



# ANATOMY

**SHEET NO. 10**

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In this lecture, we're going to discuss the trigeminal, facial and glossopharyngeal nerves, their courses, nuclei and injuries.

## Trigeminal Nerve (CN5)

Mixed cranial nerve + the biggest cranial nerve + It has 4 nuclei: **3 sensory** and **1 motor**.

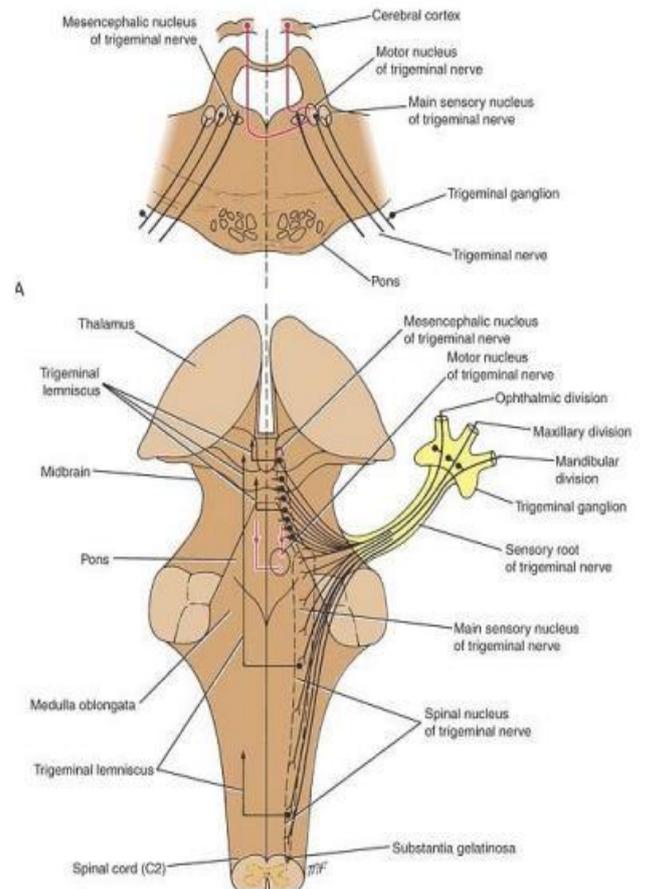
Receives sensations from all the face **except the angle of the mandible** which is supplied by great auricular nerve, + receives sensations from the oral cavity, nasal cavity, paranasal sinuses.

**Motor nucleus:** Posterior part of the pons (Medial).

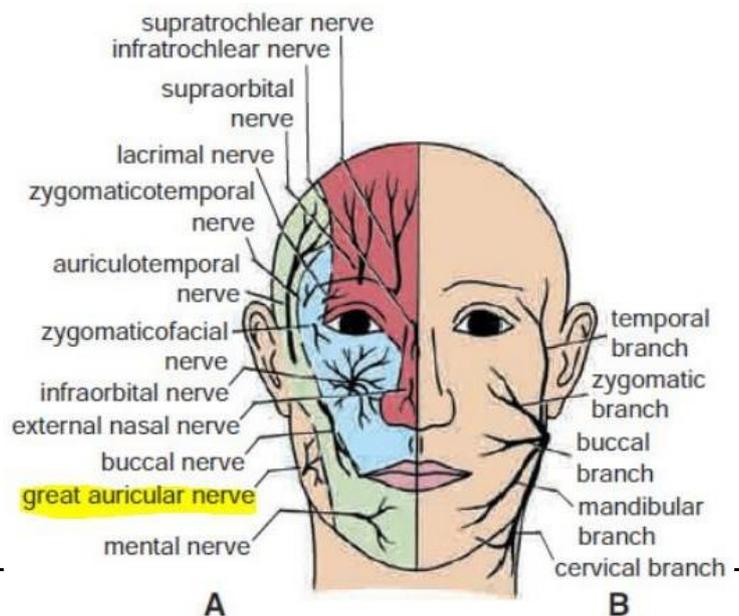
**Main sensory nucleus:** Posterior part of the pons (lateral).

**Spinal nucleus:**

- Superiorly: main sensory nucleus. (ends @ midpontine area)
- Inferiorly: C2 segment.



It supplies a wide area of the face, which will be of importance in while since some other nerves will \*intrude\* and join its course



### Mesencephalic nucleus:

- Lateral part of the gray matter around the cerebral aqueduct.
- Inferiorly main sensory nucleus.

### The modality of each nucleus:

**Main sensory nucleus:** Discriminative and light touch of the face as well as conscious proprioception. (similar to PCML)

**Spinal nucleus:** Crude touch, pain, and temperature (similar to ALS)

**Mesencephalic nucleus:** Reflex proprioception of the periodontal ligament and of the muscles of mastication in the jaw.

### Sensory Components:

Trigeminal sensory ganglion: (Cell bodies)

Ascending branches: main sensory nucleus

Descending branches: spinal nucleus

### Division of the trigeminal nerve:

Ophthalmic branch: occupies inferior part of Spinal Nucleus.

Maxillary branch: occupies middle part of SN

Mandibular branch: occupies superior part of SN

### The motor component of trigeminal nerve:

Motornucleus.

Located medial to the main sensory nucleus.

The motor nucleus receives fibers from the **corticospinal tract, red nucleus, reticular formation**, and the **tectum**.

For the **mandibular division ONLY**. It supplies: ( IMPORTANT)

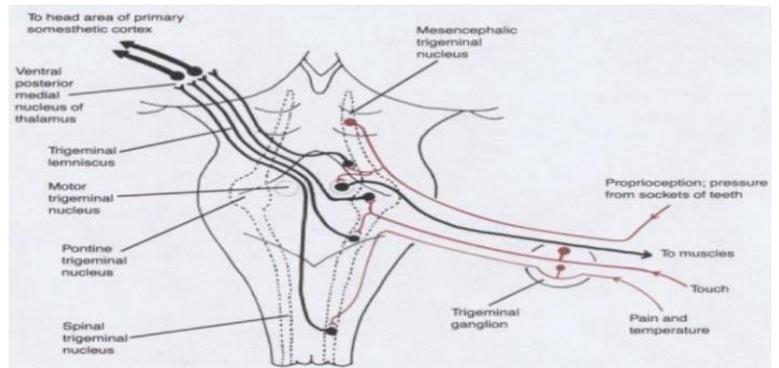
- 1- Muscles of mastication (masseter, temporalis, medial pterygoid, and lateral pterygoid)
- 2- Tensor tympani
- 3- Tensor veli palatini
- 4- Mylohyoid
- 5- Anterior belly of the digastric muscle.

## The course of trigeminal nerve:

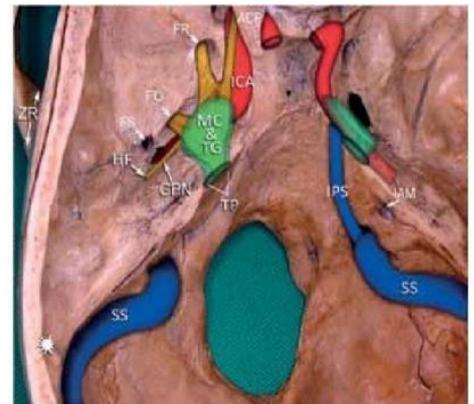
The trigeminal nerve originates from three sensory nuclei and one motor at the level of the pons anteriorly.

The sensory nuclei merge to form a sensory root. The motor nucleus continues to form a motor root (motor runs inferior to sensory).

In the middle cranial fossa they expand into the **trigeminal ganglion**.



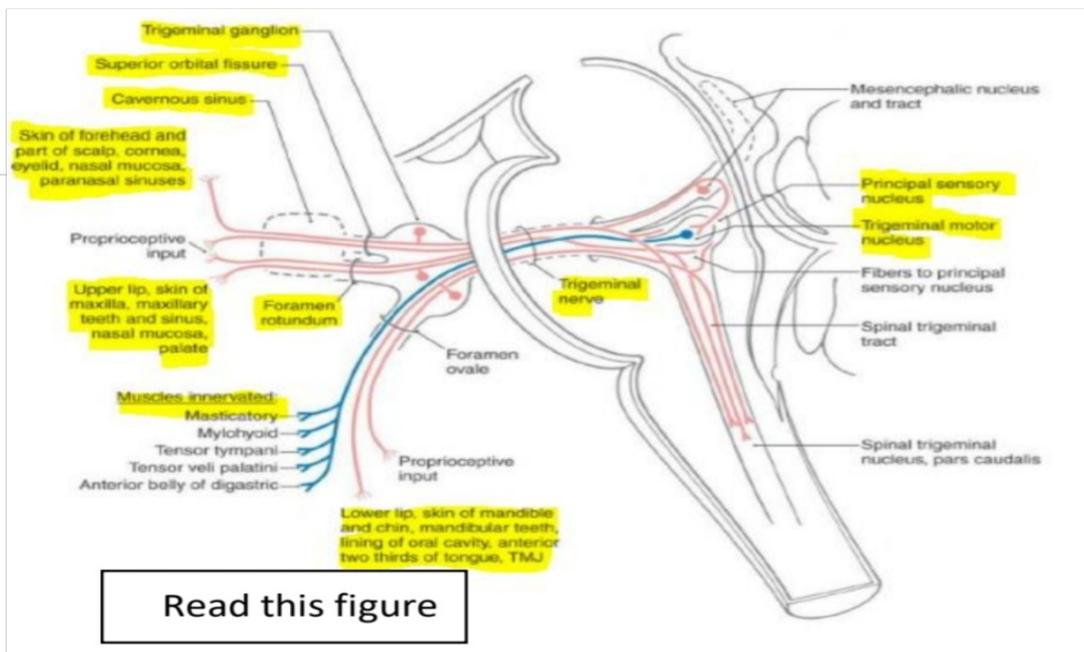
Trigeminal ganglion is located **lateral** to the cavernous sinus, in the upper surface of the apex of the petrous bone in a depression called **Meckel's cave** (which is a pouch in the dura mater)



## The divisions of this nerve will go out through:

- Ophthalmic: through superior orbital fissure.
- Maxillary: through foramen rotundum to pterygopalatine fossa.
- Mandibular: through foramen ovale to infratemporal fossa.

Sensory innervation to the face is completely from the trigeminal nerve and its divisions, except a small area at the angle of the mandible (supplied by great auricular nerve)



## Facial nerve (cranial nerve VII):

The facial nerve is a mixed nerve (motor, sensory, and parasympathetic)

1. **Main motor nucleus** is found in the deep reticular formation of the lower part of the pons (*remember cranial nerves 6,7,8 emerge from the pontomedullary junction*), then the motor fibers go posteriorly and curve around the abducens nucleus, and this curve forms a bulge in the fourth ventricle called **the facial colliculus**, then the fibers go anteriorly to leave the brainstem.

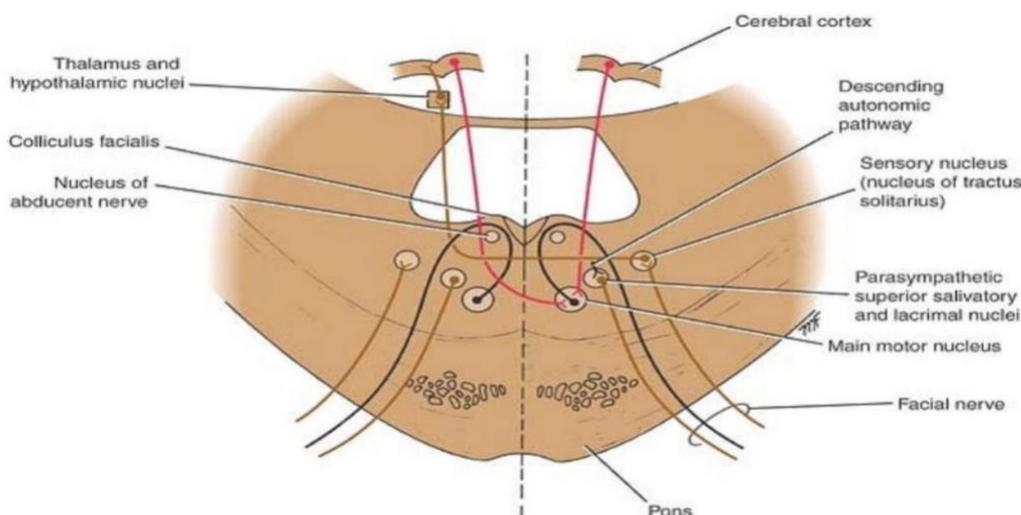
- The upper part of the face receives upper motor neurons from both hemispheres.
- The lower part only receives upper motor neurons from the contralateral hemisphere.

2. The parasympathetic nuclei (**superior salivatory lacrimal nucleus**) lie posterolateral to the motor nucleus.

Both the salivatory (*for the sublingual and submandibular glands*) and the lacrimal (*emotional tears*) parts receive fibers from the hypothalamus (*the hypothalamus is responsible of the ANS*), the lacrimal part also receives fibers from the trigeminal sensory nuclei (*reflex tears for foreign bodies*).

3. **Sensory nucleus:**

- Taste of the anterior two thirds of the tongue: The cell bodies of the first order neurons are in **the geniculate ganglia** (*from chorda tympani*), and they synapse with the second order neurons in the **nucleus of tractus solitarius**, from there it ascends to the **VPM nucleus of the thalamus** then radiates to the **primary gustatory cortex** (area 43) in the parietal lobe.
- General sensation from the skin of the external acoustic meatus is carried with the facial nerve (**geniculate ganglion**) into the spinal **trigeminal nucleus**.

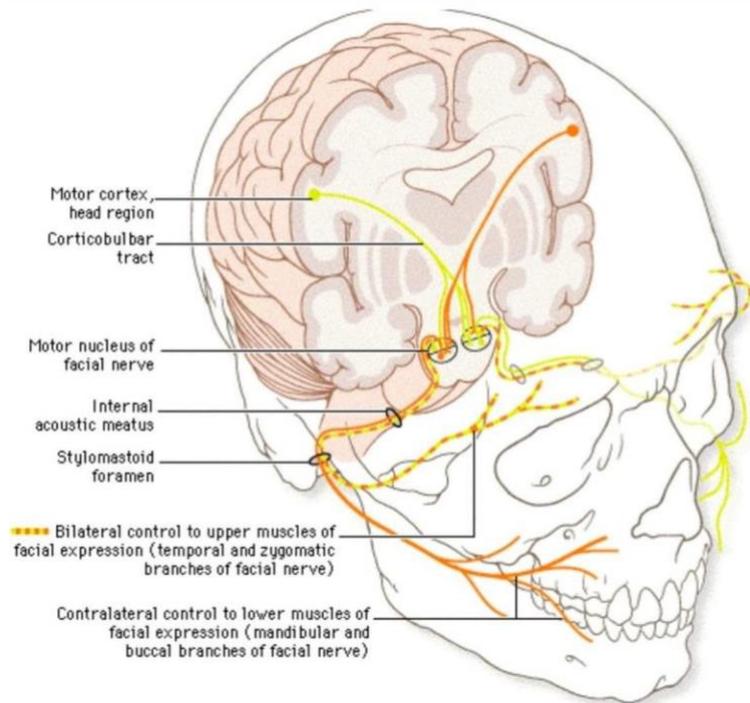


## Course:

The nerve emerges from the **pontomedullary junction**

(remember sensory fibers go towards the brain while motor away from the brain),

then enters the **internal acoustic meatus** in the petrous part of temporal bone and passes through the **facial canal** first behind the medial wall of the cavity of the middle ear (*tympanic cavity*) where it curves and forms **the geniculate ganglion** (knee), then it continues in the posterior wall of the tympanic cavity to finally emerge from the stylomastoid foramen.



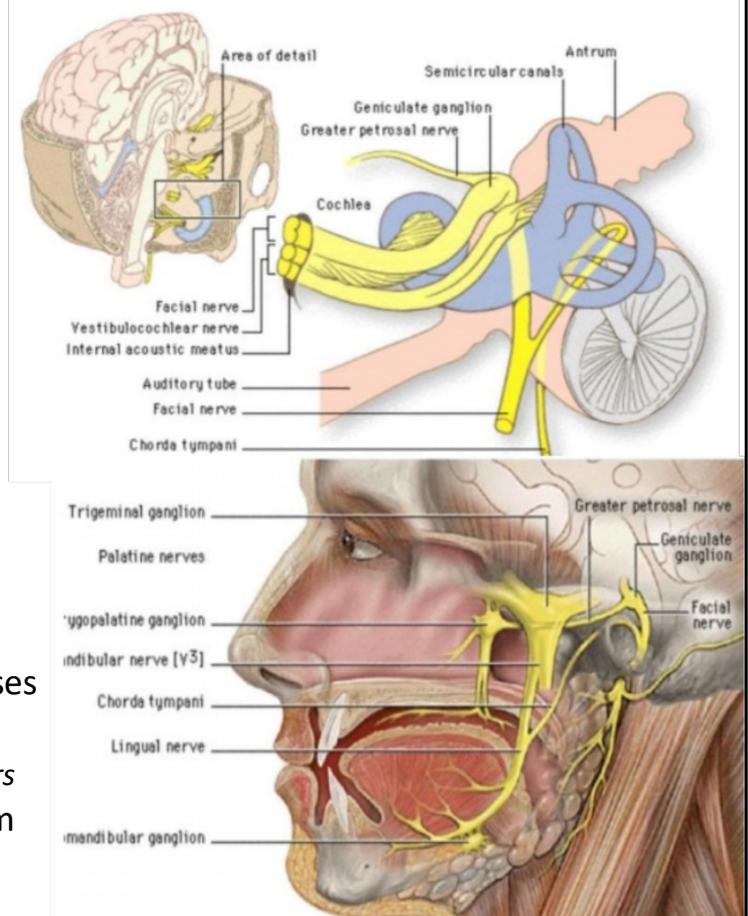
It gives two branches in the tympanic cavity:

### 1. Chorda tympani:

It leaves the middle ear through the **petrotympanic fissure** and enters the **infratemporal fossa**, then attaches to the **lingual nerve**, it carries two types of fibers, preganglionic parasympathetic from the salivatory lacrimatory nucleus (*submandibular ganglia*), and taste fibers from the anterior two thirds of the tongue.

### 2. Greater petrosal:

Emerges from the **geniculate ganglion**, then passes through the middle ear to enter the middle cranial fossa through the **greater petrosal foramen**, afterwards it passes **over foramen lacerum** and joins the **deep petrosal nerve** (*sympathetic fibers from the superior cervical ganglia*) to form



the **nerve to pterygoid canal**, which passes through the pterygoid canal to reach the **pterygopalatine fossa**.

The parasympathetic fibers synapse in the **pterygopalatine ganglia** which is suspended by the **maxillary nerve** and leave with the **zygomatic nerve** till they reach the orbit where the fibers attach to the **lacrimal nerve** and ascend to innervate the **lacrimal gland**. It also supplies nasal glands and some minor salivary glands.

\*The greater petrosal carries preganglionic parasympathetic from the salivatory lacrimatory nucleus.

## Facial nerve injury:

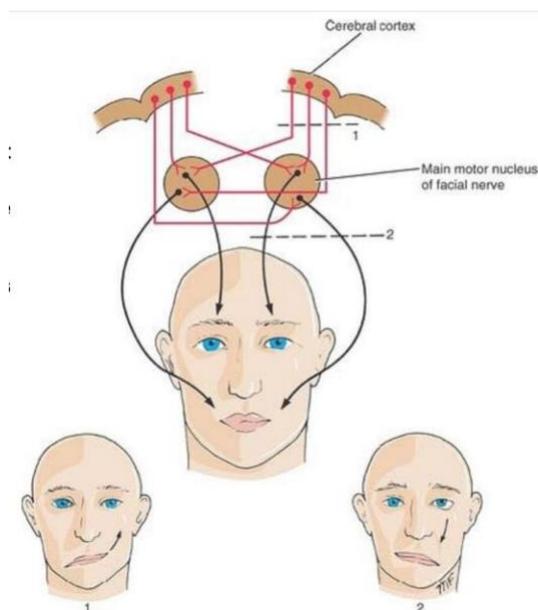
Location of the lesion

1. In the pons: Abducens and facial not working.
2. Internal acoustic meatus: Vestibulocochlear and facial
3. Chorda tympani: Loss of taste over the anterior two thirds of the tongue

Order of the neuron affected:

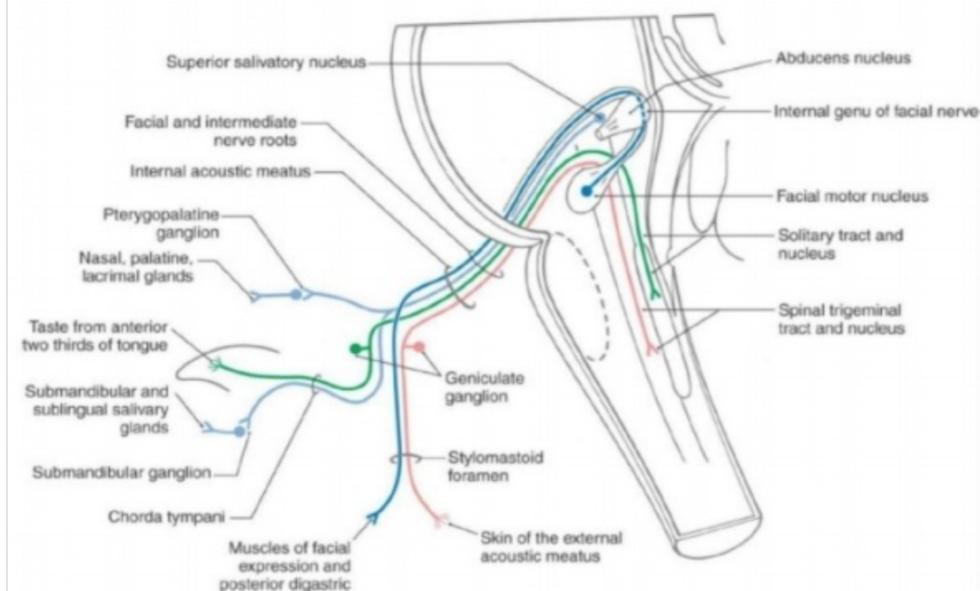
1. Cut 1 -> Upper motor neuron lesion -> contralateral lower part paralysis
2. Cut 2 -> Lower motor neuron lesion -> ipsilateral half paralysis

\*Remember that the upper part of the face is supplied bilaterally by upper motor neurons, so if there is a lesion on one side the other side will compensate.



## Bell's palsy:

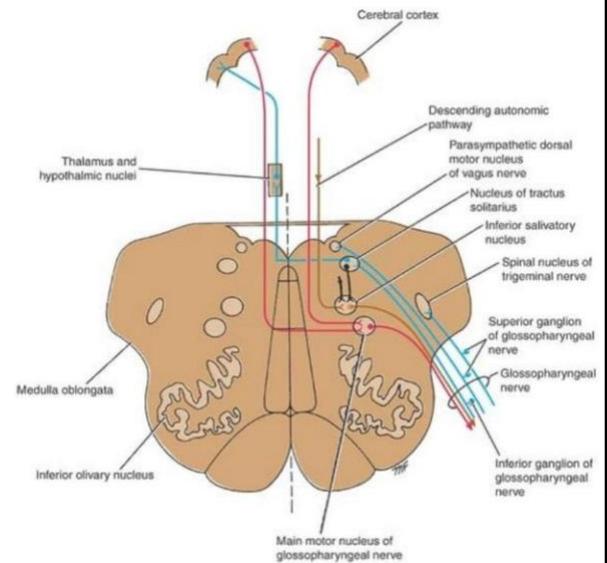
Usually unilateral, lower motor neuron paralysis, the cause is still not known.



## Glossopharyngeal nerve (cranial nerve IX):

1. **Motor nucleus**, deep in the reticular formation of the medulla, arises from the superior end of nucleus ambiguus, and only supplies the stylopharyngeus muscle.
2. Parasympathetic nucleus (**inferior salivatory nucleus**), posterior to nucleus ambiguus, receives from the hypothalamus (*all autonomic from the hypothalamus*) and passes to the otic ganglia (supplies the parotid gland).
3. **Sensory nucleus** (general, taste, and visceral sensation):

- Taste from posterior third of the tongue: cell bodies of the first order neurons are in the **inferior ganglia** (*special and visceral sensory*), then it synapses with the second order neurons in **nucleus tractus solitarius**, and from there it ascends to synapse in the **VPM** of the thalamus to reach **primary gustatory cortex**.
- Visceral sensation comes from the **carotid sinus** (baroreceptor). The glossopharyngeal passes between the internal and external carotid in the neck, and there it carries the visceral sensation from the carotid sinus. Cell bodies of the first order neurons are in the **inferior ganglia**, then they synapse in the **nucleus tractus solitarius** which is connected to the **dorsal nucleus of the vagus nerve** (*parasympathetic of the vagus*) which induces the carotid sinus reflex that reduces the blood pressure.
- General sensation from the skin of auditory meatus, middle ear, auditory tube, pharynx except the nasopharynx (*maxillary*), and posterior 1/3 of the tongue (*common sensation*), the cell bodies are in the **superior ganglion**, and then it goes to the **spinal nucleus of trigeminal** (*it carries general sensation from many cranial nerves but primarily from the trigeminal*).



### Course:

1. The glossopharyngeal nerve emerges from the groove between the olive and the inferior cerebellar peduncle.
2. Descends from jugular foramen to leave the skull and there it forms two ganglia (superior and inferior)
3. At the level of the inferior ganglia, it gives a branch called tympanic branch (*preganglionic parasympathetic fibers*)
4. It enters through the tympanic canaliculus to reach the tympanic cavity where it joins the tympanic plexus near the tympanic membrane (*that's a lot of tympanic I know*)

5. It leaves the tympanic cavity as the lesser petrosal nerve through the lesser petrosal hiatus to reach the middle cranial fossa.
6. From the middle cranial fossa, it descends through foramen ovale to the infratemporal fossa and synapses in the otic ganglia which is suspended by the mandibular nerve, and through the auriculotemporal (between its two components passes the middle meningeal artery) it reaches the parotid gland.

**Injury:**

- Loss of the gag reflex (*normally induces vomiting*)
- Loss of the carotid sinus reflex (related to blood pressure)
- Loss of taste from the posterior third of the tongue

