

# Cranial Nerves (Part 2)

ANAT 316: Clinical Human Visceral Anatomy

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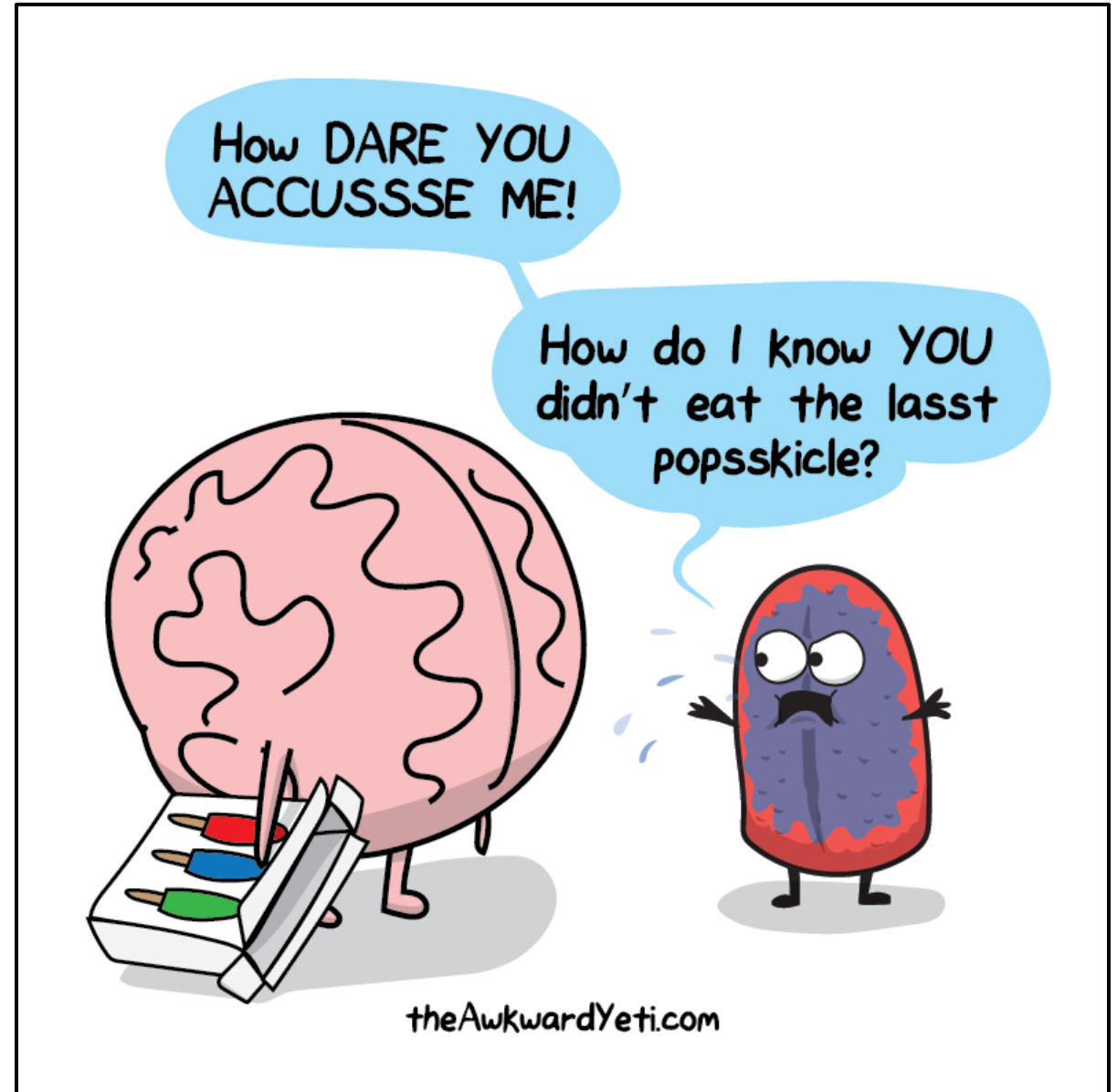
# Test Your Understanding



1. Select the cranial nerve(s) that does/do NOT pass through a foramen or fissure associated with the sphenoid bone.
  - a) Olfactory nerve
  - b) Oculomotor nerve
  - c) Optic nerve
  - d) Ophthalmic nerve
  
2. While skating at Parc La Fontaine, your friend complains of double vision. When you look at their eyes, you notice that the right eye is deviated to the left. Damage to which of these nerves would explain this resting eye position?
  - a) Trochlear nerve
  - b) Abducens nerve
  - c) Optic nerve
  - d) Oculomotor nerve

# Agenda

1. Review of cranial nerve functional classifications
2. Mixed cranial nerves (CN V, CN VII, CN IX, & CN X)
3. Motor nerves of the medulla (CN XI & CN XII)
4. Cranial nerve foramina (independent review)



# Learning Outcomes

*By the end of this lecture, you will be able to...*

1. Discuss the **types of information** that can be carried by cranial nerves → review of the modalities covered in Lecture 7
2. Identify and describe where CN V, VII, IX, X, IX, & XII are **located** with respect to other brain structures, their general **pathways** (where described), and their **major functions**
3. Describe the functions of cranial nerves that carry **parasympathetic innervation** (visceral motor) and their associated **autonomic ganglia**
4. Relate CN V, VII, IX, X, IX, & XII to their **corresponding foramina** in the base of the skull

# Cranial Nerves: Summary Table

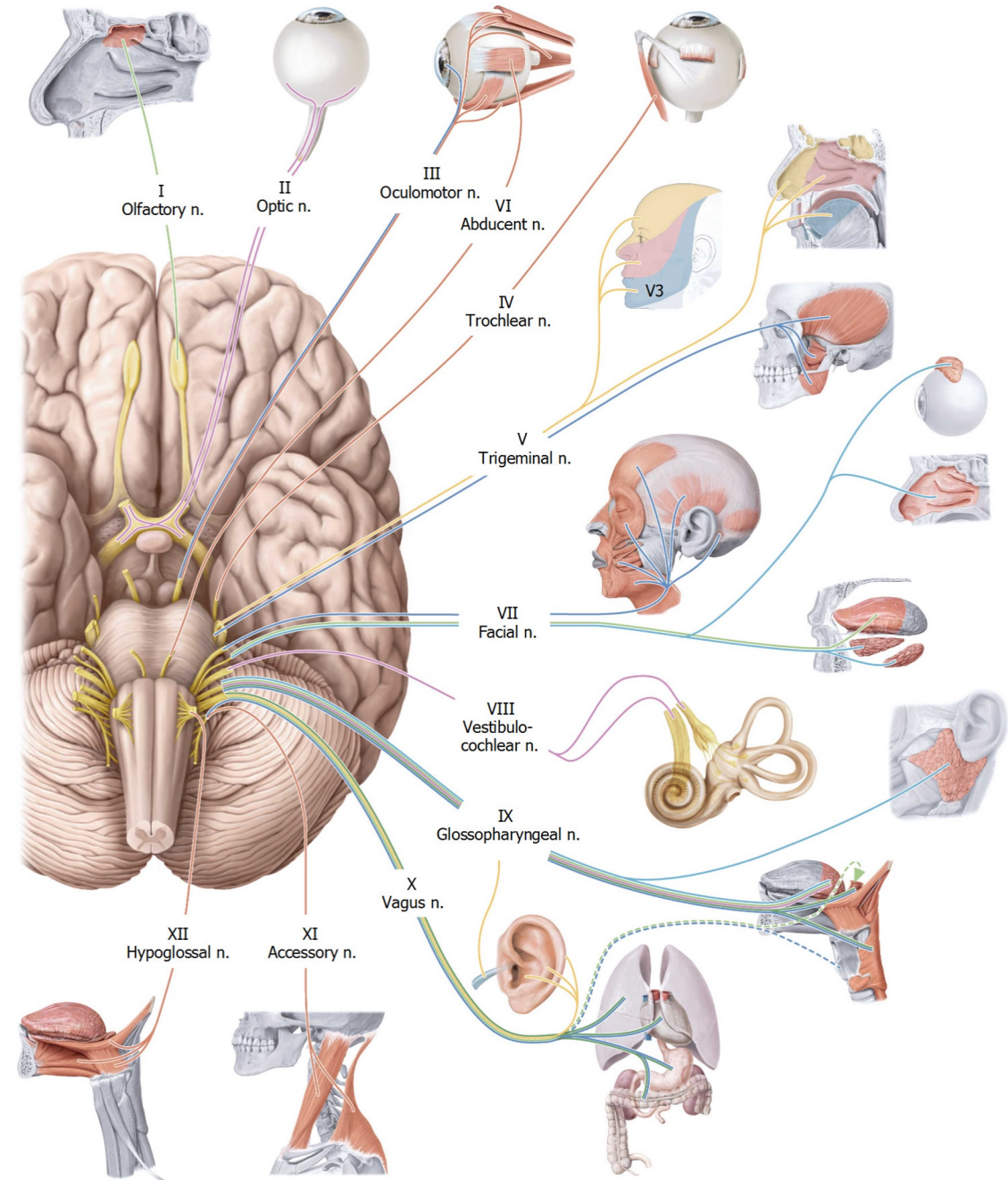
Today's Lecture

Cranial Nerve (#)	Mnemonic	Type	Mnemonic	Foramen
Olfactory (CN I)	Oh	Sensory	Some	Foramina of the cribriform plate
Optic (CN II)	Oh	Sensory	Say	Optic canal
Oculomotor (CN III)	Oh	Motor	Money	Superior orbital fissure
Trochlear (CN IV)	To	Motor	Matters	Superior orbital fissure
Trigeminal (CN V)	Touch	Both	But	V1: Superior orbital fissure V2: Foramen rotundum V3: Foramen ovale
Abducens (CN VI)	And	Motor	My	Superior orbital fissure
Facial (CN VII)	Feel	Both	Brother	Internal acoustic meatus
Vestibulocochlear (CN VIII)	Very	Sensory	Says	Internal acoustic meatus
Glossopharyngeal (CN IX)	Good	Both	Big	Jugular foramen
Vagus (CN X)	Velvet	Both	Brains	Jugular foramen
[Spinal] Accessory (CN XI)	Ah	Motor	Matter	Jugular foramen
Hypoglossal (CN XII)	Heaven	Motor	More	Hypoglossal canal

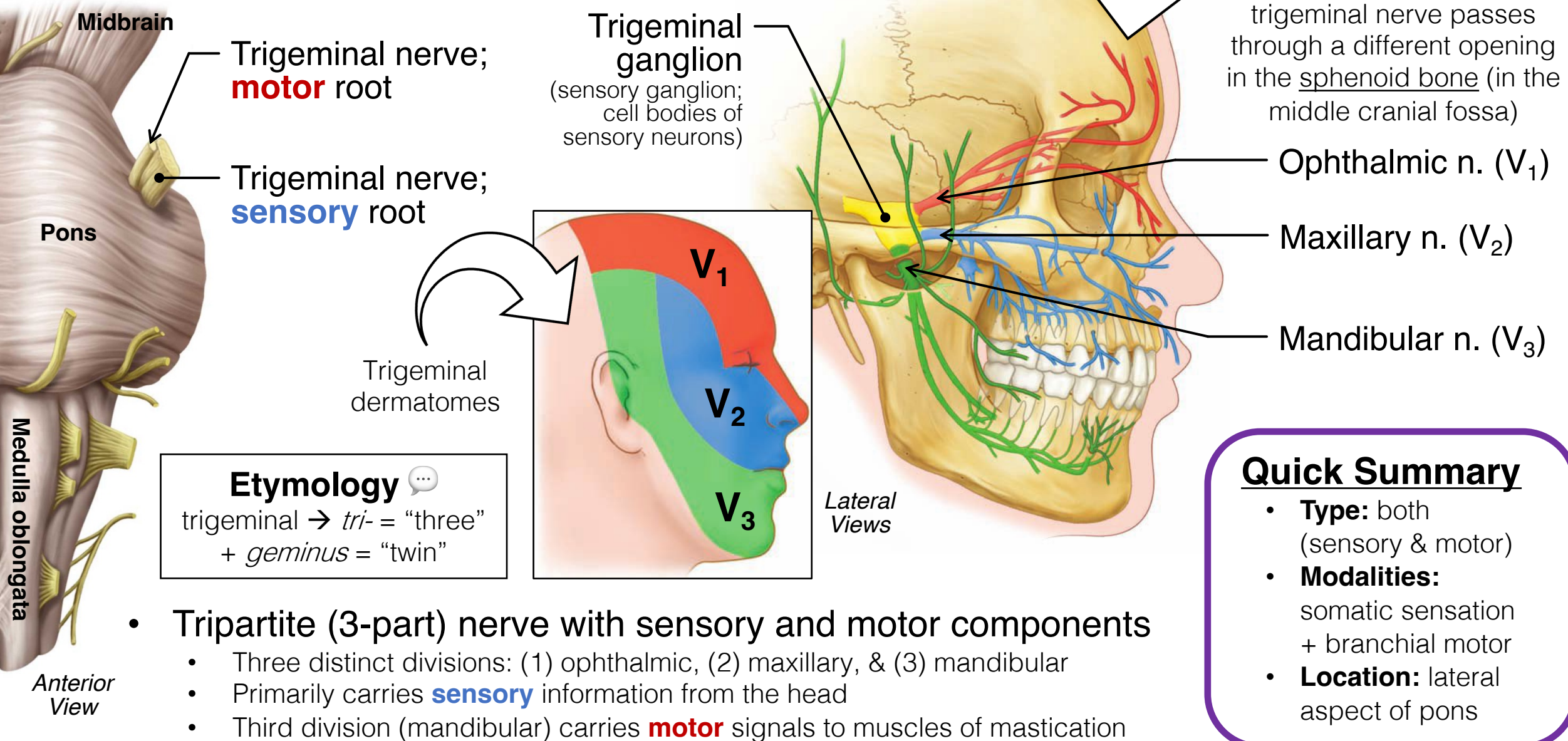
# Review: Cranial Nerves

- 12 paired nerves (i.e., bundles of axons in the peripheral nervous system) numbered approximately from rostral to caudal
  - Cranial nerves entering and/or exiting from the brainstem have one or more nuclei → *ANAT 323*
- Like spinal nerves, cranial nerves can both sensory and motor information, but they do not all carry the same specific modalities

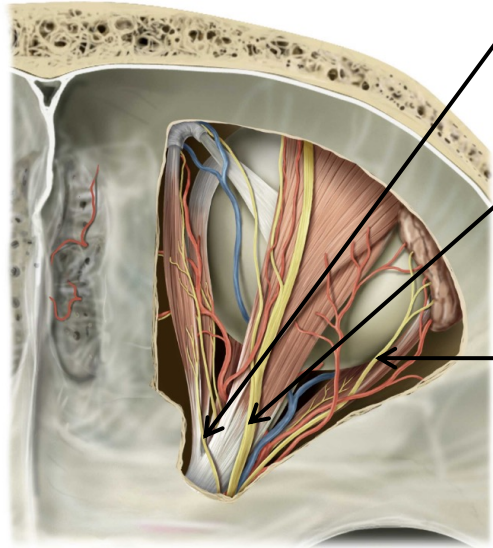
Modality	Examples
Somatic sensory	Touch (e.g., pain, temperature, vibration)
Special sensory	Vision, hearing, taste, smell, balance
Visceral sensory	Organs (typically pain)
Somatic motor	Skeletal muscle derived from somites
Branchial motor	Skeletal muscle derived from pharyngeal arches (some regions of head)
Visceral motor	Parasympathetic only (craniosacral outflow)



# CN V: Trigeminal Nerve



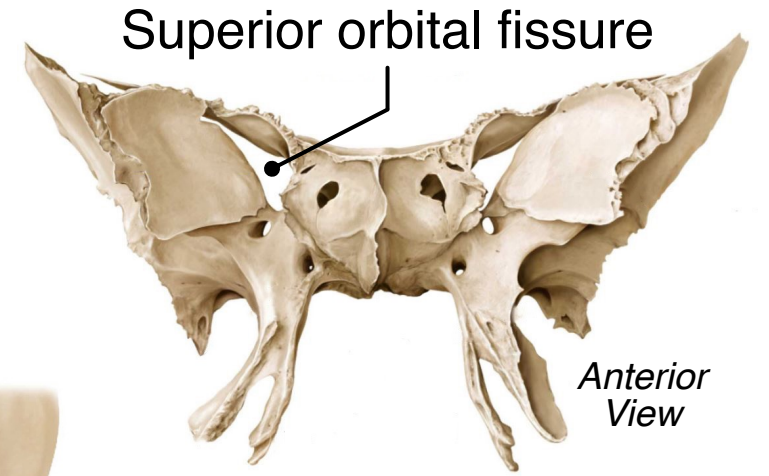
# CN V<sub>1</sub>: Ophthalmic Nerve



(1) **Nasociliary n.**  
(orbit, cornea, ant. nasal cavity, dorsum of nose)

(2) **Frontal n.**  
(anterior forehead, upper eyelid)

(3) **Lacrimal n.**  
(lacrimal gland, upper eyelid, lateral forehead)



Superior View

Tentorial branch

Ophthalmic nerve (CN V<sub>1</sub>)

(1) (2) (3)

Supraorbital & supratrochlear nerves  
(terminal branches of frontal nerve)

Lateral View

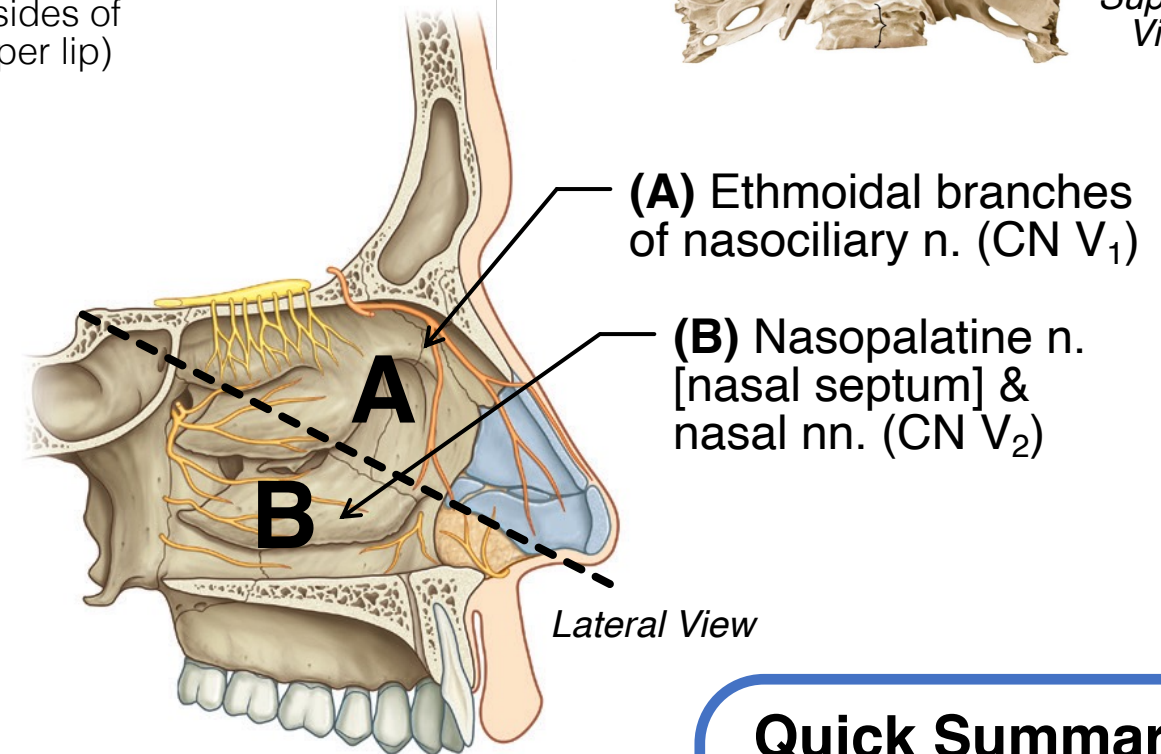
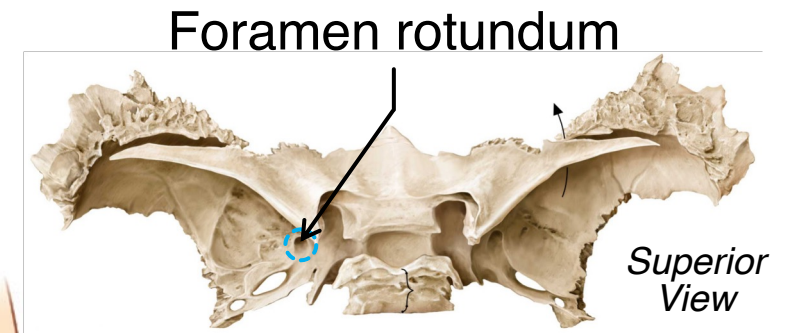
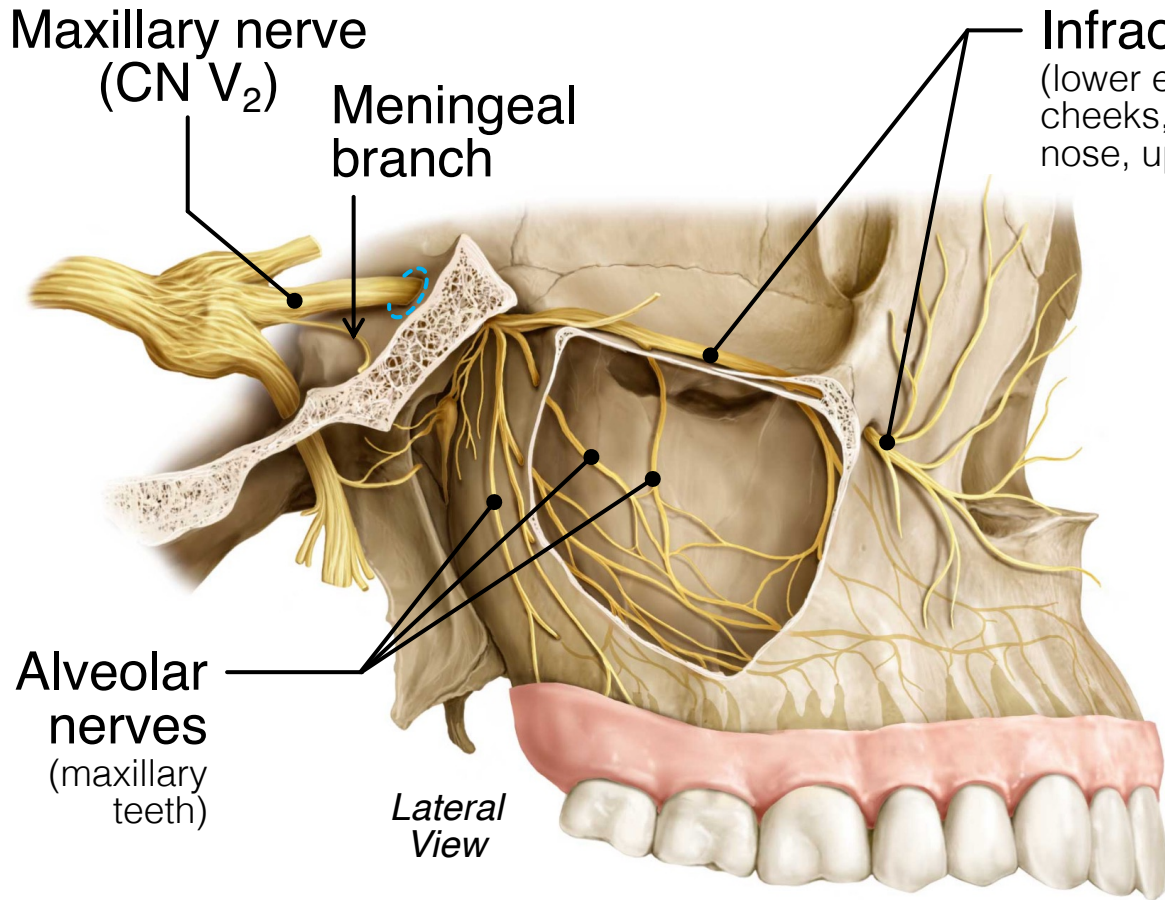
- Carries sensory innervation from the orbit, cornea, anterior nasal cavity, lacrimal gland, forehead, upper eyelids, & dorsum of nose
  - 3 branches at apex of orbit: nasociliary, frontal, and lacrimal [medial to lateral]
  - Tentorial branch remains inside cranial cavity → sensory innervation of dura mater

**Quick Summary**

- **Type:** sensory
- **Modalities:** somatic sensation
- **Base of skull:** superior orbital fissure



# CN V<sub>2</sub>: Maxillary Nerve

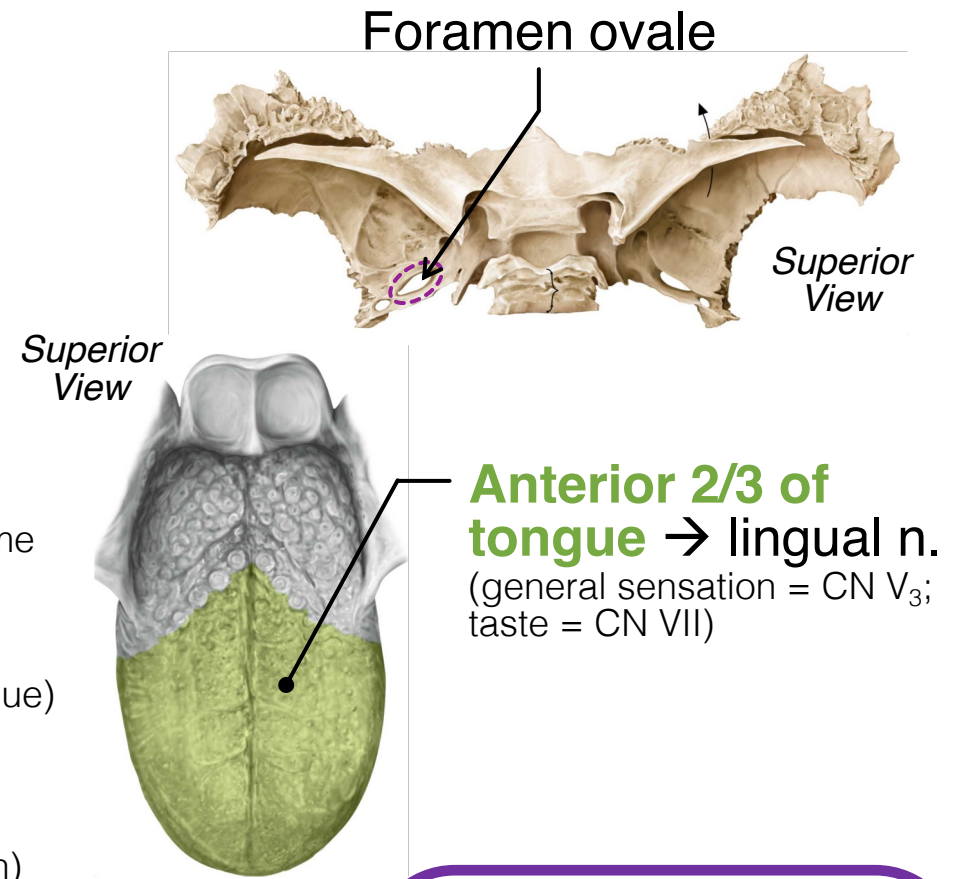
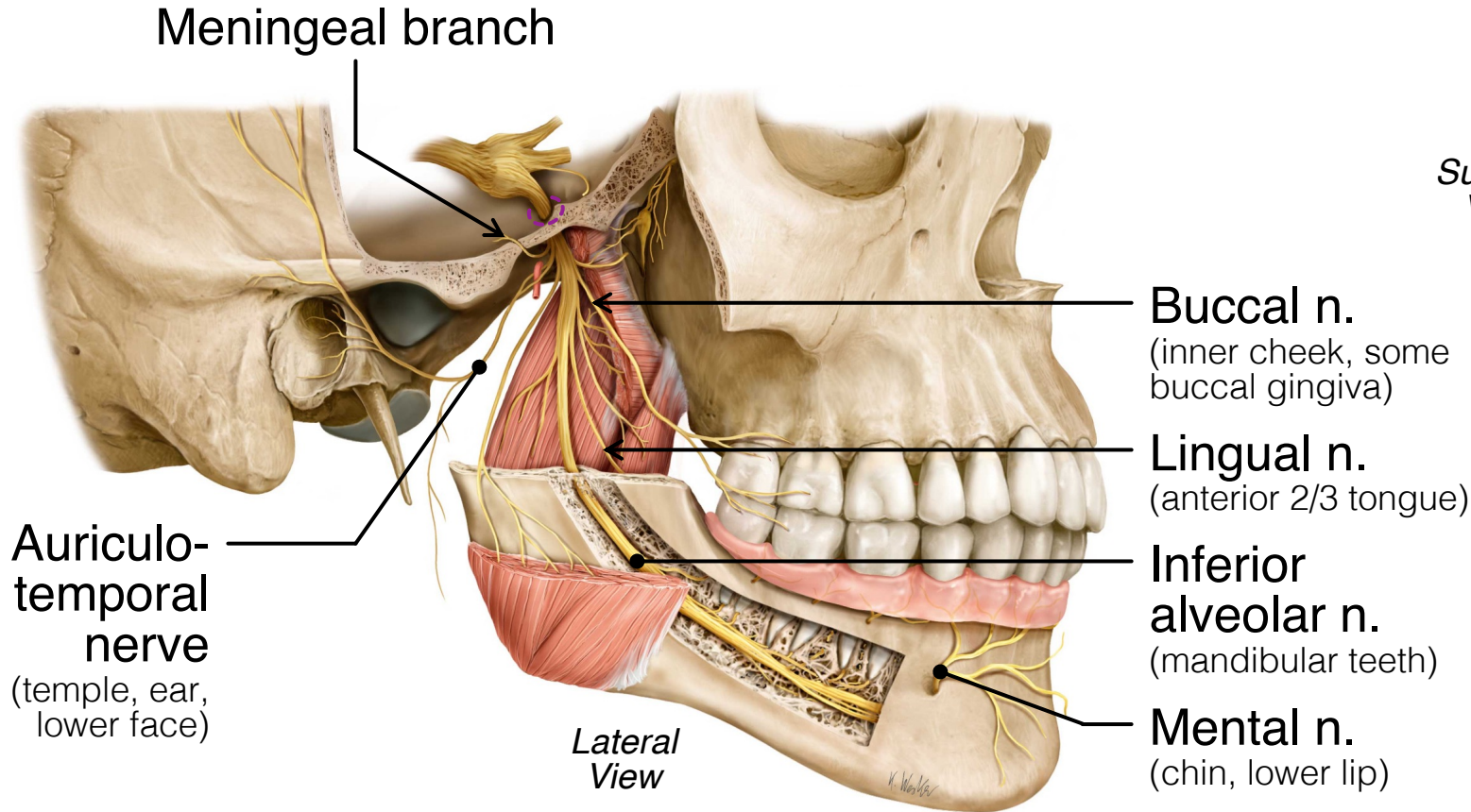


## Quick Summary

- Carries sensory innervation from the lower eyelids, cheeks, sides of the nose, upper lip, posterior nasal cavity, palate, & upper teeth
  - Numerous branches, including infraorbital n., palatine nn., alveolar nn., & nasal nn.
  - Meningeal branch remains inside cranial cavity → sensory innervation of dura mater

- **Type:** sensory
- **Modalities:** somatic sensation
- **Base of skull:** foramen rotundum

# CN V<sub>3</sub>: Mandibular Nerve



- Carries **sensation** from the temples, lower face & chin, lower lip, inner cheek, anterior 2/3 of tongue, and lower teeth AND **motor** information to muscles of mastication (+ 4 other small muscles)
  - Numerous branches, including lingual, inferior alveolar, auriculotemporal, & buccal

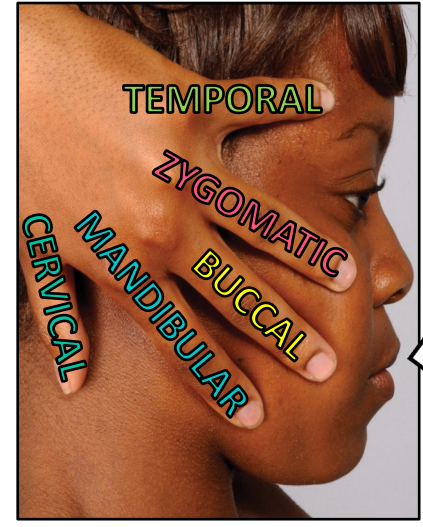
**Quick Summary**

- **Type:** both (sensory & motor)
- **Modalities:** somatic sensation + branchial motor
- **Base of skull:** foramen ovale

# CN VII: Facial Nerve



Facial nerve



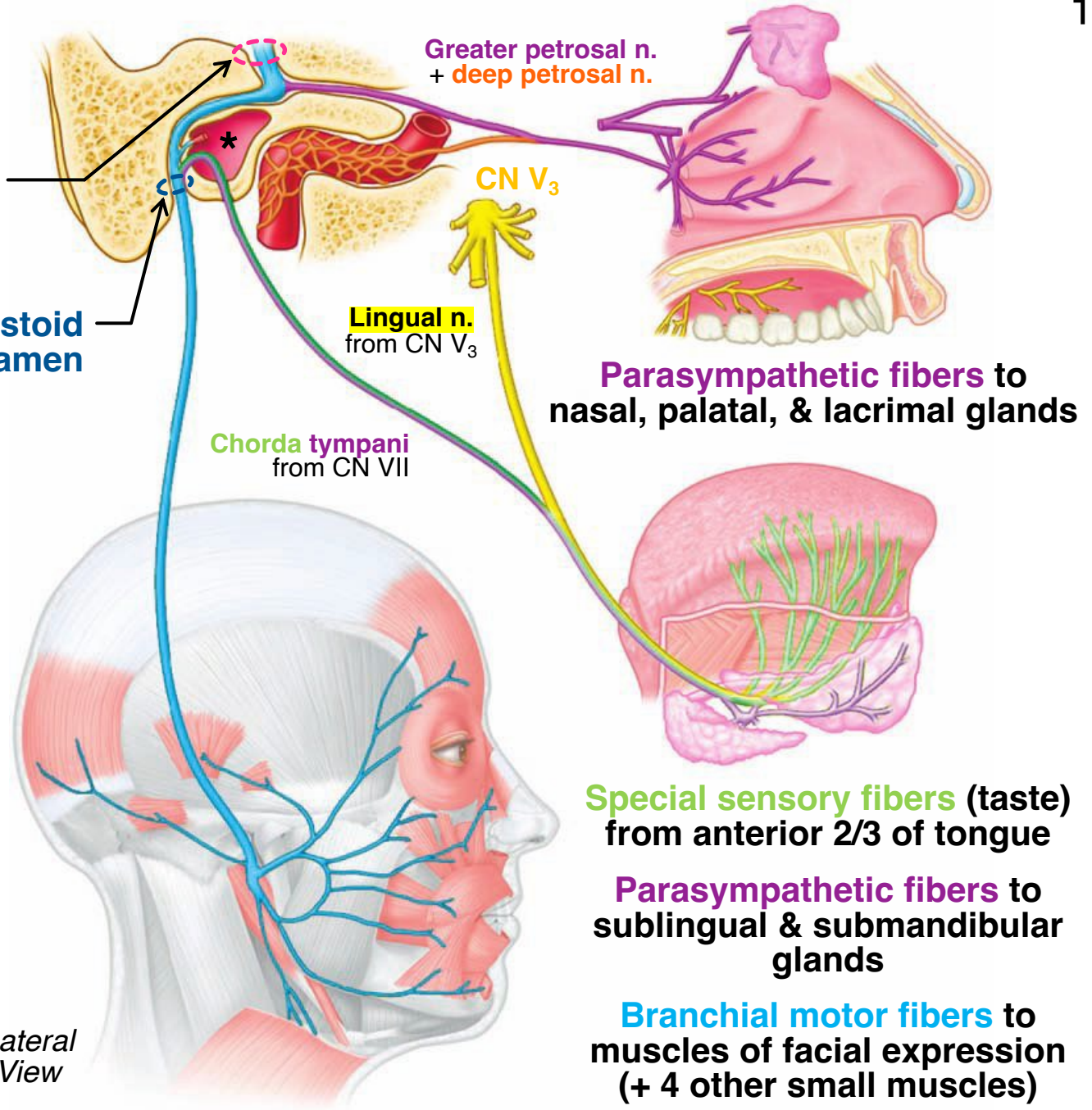
\*To Zanzibar By Motor Car

- Multimodal nerve with various pathways through temporal bone (petrous)
  - Branchial motor\*
  - Visceral motor → 3 major glands (submandibular, sublingual, & lacrimal)
  - Special sensation → taste

Internal acoustic meatus

Stylomastoid foramen

Lateral View

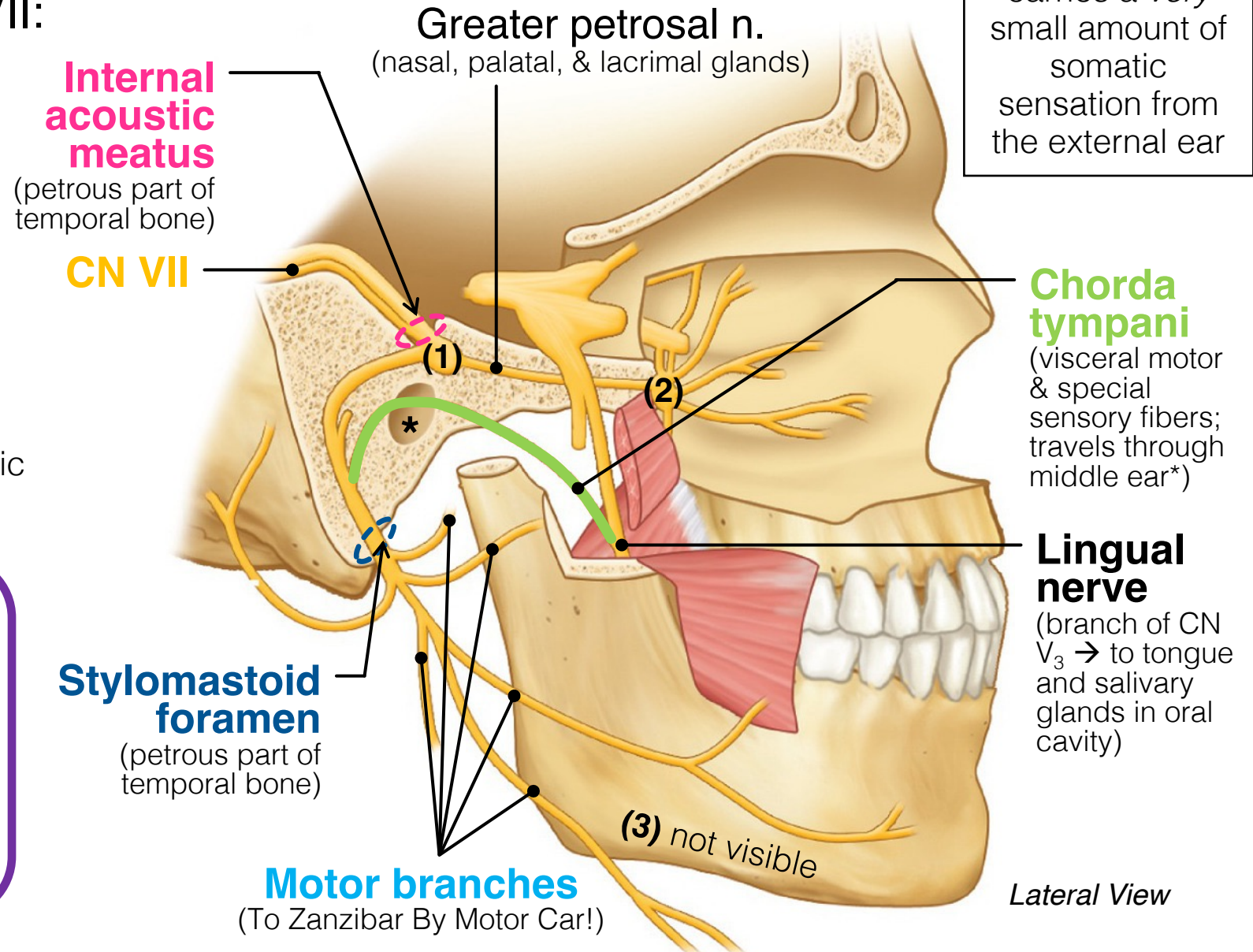


# CN VII: Facial Nerve (continued)

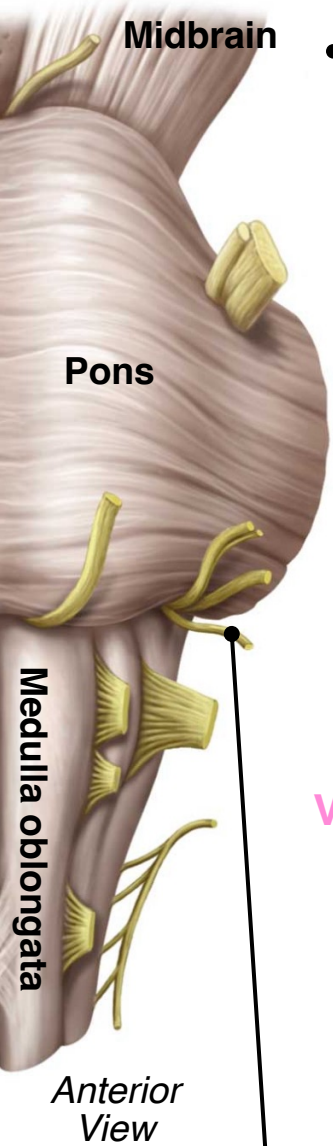
- Ganglia associated with CN VII:
  - Sensory ganglion = **(1)** geniculate ganglion [cell bodies of sensory neurons]
  - Autonomic ganglia = **(2)** pterygopalatine ganglion [preganglionic neurons in greater petrosal nerve synapse with postganglionic neurons] + **(3)** submandibular ganglion [preganglionic neurons in chorda tympani synapse with postganglionic neurons]

## Quick Summary

- **Type:** both (sensory & motor)
- **Modalities:** branchial motor, visceral motor, + special sensory [taste]
- **Base of skull:** internal acoustic meatus (+ stylomastoid foramen)
- **Location:** between pons & medulla



# CN IX: Glossopharyngeal Nerve

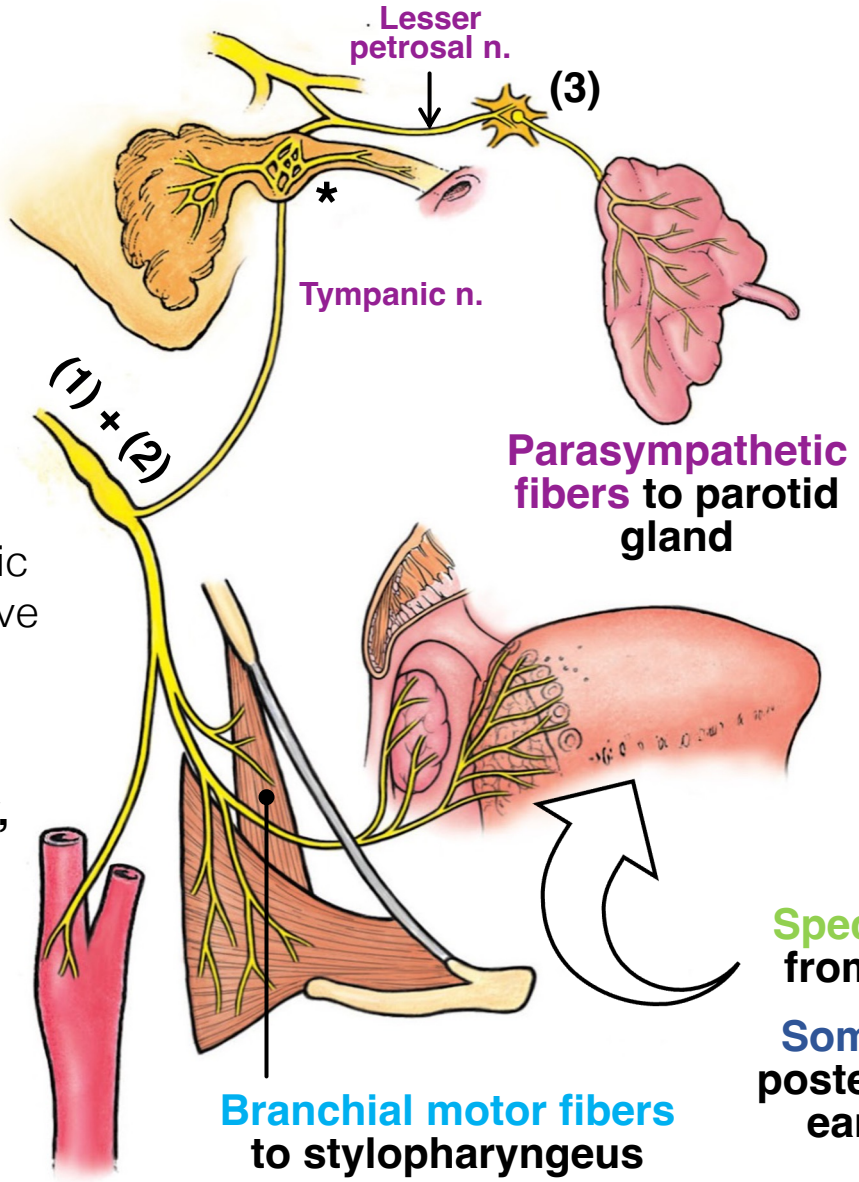


- Multimodal nerve with a small branch passing through middle ear\*
- Sensory ganglia = (1) superior & (2) inferior glossopharyngeal ganglia [cell bodies of sensory neurons]
- Autonomic ganglion = (3) otic ganglion [preganglionic neurons in lesser petrosal nerve synapse with postganglionic neurons]

**Visceral sensation** from carotid body, carotid sinus, & parts of pharynx

Stretch receptors + chemoreceptors → blood pressure & chemistry

Glossopharyngeal nerve



## Quick Summary

- **Type:** both (sensory & motor)
- **Modalities:**  
A: branchial motor, B: visceral motor, C: visceral sensory, D: somatic sensory, E: special sensory [taste]
- **Base of skull:** jugular foramen
- **Location:** lateral aspect of upper medulla

**Special sensory fibers (taste)** from posterior 1/3 of tongue

**Somatic sensory fibers** from posterior 1/3 of tongue, middle ear, tonsils, & oropharynx

# CN X: Vagus Nerve

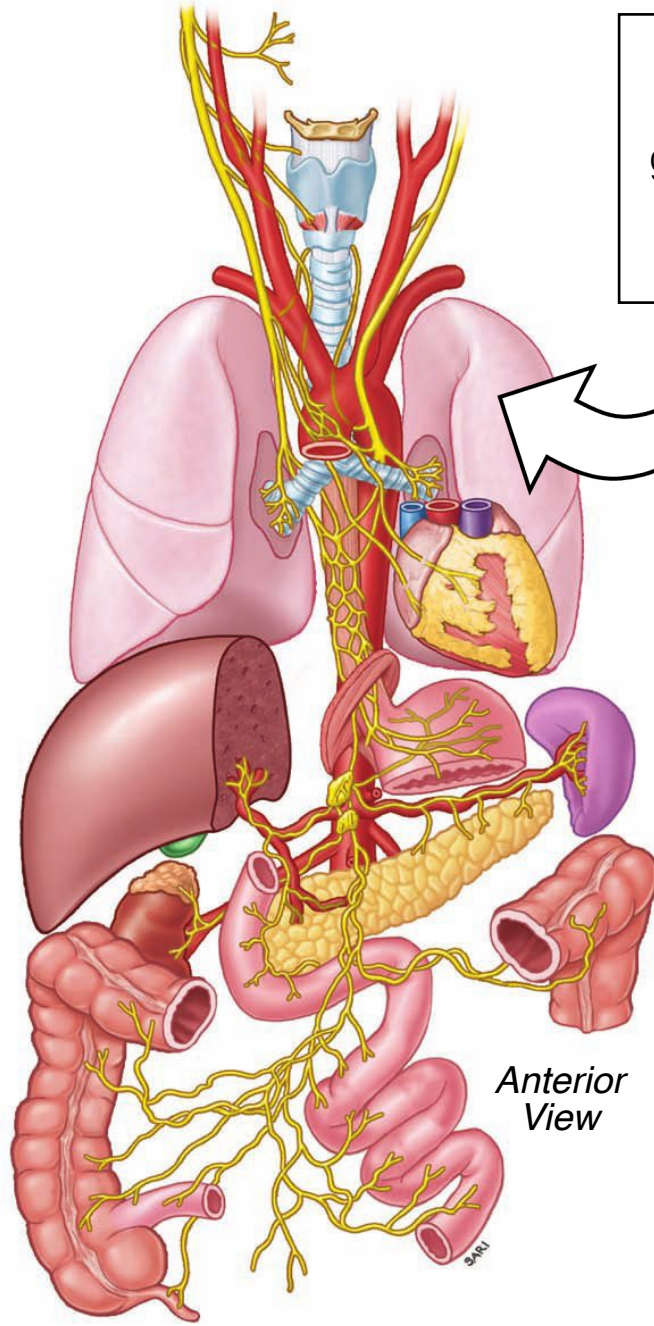


- Multimodal nerve → extends beyond the head & neck
  - A. **Branchial motor** = pharynx (except stylopharyngeus [CN IX], larynx, most of palate, upper esophagus
    - Primarily via the recurrent laryngeal nerves
  - B. **Parasympathetic** = respiratory tract, cardiac muscle, digestive tract
  - C. **Visceral sensation** = thoracic and abdominal organs
  - D. **Somatic sensation** = laryngopharynx, larynx, dura mater in posterior cranial fossa, ear / external acoustic meatus
  - E. **Special sensation [taste]** = root of tongue and epiglottis

Vagus nerve

**Etymology** ...

vagus → *vagus* = “wandering / straying”



**NOTE:** Sensory ganglia = superior & inferior vagal ganglia; autonomic ganglia → too many to name! (not visible in this image)

**Quick Summary**

- **Type:** both (sensory & motor)
- **Modalities:**
  - A: branchial motor,
  - B: visceral motor,
  - C: visceral sensory,
  - D: somatic sensory,
  - E: special sensory [taste]
- **Base of skull:** jugular foramen
- **Location:** lateral aspect of medulla (behind olives)

# Cranial Nerve Parasympathetics

- Recall: parasympathetic = “craniosacral outflow”

## Oculomotor n. (CN III)

Pupillary constriction (sphincter pupillae)  
Alteration of lens shape (ciliary muscles)

## Facial n. (CN VII)

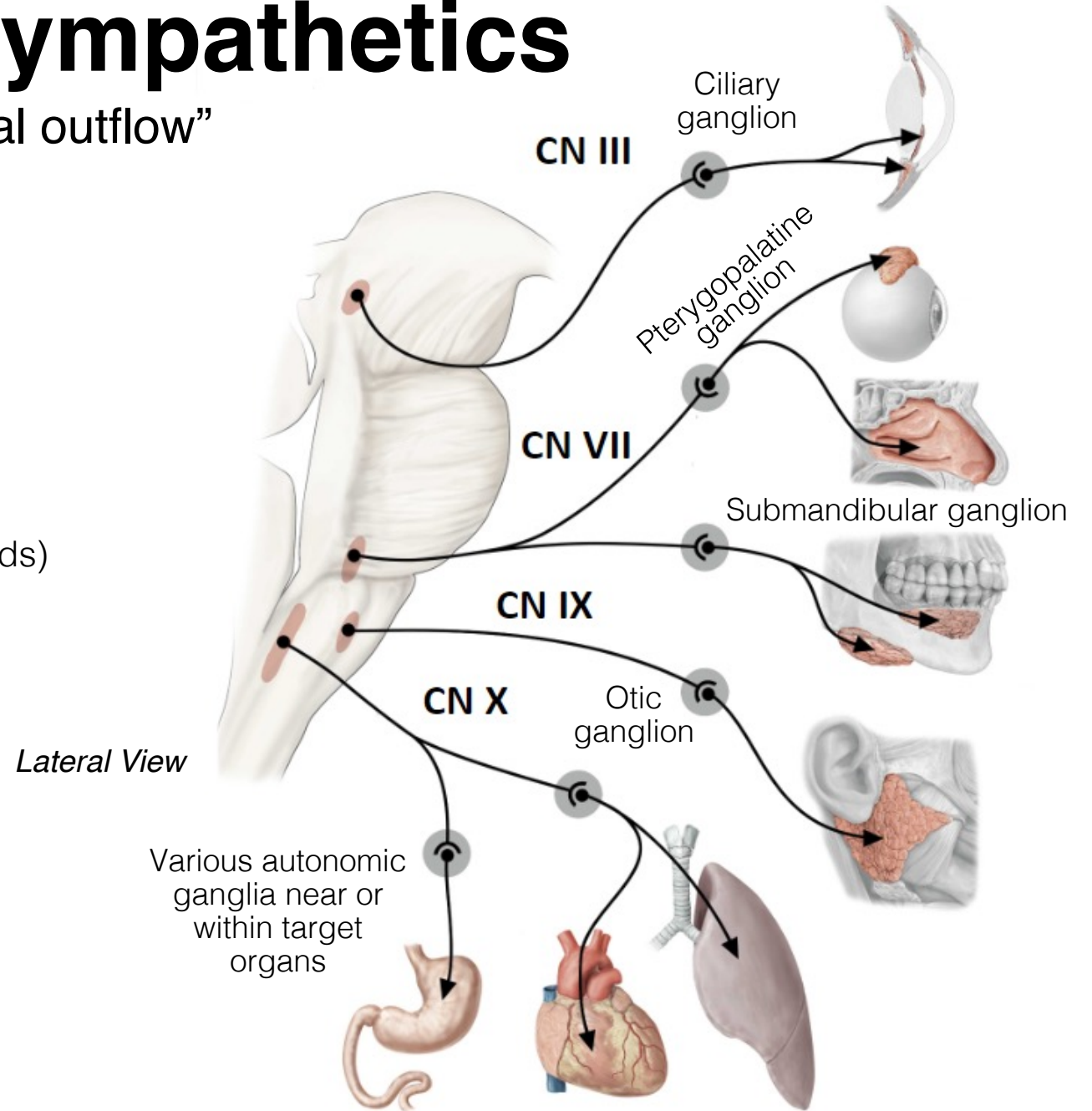
Release of tears (lacrimal gland)  
Release of saliva (sublingual and submandibular glands)  
Release of mucus (nasal cavity and palate)

## Glossopharyngeal n. (CN IX)

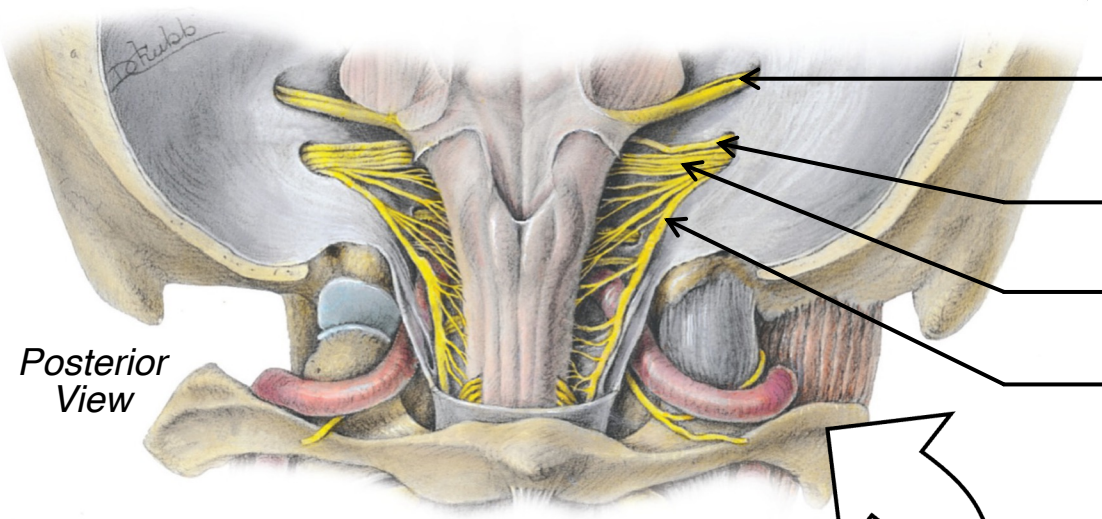
Release of saliva (parotid gland)

## Vagus n. (CN X)

Respiratory tract (trachea, bronchi)  
Heart (cardiac muscle)  
Digestive tract (foregut, midgut)



# CN XI: [Spinal] Accessory Nerve



CN VII + VIII

CN IX

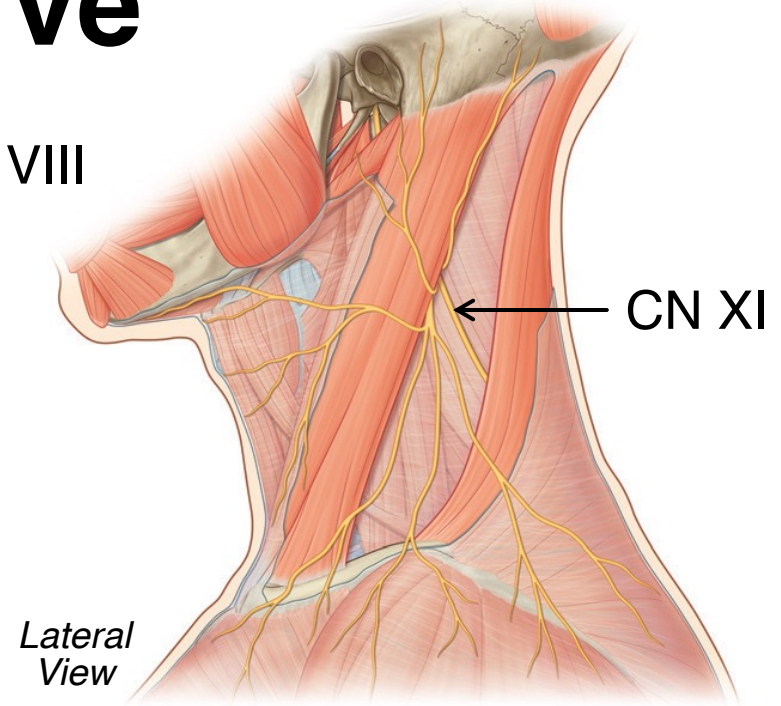
CN X

CN XI

Formed from nerve roots exiting lateral aspect of the spine → originating from C1 – C5/C6 spinal levels

[Spinal] accessory nerve

- Transmits motor information to just TWO muscles:
  - Sternocleidomastoid muscle (anterior neck)
  - Trapezius muscle (superficial back / upper limb)

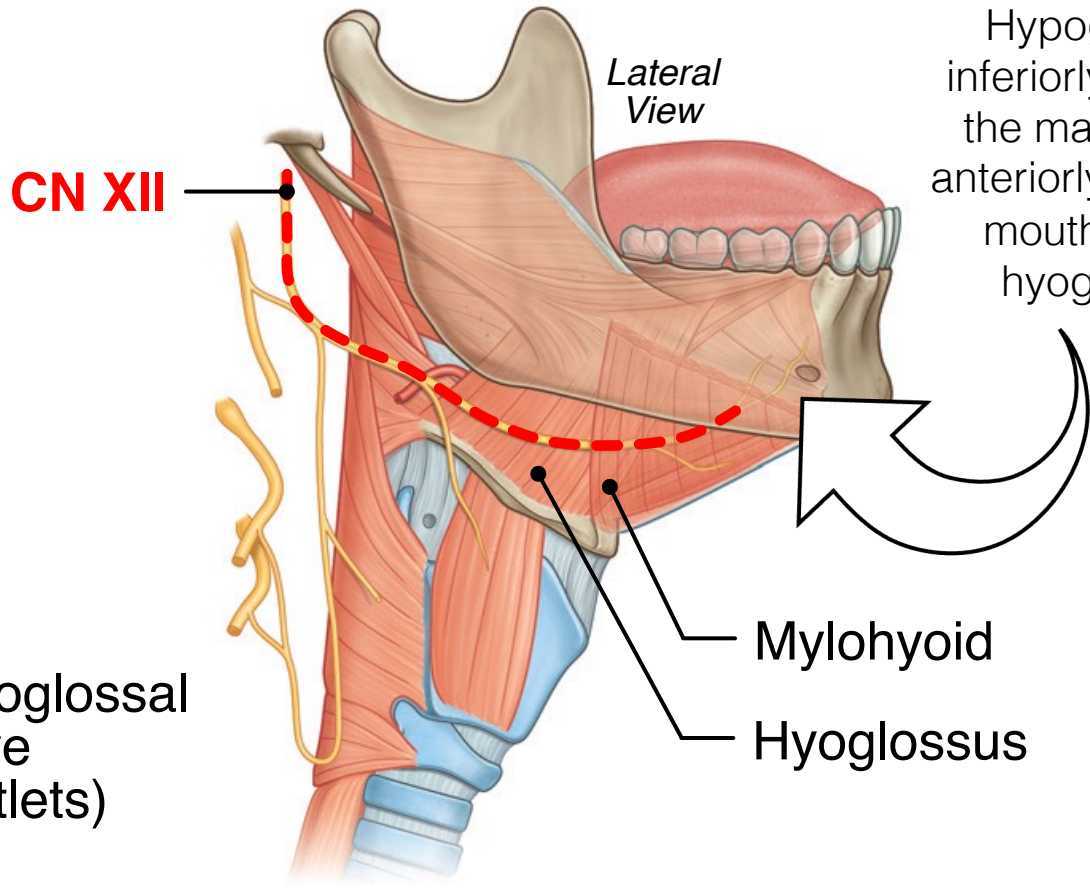
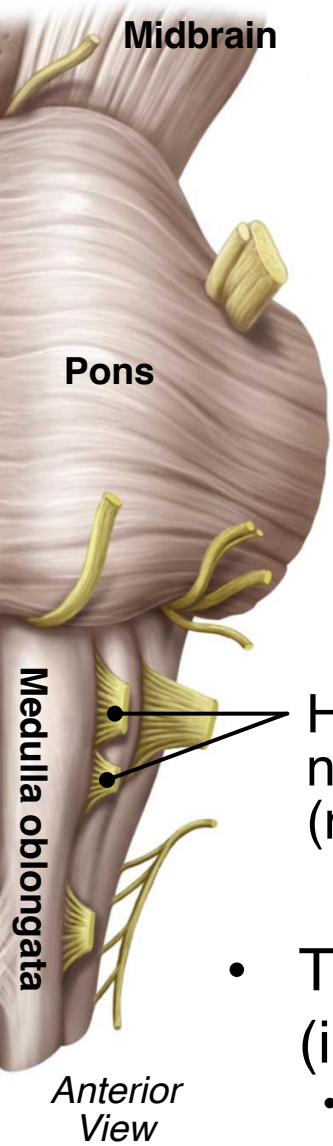


## Quick Summary

- **Type:** motor
- **Modalities:** somatic motor or branchial motor (*not definitive*)
- **Base of skull:** jugular foramen (enters via foramen magnum)
- **Location:** lateral aspect of cervical spine



# CN XII: Hypoglossal Nerve



Hypoglossal nerve travels inferiorly to below the angle of the mandible before looping anteriorly toward the floor of the mouth → passes between hyoglossus + mylohyoid

Hypoglossal canal  
(lateral aspect of foramen magnum)



- Transmits motor information to ALL tongue muscles (intrinsic + extrinsic) except palatoglossus (CN X)
  - Extrinsic muscles MOVE the tongue
  - Intrinsic muscles change the SHAPE of the tongue

**Quick Summary**

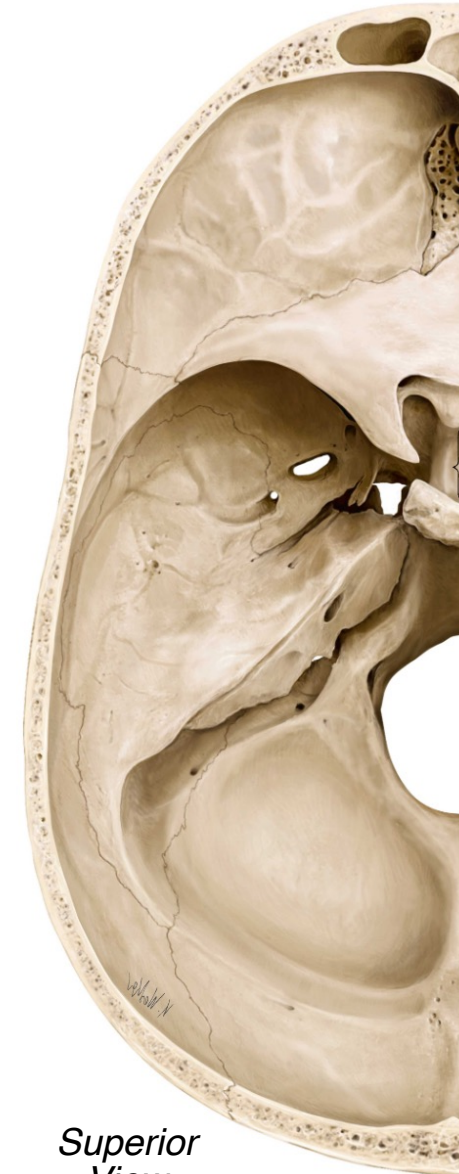
- **Type:** motor
- **Modalities:** somatic motor
- **Base of skull:** hypoglossal canal
- **Location:** anterior aspect of medulla (in front of olives)

# Cranial Nerve Foramina

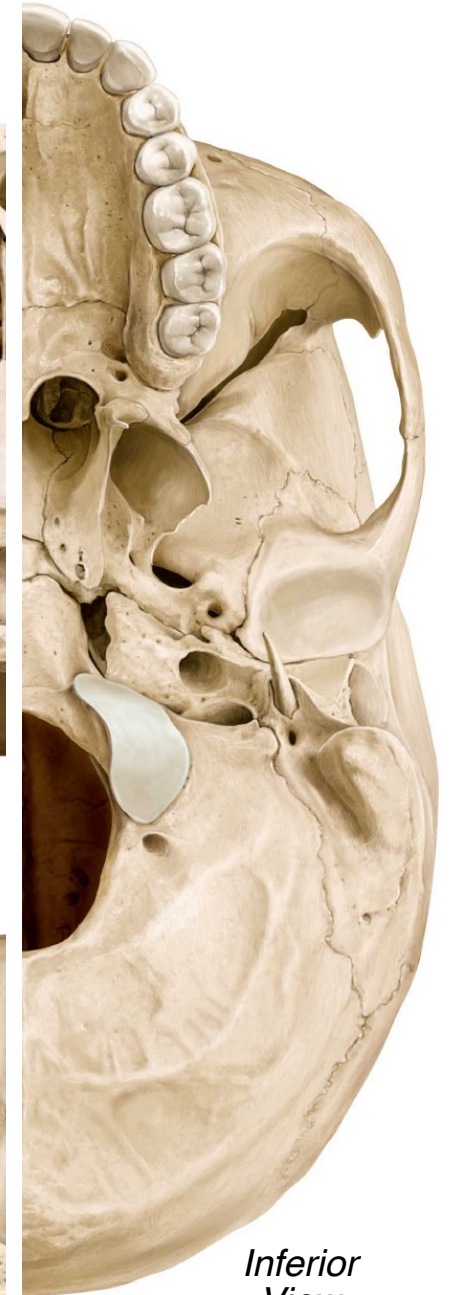
## Independent Review Activity:

Fill in the corresponding opening(s) in the base of the skull for each cranial nerve or major division. Then locate each opening on the superior and/or inferior views of the base of the skull to the right →

- CN I: Olfactory nerve \_\_\_\_\_
- CN II: Optic nerve \_\_\_\_\_
- CN III: Oculomotor nerve \_\_\_\_\_
- CN IV: Trochlear nerve \_\_\_\_\_
- CN V<sub>1</sub>: Ophthalmic nerve \_\_\_\_\_
- CN V<sub>2</sub>: Maxillary nerve \_\_\_\_\_
- CN V<sub>3</sub>: Mandibular nerve \_\_\_\_\_
- CN VI: Abducens nerve \_\_\_\_\_
- CN VII: Facial nerve \_\_\_\_\_
- CN VIII: Vestibulocochlear nerve \_\_\_\_\_
- CN IX: Glossopharyngeal nerve \_\_\_\_\_
- CN X: Vagus nerve \_\_\_\_\_
- CN XI: (Spinal) Accessory nerve \_\_\_\_\_
- CN XII: Hypoglossal nerve \_\_\_\_\_



Superior  
View

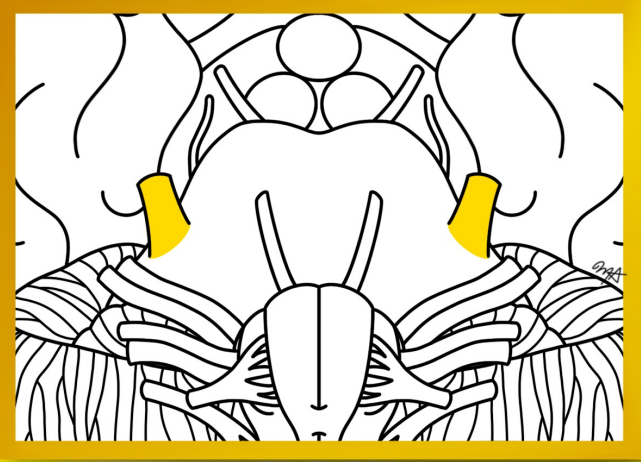


Inferior  
View

# Cranial Nerve Cards – CN V, VII, IX

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Cranial Nerve  
**Trigeminal** HP **300** 🇺🇸



Mixed Nerve. Exits from Skull: Superior Orbital Fissure, Foramen Rotundum, & Foramen Ovale

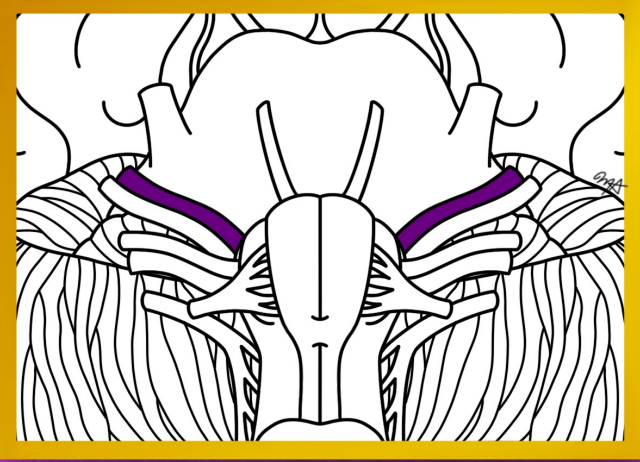
**Triple Threat** 60  
Ophthalmic and maxillary and mandibular, oh my!  
A triad destined for cephalic sensory domination

**Bite** 40  
Engages a tetrad of masticatory muscles to unleash colossal jaw clenching capabilities!

Strength: 🗨️, 🤯 Weakness: !?, 🗿

“Prominent protrusions from the pons relaying a complex network of afferent and efferent fibers throughout the head” a.k.a. the trifecta; **CN V.**

Cranial Nerve  
**Facial** HP **150** 🇺🇸



Mixed Nerve. Exit from Skull: Internal Acoustic Meatus

**Scary Face** 50  
Seemingly endless combinations of terrifying faces to pull at your discretion...To Zanzibar By Motor Car!

**Puppet Master** 40  
Show those preganglionic parasympathics some respect!  
(+30 if trigeminal is in play for postganglionic pathways)

Strength: 😬, 🗨️ Weakness: 🌿 x3, 🗡️

“Motor and sensory roots with a lengthy intraosseous path punctuated by a geniculum in the temporal bone” a.k.a. empress of expression; **CN VII.**

Cranial Nerve  
**Glossopharyngeal** HP **90** 🇺🇸



Mixed Nerve. Exit from Skull: Jugular Foramen

**Protect\*** 45  
Don't choke! Keep the oropharynx clear with the gag reflex  
\*Must be played with vagus for the efferent reflex limb

**Salivate** 30  
Secretomotor action like never experienced before!  
(+15 if facial is also in play for other salivary glands)

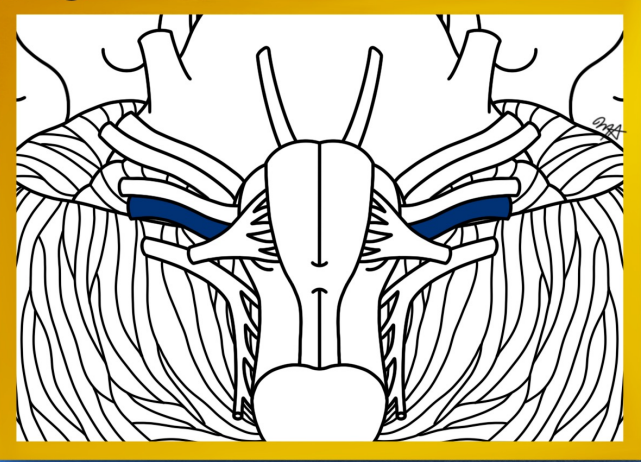
Strength: 🍷, 🗨️ x2 Weakness: 🗡️, 🤯

“Diverse mix of efferent and afferent fibers innervating regions of the tongue, pharynx, ear, neck, & parotid gland” a.k.a. jack of all trades; **CN IX.**

# Cranial Nerve Cards – CN X, XI, XII

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Cranial Nerve  
**Vagus** HP 210 🖐️



Mixed Nerve. Exit from Skull: Jugular Foramen

**U-Turn** 60  
Whether you call it “suboptimal morphology” or just “taking the scenic route,” pulling a U-turn in the superior mediastinum is an indisputable power move!

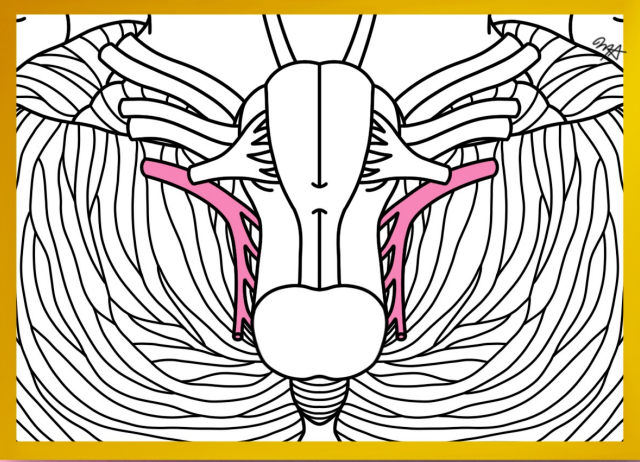
**Rest and Digest** 45  
Harness the potential of parasympathetic pathways and discover inner peace. Woosah...

Strength: 🧘 x4, 💬 Weakness: 🔥 x2, 🌀

“Overall longest cranial nerve with disperse distribution, from cranial dura to the left colic flexure & many things in between” a.k.a. the wanderer; **CN X**.

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Cranial Nerve  
**Accessory** HP 75 ⚙️



Motor Nerve. Exit from Skull: Jugular Foramen

**Breakneck Blitz** 20  
Really more of a controlled rotation and flexion of the cervical spine, but just as effective!

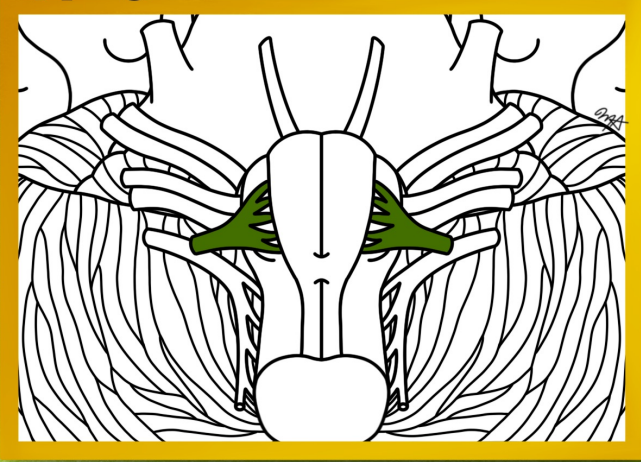
**It's a Trap!** 35  
Retraction, depression, rotation, elevation... hypnotize them with your sensational scapular skills

Strength: 🧘, 🔄 Weakness: ✂️ x3, 🚗

“Congregation of cervical spinal rootlets that enters the skull via the foramen magnum and briefly joins CN X upon its exit” a.k.a. the outsider; **CN XI**.

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Cranial Nerve  
**Hypoglossal** HP 160 ⚙️



Motor Nerve. Exit from Skull: Hypoglossal Canal

**Bolus Builder\*** 40  
It's only a tough pill to swallow for the competition  
\* Must be played with facial for buccinator involvement

**Lick** 40  
Limber up that mass of muscles and mucous membrane!

Strength: 🍦 x3, 😊 Weakness: 💀, 🗡️

“Collection of rootlets between the pyramid & olive coursing under the angle of the mandible and anteriorly to the tongue” a.k.a. tongue twister; **CN XII**.

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