



Central Nervous System

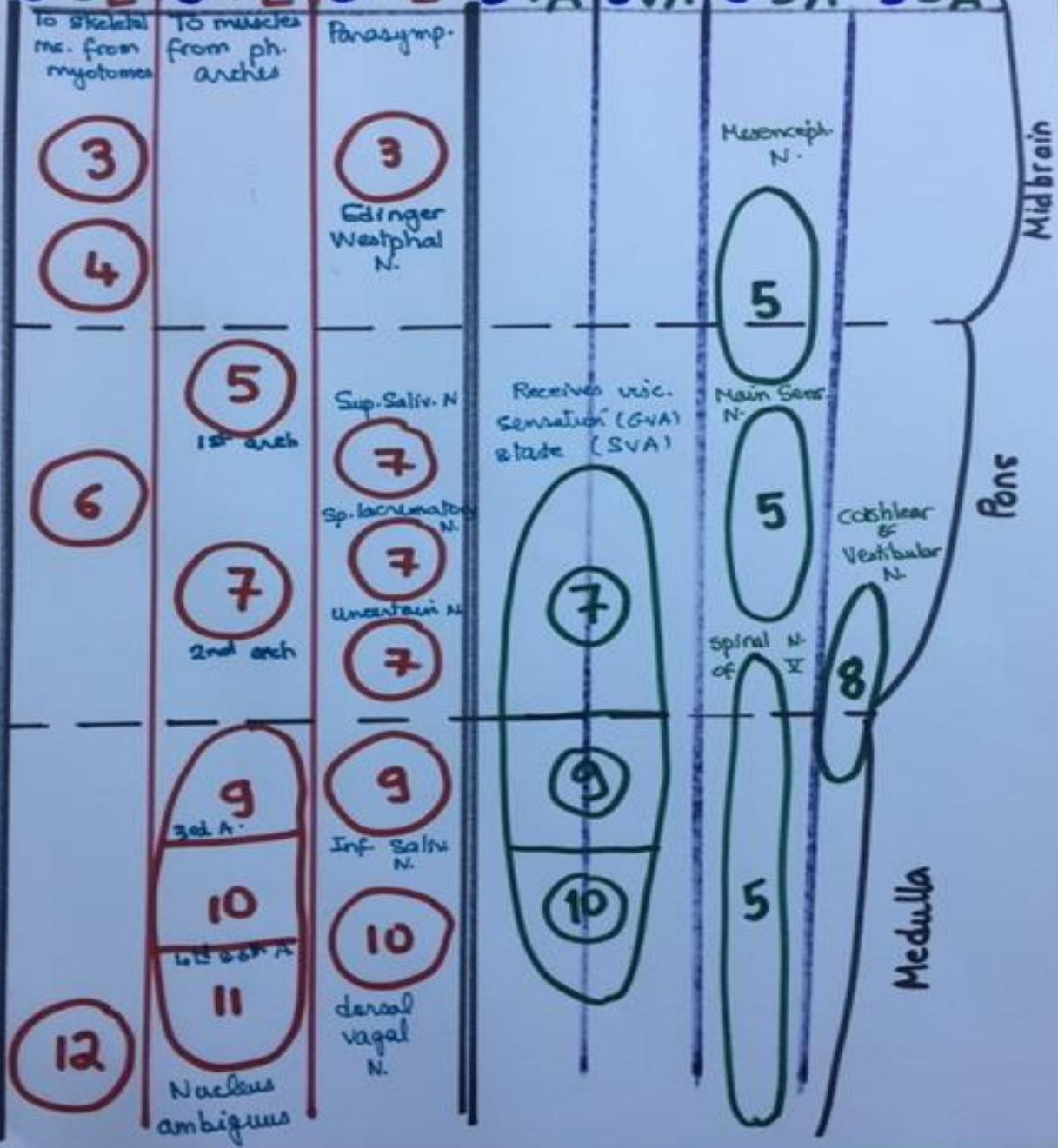
Lecture 8: Cranial Nerve Nuclei

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CRANIAL NERVE NUCLEI

- ** The nuclei for the cranial nerves form columns in the brain stem.**
- ** Each column gives origin to or receives one type of fibers.**
- ** They include three motor columns medially and four (actually three) sensory columns laterally.**
- ** They are arranged from medial to lateral and from above downwards as follows:**

GSE SVE GVE GVA SVA GSA SSA



1. General somatic efferent (GSE) column:

*** Motor to skeletal muscles that develop from myotomes (extraocular muscles and tongue muscles) i.e. it is somatomotor:**

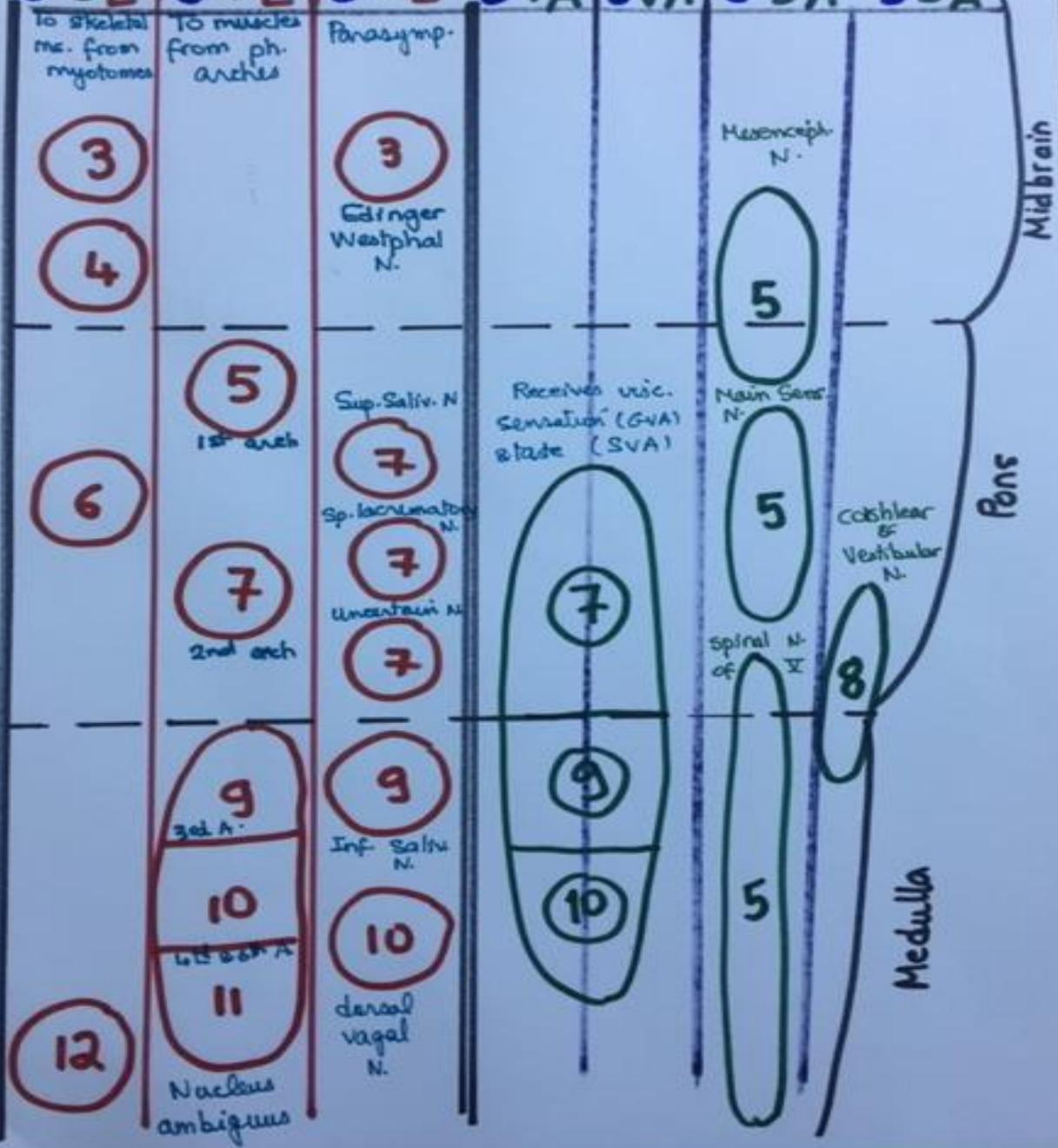
a. Nucleus of III (in the midbrain at level of superior colliculus).

b. Nucleus of IV (in the midbrain at level of inferior colliculus).

c. Nucleus of VI (in pons).

d. Nucleus of XII (in medulla oblongata).

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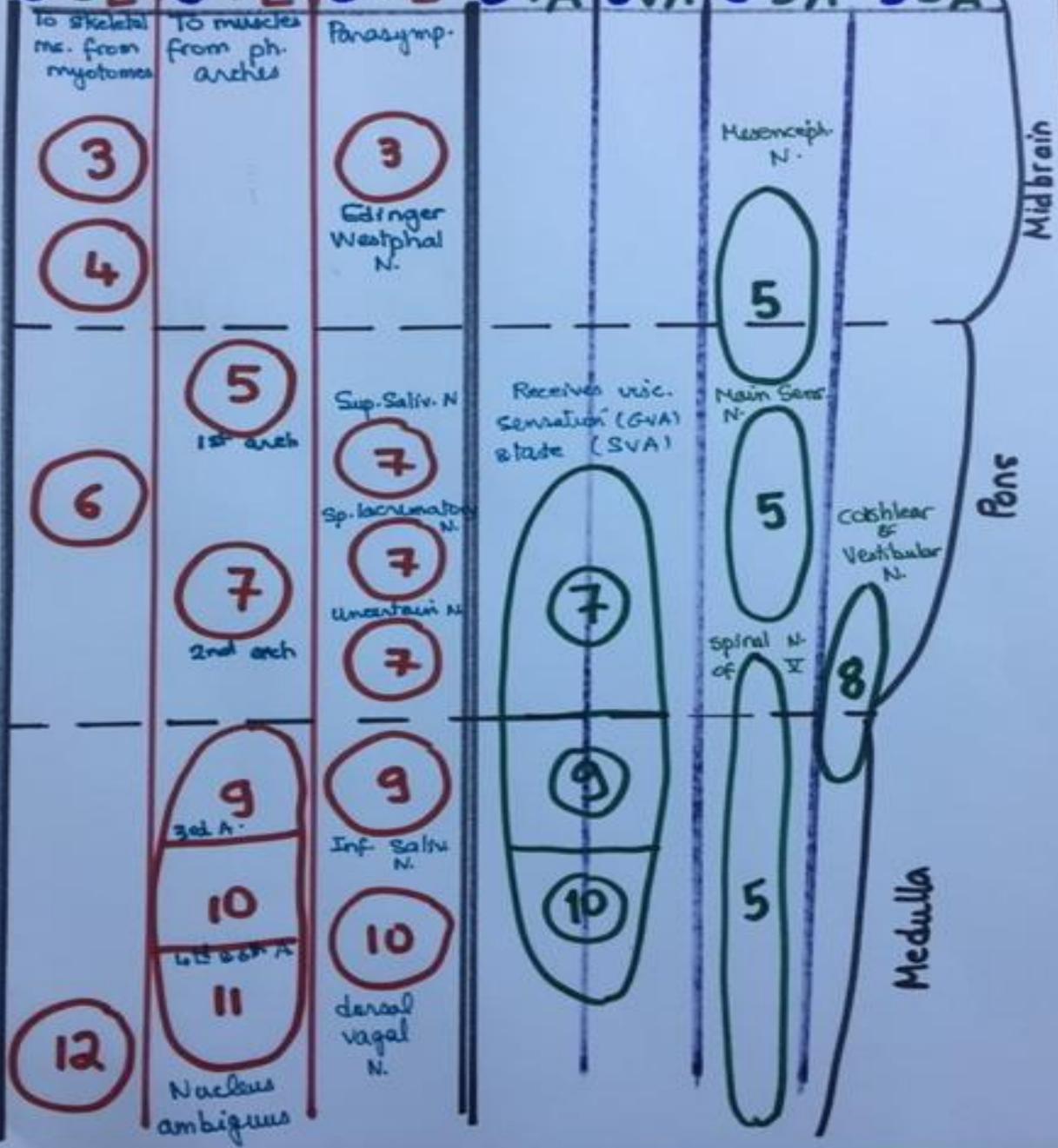


2. Special visceral efferent (SVE) column:

**** They are branchiomotor supplying skeletal muscles that develop from the visceral (branchial or pharyngeal) arches.**

- a. Motor nucleus of V:** in pons (supply muscles of the 1st arch).
- b. Motor nucleus of VII:** in pons (supply muscles that developed from the 2nd arch).
- c. Nucleus Ambiguus:** in medulla oblongata: supply fibers to:
 - i. IX** supplying muscles that develop from 3rd arch: stylopharyngeus.
 - ii. X & XI** supplying muscles that develop from the 4th & 6th arches; muscles of palate, pharynx and larynx.

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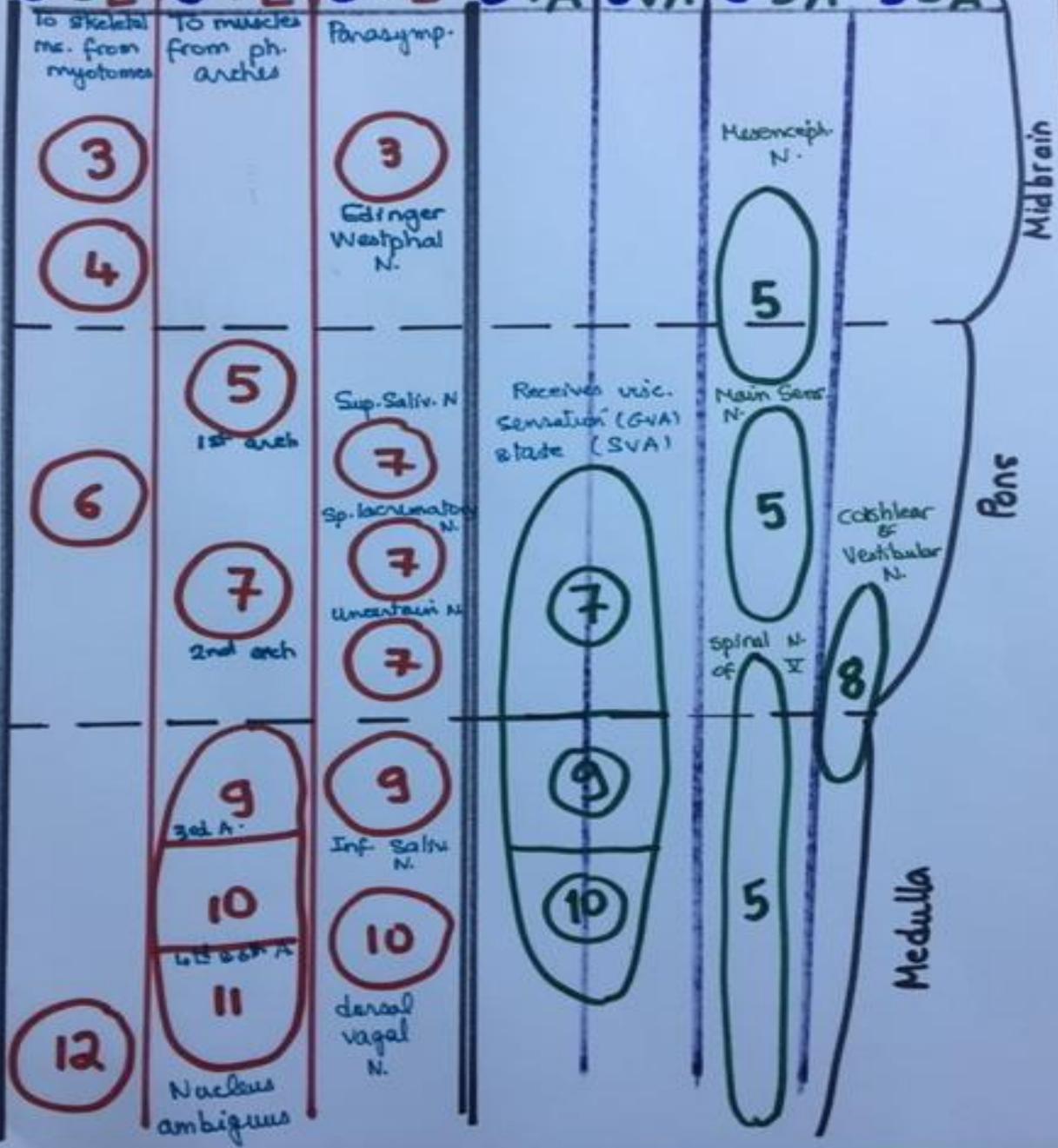


3. General visceral efferent (GVE) column:

**** Gives preganglionic parasympathetic fibers.**

- a. Edinger Westphal nucleus of (III) (in midbrain): supply ciliary muscle and sphincter pupillae muscle.**
- b. Superior salivatory nucleus (VII): supply submandibular and sublingual salivary glands.**
- c. Special lacrimatory nucleus (VII): supply lacrimal gland.**
- d. Uncertain nucleus (VII): supply glands in pharynx, palate and nose.**
- e. Inferior salivatory nucleus (IX): supply parotid gland**
- f. Dorsal vagal nucleus of (X): supply parasympathetic fibers to organs of the CVS, bronchial tree and most of the GIT (foregut & midgut).**

GSE SVE GVE GVA SVA GSA SSA



4. General & special visceral afferent (GVA & SVA) columns: Nucleus Solitarius: receives sensation from viscera (GVA) and taste sensation (SVA) via cranial nerves VII, IX, X.
5. General somatic afferent (GSA) column:
 - a. **Main sensory nucleus of V:** receives crude touch from the head.
 - b. **Spinal nucleus of V:** receives pain & temperature from the head
 - c. **Mesencephalic nucleus of V:** receives proprioception from the head
6. Special somatic afferent (SSA) column:
Cochlear and Vestibular nuclei.

III. Oculomotor Nerve

**** It has two nuclei of origin:**

- 1. Motor Nucleus (GSE):** It lies in the midbrain at the level of the superior colliculus → supply all extra-ocular muscles except the superior oblique (supplied by IV) and the lateral rectus (supplied by VI).
- 2. Parasympathetic Nucleus (Edinger Westphal Nucleus) (GVE):** Fibers arising from this nucleus pass with oculomotor nerve --- to its inferior division--- to N. to inferior oblique muscle--- then leave this nerve to relay in **ciliary ganglion** --- then postganglionic parasympathetic fibers run as short ciliary nerves that supply the ciliary muscle & sphincter pupillae muscle.

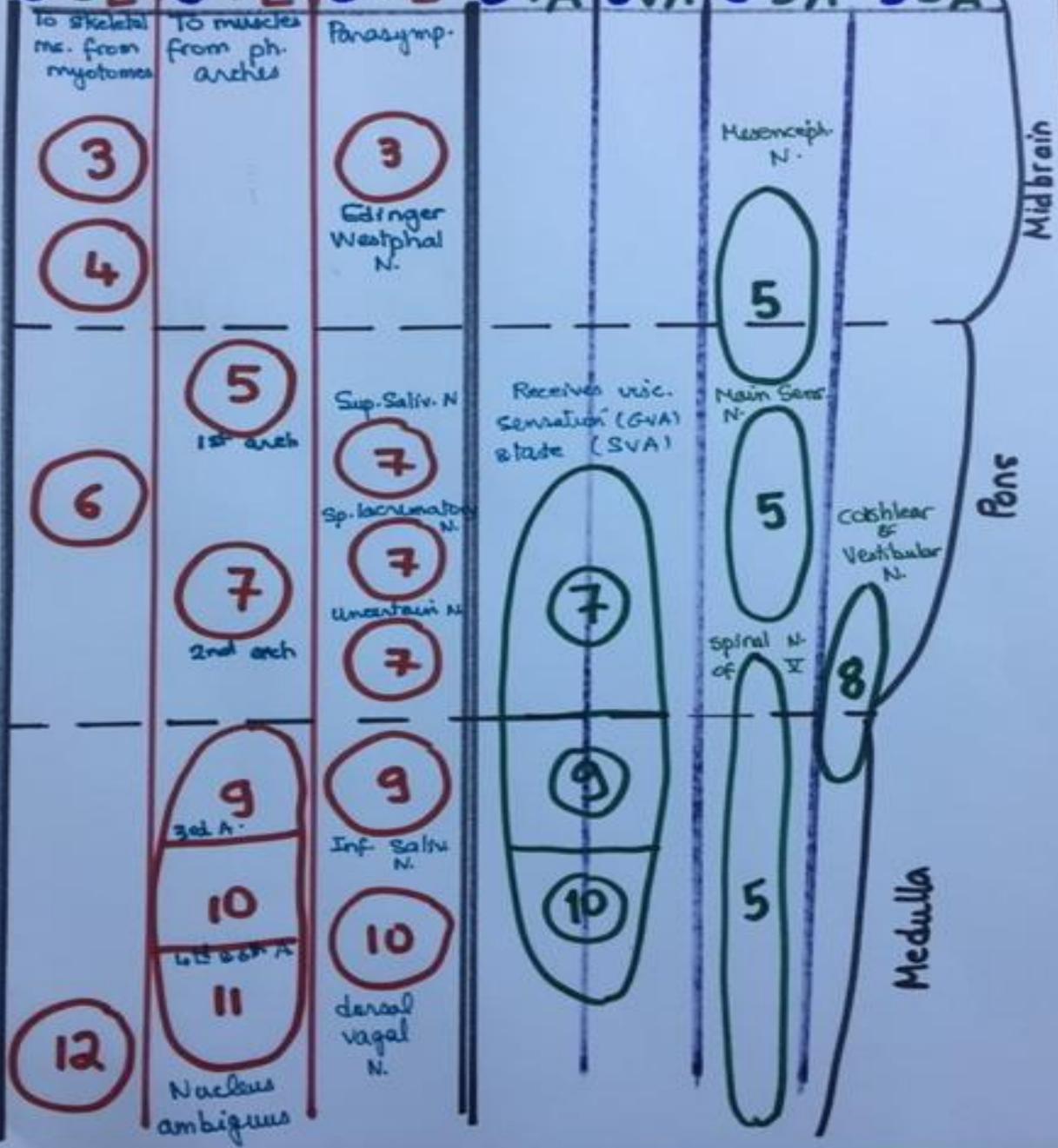
IV Trochlear nerve

**** It is a purely motor nerve that supplies one muscle in the eye “superior oblique”. Its nucleus (GSE) lies in the midbrain at level of inferior colliculus. Fibers arising from the nucleus cross and emerge from dorsal surface of midbrain and pass to supply the opposite superior oblique.**

V Trigeminal nerve

- ** It is a mixed nerve & has four nuclei of origin: 1 motor & 3 sensory:**
- 1. Motor Nucleus (SVE):** It is present in the cranial part of pons → supply muscles that developed from the 1st pharyngeal arch (4 muscles of mastication & 4 other muscles; tensor palati, tensor tympani; anterior belly of digastric & mylohyoid).
 - 2. Three sensory nuclei: (GSA) column:**
 - a. Main Sensory Nucleus:** It is present in pons lateral to the motor nucleus. It receives touch fibers from head & face.
 - b. Spinal Nucleus of V:** It is present in pons & extends downwards to medulla & upper cervical levels of spinal cord. It receives pain & temperature from head & face. It receives also GSA sensory fibers from VII, IX & X cranial nerves.
 - c. Mesencephalic Nucleus:** It is present in pons & extends upwards to midbrain. It receives proprioceptive fibers from head & face. It contains pseudounipolar cells which are considered as 1st order neuron.

GSE SVE GVE GVA SVA GSA SSA



VI Abducent nerve

- It is a purely motor nerve that supplies one muscle in the eye “lateral rectus”. Its nucleus (**GSE**) lies in the pons deep to the medial eminence in the floor of fourth ventricle.

VII Facial nerve

**** It is a mixed nerve. It has 2 motor & 2 sensory nuclei:**

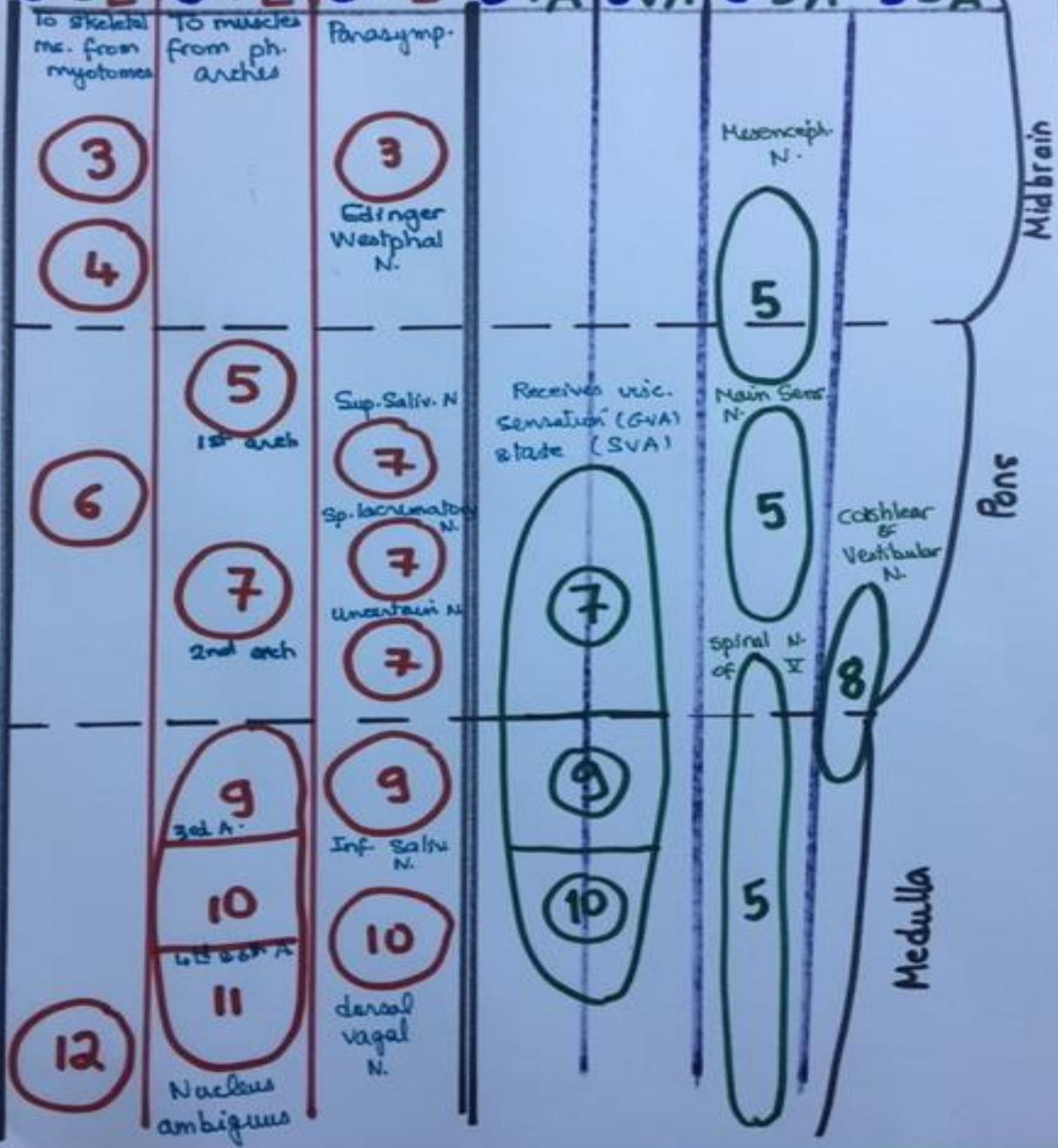
1. Motor Nucleus (SVE): It is present in the caudal part of pons & its fibers supply muscles that develop from the 2nd pharyngeal arch (muscles of facial expression, platysma, posterior belly of digastric, stylohyoid & stapedius).

**** Fibers of the nucleus make a loop around the lower part of abducent nucleus, raising the facial colliculus in the floor of 4th ventricle. The dorsal part of the nucleus that supplies muscles of the upper part of face receives bilateral cortico-nuclear fibers, while the ventral part of this nucleus that supplies muscles of the lower part of face receives only contralateral cortico-nuclear fibers.**

*** Thus in an upper motor neuron lesion UMNL of the facial nerve, muscles of the upper face are spared while muscles of the lower face are affected.**

- 2. Parasympathetic Nuclei (GVE):** lie in the caudal pons:
 - a. Superior Salivatory nucleus:** Its fibers pass with the chorda tympani branch of facial nerve----relay in submandibular ganglion---postganglionic parasympathetic fibers supply submandibular & sublingual salivary glands.
 - b. Lacrimal nucleus:** Its fibers pass with the greater petrosal branch of facial nerve----relay in pterygopalatine ganglion----postganglionic parasympathetic fibers supply lacrimal gland.
 - c. Uncertain nucleus:** Its fibers pass with the greater petrosal branch of facial nerve----relay in pterygopalatine ganglion----postganglionic parasympathetic fibers supply glands of palate, pharynx & nose.
- 3. Nucleus Solitarius (SVA):** Its upper part receives taste fibers carried by chorda tympani from anterior 2/3 of tongue & by the greater petrosal nerve from the soft palate.
- 4. Spinal Nucleus of Trigeminal (GSA):** It receives fibers of general sensation from concha of ear.

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VIII Vestibulo-cochlear nerve

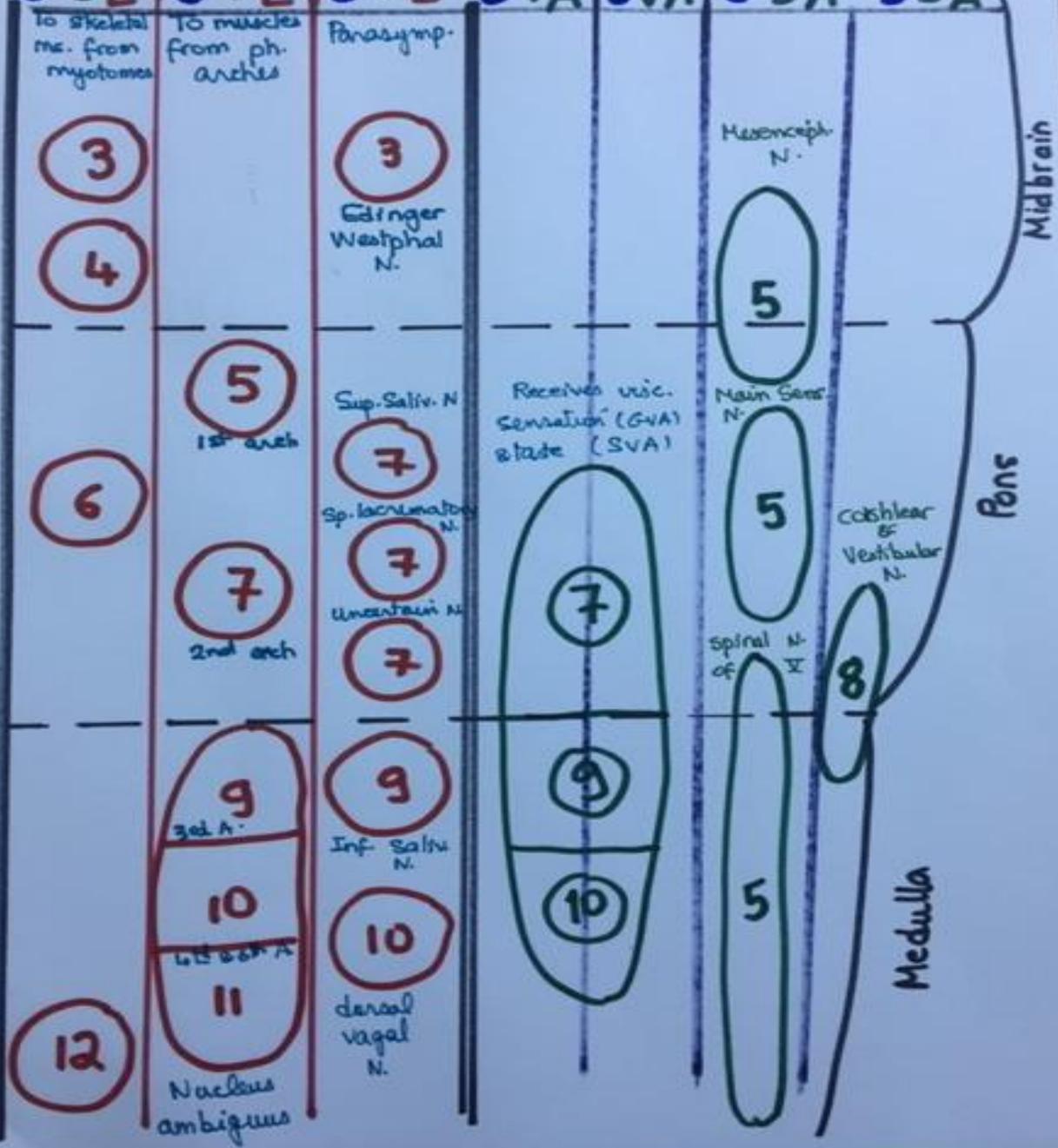
- ** It is a purely sensory nerve.
- ** Vestibular & Cochlear Nuclei (SSA): These nuclei lie at the ponto-medullary junction.
- * There are medial & lateral, superior & inferior vestibular nuclei.
- * There are dorsal & ventral cochlear nuclei.

IX Glossopharyngeal nerve

** It is a mixed nerve. It has 2 motor & 2 sensory nuclei:

1. **Nucleus Ambiguus (SVE)**: Fibers from upper part of nucleus ambiguus pass with glossopharyngeal nerve to supply only muscle that develops from the 3rd pharyngeal arch (stylopharyngeus muscle).
2. **Parasympathetic nucleus (Inferior salivatory nucleus) (GVE)**: Its fibers pass with tympanic branch of IX.....tympanic plexus.....lesser petrosal nerve.....relay in otic ganglion.....postganglionic parasympathetic fibers reach & supply parotid gland via auriculotemporal nerve.
3. **Nucleus Solitarius (SVA)**: Its middle part receives fibers of IX nerve carrying taste from posterior 1/3 of tongue & circumvallate papillae.
4. **Spinal Nucleus of Trigeminal (GSA)**: It receives fibers of IX nerve carrying general sensation from the oropharynx, tonsils, posterior 1/3 of tongue, auditory tube & middle ear.

GSE SVE GVE GVA SVA GSA SSA



X Vagus nerve

**** It is a mixed nerve. It has 2 motor & 2 sensory nuclei:**

- 1. Nucleus Ambiguus (SVE):** Fibers from the middle part of this nucleus pass with X to supply muscles that develop from 4th & 6th pharyngeal arches which include muscles of palate (except tensor palati), muscles of pharynx (except stylopharyngeus) & muscles of larynx.
- 2. Parasympathetic Nucleus (dorsal vagal nucleus) (GVE):** It lies in the medulla beneath the vagal trigone in the floor of the 4th ventricle. Its fibers are motor to the involuntary muscles in thorax (heart & bronchial tree) and abdomen (GIT) till the end of the midgut.
- 3. Nucleus Solitarius (SVA& GVA):** Its lower part receives fibers of X nerve carrying taste from most posterior part of tongue, valleculae & epiglottis. It also receives general visceral sensations from the organs supplied by the vagus nerve.
- 4. Spinal Nucleus of Trigeminal (GSA):** It receives fibers of X nerve carrying general sensory fibers of auricular branch of X.

XI Accessory nerve

**** It is a motor nerve that consists of two parts: spinal & cranial parts.**

- 1. Spinal part:** Its fibers take origin from the **Spinal Nucleus** located in the ventral horn of upper five cervical segments of the spinal cord. Fibers emerge from the spinal cord between the ventral and dorsal roots of spinal nerves. They supply the sternomastoid & trapezius.
- 2. Cranial part:** Its fibers take origin from the lower part of the **Nucleus Ambiguus (SVE)**. These fibers join vagus nerve in the jugular foramen to be distributed to muscles of palate (except tensor palati), muscles of pharynx (except stylopharyngeus) & muscles of larynx.

XII Hypoglossal nerve

**** It is a motor nerve.**

**** The hypoglossal nucleus (GSE): lies in the medulla oblongata deep to the hypoglossal trigone in the floor of 4th ventricle. It extends down to the closed medulla. Fibers arising from the hypoglossal nucleus supply all muscles of tongue except the palatoglossus muscle. The part of the hypoglossal nucleus that innervates genioglossus muscle receives contralateral cortico-nuclear fibers only.**

NOTICE

- ** 3 cranial nerves are **purely sensory** (I, II & VIII).
- ** 5 cranial nerves are **purely motor** (III, IV, VI, XI & XII).
- ** 4 cranial nerves are **mixed** (V, VII, IX & X); each of the mixed nerves has 4 nuclei.
- ** All motor nuclei of cranial nerves receive **bilateral cortico-nuclear tract fibers** **except the part of facial nucleus that innervates muscles of lower part of face & the part of hypoglossal nucleus that innervates genioglossus muscle**. These two exceptions receive contralateral cortico-nuclear fibers only so are liable to an UMNL.

NOTICE

**** Nucleus Ambiguus: is shared by 3 cranial nerves IX, X, XI.**

**** Nucleus Solitarius: is shared by 3 cranial nerves VII, IX, X.**

**** Spinal nucleus of trigeminal: is shared by all cranial nerve that carry fibers of general sensation; V, VII, IX, X.**

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