Head and Neck Cranial Nerves



This study guide will help summarize the functional columns in the cranial nerves.

Functional Column Table- sorted by each Cranial Nerve

Olfactory	SVA
Optic	SSA
Oculomotor	GSE, GVE
Trochlear	GSE
Trigeminal	GSA, SVE
Abducens	GSE
Facial	GSA, SVA, GVE, SVE
Vestibulocochlear	SSA
Glossopharyngeal	GSA, SVA, GVA, GVE, SVE
Vagus	GSA, SVA, GVA, GVE, SVE
Accessory	GSE/SVE
Hypoglossal	GSE

GSA	V, VII, IX, X
SSA	II, VIII
GVA	IX, X
SVA	I, VII, IX, X
GVE	III, VII, IX, X
GSE	III, IV, VI, XII
SVE	V, VII, IX, X, XI

Cranial Nerve Table- sorted by each column

Olfactory (CN I)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
SVA	Bipolar neurons NOT located in ganglion; instead, neurons and processes located in olfactory mucosa	Olfactory mucosa	Primary fibers pass through cribriform plate and synapse in ipsilateral olfactory bulb Second order fibers form olfactory tract Third order fibers in cerebral cortex

Functional Column	Origin of fibers	Origin of fibers location	Pathway
SSA	Retinal ganglion cells	Retina	Fibers pass posteromedially, exiting through the optic canal to enter middle cranial fossa, forming optic chiasm Optic tract passes posteriorly from optic chiasm; most fibers terminate in lateral geniculate nucleus of the thalamus (second order neurons) Axons relayed to visual cortices of occipital lobes

Optic (CN II)

Oculomotor (CN III)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSE	Nucleus of the oculomotor nerve	Midbrain	Primary motor nerve to most extraocular muscle and the levator palpebrae superioris muscle
GVE	Edinger-Westphal nucleus	Midbrain	Presynaptic parasympathetic fibers to ciliary ganglion, and postganglionic fibers travel to ciliary muscle (adjusts lens shape) and sphincter pupillae muscle (constricts pupil)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSE	Trochlear nucleus (immediately caudal to oculomotor nucleus)	Posterior surface of midbrain	Fibers to superior oblique muscle

Trochlear (CN IV)

Trigeminal (CN V)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSA	 Mesencephalic nucleus Principle nucleus Sensory nucleus 	1. Midbrain 2. Pons 3. Pons and medulla	Principle sensory nerve for the head: skin, dura mater, teeth, mucosa of nasal and oral cavities, anterior ² / ₃ of tongue
SVE	Motor nucleus of trigeminal	Pons	Muscles of mastication, mylohyoid, anterior tensor veli palatini, tensor tympani

Abducens (VI)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSE	Abducens nucleus	Pons	To lateral rectus muscle

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSA	Spinal nucleus of trigeminal	Pons and medulla	To small portion of skin around ear
SVA	Solitary tract nucleus	Medulla	Taste to anterior ⅔ of tongue via chorda tympani nerve
GVE	Superior salivatory nucleus	Pons	Parasympathetic innervation to lacrimal glands, nasal, palatal, pharyngeal glands (pterygopalatine ganglion) and sublingual and submandibular glands (submandibular ganglion)
SVE	Facial motor nucleus	Pons	Muscles of facial expression, posterior belly of digastric, stylohyoid, and stapedius (second pharyngeal arch derivatives)

Facial (VII)

Vestibulocochlear (VIII)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
SSA	1. Vestibular nuclei 2. Cochlear nuclei	1. Junction of pons and medulla 2. Medulla	Responsible for hearing and equilibrium

Glossopharyngeal (IX)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSA	Spinal nucleus of trigeminal	Pons and medulla	Sensation from posterior ½ of tongue, middle ear and Eustachian tube, oropharynx, palatine tonsil, soft palate; afferent limb of gag reflex
SVA	Solitary nucleus	Medulla	Taste to posterior $\frac{1}{3}$ of tongue
GVA	Inferior solitary nucleus	Medulla	From carotid body (chemoreceptor) and carotid sinus (baroreceptor)
GVE	Inferior salivatory nucleus	Medulla	Parasympathetic innervation to parotid gland (otic ganglion)
SVE	Nucleus ambiguus	Medulla	Stylopharyngeus muscle (3rd pharyngeal arch derivative)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSA	Spinal nucleus of trigeminal	Pons and medulla	Inferior pharynx and larynx, root of tongue, epiglottis; external auditory meatus, and part of external ear
SVA	Solitary nucleus	Medulla	Taste to root of tongue
GVA	Inferior solitary nucleus	Medulla	Thoracic and abdominal organs
GVE	Dorsal vagal nucleus	Medulla	Parasympathetic to thoracic and abdominal organs (foregut and midgut viscera)
SVE	Nucleus ambiguus	Medulla	Muscles of soft palate, pharynx, and larynx (4th and 6th pharyngeal arch derivatives)

Vagus (CN X)

Accessory (CN XI)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSE/SVE (this debate doesn't really matter, just know that it's motor)	Nucleus- column of anterior horn motor neurons Cranial root of CN XI Spinal root of CN XI	Nucleus- superior 5-6 cervical segments of spinal cord Cranial root- arises from brainstem; joins vagus nerve Spinal root- arises from C1-C5	To sternocleidomastoid muscle and trapezius muscle

Hypoglossal (CN XII)

Functional Column	Origin of fibers	Origin of fibers location	Pathway
GSE	Nucleus- Arises by several rootlets between the pyramids and olives of medulla	Medulla	To intrinsic and 3 out of the 4 extrinsic muscle of the tongue (palatoglossus muscle innervated by CN X)

Sensory Ganglion Summary

Cranial Nerve	Ganglion	Functional Column(s)
CN V	Trigeminal (Gasserian Semilunar) ganglion	GSA
CN VII	Geniculate ganglion	SVA (taste) and GSA
CN VIII	Cochlear (Spiral) ganglion	SSA (hearing)
	Vestibular (Scarpa) ganglion	SSA (equilibrium)
CN IX	Superior sensory ganglion	GSA
	Inferior sensory ganglion	SVA (taste) and GVA
CN X	Superior (Jugular) ganglion	GSA
	Inferior (Nodose) ganglion	SVA (taste) and GVA

Motor Ganglion Summary

Cranial nerve motor ganglia are GVE (parasympathetic)

CN III, XII, IX, and X are the "parent nerves" that bring presynaptic parasympathetic fibers from CNS to the head ganglia

Cranial Nerve	Motor Ganglion	Presynaptic fibers	Postsynaptic fibers
CN III	Ciliary ganglion	Cell bodies located in Edinger-Westphal nucleus and synapse at ciliary ganglion	Travel via short ciliary nerves to enter posterior part of eye to innervate the sphincter pupillae muscle and ciliary muscle
CN VII	Pterygopalatine ganglion	Cell bodies located in Superior salivatory nucleus in pons and carried by greater petrosal nerve to pterygopalatine ganglion	Fibers distributed to lacrimal, nasal, palatine, pharyngeal, and paranasal sinus glands
CN VII	Submandibular ganglion	Cell bodies located in Superior salivatory nucleus in pons and carried by chorda tympani nerve to submandibular ganglion	Fibers distributed to submandibular and sublingual glands
CN IX	Otic ganglion	Cell bodies located in Inferior salivatory nucleus- gives rise to tympanic nerve, which forms tympanic plexus in middle ear; tympanic plexus reforms as lesser petrosal nerve→ exits foramen ovale to enter infratemporal fossa to synapse at otic ganglion	Fibers travel on auriculotemporal nerve (CN V3) to parotid gland

	Motor (efferent)	Sensory (afferent)	
Midbrain	3 total: Accessory (Edinger-Westphal) nucleus of the oculomotor nerve	1 total: Mesencephalic nucleus of trigeminal nucleus	
	Nucleus of oculomotor nerve		
	Nucleus of trochlear		
Pons	4 total: Motor nucleus of trigeminal nerve	1 total: Principal sensory nucleus of trigeminal nerve	
	Nucleus of abducens nerve		
	Motor nucleus of facial nerve		
	Superior salivatory nucleus		
Pons/Medulla		3 total: Sensory nucleus of trigeminal nerve	
		Spinal nucleus of trigeminal nerve	
		Vestibular nuclei	
Medulla	5 total: Inferior salivatory nucleus	3 total: Cochlear nuclei	
	Nucleus ambiguus	Solitary tract nucleus	
	Posterior motor nucleus of vagus nerve (Dorsal vagal nucleus)	Inferior solitary tract nucleus	
	Nucleus of hypoglossal nerve		
	Nucleus of accessory nerve		
Superior cervical segments of spinal cord	1 total: Nucleus of accessory nerve		

Cranial Nerve Nuclei and Brainstem