THE "VENTRAL HORN"

CN XII - Hypoglossal- the impolite





Nucleus in medulla

Innervates muscles of **tongue** for **swallowing and speech**

FOLLOWS THE RULES!

Thanks for your Attention