

A silhouette of a person standing on a hillside, looking out over a vast mountain range under a hazy, golden sky. The scene is framed by a white L-shaped graphic element in the top-left and bottom-right corners.

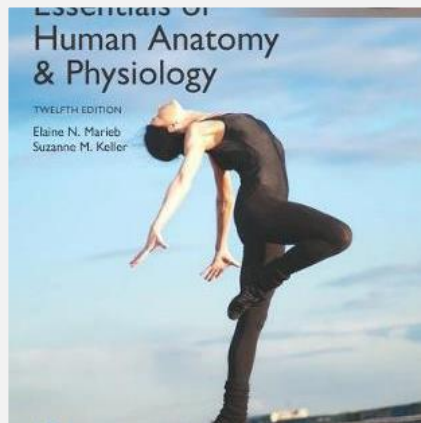
LAST FOUR CRANIAL NERVES

Khaleel Alyahya, PhD, MEd

www.khaleelalyahya.net

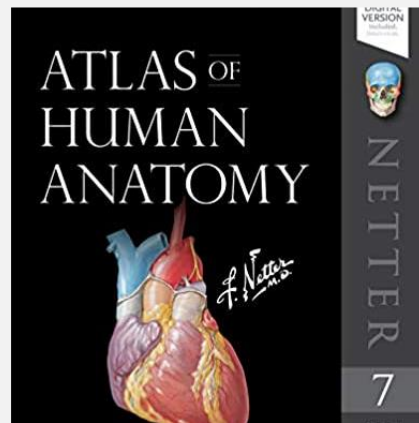
“Cranial nerves are the nerves that emerge directly from the brain, in contrast to spinal nerves which emerge from the spinal cord”

Resources



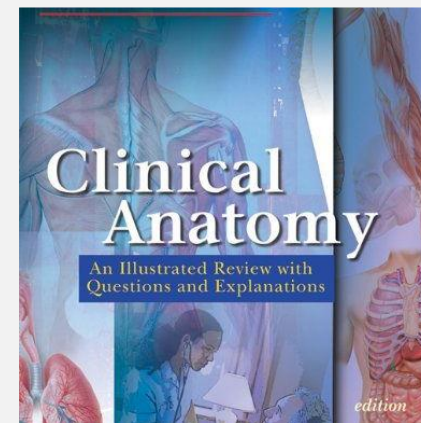
Essential of Human Anatomy & Physiology

By Elaine Marieb and Suzanne Keller



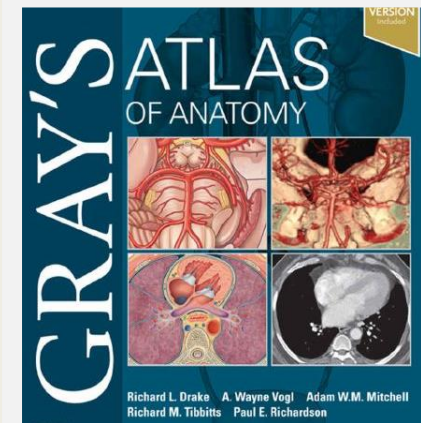
Atlas of Human Anatomy

By Frank Netter



Clinical Anatomy

By Richard Snell



Gray's Anatomy

By Richard Drake, Wayne Vogl & Adam Mitchell

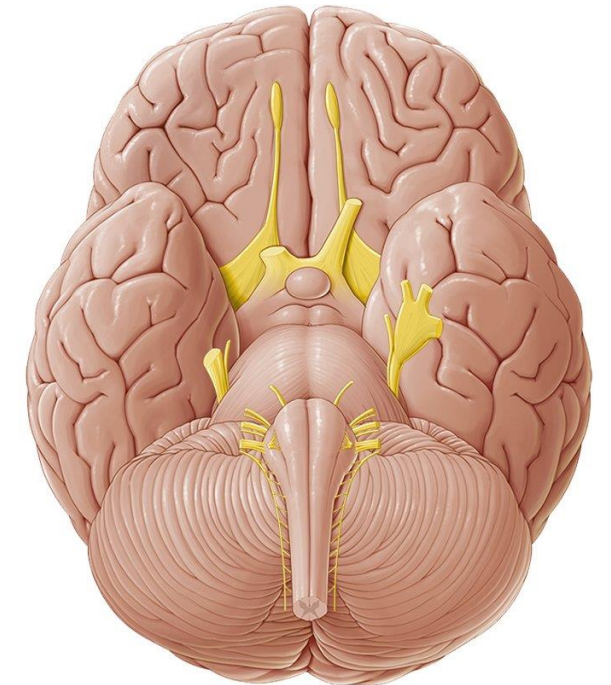


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Introduction

- There are 12 pairs of cranial nerves in our body (I-XII)
- They are called cranial nerve because they originated directly from the brain.
- They communicate and relay information between the brain and parts of the body, primarily to and from regions of the head and neck.
- They are generally named from anterior to posterior based on structure or function.
 - For example, the olfactory nerve (I) provides smell, and the facial nerve (VII) provides motor innervation to the face.



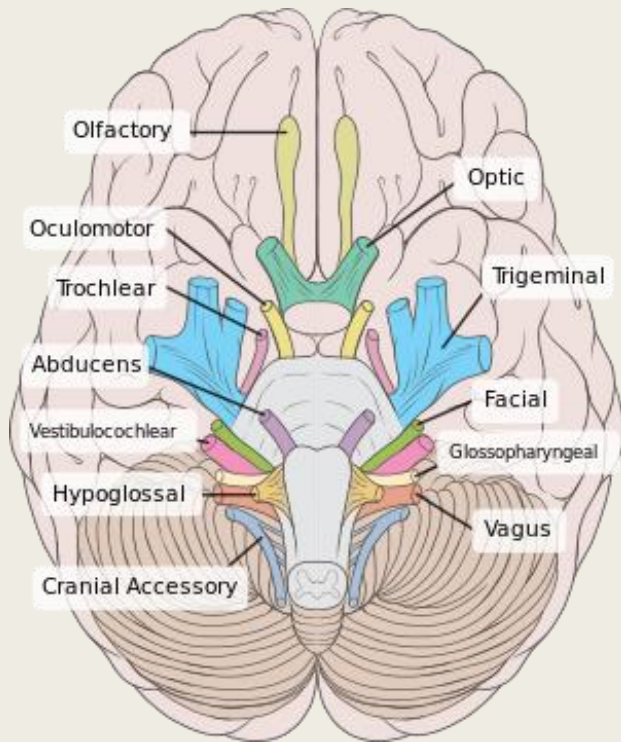
Last 4 Cranial Nerves

IX Glossopharyngeal Nerve

X Vagus Nerve

XI Accessory Nerve

XII Hypoglossal Nerve





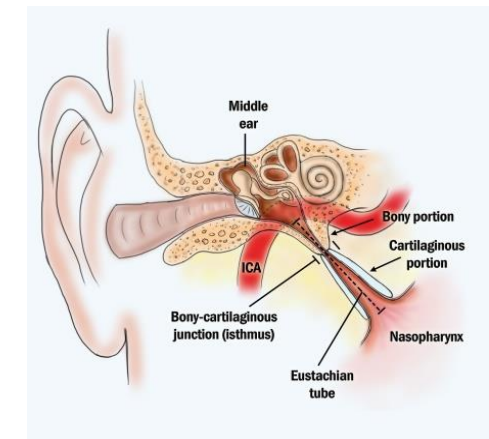
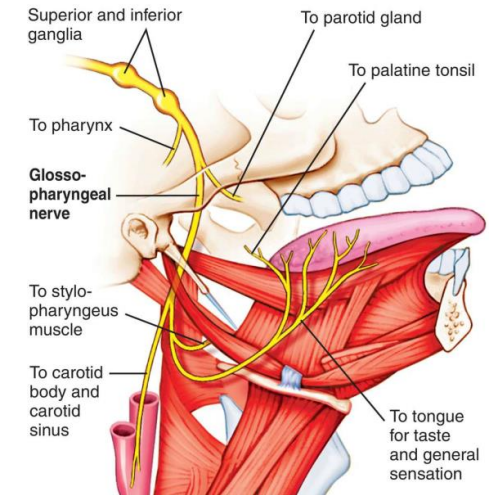
GLOSSOPHARYNGEAL

MIXED



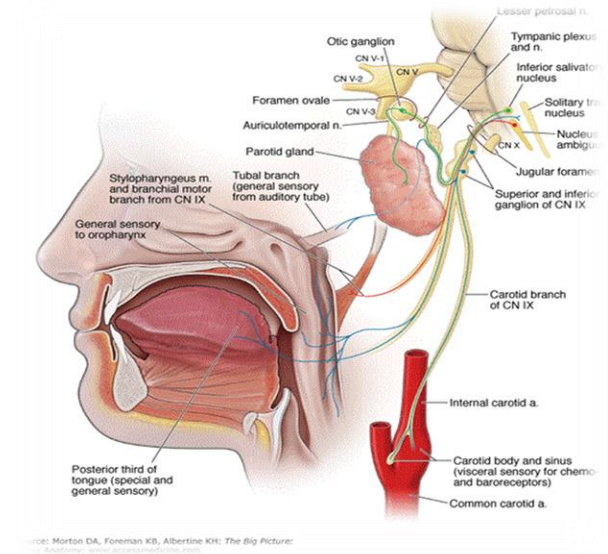
Introduction

- It is the 9th paired cranial nerve.
- It has a mixed sensory, motor and parasympathetic composition.
- **Sensory:** innervates the following;
 - Oropharynx
 - Carotid body and sinus
 - Middle ear cavity
 - Auditory tube (link the nasopharynx to middle ear)
- **Special Sensory:** provides taste sensation to the posterior 1/3 of the tongue.
- **Motor:** innervates the stylopharyngeus muscle of the pharynx.
- **Parasympathetic:** provides parasympathetic innervation to the parotid gland.

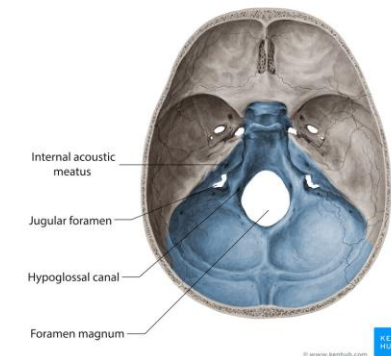


Course

- It originates in the **medulla oblongata**.
- It emerges from the anterior aspect of the medulla, moving laterally in the posterior cranial fossa.
- The nerve leaves the cranium via the **jugular foramen**.
- At this point, the **tympanic nerve** arises.
- Immediately outside the jugular foramen lie two ganglia (collections of nerve cell bodies).
- They are known as the superior and inferior ganglia – they contain the cell bodies of the sensory fibers in the glossopharyngeal nerve.

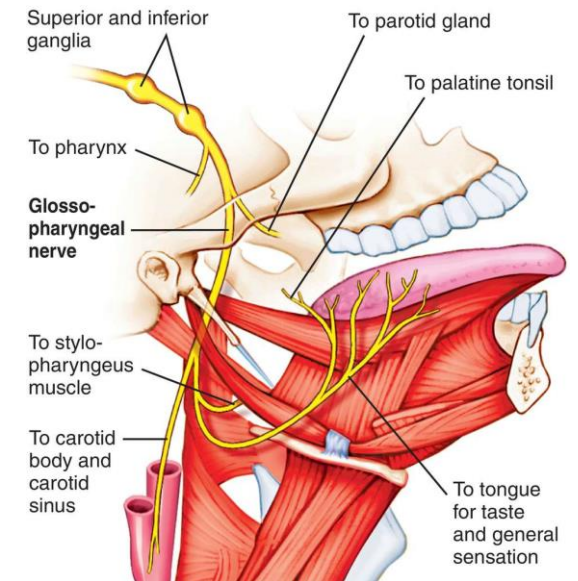


Source: Morton DA, Foreman KB, Albertine KH: The Big Picture: Anatomy. www.accessmedicine.com



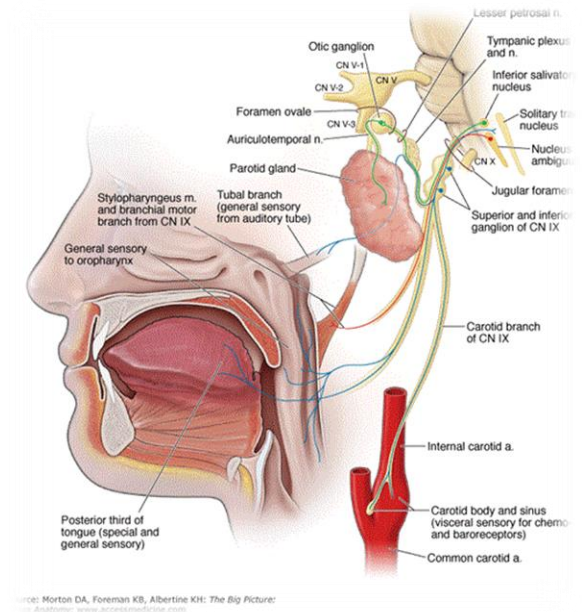
Branches

- The glossopharyngeal nerve descends the neck, anterolateral to the **internal carotid artery**.
- At the inferior margin of the **stylopharyngeus muscle**, several branches arise to provide motor innervation to the muscle.
- The nerve enters the pharynx by passing between the superior and middle pharyngeal constrictors.
- Within the pharynx, it terminates by dividing into several branches:
 - Lingual
 - Tonsil
 - Pharyngeal



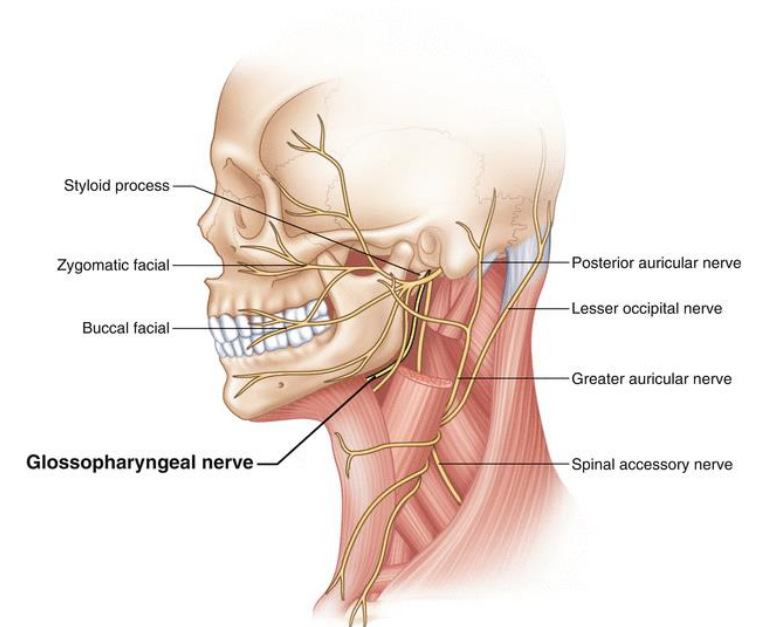
Sensory functions

- It provides sensory innervation to variety of structures in the head and neck.
- The **tympanic nerve** provides sensory innervation to the middle ear, internal surface of the tympanic membrane and eustachian tube.
- At the level of stylopharyngeus muscle, the carotid sinus nerve arises to innervate both the carotid sinus and carotid body, which provide information about blood pressure and oxygen saturation, respectively.
- The glossopharyngeal nerve terminates by giving several sensory branches:
 - **Pharyngeal branch** – combines with fibers of the vagus nerve to form the pharyngeal plexus. It innervates the mucosa of the oropharynx.
 - **Lingual branch** – provides the posterior 1/3 of the tongue with general and taste sensation
 - **Tonsillar branch** – forms a network of nerves, known as the tonsillar plexus, which innervates the palatine tonsils.



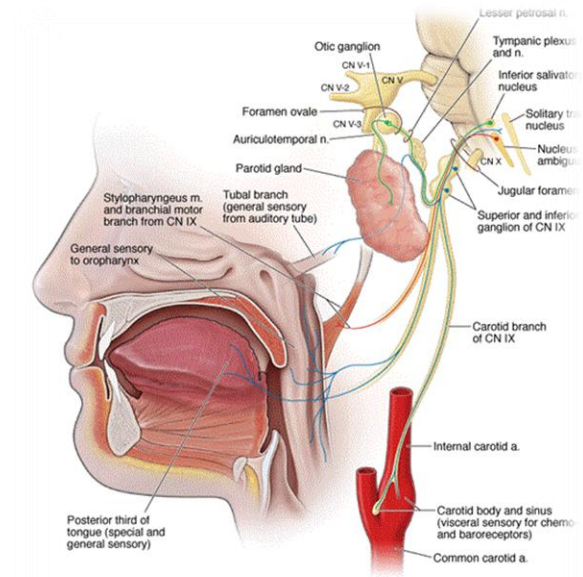
Motor functions

- The **stylopharyngeus muscle** of the pharynx is innervated by the glossopharyngeal nerve.
- This muscle acts to shorten and widen the pharynx and elevate the larynx during swallowing.



Parasympathetic functions

- The glossopharyngeal nerve provides parasympathetic innervation to the **parotid gland**.
- These fibers originate in the inferior salivatory nucleus of CN IX.
- These fibers travel with the tympanic nerve to the middle ear.
- From the ear, the fibers continue as the lesser petrosal nerve, before synapsing at the otic ganglion.



Source: Morton DA, Foreman KB, Albertine KH: The Big Picture: Anatomy. www.accessmedicine.com

Clinicals

- Damage to **glossopharyngeal nerve** could result in loss of taste from the back of the tongue and absence of the pharyngeal reflex (gag reflex).
- Since cranial nerves IX, X, and XI are so close together, usually damage to glossopharyngeal nerve share damage to X and XI.
- Also, glossopharyngeal nerve supplies sensory innervation to the oropharynx, and thus carries the afferent information for the gag reflex.
- When a foreign object touches the back of the mouth, this stimulates glossopharyngeal nerve, beginning the reflex.
- An absent gag reflex signifies damage to the glossopharyngeal nerve.



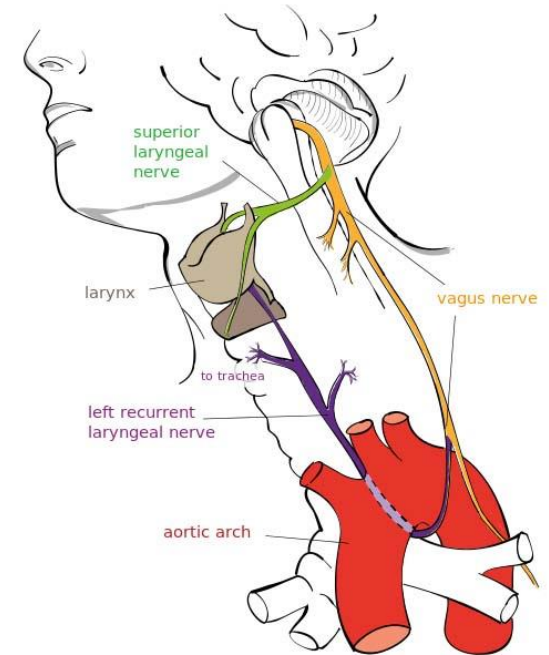


VAGUS

MIXED

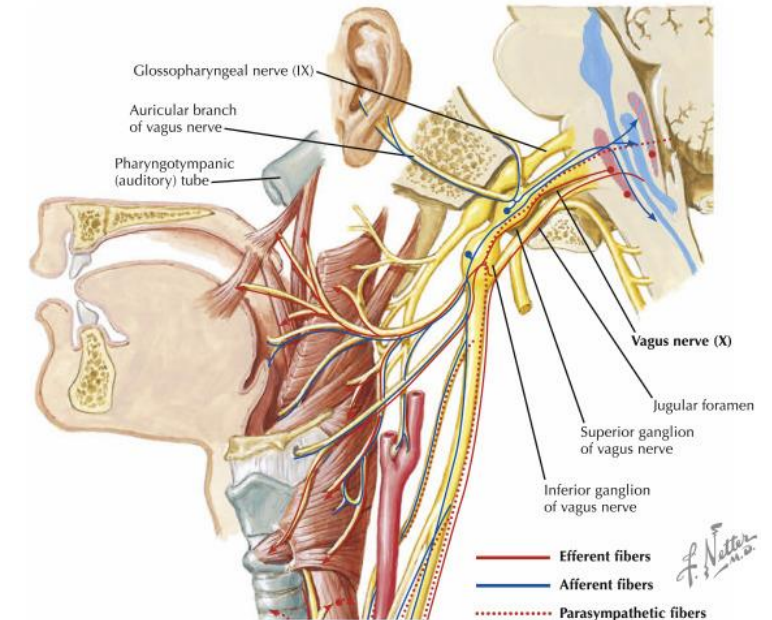
Introduction

- It is the 10th cranial nerve.
- It is the only cranial nerve that extends beyond the head and neck to reach the abdomen.
- It is a functionally diverse nerve, offering many different modalities of innervation.
- Due to its widespread functions, pathology of the vagus nerve is implicated in a vast variety of clinical cases.



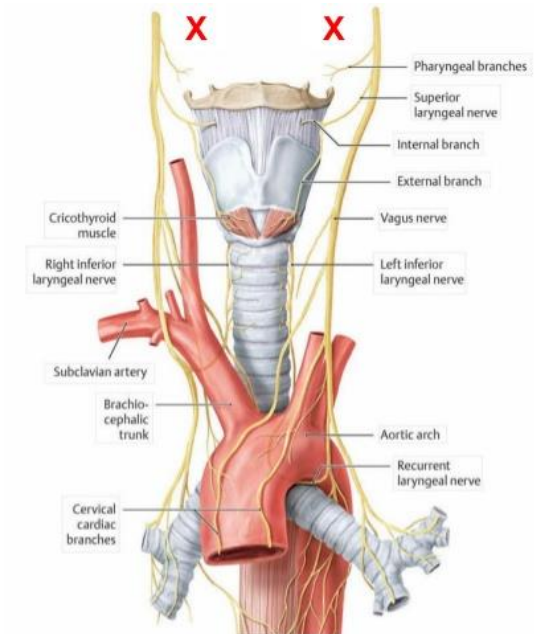
Vagus in head

- It originates from the medulla of the brainstem.
- It exits the cranium via the **jugular foramen**, with the glossopharyngeal and accessory nerves, respectively.
- Within the cranium, the auricular branch arises.
- This supplies sensation to the posterior part of the external auditory and canal external ear.



Vagus in neck

- It passes into the **carotid sheath**, travelling inferiorly with the internal jugular vein and common carotid artery.
- At the base of the neck, the right and left nerves have different pathways:
 - The **right vagus nerve** passes anterior to the subclavian artery and posterior to the sternoclavicular joint, entering the thorax.
 - The **left vagus nerve** passes inferiorly between the left common carotid and left subclavian arteries, posterior to the sternoclavicular joint, entering the thorax.
- Several branches arise in the neck:
 - **Pharyngeal branches** to provides motor innervation to the majority of the muscles of the pharynx and soft palate.
 - **Superior laryngeal nerve** to splits into internal and external branches. The external laryngeal nerve innervates the cricothyroid muscle of the larynx. The internal laryngeal provides sensory innervation to the laryngopharynx and superior part of the larynx.
 - **Recurrent laryngeal nerve** (right side only) hooks underneath the right subclavian artery, then ascends towards to the larynx. It innervates the majority of the intrinsic muscles of the larynx.

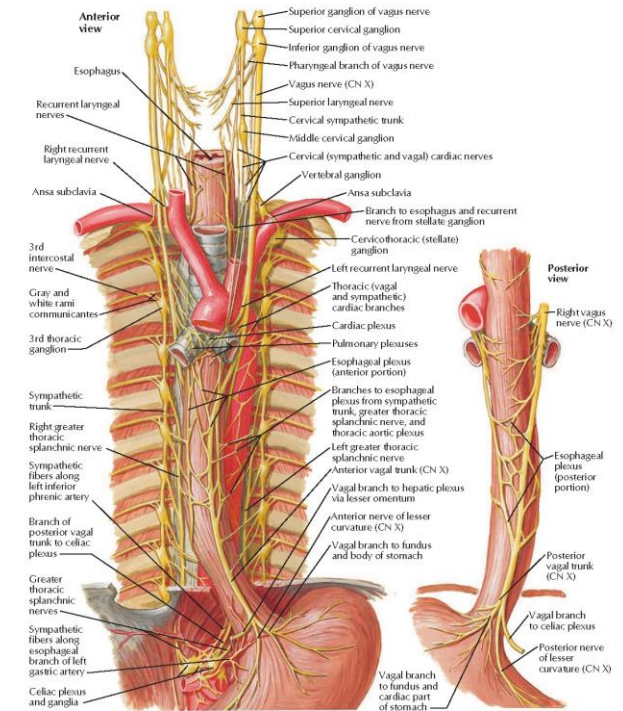


Paired vagus nerves
Extensively branched

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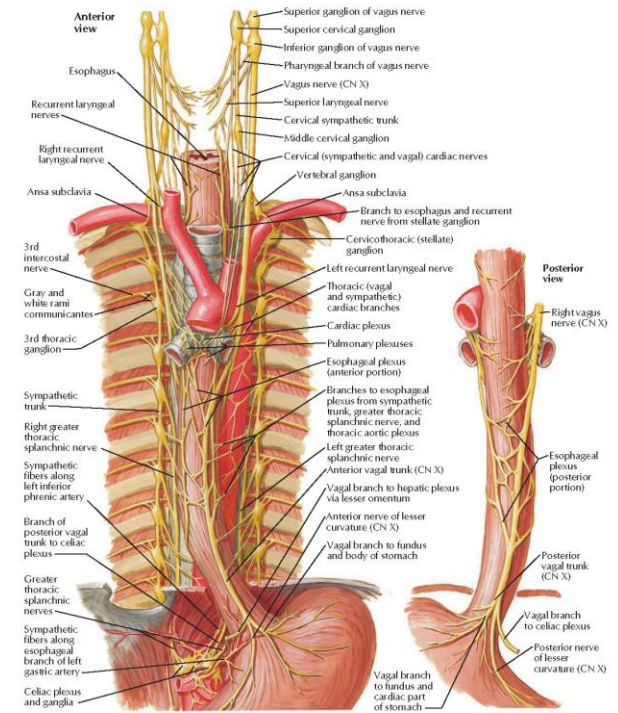
Vagus in thorax

- The right vagus forms the **posterior vagal trunk**, and the left vagus forms the **anterior vagal trunk**.
- Branches from the vagal trunks contribute to the formation of the **esophageal plexus**, which innervates the smooth muscle of the oesophagus.
- Two other branches arise in the thorax:
 - **Left recurrent laryngeal nerve** – it hooks under the arch of the aorta, ascending to innervate the majority of the intrinsic muscles of the larynx.
 - **Cardiac branches** – these innervate regulate heart rate and provide visceral sensation to the organ.



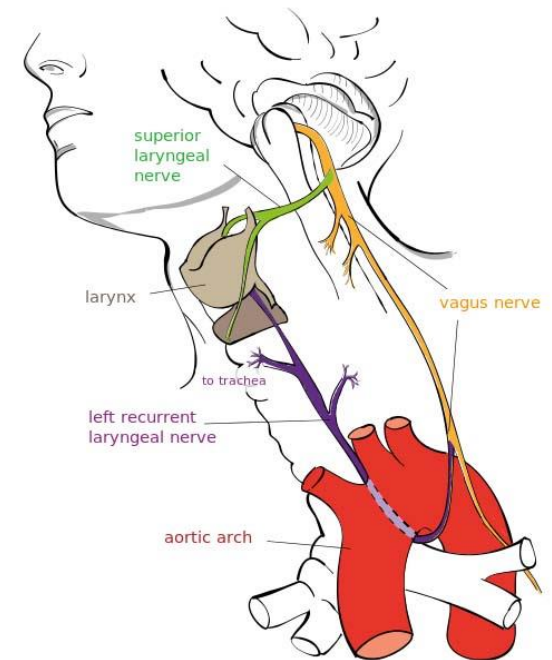
Vagus in abdomen

- The vagal trunks enter the abdomen via the **esophageal hiatus**, the opening in the diaphragm.
- In abdomen, the vagal trunks terminate by dividing into branches that supply the oesophagus, stomach and the small and large bowel (up to the splenic flexure).



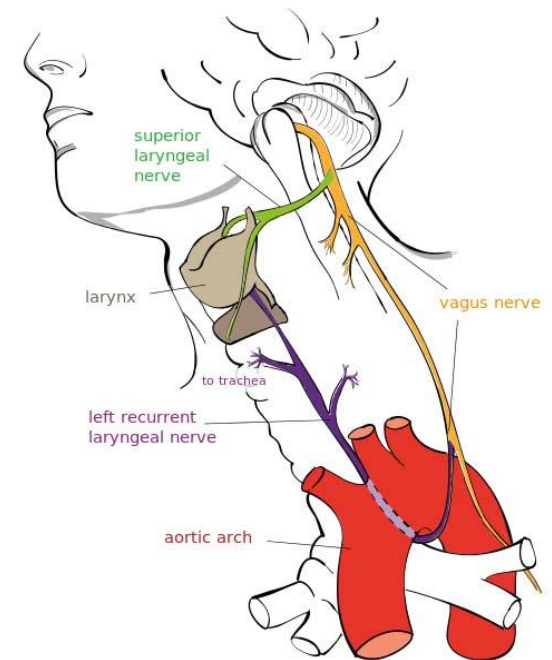
Sensory functions

- There are somatic and visceral components to the sensory function of the vagus nerve.
- Somatic refers to sensation from the skin and muscles. This is provided by the **auricular nerve**, which innervates the skin of the posterior part of the external auditory canal and external ear.
- Viscera sensation is that from the organs of the body.
- The vagus nerve innervates:
 - **Laryngopharynx** via internal laryngeal nerve.
 - **Superior aspect of larynx** (above vocal folds) via internal laryngeal nerve.
 - **Heart** via cardiac branches of the vagus nerve.
 - **Gastro-intestinal tract** (up to the splenic flexure) via terminal branches of the vagus nerve.
- The vagus nerve has a minor role in taste sensation.
- It carries afferent fibers from the root of the tongue and epiglottis. (not to be confused with the special sensation of the glossopharyngeal nerve).



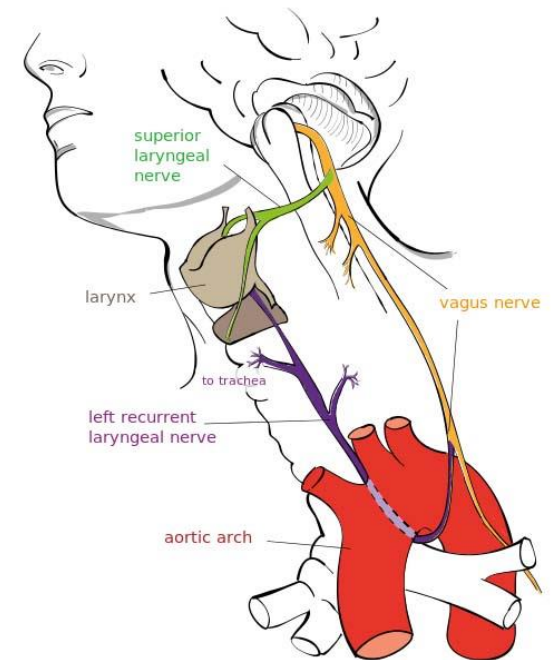
Motor functions

- The vagus nerve innervates the majority of the muscles associated with the **pharynx** and **larynx**.
- These muscles are responsible for the initiation of swallowing and phonation.
- Most of the muscles of the pharynx are innervated by the pharyngeal branches of the vagus nerve:
 - Except stylopharyngeus, that is innervated by the glossopharyngeal nerve.
- Innervation to the intrinsic muscles of the larynx is achieved via the **recurrent laryngeal nerve** and external branch of the **superior laryngeal nerve**.
- In addition to the pharynx and larynx, the vagus nerve also innervates the palatoglossus of the tongue, and the majority of the muscles of the soft palate.



Parasympathetic functions

- In the thorax and abdomen, the vagus nerve is the main **parasympathetic outflow** to the heart and gastro-intestinal organs.
- The heart, cardiac branches arise in the thorax, conveying parasympathetic innervation to the sino-atrial and atrio-ventricular nodes of the heart.
- These branches stimulate a reduction in the resting heart rate.
- Gastro-Intestinal System
 - The vagus nerve provides parasympathetic innervation to the majority of the abdominal organs. It sends branches to the oesophagus, stomach and most of the intestinal tract – up to the splenic flexure of the large colon.
 - The function of the vagus nerve is to stimulate smooth muscle contraction and glandular secretions in these organs. For example, in the stomach, the vagus nerve increases the rate of gastric emptying, and stimulates acid production.



Clinicals

- Disorders of the vagus nerve could cause the following symptoms:
 - Slow the heart rate.
 - Dysphagia (difficulty swallowing) due to a lesion to the pharyngeal branches.
 - Loss of the Gag reflex due to loss of sensory innervation to the oropharynx and laryngopharynx with the motor efferent involved in the Gag reflex.
- Paralysis of vagus nerve leads to hoarseness.



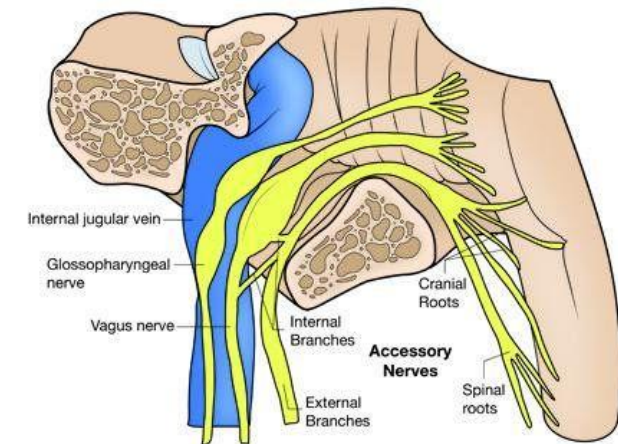


ACCESSORY
MOTOR



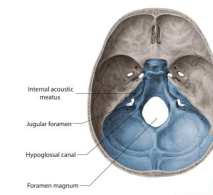
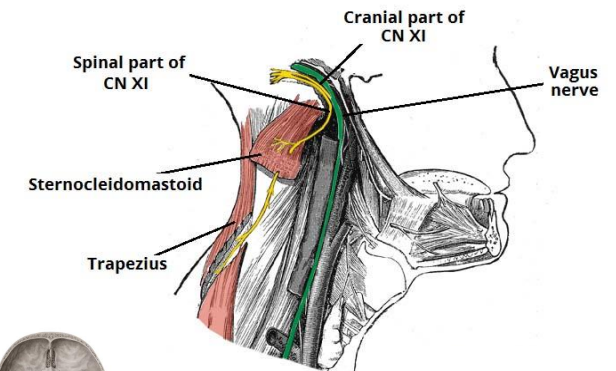
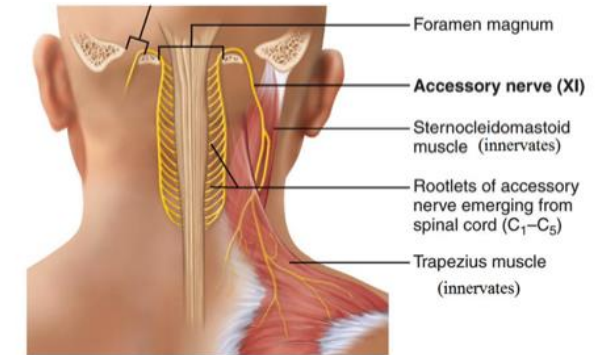
Introduction

- It is the 11th \ paired cranial nerve.
- It has a purely somatic motor function, innervating the **sternocleidomastoid** and **trapezius** muscles.
- It is divided into two parts:
 - Spinal part
 - Cranial part



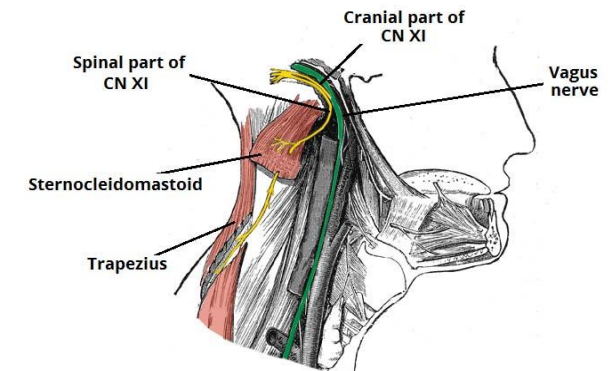
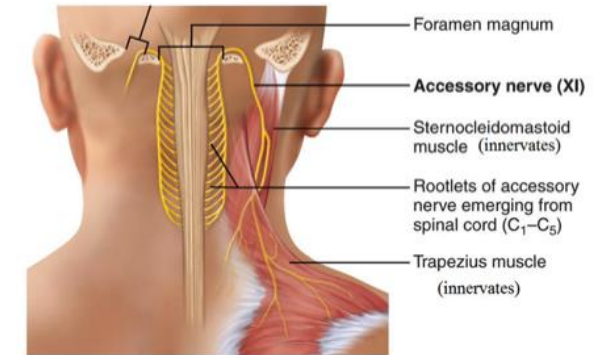
Anatomy – spinal portion

- The **spinal portion** arises from neurons of the upper spinal cord, specifically C1-C5/C6 spinal nerve roots.
- These fibers unite to form the spinal part of the accessory nerve, which then runs superiorly to enter the cranial cavity via the **foramen magnum**.
- The nerve traverses the posterior cranial fossa to reach the **jugular foramen**.
- It briefly meets the cranial portion of the accessory nerve, before exiting the skull (along with the glossopharyngeal and vagus nerves).
- Outside the cranium, the spinal part descends along the internal carotid artery to reach and innervate the sternocleidomastoid muscle.
- It then moves across the posterior triangle of the neck to supply motor fibres to the trapezius.



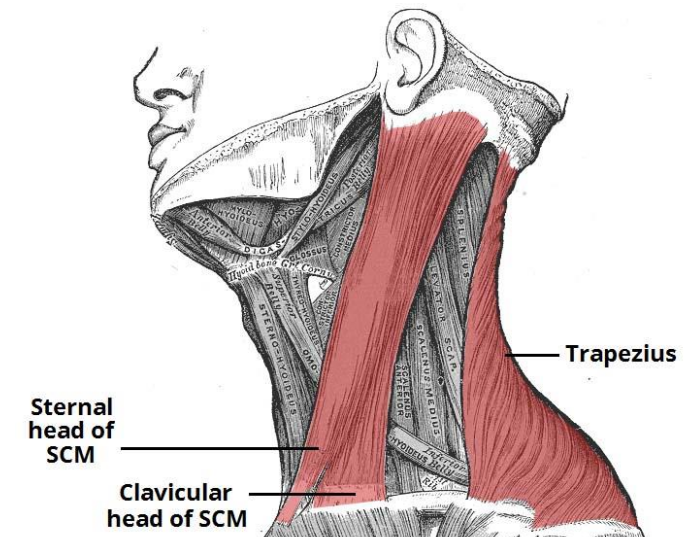
Anatomy – cranial portion

- The cranial portion is much smaller and arises from the lateral aspect of the medulla oblongata.
- It leaves the cranium via the jugular foramen, where it briefly contacts the spinal part of the accessory nerve.
- Immediately after leaving the skull, cranial part combines with the vagus nerve at the inferior ganglion of vagus nerve (a ganglion is a collection of nerve cell bodies).
- The fibers from the cranial part are then distributed through the vagus nerve.
- For this reason, the cranial part of the accessory nerve is considered as part of the vagus nerve.



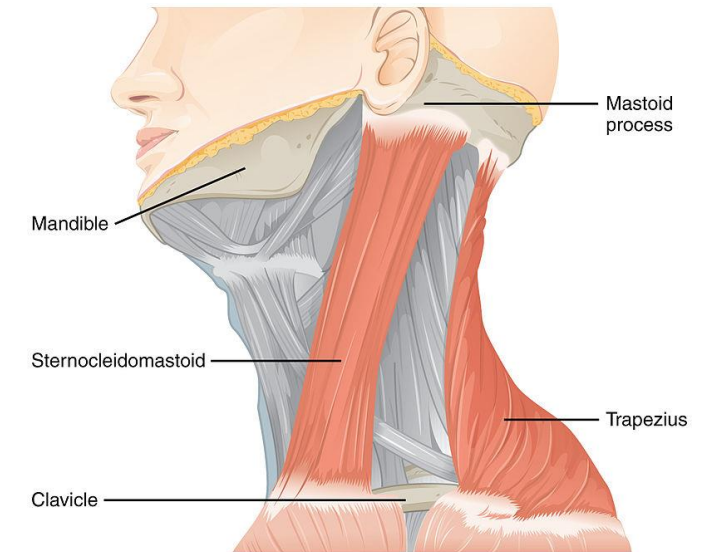
Motor functions

- The spinal accessory nerve innervates two muscles; the sternocleidomastoid and trapezius.
- **Sternocleidomastoid**
 - Runs from the mastoid process of the temporal bone to the manubrium (sternal head) and the medial third of the clavicle (clavicular head).
 - Actions is lateral flexion and rotation of the neck when acting unilaterally, and extension of the neck at the atlanto-occipital joints when acting bilaterally.
- **Trapezius**
 - Runs from the base of the skull and the spinous processes of the C7-T12 vertebrae to lateral third of the clavicle and the acromion of the scapula.
 - Actions is made up of upper, middle and lower fibers. The upper fibers of the trapezius elevate the scapula and rotate it during abduction of the arm. The middle fibers retract the scapula, and the lower fibers pull the scapula inferiorly.



Clinicals

- The most common **cause** of accessory nerve damage is **iatrogenic**.
- **Operations** such as cervical lymph node biopsy or cannulation of the internal jugular vein can cause trauma to the nerve.
- **Clinical features** include muscle wasting and partial paralysis of the sternocleidomastoid, resulting in the inability to rotate the head or weakness in shrugging the shoulders.
- Damage to the muscles may also result in an asymmetrical neckline.





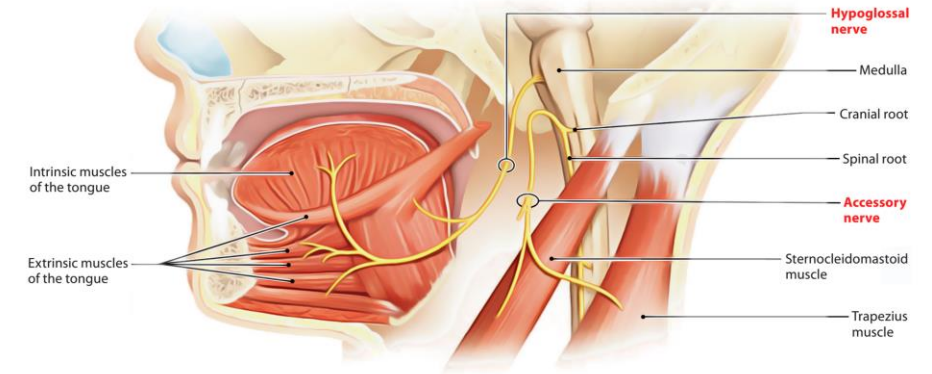
HYPOGLOSSAL

MOTOR



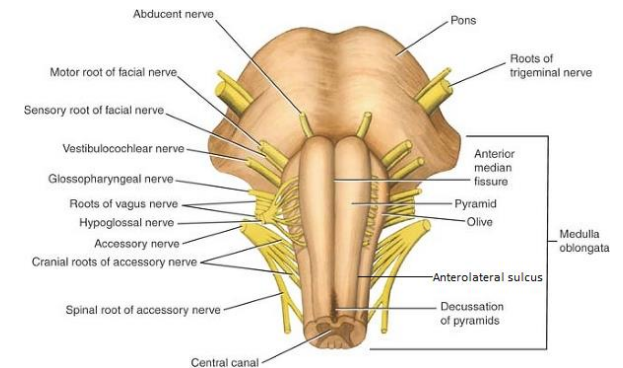
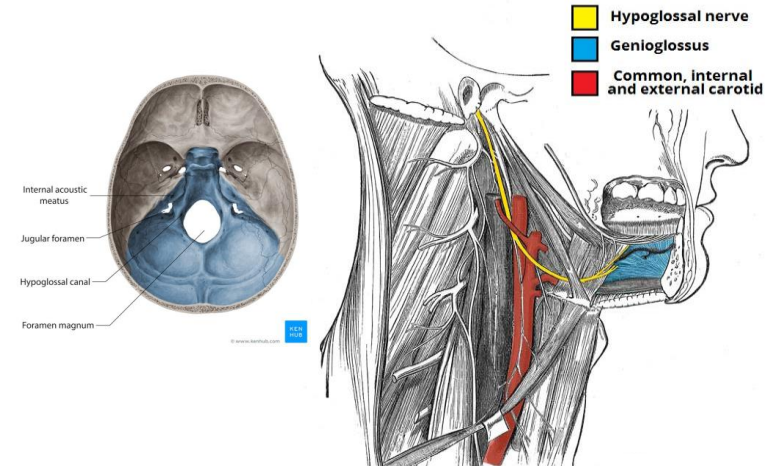
Introduction

- It is the 12th paired cranial nerve.
- Its name is derived from ancient Greek, “**hypo**” meaning under, and “**glossal**” meaning tongue.
- The nerve has a purely somatic motor function, innervating the majority of the muscles of the tongue.



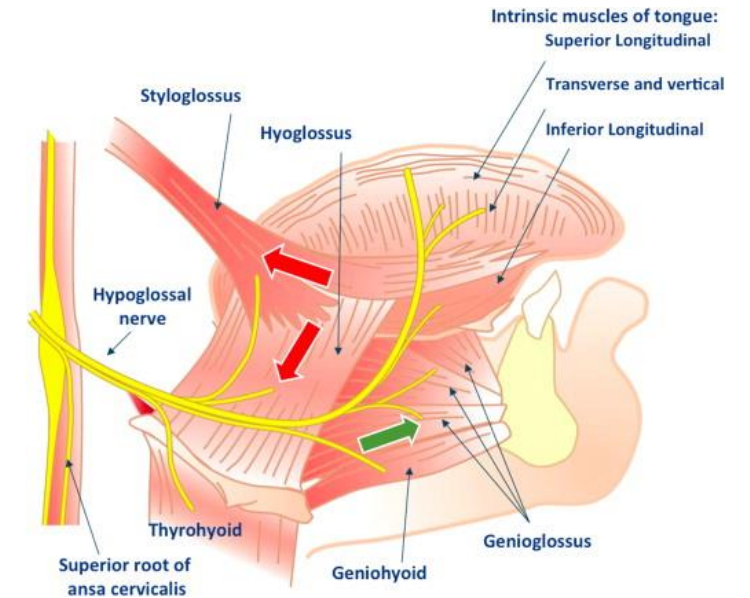
Anatomy

- The hypoglossal nerve arises from the hypoglossal nucleus in the medulla oblongata of the brain.
- It then passes laterally across the posterior cranial fossa, within the subarachnoid space.
- The nerve exits the cranium via the hypoglossal canal.
- The nerve receives a branch of the cervical plexus that conducts fibres from C1/C2 spinal nerve roots.
- These fibres do not combine with the hypoglossal nerve – they merely travel within its sheath.
- It then passes inferiorly to the angle of the mandible, crossing the internal and external carotid arteries, and moving in an anterior direction to enter the tongue.



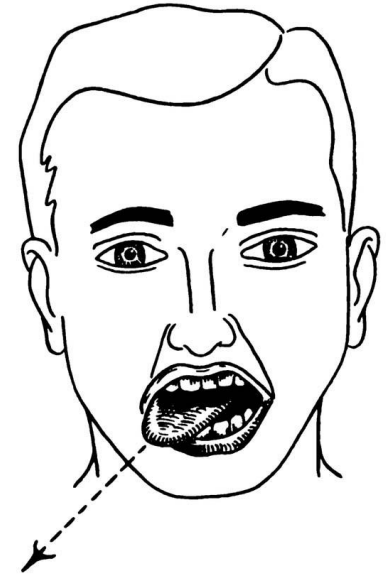
Motor functions

- The hypoglossal nerve is responsible for motor innervation of the vast majority of the **muscles of the tongue** (except for palatoglossus that is innervated by **vagus**).
- These muscles can be subdivided into two groups:
 - Extrinsic muscles
 - Intrinsic muscles
- Together, these muscles are responsible for all movements of the tongue.
- Role of the C1/C2 Roots
 - The C1/C2 roots that travel with the hypoglossal nerve also have a motor function.
 - They branch off to innervate the geniohyoid (elevates the hyoid bone) and thyrohyoid (depresses the hyoid bone).



Clinicals

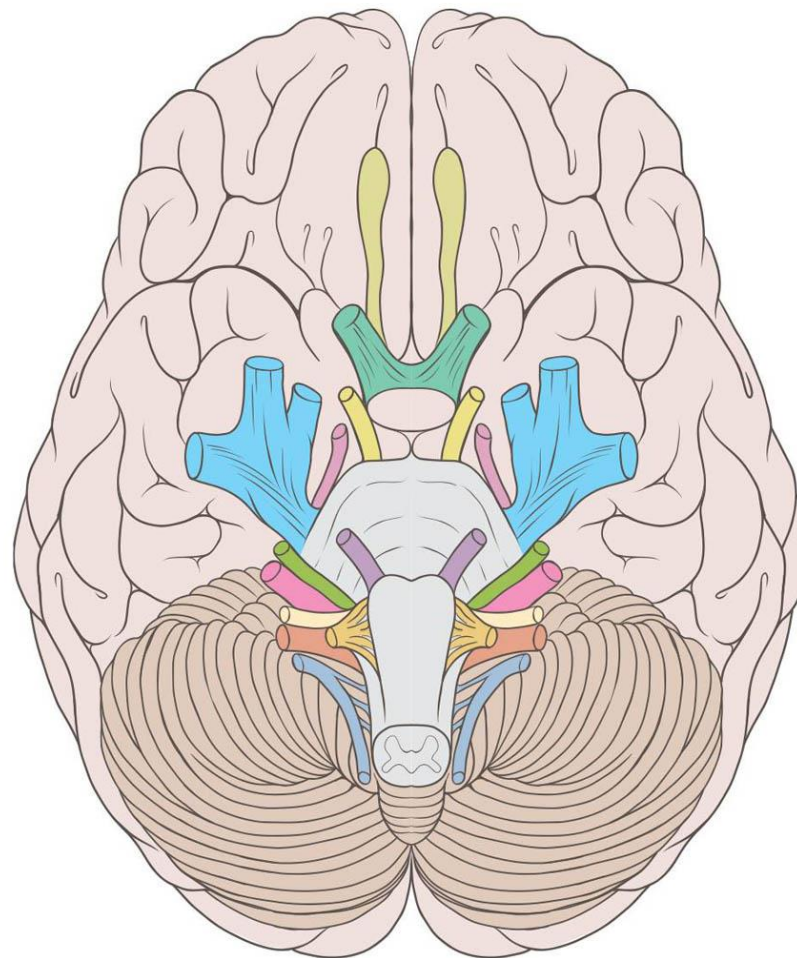
- **Damage** to the hypoglossal nerve is a relatively uncommon cranial nerve palsy.
- Possible **causes** include tumors and penetrating traumatic injuries.
- If the **symptoms** are accompanied by acute pain, a possible cause may be dissection of the internal carotid artery.
- Patients will present with deviation of the tongue towards the damaged side on protrusion, as well as possible muscle wasting and fasciculations (twitching of isolated groups of muscle fibers) on the affected side.



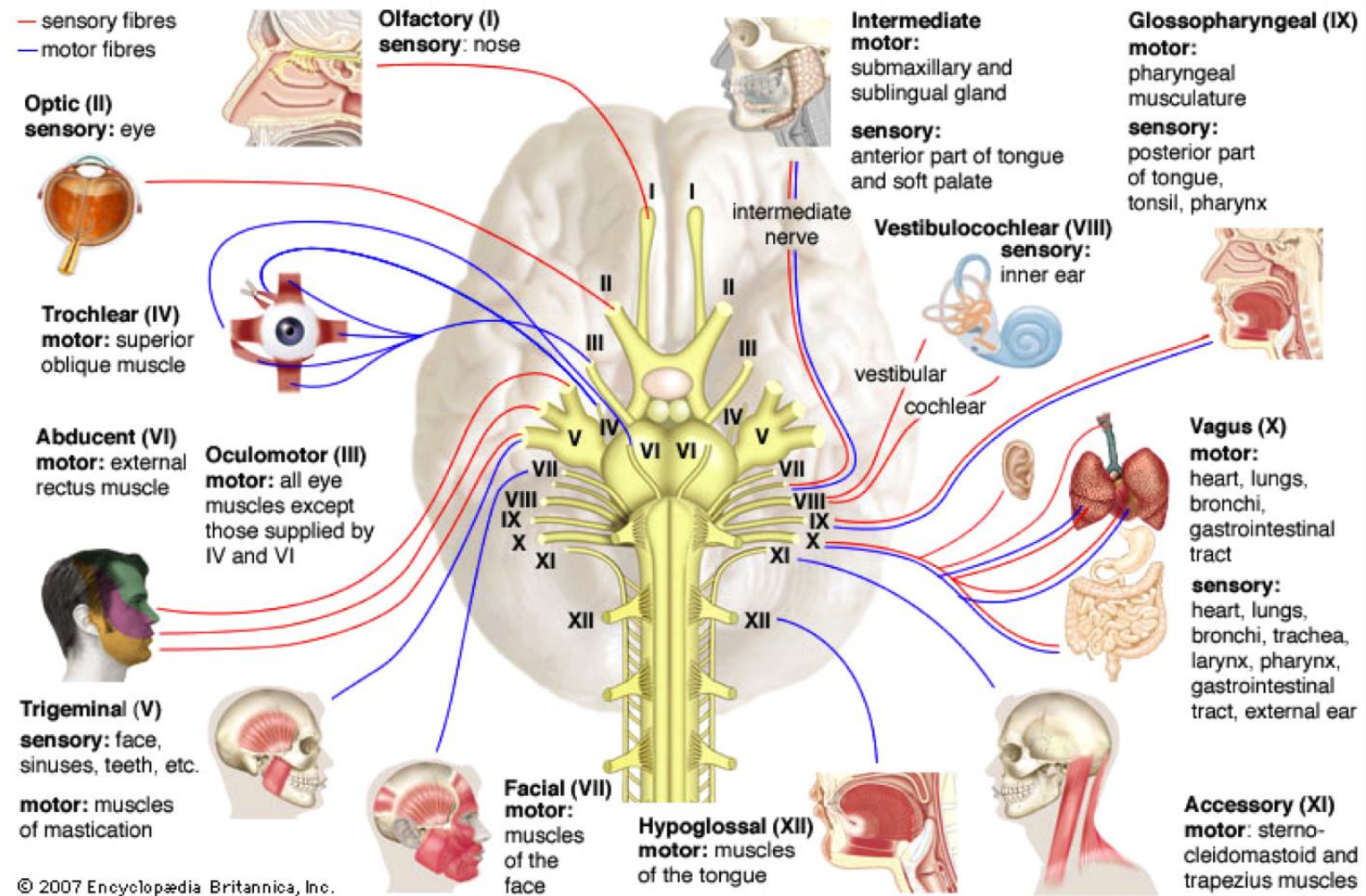


SUMMARY





- CN I Olfactory n.
- CN II Optic n.
- CN III Oculomotor n.
- CN IV Trochlear n.
- CN V Trigeminal n.
- CN VI Abducens n.
- CN VII Facial n.
- CN VIII Vestibulocholear n.
- CN IX Glossopharyngeal n.
- CN X Vagus n.
- CN XI Accessory n.
- CN XII Hypoglossal n.



Cranial Nerves	Foramen	Region Entered	Components
I	Cribriform plate	Nasal cavity	Sensory
II	Optic canal	Orbit	Sensory
III	Superior orbital fissure	Orbit	Motor
IV	Superior orbital fissure	Orbit	Motor
V1 V2 V3	Superior orbital fissure Foramen rotundum Foramen ovale	Orbit Pterygopalatine fossa Infratemporal fossa	Mixed
VI	Superior orbital fissure	Orbit	Motor
VII	Internal acoustic meatus	Temporal bone	Mixed
VIII	Internal auditory meatus	Temporal bone	Sensory
IX	Jugular foramen	Neck	Mixed
X	Jugular foramen	-	Mixed
XI	Jugular foramen	Neck	Motor
XII	Hypoglossal canal	Neck	Motor

A person wearing a red coat is leaning over a table, interacting with a vintage suitcase. The suitcase is light-colored with dark brown leather straps and buckles. The person's hand is visible, touching the suitcase. The background is dark and out of focus. The text "QUESTIONS?" is overlaid in the center in a large, white, sans-serif font. Below it, the email address "alkhaleel@ksu.edu.sa" is written in a smaller, white, sans-serif font. The entire scene is framed by a white L-shaped graphic element in the top-left and bottom-right corners.

QUESTIONS?

alkhaleel@ksu.edu.sa